STUDY

RESTORATION OF DEGRADED LANDS AND REHABILITATION OF SOILS IN THE BRAZILIAN CERRADO

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Introduction

According to The World Bank Group (2020, agriculture is an important sector of Brazil's economy that benefits rom a variety of benign production conditions and the natural resources to scale production. The agribusiness sector has contributed to the expansion of the Brazilian economy over the past four decades and represents around one fth of its GDP. Brazil is an important agricultural commodities' producer, for both national and international markets.

Historically, the production was concentrated in the Northeast, South and Southeast of the country, producing grains, sugarcane, beef, fruits, etc. With the food, fibe , fuel and feed demand growth in the last four decades, production expansion was driven to the Center West and North regions, displacing forests, savannahs and other types of native vegetation.

This expansion resulted in large areas of pastures (planted pasture) which, according to Mapbiomas - Collection 5 (2020) sum 167.5 million hectares in 2019 (65% of total area allocated to agricultural production),

mostly used for extensive cattle production. In addition, the lack of good agricultural practices and pasture management resulted in degraded areas, with low productivity and income, also becoming a driver of deforestation. Other crops, mostly soybean, have displacing pasture areas for their expansion, but also native vegetation mainly in the Cerrado.

Degraded pasture recovery represents the following benefits: higher yield for cattle production, higher income for farmer, increase of carbon stocks in the soil, avoiding the need to clear additional areas for agricultural expansion (avoided deforestation), among others.

The rationale behind the importance of addressing the recovery of degraded areas relates to the explicit need to use natural resources comprehensively. Despite the availability of native vegetation areas suitable for agriculture, it is important to drive the use of converted areas optimizing land use and maximizing production and conservation, in line with the Forest Code (Law n. 12,651/2012) regulation requirements.

In this respect, it is critical to discuss and create opportunities to convert degraded land into highly productive land,

combining technology adoption and development that presents economic returns for agriculture, forestry and livestock supply chains.

Based on this scenario, the present paper aims to analyze and put into perspective the challenges and ways to recover degraded land in the Cerrado biome. Within the scope of the consultancy on degraded lands restoration in the Brazilian Cerrado, Agroicone presents this document as a final report with the results of degraded pastures' zoning in the Cerrado, the financing available for degraded land recovery, an exploratory analysis about why farmers are not taking credit and/or implementing these practices and business cases based on cattle ranching activities in the Guariroba river basin (Mato Grosso do Sul), in Araguaçu (Tocantins) and Canarana (Mato Grosso).

The first section of this report gives a brief introduction about the Cerrado, showing land use and land cover data. It then presents the degraded pastures in the Cerrado and the potential that some agricultural supply chains have to recover these areas. Two types of production systems are also presented: integrated systems and agroforestry systems.

The second section introduces the rural credit in Brazil, the main public policy that has been used to promote agriculture in the country, and, through data from Brazil's Central Bank, the resources allocated to recover degraded lands in the Cerrado were evaluatedd. Then, recent data from Agricultural Census to understand the number of farms twith access to rural credit was analyzed.

The third section presents how soybean farmers have been funding their operational costs, based on data for Mato Grosso state.

The fourth section explores rural producers' confidence in the Brazilian economy and in the agribusiness sector.

The fifth section explores the research on investment intention by cattle ranchers.

The sixth section presents the perceptions regarding the decision of producers to advance agricultural production over cleared areas.

The seventh section provides the results of the questionnaires and the assessment about why ranchers are not taking credit / implementing land recovery practices.

The eighth section presents business cases for pasture recovery in three regions: in Guariroba River basin (Mato Grosso do Sul state), in Araguaçu (Tocantins state) and in Canarana (state of Mato Grosso).

The last section presents the final remarks of this study and recommendations to support WWF to address the degraded pasture areas recovery in the Cerrado.

CHAPTER 1

Zoning of degraded pastures

1.1 The Cerrado

The Brazilian Cerrado is characterized as a tropical savanna. It is the second largest biome in South America, with 200 million hectares, occupying 22% of the national territory and its continuous area covers (partially or totally the states of Goiás, Tocantins, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Bahia, Maranhão, Piauí, Rondônia, Paraná, São Paulo and Distrito Federal.

Due to its geographical position and ecological characteristics, the Cerrado plays an important role for Brazilian society in terms of biodiversity and maintenance of natural resources, particularly freshwater resources, as well as agricultural production developed in its territory. The springs of the three largest river basins in South America (Amazon/Tocantins, São Francisco and Prata).

At the time of the study, the most current and complete data on land use and land cover were MapBiomas - Collection 5 (2020).

According to this source, in 2019 the Cerrado had anarea of 89.2 million hectares (46.5%) with forest formation, which includes forests, savannas and mangroves. Agricultural activity occupied 86.9 million hectares (43.8%), of which 25.9 million was agriculture and 61 million was pasture. In ***Figure 1*** and ***Figure 2*** it is possible to observe in more detail the land use and land cover in the biome.

Figure 1. Land Use and Land Cover in the Cerrado in 2019

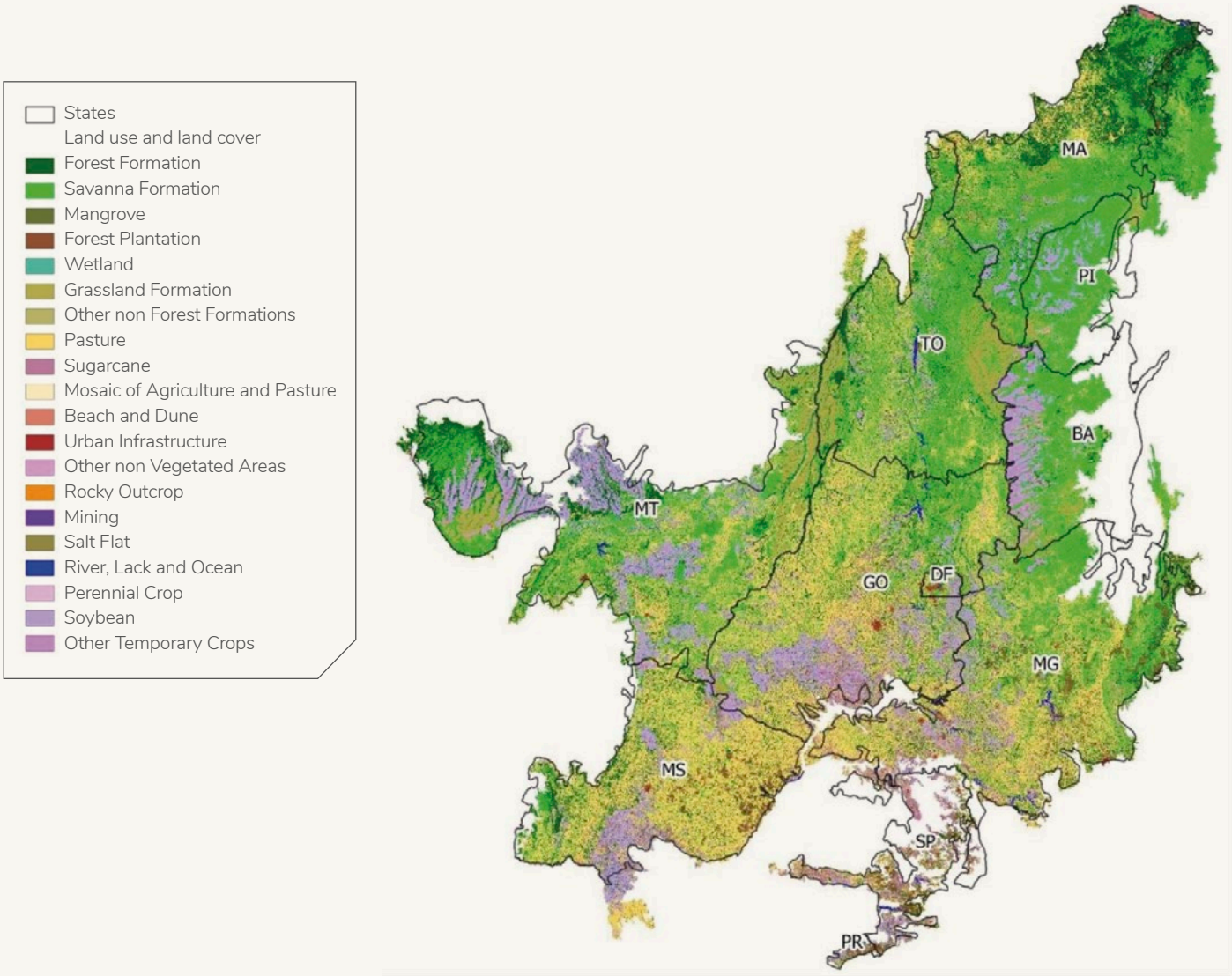
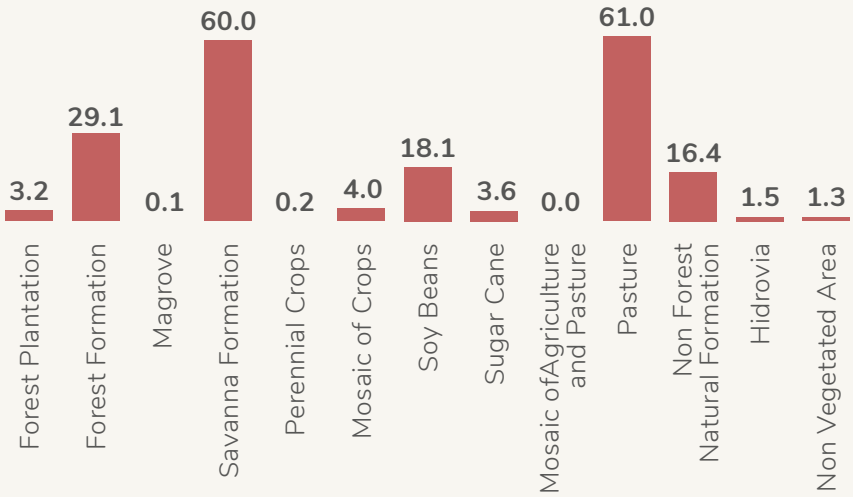


Figure 2.
Land Use and Land Cover in the Cerrado - area by use in million hectares

Source: MapBiomas – Collection 5 (2020). Elaborated by Agroicone



From 2010 to 2019, the native vegetation of the Cerrado was removed and replaced by 5.5 million hectares (Mha) of pastures and another 2.1 Mha of annual and perennial crops. Agricultural crops expanded by 14 Mha in the same period, showing that the expansion was occurring mainly over pasture areas (more details are in ***Annex 2*** - Transition of land use (net) from 2010 to 2019 in the Cerrado). According to MAPA (2020), the grain area was projected to increase 11 Mha from 2019 to 2030 in Brazil, mainly in the Cerrado biome.

A study conducted by Agrosatélite (2018) indicated that the pattern of soybean expansion in the Cerrado had changed over the years. In the period from 2000 to 2007, 32% expanded over native vegetation and another 68% over cleared areas. Between 2007 and 2014, the scenario was similar, 25% of the expansion occurred over vegetation. Between 2014 and 2017, the expansion in vegetation area reached 8%.

Even with the change in the pattern of expansion, agriculture can still represent a risk for the conservation of the Cerrado (TNC, 2020). The use of technologies and good agricultural practices, such as degraded pasture recovery and integrated systems, can play a significant role in promoting changes in land use and a more sustainable agriculture.

Related to that, it is estimated[1] that in Brazil, between 2010 and 2017, 10.44 million hectares of pastures were recovered, which allowed the mitigation equivalent of between 39.57 and 57.52 million Mg CO_2. The integrated systems have achieved an area expansion from 2010 to 2016, of 5.83 million ha, allowing the mitigation equivalent of between 22.10 and 36.40 million Mg CO_2.

The high stock of pasture and the intensification of cattle ranching (increasing cattle ranching while reducing pasture area) provides the opportunity to expand agriculture over or along with pasture. This intensification, for example, is fundamental to fill productivity gaps, allowing efficiency in livestock production and, at the same time, reduce land degradation and carbon emissions from cattle (as it reduces the slaughter age of cattle).

[1] Source: MANZATTO, C. V. (et. al). Mitigação das emissões de Gases de Efeitos Estufa pela adoção das tecnologias do Plano ABC: estimativas parciais. Embrapa Meio Ambiente. Jaguariúna, SP. 2020; MAPA, Diagnóstico da expansão da adoção da tecnologia de Tratamento de Dejetos Animais (TDA) no território brasileiro entre 2010 e 2019.

1.2 Degraded pasture in the Cerrado

The pastures referred to in this report consists of areas fenced and covered by planted forage plants, being the main ones of the genera Brachiaria, Panicum and Cynodon, which are directly used as food by animals. Macedo and Zimmer (1993, apud Zimmer et al., 2012), Macedo (1995, apud Kichel et al., 1999), Peron and Evangelista (2004), Townsend et al. (2012), Moreira and Assad (2000), Macedo et al. (2000), Macedo et al. (2013) and Ismar (2015), define pasture degradation as “an evolutionary process of the loss of vigor, productivity, the capacity of natural recovery of pastures to sustain the levels of production and the quality required by animals, as well as the to overcome the harmful effects of pests, diseases and invaders, culminating in the advanced degradation of natural resources due to inadequate management”.

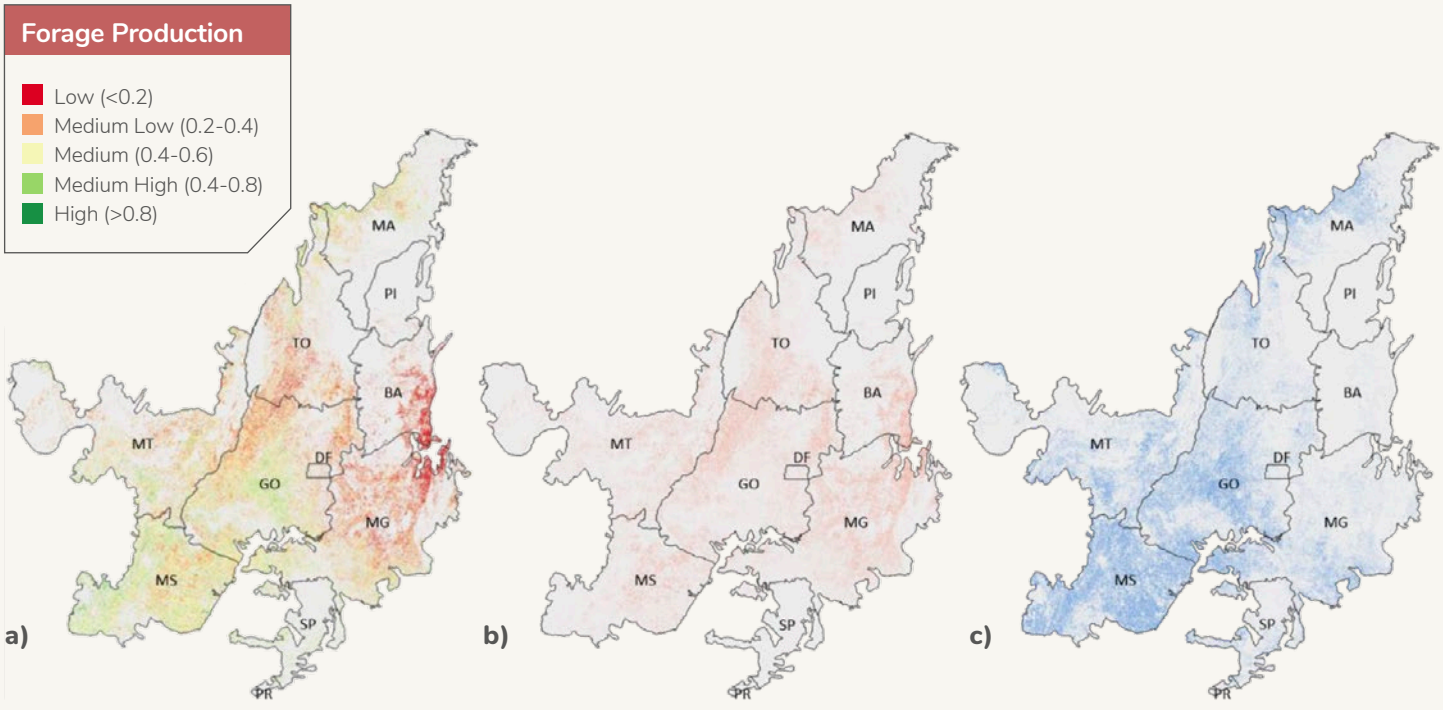
For Dias-Filho (2014a) the pasture can be considered degraded due to different conditions. The extremes of these conditions are called **agricultural degradation**, where there is a change in the botanical composition with an increase in the proportion of weeds in the pasture and a decrease in the carrying capacity, and **biological degradation**, when the soil loses its capacity to support plant production significantly, with drastic decrease in plant biomass.

The researchers of Image Processing and Geoprocessing Laboratory – LAPIG conducted a study about degraded pastures in 2019, classifying pasture areas for the year 2018. They analyzed the pasture by Normalized Difference Vegetation Index (NDVI over the years, using images from Modis and Landsat satellites. From the index, forage production classes, ranging from 0 to 1 were defined ***(Figure 3a)***.

The low productive pastures (below 0.4 were classified as degraded. And the high productive pastures (above 0.4 were classified as undeg aded. Approximately 62.8 million hectares of pasture were classiĀed: 23.7 million of degraded pasture ***(Figure 3b)*** and 39.1 million of undegraded pasture ***(Figure 3c)***.

Figure 3.
a) Map of pasture quality in 2018;
b) Map of degraded pastures;
c) Map of undegraded pastures

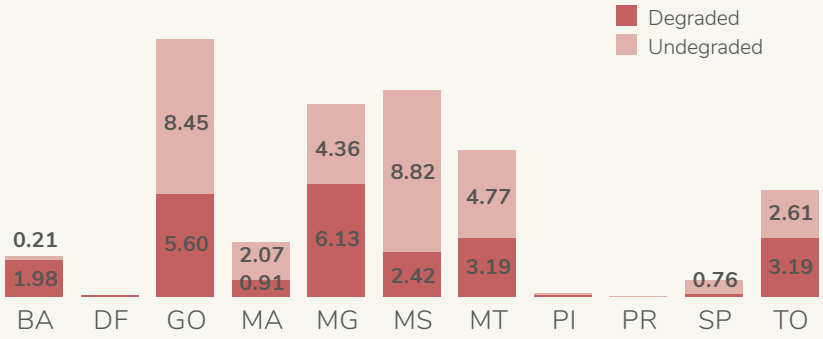
Source: LAPIG (2019).



The states with the largest areas of degraded pasture are Goiás, Mato Grosso do Sul, Mato Grosso e Minas Gerais ***(Figure 4)***.

Figure 4.
Pasture areas in the Cerrado in 2018 (million hectares)

Source: LAPIG (2019).
Elaborated by Agroicone.



When it comes to optimizing land use and incorporating technology, the aim to restore pastures and turn it into productive areas is a challenge . However, since 2011, the recovery of degraded pastures and integrated systems implementations were incorporated into a Low Carbon Agricultural Policy, in an effort for Brazil to address climate change mitigation and adaptation targets presented at COP-15 in Copenhagen. In addition, the restoration of 15 million hectares (MH) of degraded pastures and implementing 5 MH of integrated crop-livestock-forestry systems are part of Brazil's contributions to the Paris Agreement - key actions towards low carbon agriculture, together with deforestation reduction. Those practices are essential to recover the capacity of areas that were converted, abandoned or inappropriately managed over time.

From a policy perspective, it is possible to say that while tackling deforestation and conversion will continue to be a target, especially ending illegal deforestation, Brazil has an enormous opportunity to strategically use pastures, degraded or not. The rationale is to reduce abruptly the deforestation and conversion rates, while cleared areas are recovered and managed, maximizing productivity and increasing technology adoption.

There are different agronomic techniques to improve degraded pastures, such as pasture recovery and renovation, or the implementation of integrated crop-livestock-forestry systems (ICLFS) and their combinations.

Recovery consists of the rehabilitation of foddeer production, keeping the same species or cultures. Renovation consists of re-establishing fodder production with the introduction of a new species or varieties, replacing the degraded ones. Recovery and renewal may occur directly or indirectly: when the machinery and soil correctives are used, the recovery or renewal is classified as direct. In the indirect technique it is used other crops in rotation, as grain or green manure, to improve the soil aspects (MACEDO et al., 2000).

The technique to be used will depend on the intended purpose for the pasture (intensification of cattle production, soybean expansion, planting of commercial forests) and on the degree of pasture degradation.

Therefore, it is important to make the evaluation in the field and to enable the best decision for the land rehabilitation.

1.3 Agricultural supply chains

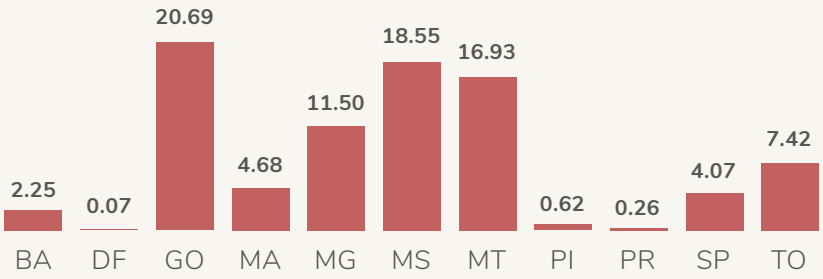
1.3.1 BEEF SECTOR

In 2018, Brazilian cattle herd sum 213.4 million heads, according to data from the Municipal Livestock Research - Brazilian Institute of Geography and Statistics (PPM – IBGE, 2018). In the Cerrado this sum was 94 million heads, which represented 44% of Brazil's total. The states with the largest cattle herd are Goiás, Mato Grosso do Sul, Mato Grosso, and Minas Gerais.

PPM-IBGE does not inform the number of cattle specifically for the beef sector. For this reason, this data was estimated from the difference between the total herd and the number of dairy cows, using other data from PPM-IBGE. In the Cerrado, the number of cattle herds in the beef sector reached 88.6 million ***(Figure 5)***, representing 94.3% of the total herd. About 84% of this herd is concentrated in media and large properties and 16% in family farms.

Figure 5.
Beef cattle herd estimated (million heads)

Source: Estimated data from PPM – IBGE (2018). Elaborated by Agroicone.

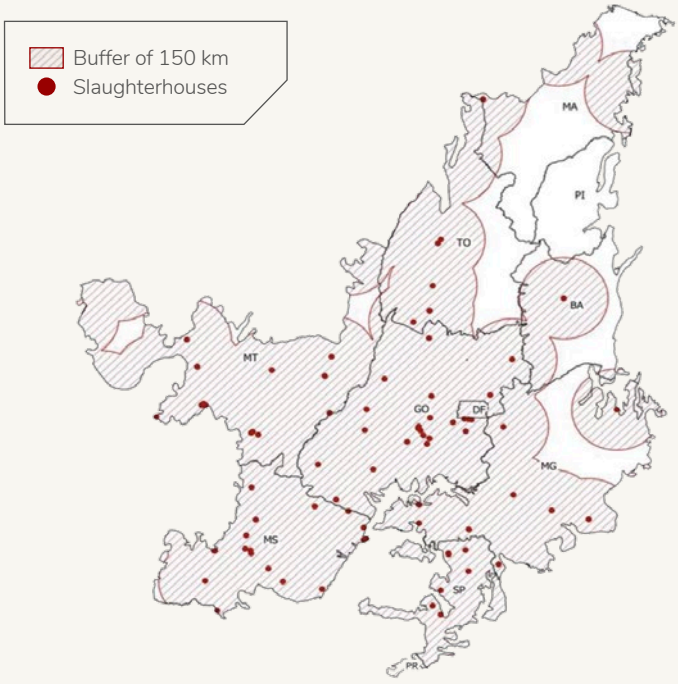


To identify the degraded pasture areas with potential for intensification of beef cattle production, the following criteria were used:

Proximity to slaughterhouses - the Cerrado has 80 slaughterhouses according to the survey conducted by LAPIG. A radius of 150 km was generated from these slaughterhouses. This represents the economic radius of this industry; it was obtained from conversations with partners who work in the chain and studies conducted by Agroicone. Properties within this radius were selected ***(Figure 6)***.

Figure 6.
Slaughterhouses and radius of 150 km

Source: LAPIG (2017). Elaborated by Agroicone



Properties with livestock as their main activity - properties with at least 50% of their area with pasture.

In order to obtain the information by property size, the degraded pastures were combined with the land tenure data prepared by Imaflora (2018). After applying the criteria, the results show an area of 5.6 million hectares (Mha) of degraded pasture with potential for intensification of beef cattle production ***(Figure 7)***. Regarding the size of the farms, 3.1 Mha are in small properties, 1.4 Mha in medium and 1.1 Mha in large. The states with the largest potential areas are Goiás (2 Mha) and Mato Grosso do Sul (1.3 Mha).

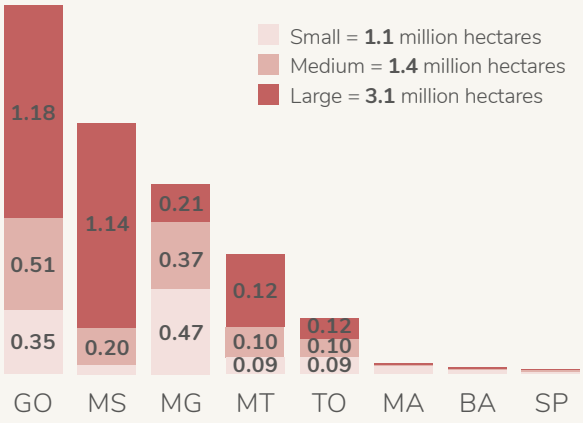
Figure 7.
Degraded pastures with potential for livestock intensification

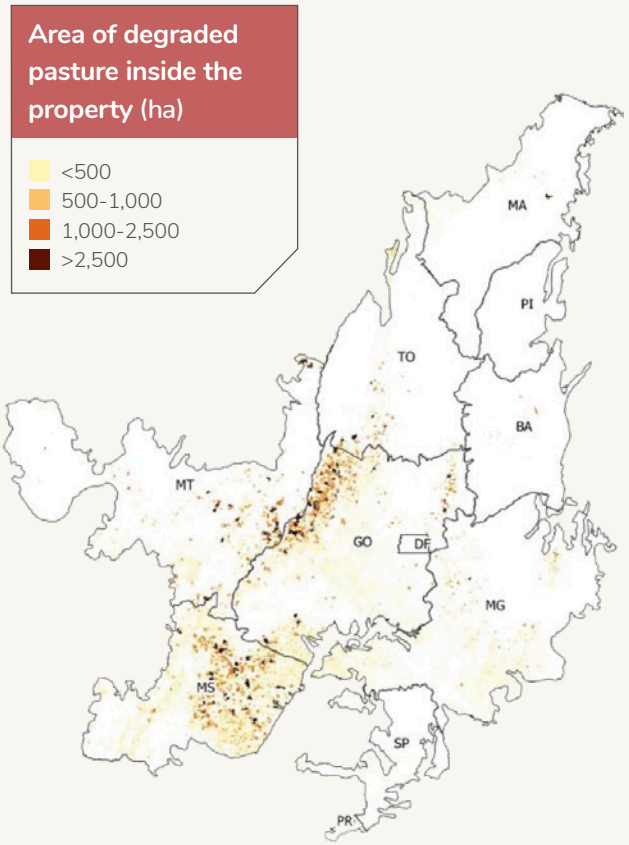
Source: Study results. Elaborated by Agroicone.

5.6 MILLION HECTARES

of degraded pastures for livestock intensificatio

Area of degraded pastures (million hectares)





1.3.2 DAIRY SECTOR

For the dairy sector, data from IBGE - Agricultural Census (2017) was used. According to this source, there were 3.7 million heads of dairy cows, with 1.6 million in medium/large properties and 2.1 million in family farming. Production reached 9.9 billion liters of milk for each type of property - family and medium/large – contributing with 50% of this production. Thus, it is important to mention that productivity in family farming is lower than in medium/large farms, 2,354 and 3,173 liters/cow/year, respectively.

The criteria to evaluate degraded pasture with intensification potential for the dairy sector were the proximity to dairy plants and properties with livestock as their main activity. For the first criteria a radius of 100 km from the dairy plants was generated (51 plants in the Cerrado). After the properties were selected within this radius, those with at least 50% of their area with pasture were selected ***(Figure 8)***. As a result, an area of 4.3 million hectares (Mha) of degraded pastures with potential for dairy production intensification was selected ***(Figure 9)***. About 1.2 Mha in small properties, 1.3 Mha in medium and 1.8 Mha in large. The states with the largest potential areas are Minas Gerais (2 Mha) and Goiás (1.7 Mha).

Figure 8.
Dairy plants in the Cerrado

Source: MAPA (2018).
Elaborated by Agroicone

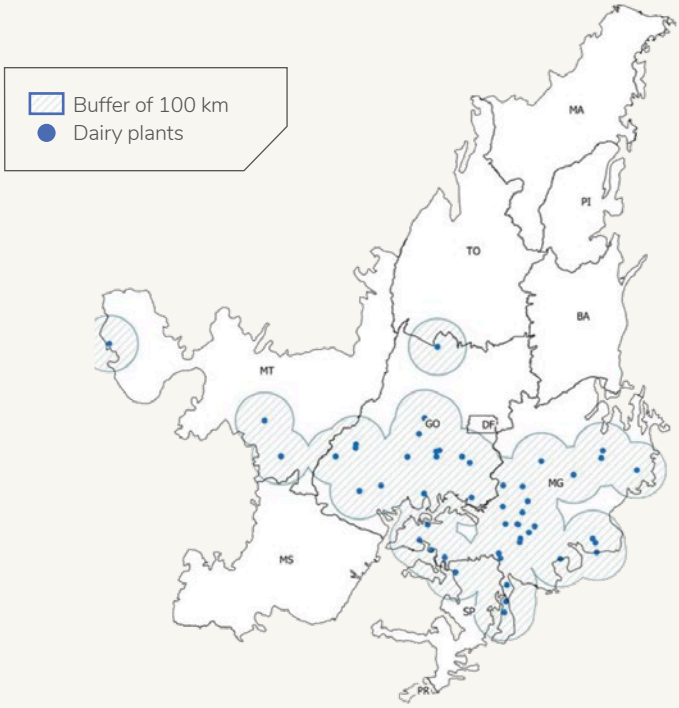


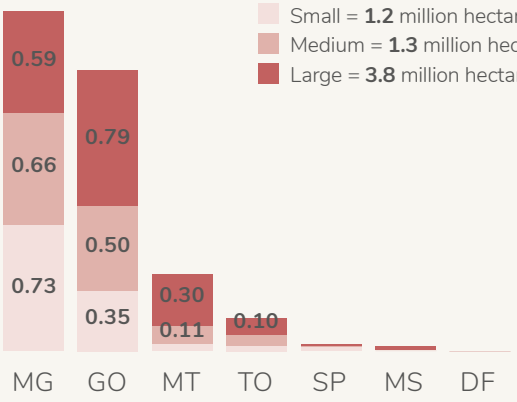
Figure 9.
Degraded pasture with potential for intensification of dairy farming

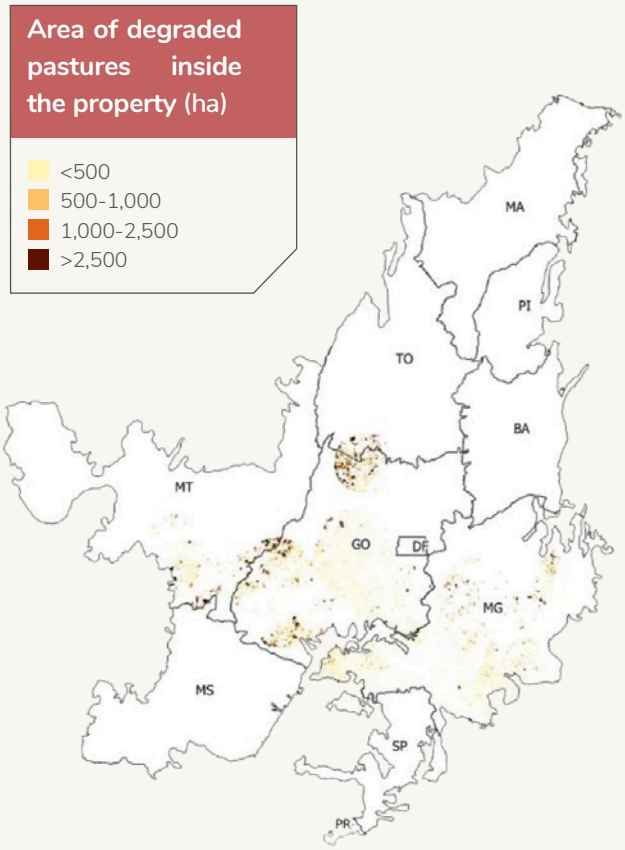
Source: Study results.
Elaborated by Agroicone.

4.3 MILLION HECTARES

of degraded pastures for intensification f milk production

Area of degraded pastures (million hectares)



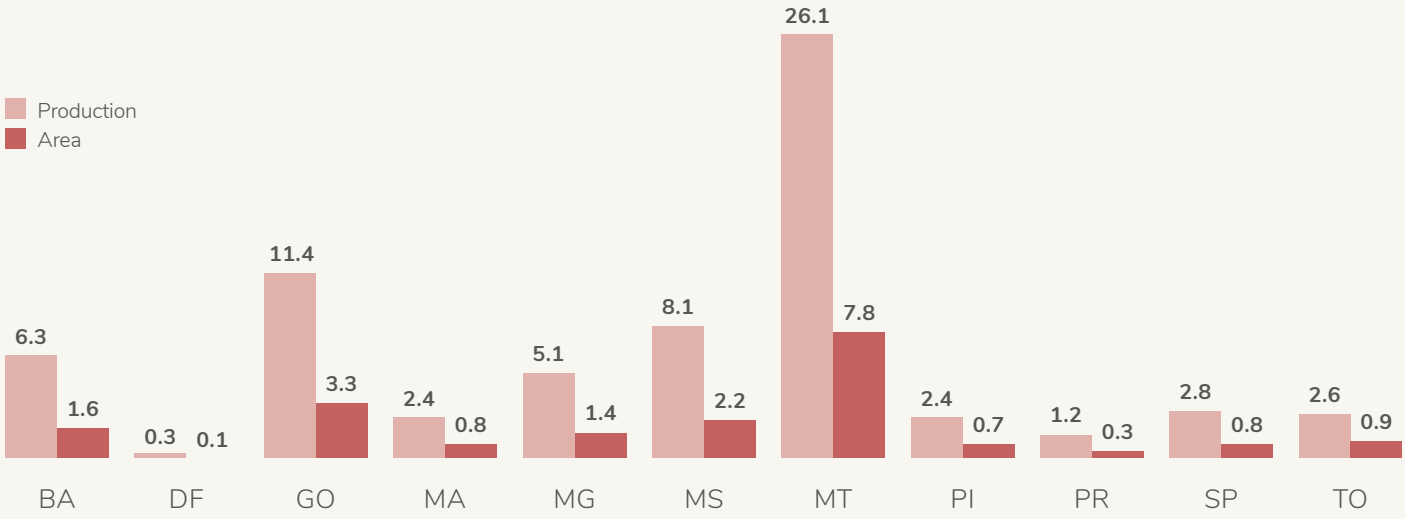


1.3.3 SOYBEAN SECTOR

Brazil is a major producer of soybeans, disputing the position of the world's largest producer with the United States. In 2018, the soybean planted area in Brazil was 34.8 million hectares, and production reached 117.9 million tons. The Cerrado had 59% share of the production (69.3 million tons). This production was distributed over 20 million hectares (PAM-IBGE, 2018), 98% of which was concentrated in medium and large properties ***(Figure 10)***.

Figure 10.
Area (million hectares) and production (million tons) of soybean in the Cerrado

Source: PAM-IBGE (2018). Elaborated by Agroicone.



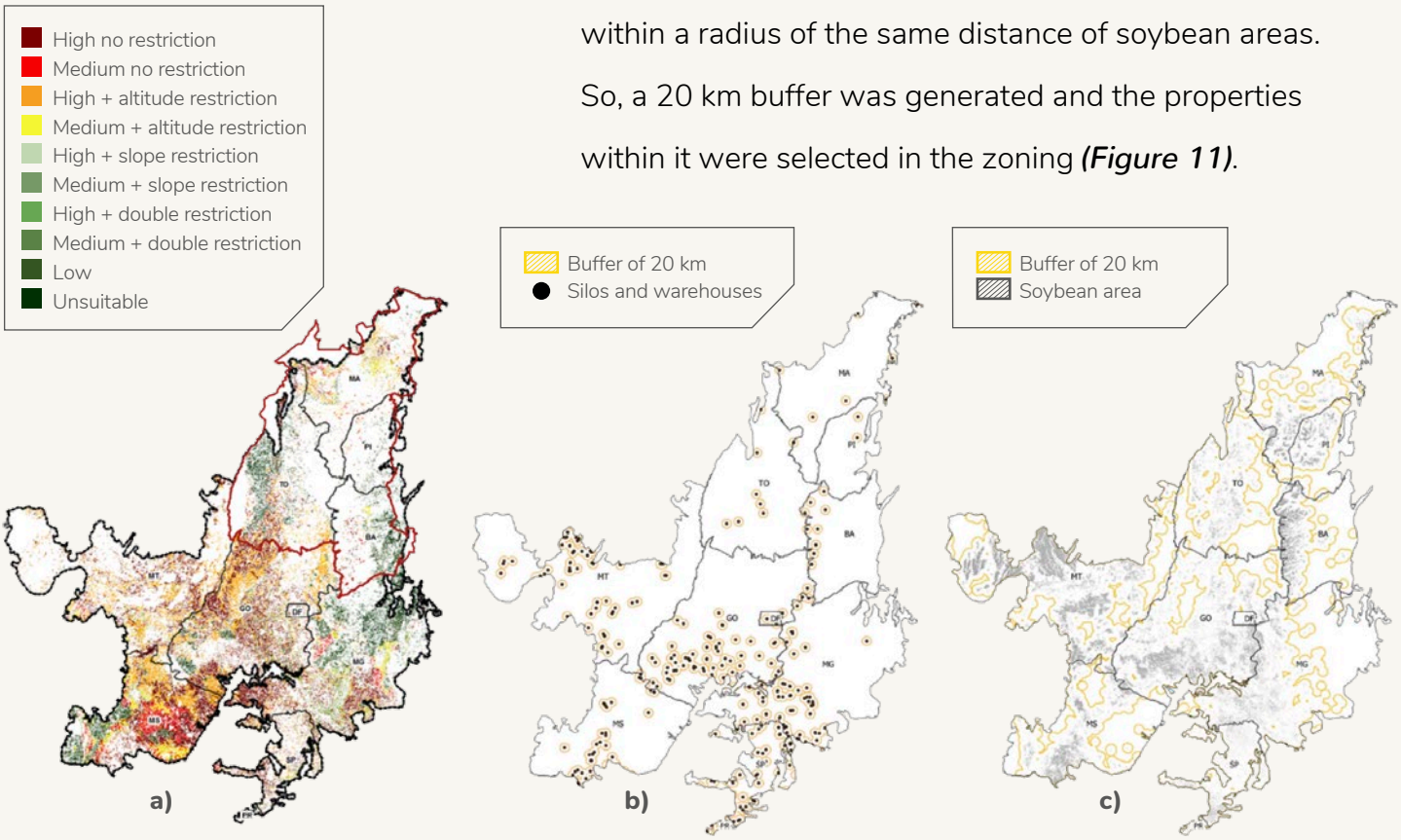
To identify degraded pastures with potential for soybean expansion, the criteria used were agricultural suitability, proximity to silos and warehouses, and proximity to soybean planted areas.

Agrosatélite (2017) was used for agricultural suitability[2]. The degraded pastures were combined with the high agricultural suitability categories, making it possible to select the pastures suitable for soybean expansion. To assess the proximity of silos and warehouses, data from the National Supply Company (CONAB, 2019) was used. In total, the Cerrado has 5,550 silos and warehouses. And, for the proximity to the soybean area, the soybean map prepared by Agrosatélite (2018)was used. According to the study conducted by Romeiro et. al

(2018), more than 90% of the soybean area falls within a radius of 20 km from silos and warehouses, and within a radius of the same distance of soybean areas. So, a 20 km buffer was generated and the properties within it were selected in the zoning ***(Figure 11)***.

Figure 11.
Zoning criteria for soybean expansion:
a) Agricultural suitability;
b) Silos and warehouses;
c) soybean area

Source: Agrosatélite (2017 and 2018) and CONAB (2019). Elaborated by Agroicone.



[2] Agrosatelite classifies suitability in 4 categories (high, medium, low, and not suitable) and 4 types of restriction (height, slope, both height and slope, and no restriction). For the zoning we used the category of high suitability only, considering the 4 restrictions (which can be overcome using technologies).

With this cut out the degraded pastures with high agricultural aptitude for soybean, close to soybean infrastructure and markets were identified. Additionally, since soybeans in Brazil are predominantly in medium and large properties, another filter was applied to select the suitable areas of degraded pastures, those with more than 100 continuous hectares.

Applying the criteria described above, we obtained an area of 4.9 million hectares of degraded pastures with potential for soybean expansion. This is enough area to increase the current soybean area by 25%. The potential areas are almost all allocated in medium and large properties ***(Figure 12)***.

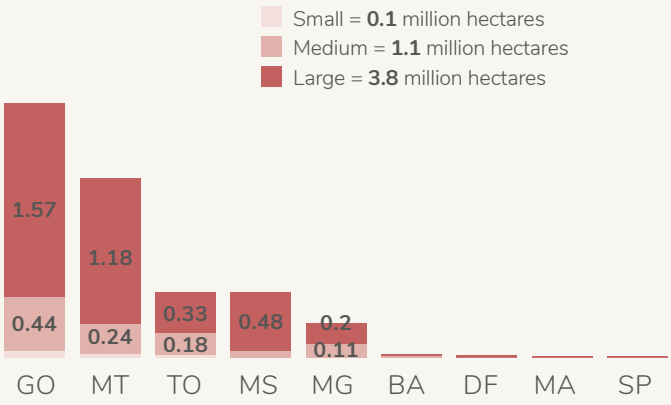
Figure 12.
Degraded pastures with potential for soybean expansion

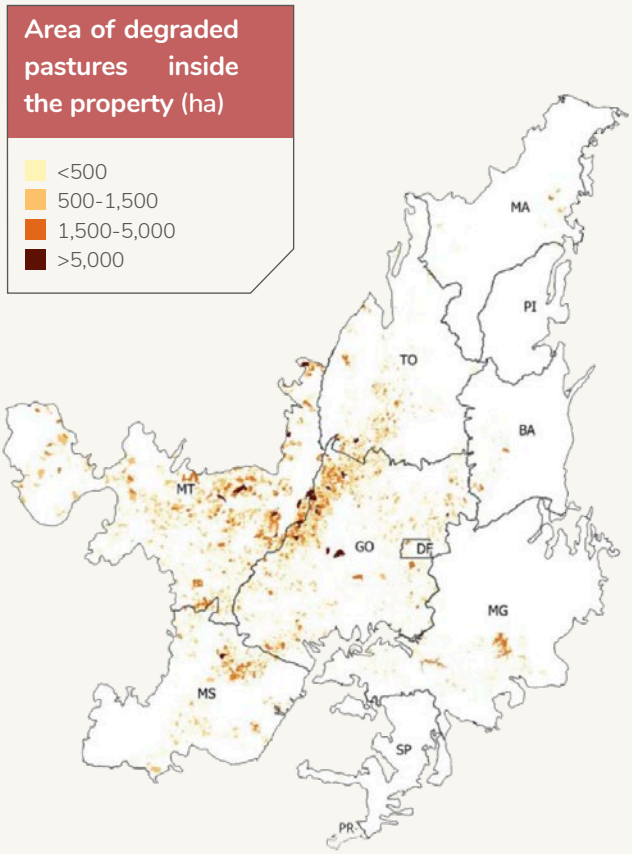
Source: Study results. Elaborated by Agroicone.

5 MILLION HECTARES

of degraded pastures for soybean expansion

Area of degraded pastures (million hectares)

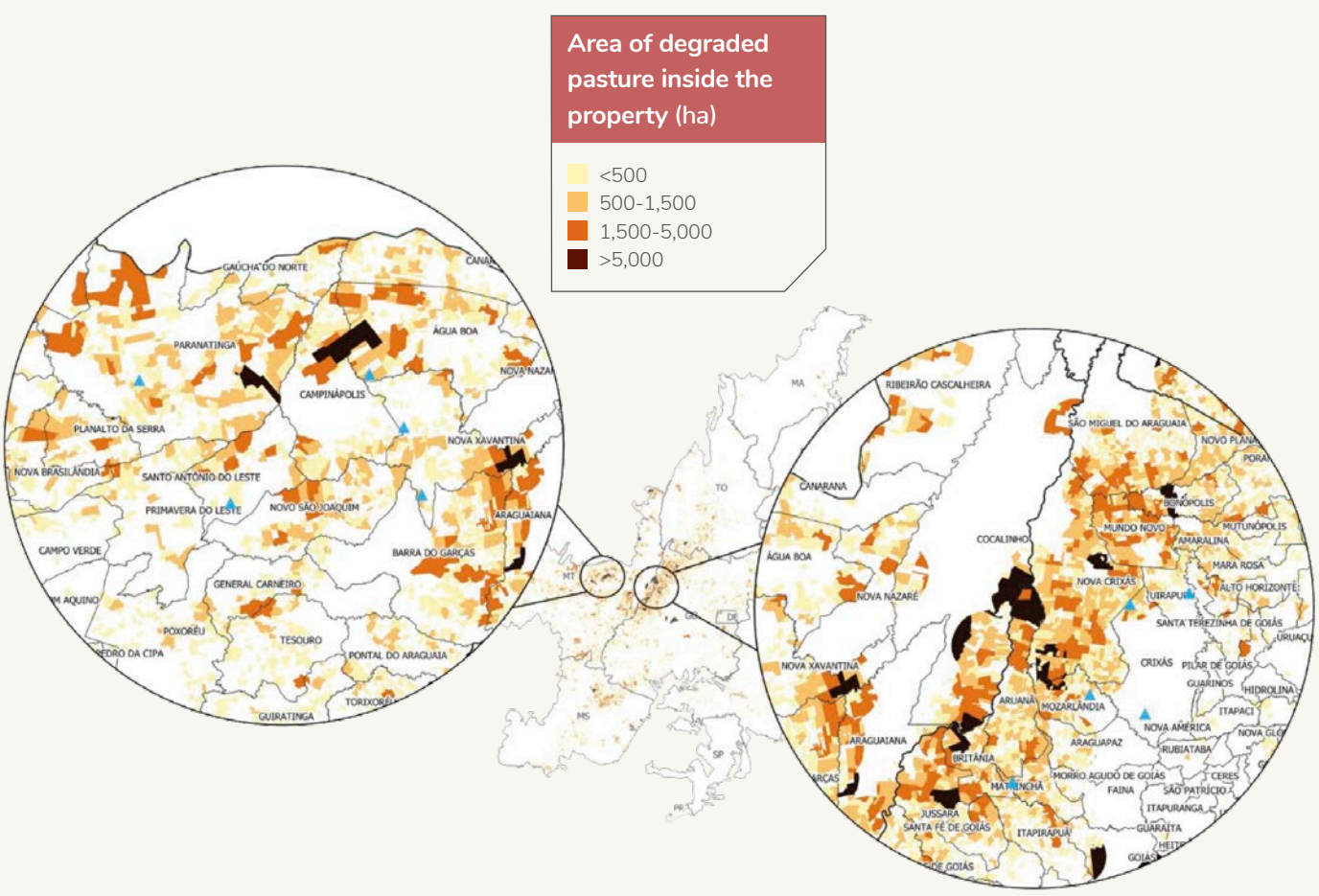




The potential areas are concentrated on the border between the states of Goiás, Mato Grosso and Tocantins. ***Figure 13*** shows an elargment of this region, so it is possible to know which are the municipalities with the best opportunities for soybean expansion.

Figure 13.
Enlargement of selected regions with potential areas for soybean expansion in degraded pastures

Source: Study results. Elaborated by Agroicone

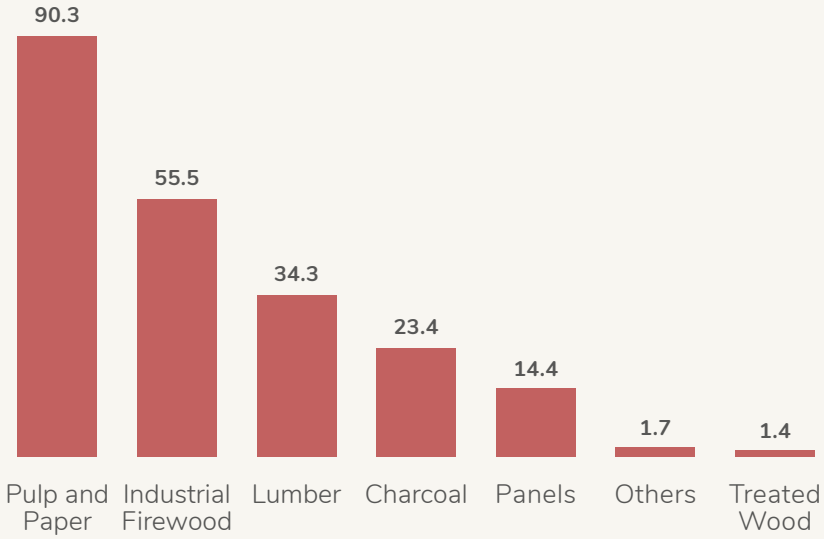


1.3.4 COMMERCIAL FOREST

Brazil has 8.6 million hectares of commercial forests, according to Mapbiomas (2019). Production reached 221 million m³, which was distributed among different types of industries, as shown in ***Figure 14*** (IBÁ, 2018).

Figure 14.
Wood consumption for industrial use (million m³)

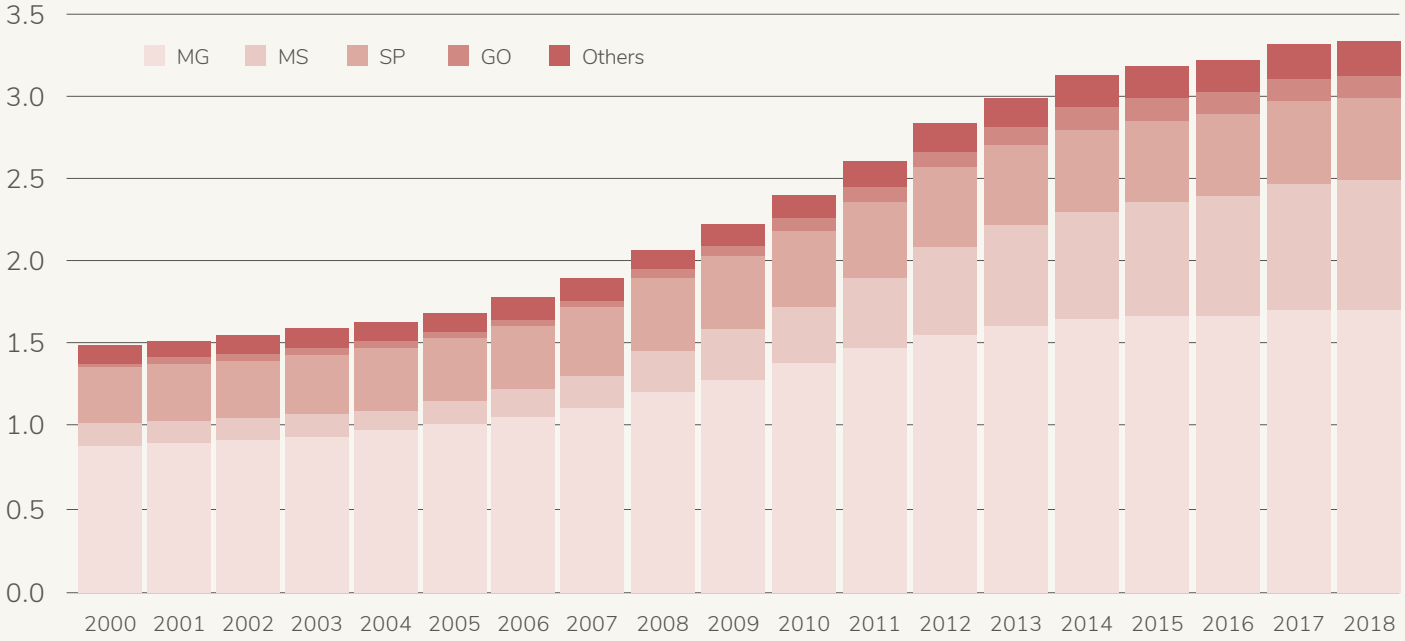
Source: Brazilian Tree Industry (IBÁ), 2018. Elaborated by Agroicone.



Between 2000 and 2018, the national area of commercial forests grew by 1.8 million hectares, mainly in the states of Minas Gerais and Goiás ***(Figure 15)***, which are the states with the largest areas as well. In the Cerrado, the area of commercial forests was 3.3 million hectares in 2018, representing a 38.6% share.

Figure 15.
Evolution of planted forest area between 2000 and 2018 (million hectares)

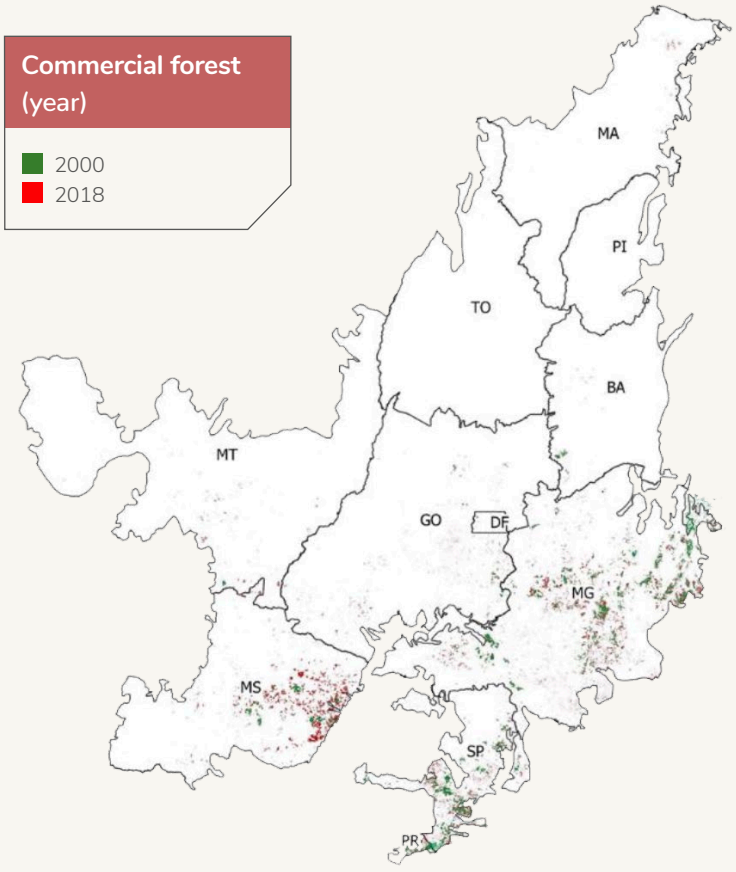
Source: Mapbiomas (2019). Elaborated by Agroicone.



When analyzing ***Figure 16***, it is possible to observe the area that has expanded in these 18 years is concentrated near the areas already existing in 2000. In a brief analysis, it was verified that 95% of this expansion occurred within a 20 km radius of the consolidated commercial forest areas.

Figure 16.
Commercial forest areas

Source: Mapbiomas Collection 4 (2018). Elaborated by Agroicone.



Based on this, a criteria to select potential commercial forest area expansion was defined as needing to be within a radius of 20 km of the consolidated areas from 2018. These would be the most favourable areas for the expansion of commercial forests, because they are close to consumer industries and the tree varieties would be adapted to these regions.

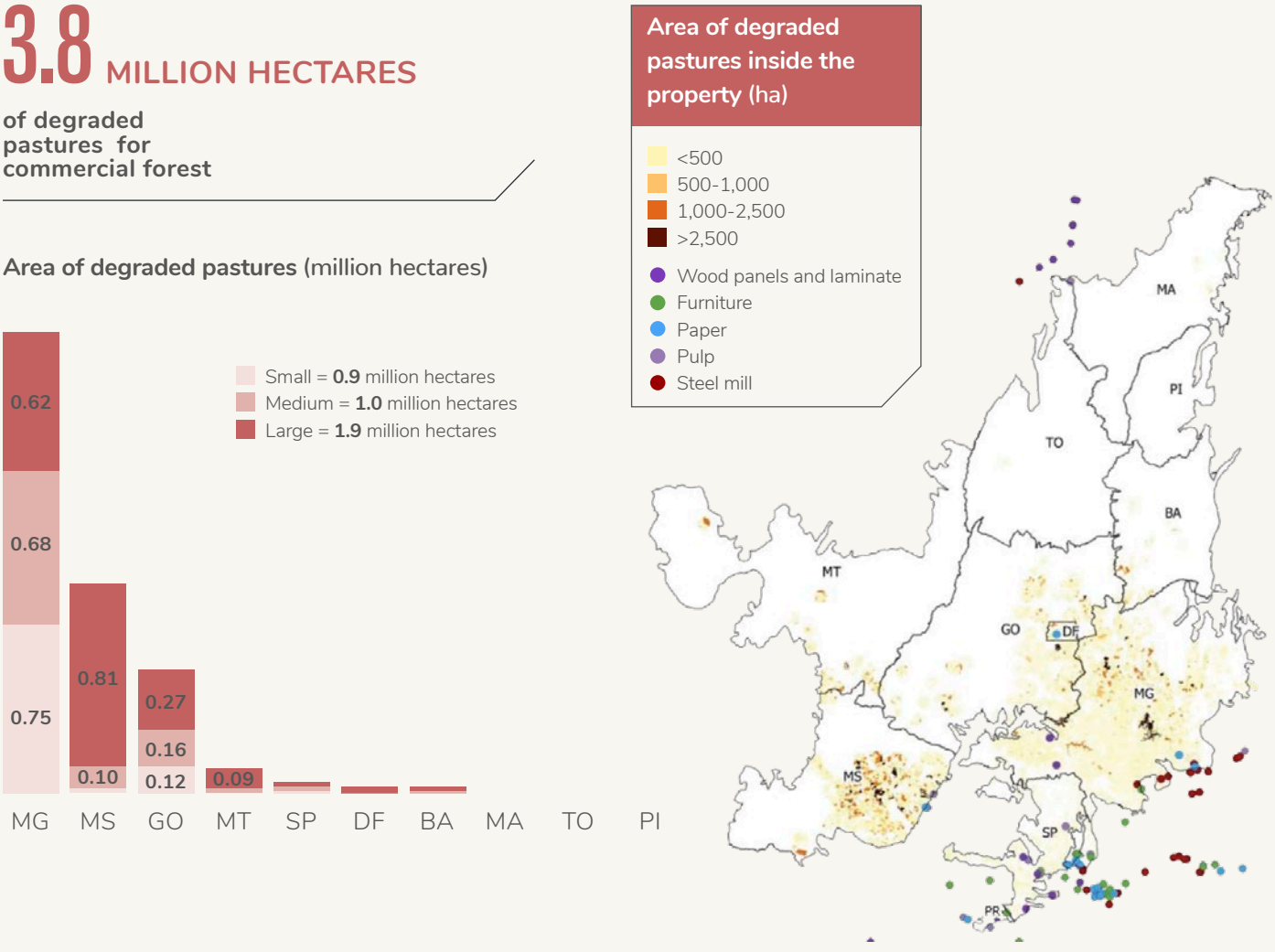
As a result, the zoning shows an area of 3.8 million hectares of degraded pastures with potential for commercial forests expansion ***(Figure 17)***. This area is mainly concentrated in medium and large properties, around 2.9 Mha. The state with the greatest potential is Minas Gerais (2.1 Mha), followed by Mato Grosso do Sul (1.1 Mha), Goiás (0.9 Mha) and Mato Grosso (0.6 Mha).

Figure 17.
Degraded pastures with potential for commercial forest - most favourable (million hectares)

Source: Study results.
Elaborated by Agroicone.

3.8 MILLION HECTARES

of degraded pastures for commercial forest



Agricultural sector industries, which have already been mentioned in the previous sections, such as slaughterhouses, dairy plants, silos, and warehouses.

These industries demand firewood to generate energy and, according to data from the Production of Vegetable Extraction and Forestry (PEVS-IBGE, 2018), still 28% of the firewood used in the Cerrado comes from extractivism. Another industry added to this analysis due to its potential to demand firewood is the ethanol production from corn, located in Mato Grosso and Goiás. All degraded pastures with the potential for soybean expansion through livestock intensification (including dairy), plus the area within the radius of 150 km of corn ethanol plants, was considered as the potential opportunity to grow commercial forests for firewood production ***(Figure 18)***.

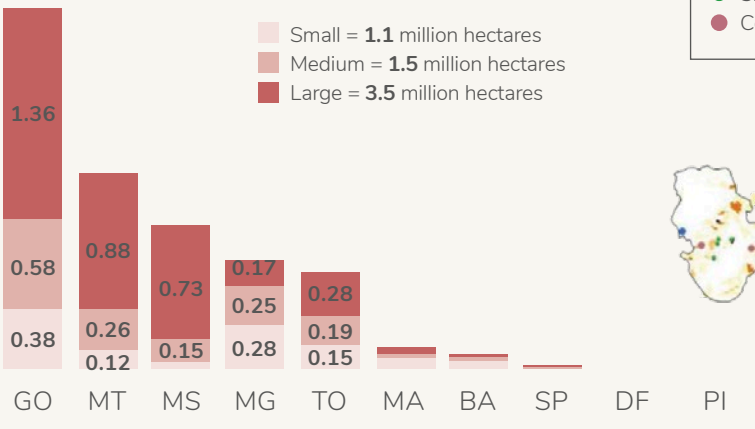
Figure 18.
Degraded pastures with potential for commercial forest - opportunities (million hectares)

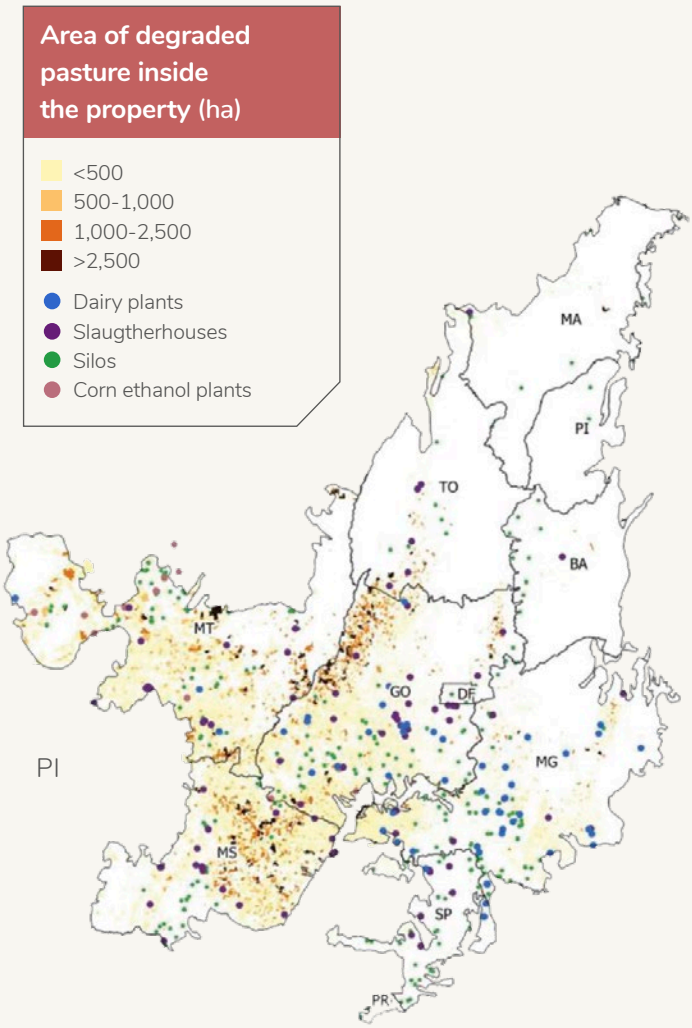
Source: Study results.
Elaborated by Agroicone.

6.1 MILLION HECTARES

of degraded pastures for commercial forest

Area of degraded pastures (million hectares)





The zoning shows 6.1 Mha of degraded pasture areas with opportunities to expand commercial forests production, near agricultural sector industries.

1.4 Integrated systems

According to the Brazilian Agricultural Research Corporation (EMBRAPA), the defin tion for integrated system is *"The crop-livestock-forestry integration system involves production of grain, fiber, wood, energy, milk or meat in the same area, in rotation, consortium and/or succession plantations"*. Those three types of agronomic practices are defined as

ROTATION

Crop rotation consists in alternating, annually, plant species in the same agricultural area.
An example of crop rotation is planting of soybeans in sugarcane areas for sugarcane renewal.

SUCCESSION

It is the repetitive sequence of crops grown in the same area and in the same crop year.
The cultivation of corn as a second crop after soybean cultivation is an example of succession.

CONSORTIUM

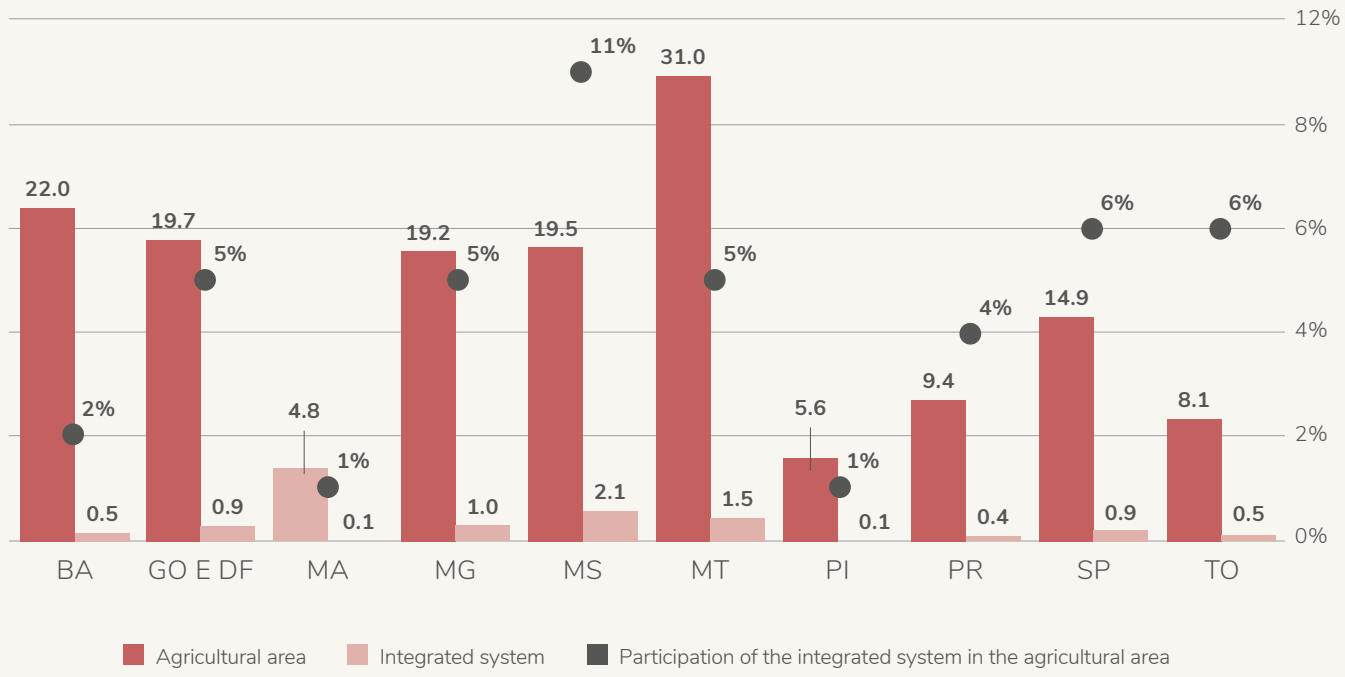
Consists of planting two or more crops in an area at the same time. The planting of corn intercalated with brachiaria, as in the Santa Fe system, is an example of a consortium of cultures.

The *Rede ILPF* network is formed and co-financed by different public and private organizations. EMBRAPA is the founder and one of the public organizations. It was initiated in 2012 and its objective is to accelerate the wide adoption of integrated crop-livestock-forestry

techniques (ILPF in Portuguese) by rural producers as part of an effort aimed towards sustainable intensification of Brazilian agriculture. According to this network, in 2018 the agricultural area with integration systems in Brazil totaled 11.5 million hectares. This corresponds to 5.5% of the total agricultural area (Rede ILPF, 2018). Analyzing the states in the Cerrado, Mato Grosso do Sul stands out with 2.1 million hectares ***(Figure 19)***.

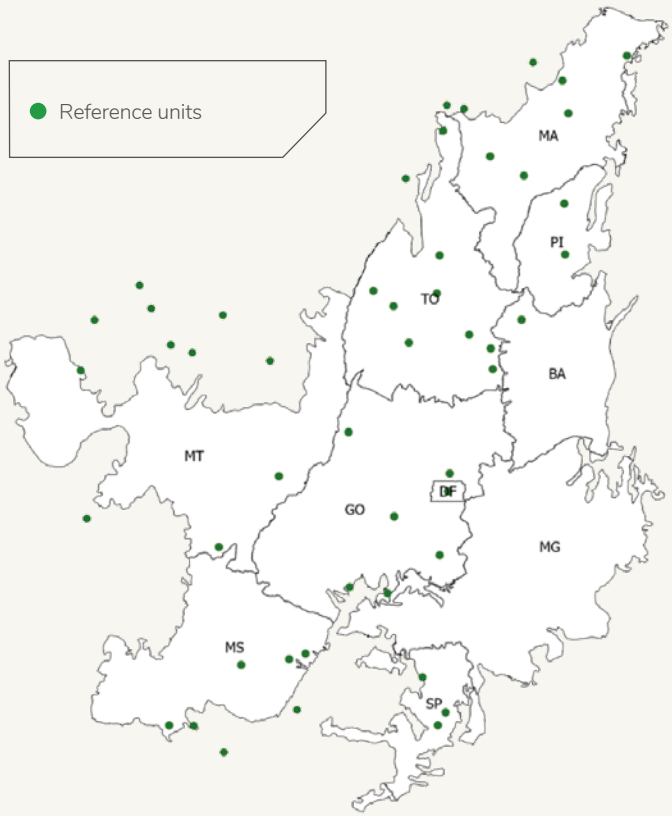
Figure 19.
Area of agriculture and integrated systems (million hectares)

Source: REDE ILPF (2018). Elaborated by Agroicone.



In the Cerrado there are 32 reference units in the Rede ILPF, as shown in ***Figure 20***. These units demonstrate different combinations of integrated systems, cultivars and agronomic practices implemented.

Figure 20.
Reference units in Rede ILPF in the Cerrado
Source: REDE ILPF (2018). Elaborated by Agroicone.



From several studies on integrated systems, Embrapa identified the main benefits and challenges of thes type of production system:

BENEFITS

- Reduced implementation and pasture reform costs, product diversification an increased producer's net income
- Increased fertility, increased organic matter, decompaction and improved water infiltration in the soil. General improved soil quality and conservation
- Improved animal comfort with tree planting, increased support capacity of pastures, increased the supply of fodder and increased animal productivity
- Can be applied to all producer profile , property sizes and technological levels
- Reduced the pressure for new deforestation and or conversion and climate risk

CHALLENGES AND BOTTLENECKS

- Lack of specialized tecnical assistance and rural extension to producers
- Lack of producers qualification and difficulty in finding qualified labor in the diferent activities of the integration system: agriculture, livestock and forestry
- Lack of customized technological packages
- Lack of local infrastructure, difficulty in accessing the market and distance from consumer and agro-industrial centers
- Long term agronomic results, system management is adjusted with time and gain of experience
- High investment with machines and inputs
- Difficulty or restriction of access to credit lines
- Lack of knowledge of financial agents in relation to integrated systems, restricting the access of producers

Source: BALBINO et al. (2011). Elaborated by Agroicone.

There are four different types of integrated systems, detailed as following: integrated crop-livestock (ICLS); integrated crop-forestry (ICFS); integrated livestock-forestry (ILFS) and integrated crop-livestock-forestry (ICLFS).

1.4.1 Integrated Crop-Livestock System (ICLS)

Embrapa's definition for integrated crop-livestock: *"The system consists of the exploration of agricultural and livestock activities, in an integrated manner, in rotation or succession, in the same area and at different times, increasing the efficiency in the use of natural resources, with less impact on the environment, since the degradation processes are controlled by means of conservationist practices"*. This system can have different focuses:

- **Livestock -** the system has a focus on livestock withthe objective of the annual crop planting to recover/improve pasture production. In addition, the sale of the annual crops helps pay the expenses of pasture improvement.

- **Agriculture -** the system has a focus on agriculture with the objective to plant pastures in the areas of annual crops, to improve physical and biological aspects of the soil, besides producing a large amount of straw. The pasture can be used as cattle feed.

Agriculture and livestock - the system has a focus on both agriculture and cattle production aims to diversify production. Often, it can be carried out in partnership between farmers and cattle ranchers.

Integrated crop-livestock is the most disseminated system in Brazil, and the main techniques are:

Barreirão System (1991): A technology of pasture recovery and renovation in combination with annual crops. It consists of upland rice, corn, sorghum, and millet with forage, such as *Andropogon gayanus*, *Panicum sp. Stylosanthes sp.*, *Calopogonio mucunoides* and *Arachis pintoe*.

Santa Fé System (2001): A combination of annual crops with fodder species, mainly brachiaria, planted in partial or duly corrected soil. This system enables grain production, and production of silage for animal feed, production of fodder and straw.

Santa Brígida System (2010): A combination of corn with green manures, specifically the guandu-anão *(Cajanus cajan*) or crotalaria *(Crotalaria spectabilis)* species. The use of leguminous species as green manure brings nitrogen to the soil, benefiting the subsequent

crops and reduction the cost of mineral nitrogen fertilization. Moreover, this combination increases the amount and diversity of the straw for the no-tillage systems, adding organic matter and improving the physical, chemical, and biological aspects of the soil.

São Mateus System (2013): A rotation of soybean and pasture, is indicated for the south of Mato Grosso do Sul state. It is based on the use of crop-livestock integration with the anticipation of soil chemical and physical correction and the cultivation of soybean in no-till to amortize pasture recovery costs. This production system, provides a diversification of activities, diluting the risks of frustrations and increasing profitability.

Gravataí System (2018): an available technology for crop-livestock integration, specifically in the "boi safrinha" modality (cattle ranching after soybean production, with forage and livestock as the main activities of the second crop. It is a combination of "feijão-caupi" *(Vigna unguiculata)* with grasses of the genus Brachiaria, such as *B. ruziziensis* and *B. brizantha* 'BRS Paiaguás' and 'BRS Piatã'.

São Francisco System (2013): is the over-seeding of the Panicum genus forage over soybean or corn crops at the end of the cycle.

If handled correctly, the system assists with the recovery of degraded pastures, ensuring quantity and quality of forage for the cattle herds in the dry season of the year in Central Brazil and sufficient straw to establish direct planting system in subsequent summer crops.

1.4.2 Integrated Crop-Forestry System (ICFS)

Is a production system that integrates the forestry and agricultural components through the combination of tree and perennial agricultural species or the consortium of tree and agricultural (annual) species in rotation and/or succession.

1.4.3 Integrated Livestock-Forestry System (ILFS)

Is the intentional integrated management of trees, pasture, and cattle in the same area with the objective to increase productivity per unit area.

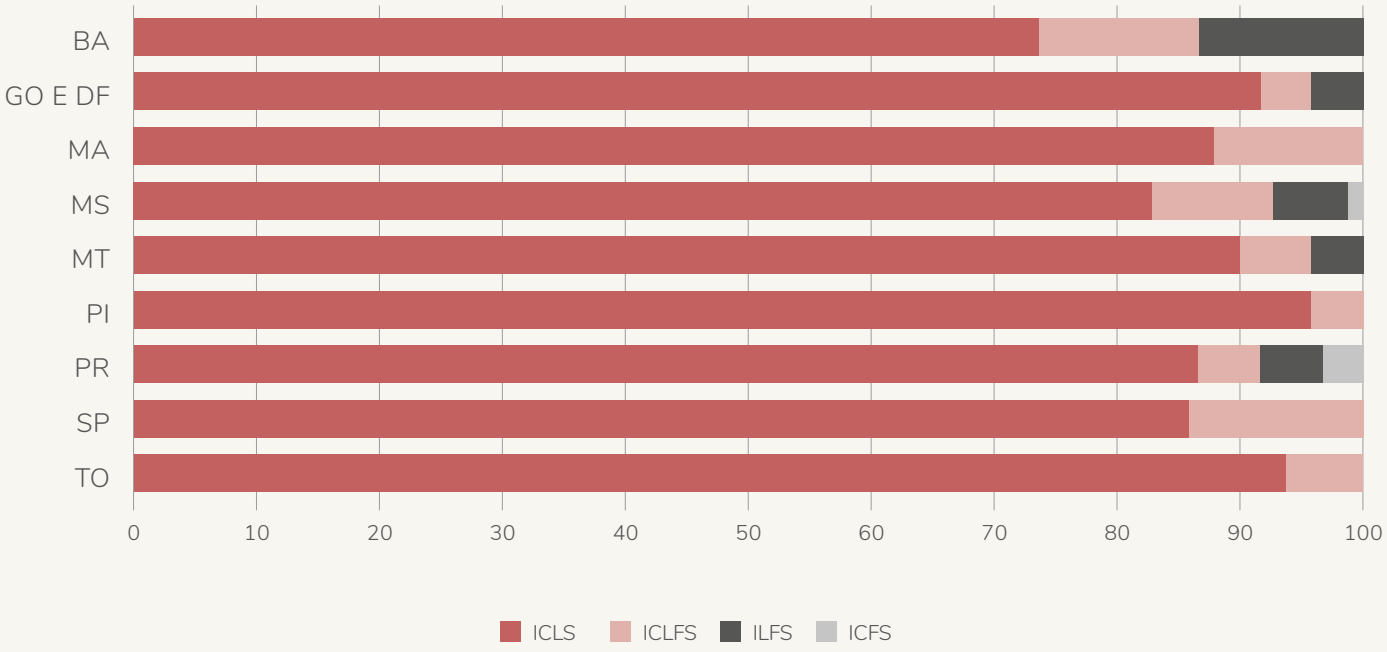
1.4.4 Integrated Crop-Livestock-Forestry System (ICLFS)

Crop-livestock-forestry integration is a production strategy that integrates different production systems, agriculture, livestock, and forestry within the same area.

Figure 21.
Types of integrated systems adopted by state (share in % of total integrated system area in the state)

Source: Rede ILPF (2018). Elaborated by Agroicone.

According to the Rede ILPF, the most adopted type of system in the Cerrado states is the ICLS. For more details see ***Figure 21***.



The last three systems integrate a forest component as a common characteristic. In the case of the ICFS, the component crop is implemented before the forest component, the opposite occurs in the ILFS. The choice of the tree species chosen for cultivation depends on soil and climate factors (temperature, precipitation, soil type, altitude, among others) as well as the purpose of its use.

It is important to analyze potential markets close to the property to ensure that whatever is generated through the forest componet can be sold or used by the producer.

The tree species can be either exotic or native, but the most common species is the eucalyptus. The ICLS described above can be transformed into integrated crop-livestock-forestry with the addition of the forestry component.

The composition of the integrated systems can vary according to the region of the Cerrado and the profile of the rural producer, as well as the local infrastructure for production flow, investment and the costs of implementing the system and selling price of the products. The whole scenario should be evaluated.

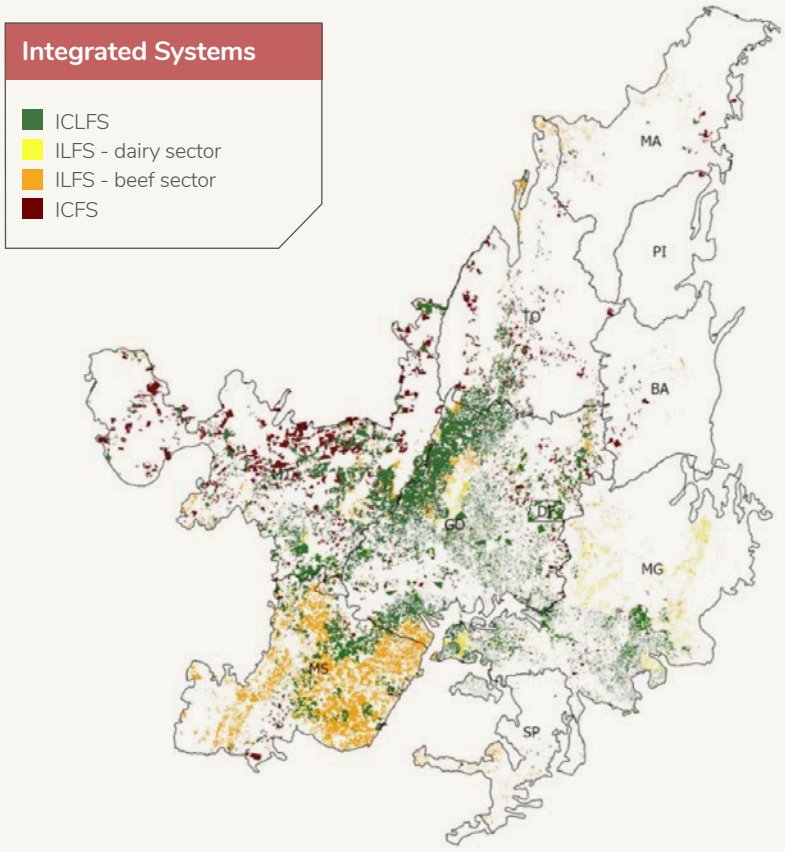
Integrated systems have proved to be great strategies for recovery, renewal, diversification and intensification, and p oper management of pastures. From this idea, EMBRAPA developed the protocol to the neutralize methane emissions and launched the seal “Carbon Neutral Brazilian Beef” (CCN – *Carne Carbono Neutro*, in Portuguese), which aims to attest the production of beef in an integrated system with the introduction of a forest component. *“The certification CCN is a concept brand that aims to demonstrate that beef produced in a system intregrated with trees like ILFS or ICLFS neutralizes GHG emission volumes through production*

processes parameterized and audited" (EMBRAPA, 2015). To obtain the certification, the product must conform to the following requirements: commitment to adopt ILFS/ICLFS system, technical evaluation of carbon emission, calculation of fixed carbon, calculation emissions neutralization and carbon stock guarantees.

To identify potential degraded pastures for each type of integrated system, the agricultural supply chains zoning presented in section were combined. The result are illustrated in the map indicating the types of systems indicated for each region of the Cerrado[3] ***(Figure 22)***.

Figure 22.
Degraded pastures with potential for integrated systems

Source: Study results. Elaborated by Agroicone.

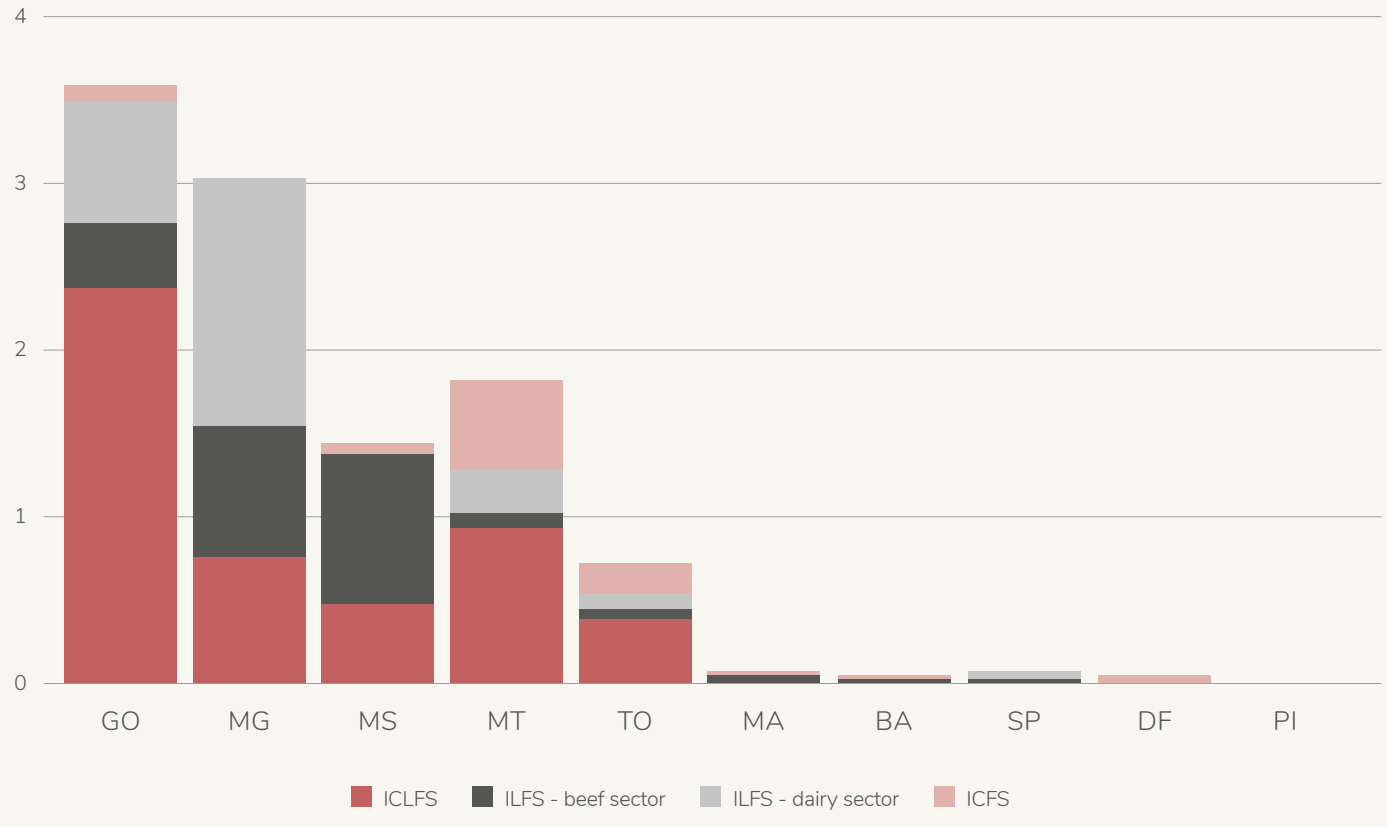


[3] We presented all opportunities for each integrated system separately in the report (in PPT) for WWF-Brasil and GTPastagens, but only the summary with all results was presented in this report.

In the Cerrado there are 10.8 million hectares of pastures with potential for integrated systems ***(Figure 23)***. The system with the largest potential to recover degraded pastures area is the integrated crop-livestock-forestry with 5.1 million hectares (which can also be used by any combination of integrated systems), followed by the integrated crop-livestock-forestry (dairy cattle) with 2.6 Mha. The integrated livestock-forestry (beef cattle) totaled 1.6 Mha and, finall , the integrated crop-forestry with 0.8 Mha. The states with the largest potential areas are Goiás, Minas Gerais, Mato Grosso and Mato Grosso do Sul, respectively.

Figure 23.
Area of degraded pastures with potential for integrated systems (million hectares)

Source: Study results.
Elaborated by Agroicone.



1.4.5 Agroforestry Systems

Embrapa's definition of agroforestry system (SAF, acronym in Portuguese) is: *"productive systems that can be based on ecological succession, similar to natural ecosystems, in which exotic or native trees are used in combination with agricultural crops, creepers, forage, shrubs, according to a pre-established spatial and temporal arrangements, with high species diversity and interactions among them"*.

The types of elements found in an agroforestry system are:

PERENNIAL ELEMENTS

Arboreal or shrub species, fruit, wood or fertilizer.

E.g.: jatobá, copaíba, cedar, xixá, caju, mahogany, mango, jackfruit, cinamom.

SEMI-PERENNIAL ELEMENTS

Species that remain in the system for two to three years being deployed at the beginning of the system.

E.g.: Banana, feijão-guandu

SHORT-CYCLE ELEMENTS

Agricultural components.

E.g. sweet potato, pork bean, cabbage, pumpkin, bean, lettuce, corn, sweet potato, manioc).

EVENTUAL ELEMENT

Animal production.

E.g.: cattle, goats, pigs, among others.

The benefits, challenges and bottlenecks to implement agroforestry systems are:

BENEFITS

- Maintenance and increase of biodiversity
- Conservation and maintenance of doil fertility and nutrient cycling
- Conservation and maintenance of water resources
- Better use of the land
- Income diversity
- Reduced economic risk due to price and climate variations
- Improved the quality of life for the producer
- Strengthened social organizations in the countryside

CHALLENGES AND BOTTLENECKS

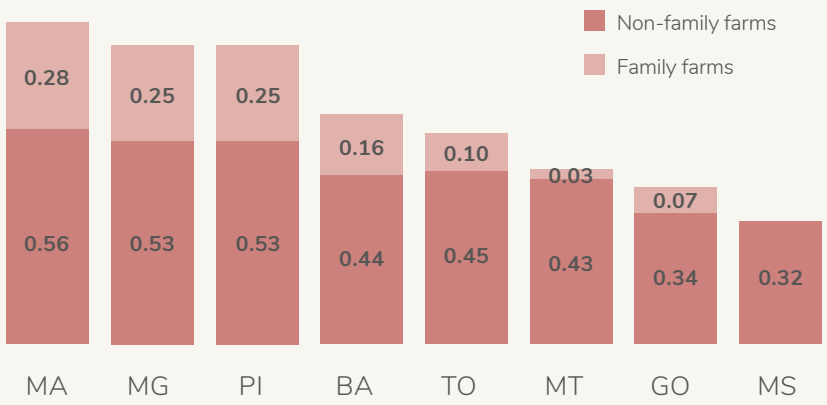
- Access to knowledge regarding the technology
- Availability of labor
- Limiting factors of the physical environment
- Access to inputs
- Lack of adequate agroforestry and economic planning

Source: MACEDO (2013) and Embrapa. Elaborated by Agroicone.

According to IBGE - Agricultural Census (2017), the property areas with agroforestry systems sum 4.8 million hectares in the Cerrado. Non-family farms have the largest share with 3.6 million hectares, compared to 1.2 million for family farms ***(Figure 24)***.

Figure 24.
Agroforestry systems area (million hectares)

Source: IBGE - Agricultural Census (2017). Elaborated by Agroicone.



The agroforestry system could be a good option to recover degraded pastures in small properties (MACEDO, 2013). It offers a way to diversify production, increase income and reduce risks for the small producer. To select the best agroforestry system, it is important to know the local markets, such as fairs, restaurants, small businesses where the products have the potential to be sold. The map in ***Figure 25*** presents the areas of degraded pastures in small properties by municipality.

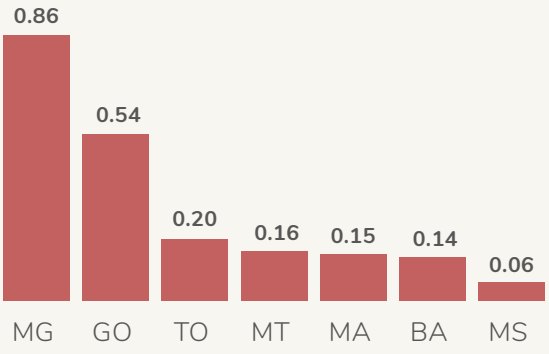
Figure 25.
Degraded pastures in small properties with potential for implement agroforestry systems

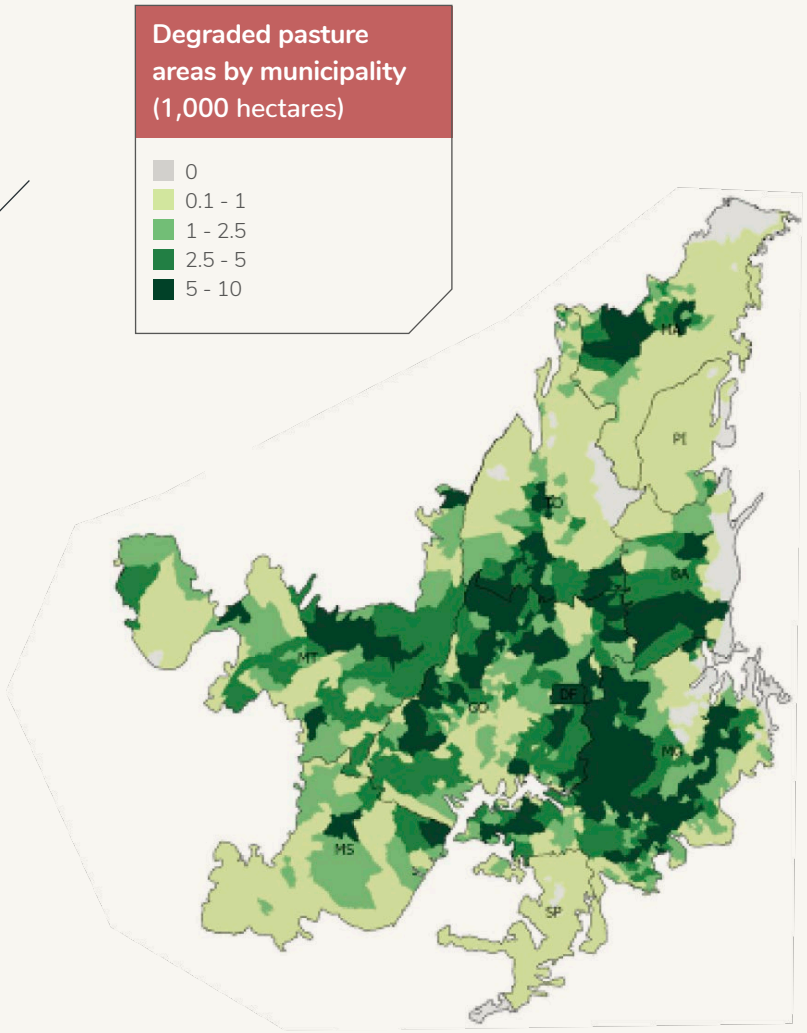
Source: Study results.
Elaborated by Agroicone.

2.5 MILLION HECTARES

of degraded pastures in small properties with potential to implement agroforestry systems

Degraded pastures in small properties (Mha)





There are 2.5 million hectares of degraded pastures in small properties in the Cerrado that could be recovered with the implementation of agroforestry systems. The states with the largest areas are Minas Gerais and Goiás, although Tocantins, Mato Grosso, Maranhão, Bahia and Mato Grosso do Sul also have important potential.

CHAPTER 2

Rural credit in the Brazilian Cerrado

Brazil's agricultural policy has three main components: market price policy[4], crop insurance subsidies[5] and rural credit policy. The rural credit policy is the major policy instrument for the sector and is provided to both commercial and small-scale family farms. The National Rural Credit System (SNCR) directs credit to farmers at preferential interest rates and corresponds to 80% of all subsidies granted to the agricultural sector in 2019.

According to The World Bank (2020)[6], Brazilian "government support for the agriculture sector in Brazil has mainly been focused on rural credit as a policy tool. The overall level of public subsidies granted by Brazil to agriculture is lower than in peer countries.

[4] The basic element of market price policy consists of regionally set minimum guaranteed prices, which cover a broad range of crops and a few livestock products. Given these minimum guaranteed prices, the government implements several price support mechanisms, including direct government purchases (AGF program); premiums to commercial buyers who pay minimum prices to producers; and public and private options contracts backed by a private risk premium option.

[5] There are four mains federal programs related to rural insurance in Brazil, providing support either in the form of insurance premium subsidies or by compensating farmers for production losses due to natural disasters.

[6] Agroicone was hired by The World Bank Group to support the development of this published agricultural policy note.

Overall, it is estimated that in 2017 the fiscal costs of the agriculture support programs stand at 0.35 percent of GDP (BRL$ 22.7 billion). Agricultural subsidies accounted for slightly more than a quarter of all subsidies paid in 2017. The total is roughly equally split between direct and indirect subsidies. Direct agricultural subsidies of BRL$ 11.1 billion accounted for around 0.9 percent of total fiscal expenditures in 2017. Although modest, as an overall agriculture support subsidy, it is a substantial financial sector subsid . In previous decades, unstable macroeconomic conditions with high inflation and inte est rates, led policymakers to pursue directed lending programs to support agriculture. However, market conditions have changed, questioning the efficienc , targeting, and effectiveness of the current programs." (adapted from The World Bank, 2020, p. 1).

Currently, the main way to finance the degraded areas recovery is through agricultural policy, specifically the rural credit. The techniques are financed via rural credit programs, by the own resources of banks that operate rural credit and also by the own resources of rural producers. The creation of funds by large companies linked to agribusiness, which aim, among other objectives, to finance the recovery of degraded areas has also been observed.

Considering this scenario presented, this section aims to analyze rural credit resources allocated to recover degraded lands.

An overview of the total resources borrowed in Brazil and the amount driven to municipalities in the Cerrado is presented. In a second step, greater focus has been given to resources allocation through investment purposes in the biome, where the funds for degraded land and pasture recovery were evaluated. Important to note that the data analysis for the Cerrado are disaggregated into non-family farmers credit programs and family farmers credit program (Pronaf[7]), detailed in the following.

2.1 Overview of the rural credit in Brazil

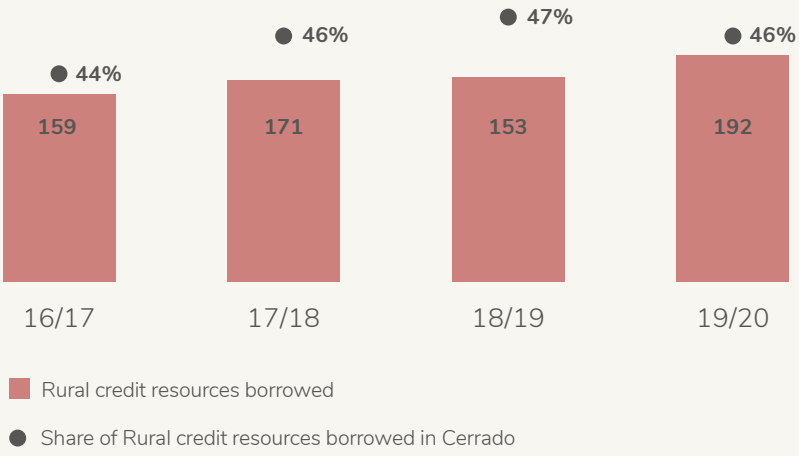
Official rural credit is significant for funding Brazilian agricultural production and represents one of the main instruments for incentivizing this sector of the national economy. In the last four crop-years, resources borrowed by producers increased 20%, from BRL$ 159 billion to BRL$ 192 billion, mostly for costing the production and for investment. Both finalities represented, during the period, 56% and 24% of the total resources, respectively, while commercialization and industrialization were 15% and 4%.

[7] PRONAF - National Program for Strengthening Family Farming or "Programa Nacional de Fortalecimento da Agricultura Familiar" in Portuguese.

Municipalities in the Cerrado play significant role in the rural credit market as, on average, 46% of their resources are allocated to it ***(Figure 26)***.

Figure 26.
Total rural credit resources borrowed in Brazil and participation of the municipalities in the Cerrado (Billion BRL$) – all programs by crop-year

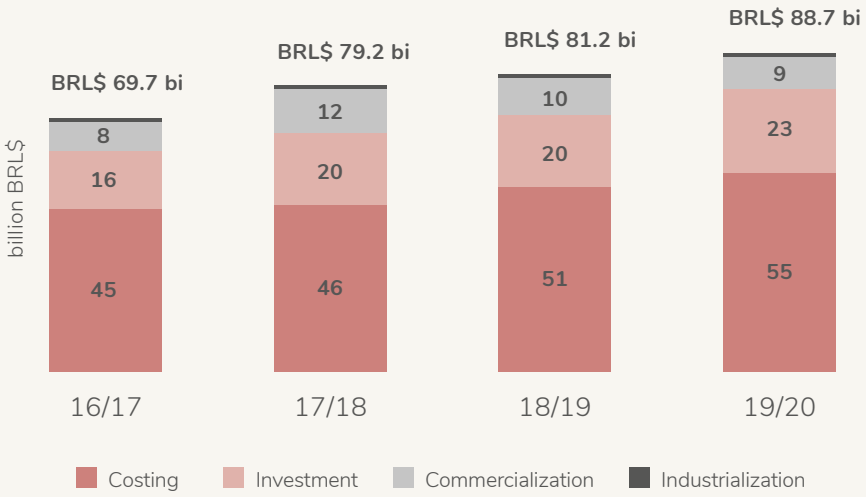
Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.



In the last four crop-years, borrowed resources in the Cerrado increased 27% (higher value when compared to Brazil's scenario), mainly for industrialization (95%) and investment (44%) ***(Figure 27)***. Industrialization represented, on average, 2% of the total resources borrowed in that period, while investment represented 24%. It is important to note that, in recent years, resources allocated for investments in agriculture increased substantially in Brazil, and even more in the Cerrado. However, resources for costing the production are even more significan , with a share of 61% of the total borrowed in the same period.

Figure 27.
Rural credit resources allocated in the Cerrado municipalities (Billion BRL$) by purpose – all programs by crop-year

Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.



Resources are allocated through different credit programs, on various purposes and producers' profile , which are mainly agricultural family farmers (Pronaf) and non-family farmers. During the period analyzed, on average, 14% of resources were borrowed through Pronaf nationwide. In the Cerrado, it represented only 4%. For this reason, the analysis conducted in the next section is focused on non-family farmers' credit programs.

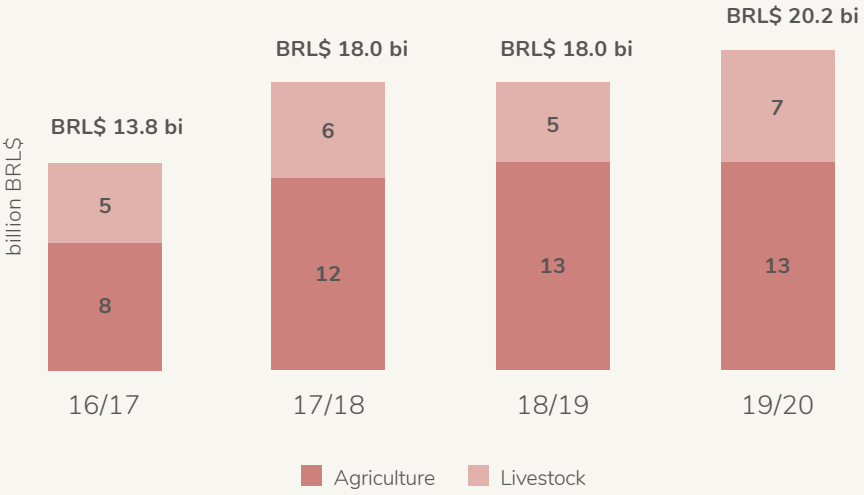
2.2 Rural credit resources allocated for investments in general and in land recovery - non- family farmers' programs

Considering a broader view of how the producers take credit for investment in the Cerrado, most of it has been borrowed by the agricultural activity, representing, on average, 65% of the total, while for livestock it represents 35% (***Figure 28***).

Figure 28.
Total of rural credit resources allocated for investment in the Cerrado - by activity

Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.

Note: Does not include Pronaf.



The largest share of these investment resources has been oriented to the acquisition of cattle (animal acquisition), harvesters, machinery, implements and tractors, which together represented 54% of the total investment resources borrowed in 2019/2020 in the Cerrado[8] ***(Table 1)*** .

Resources to recover degraded lands (soil recovery including pasture improvements) represented 14% (BRL$ 2.95 billion) of the total invested resources in 2019/2020, an increase of 91% since 2016/2017 (BRL$ 1.54 billion). Agriculture is the activity that accessed most part of these resources during the last four crop-years analyzed, on average, 60% of the total, and 40% for livestock.

The majority has been borrowed in the states of Mato Grosso, Goiás, Minas Gerais, Tocantins and Mato

[8] In general, the participation of these products in the total resources borrowed has not been changing in the last years.

Grosso do Sul, which concentrating75% of the total resources for this purpose in 2019/2020 ***(Figure 29)***. Important to note that these states accommodate 89% of the total pastures in the biome, and 87% of the degraded pastures[9].

Table 1.
Distribution of rural credit resources for investments borrowed in the Cerrado - by product

Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.
Note: Does not include Pronaf.

	Billion BRL$		Δ 16/17 – 19/20	Share in the total resources for investment in 19/20
	2016/2017	2019/2020		
Cattle (animals' acquisition)	3.46	3.57	3%	18%
Harvester machinery	1.58	2.77	76%	14%
Machinery and Implements	2.44	2.77	13%	14%
Tractor	1.43	1.89	32%	9%
Soil correction, protection and fertilization	0.98	1.91	96%	9%
Pasture	0.57	01.04	84%	5%
Sugarcane	0.42	0.85	103%	4%
Others	2.94	5.44	85%	27%
TOTAL	13.81	20.23	46%	100%

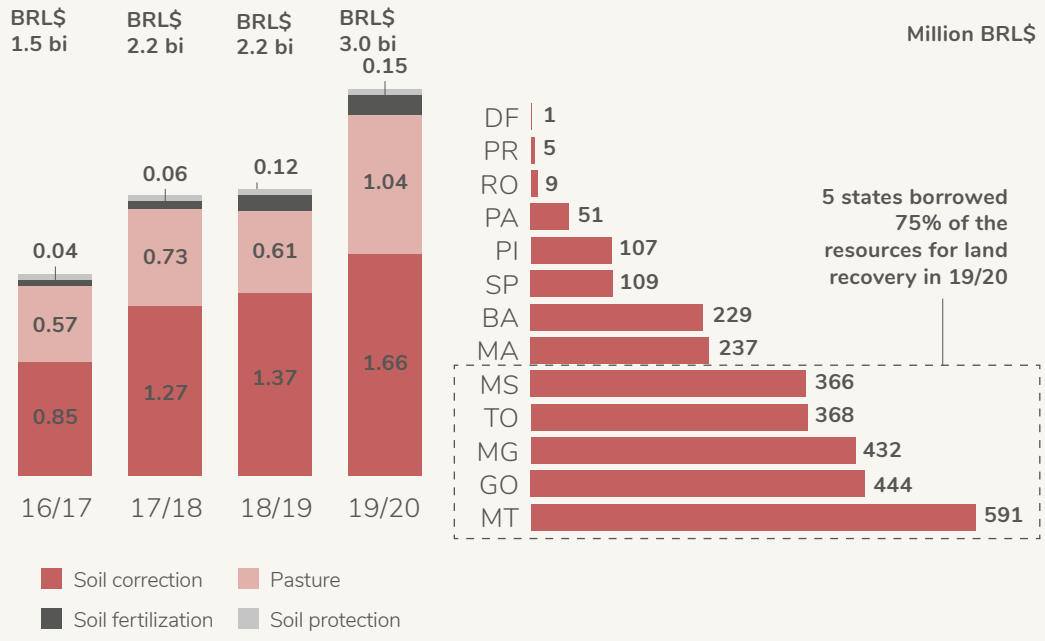


Figure 29.
Resources borrowed for investments in soil recovery in the Cerrado (left) and resources borrowed for investments in soil recovery by state in the Cerrado in 2019/2020 (right)

Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.
Note: Does not include Pronaf.

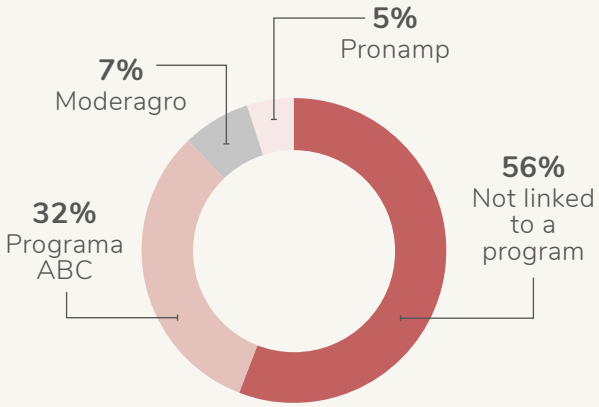
[9] Atlas Digital das Pastagens Brasileiras – Laboratório de Processamento de Imagens e Geoprocessamento (LAPIG). Available at: <https://pastagem.org/atlas/map>.

The resources for soil recovery purpose have been accessed by producers through different rural credit public programs[10], for example the ABC Program (program to implement low carbon agriculture techniques, like pasture recovery, integrated agronomic systems, no-till, waste treatment, planted forests, among others), Moderagro (program for agriculture modernization and natural resources' conservation) and Pronamp (a program oriented to medium producers, comprising costing, investments and commercialization). However, considerable value was borrowed without link to a specific credit program, which represented 56% of the total resources for in 2019/2020 ***(Figure 30)***. In addition, other programs have financed recovery of degraded lands in this same year, as Inovagro (program to implement innovation, as green energy systems and improvements for cattle breeding) and Moderinfra (program to implement irrigation), however with a small share. In previous crop-years, Moderfrota, PCA (program for building warehouses) and PROCAP-AGRO (program for supporting cooperatives) also financed it.

[10] The Brazilian agricultural policy has historically been focused on subsidizing credit (interest rates) for farmers, for several purposes. For investments, there are around 8 programs for specific purposes (as rograma ABC, Moderagro, Inovagro, Moderfrota, Moderinfra, Procap-Agro, Prodecoop and PCA) and 2 for public-specifi , as Pronaf - Brazilian Family Farming Strengthening Program and Pronamp – Brazilian Support for Medium Farmers. In parallel there are resources not linked to any of those programs and can finance co ting, commercialization, industrialization and investments for several purposes including land recovery.

Figure 30.
Rural credit resources for investment borrowed for recovering degraded lands in 2019/2020 in the Cerrado by program

Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.
Note: Does not include Pronaf.



In 2019/2020, BRL$3 billion were borrowed to invest in degraded land recovery into the Cerrado.

In the last four crop-years, increased resources borrowed through these programs was higher for "Not linked to a specific program" and for Pronamp, by 110% and 247%, respectively. However, Programa ABC represents an important investment program for low carbon agriculture and, in this case, resources destined for degraded land recovery through it increased to74%.

2.2.1 Financing conditions for resources allocated to recover degraded lands in the Cerrado

Analyzing rural credit allocated for investment to recover degraded land in the Cerrado, it is possible to identify that the average interest rate paid over the loans is lower for livestock producers (6.4% p.a.) compared to agriculture (7.2% p.a.) in 2018/2019 crop-year[11]. The opposite is observed for average payment term, 8 years for livestock and 6.3 years for agriculture.

[11] For this analysis microdata were available for 2018/2019 crop-year.

The lower interest rate for livestock can be explained by the fact that both, the average value financed and the average area nanced by contract, were lower when compared to the same variables for agriculture. Also, federal government policies specifi for technology adoption offered lower interest rates for the livestock sector. Related to the payment term being larger for livestock, is be linked, mainly to the cattle ranching, activity that presents higher payback, demanding larger payment terms over financin [12].

Regarding financial conditions by program, in general, average and maximum interest rates observed are closer to what was stipulated in the Agricultural and Livestock Plan ***(Table 2 and Figure 31)***. Lowest values were found in Pronamp, Moderagro and "Not linked to a specific program", which the last one is also an exception, presenting the highest maximum value. Analyzing the data, it is possible to verify that the highest interest rates allocated through "Not linked to a specific program", so over the average, refers to resources not subsidized, which the conditions (interest rates and payment terms) were free agreed between fin ncial institution and rural producer[13].

[12] Important to note that interest rate and payment term are evaluated by financial institution considering rural project investment presented by the rural producer.

[13] The Rural Credit Manual (1-6-3) refers to it as: "... rural credit operations carried out using free resources from financial in titutions, contracted at freely agreed rates, not supported by the Union's economic subsidy in the form of equalization of interest rates and other financial charges."

Table 2.
Financial conditions from the rural credit resources allocated to recover degraded land in the Cerrado - 2018/2019 crop-year by program

Source: Central Bank of Brazil and MAPA (2018). Elaborated by Agroicone.

Note: Does not include Pronaf.

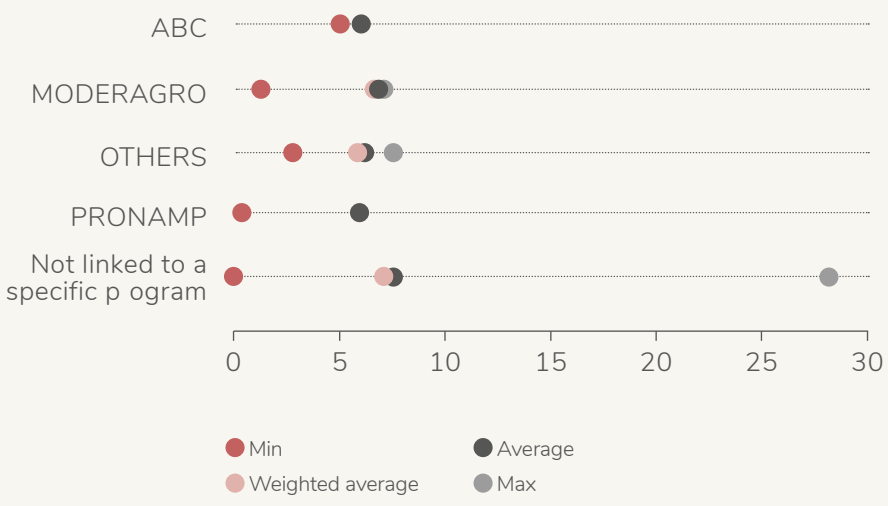
The private market (not subsidized resources) may represent an impediment to financing long-term investment, like degraded lands recovery.

Program	Interest rate (% py)			Payment term (years)			Agricultural and Livestock Plan 2018/2019	
	Min	Average	Max	Min	Average	Max	Interest rate (max % py)	Payment term (max years)
Not linked to a specific program	1.0	7.1	28.2	0.6	7.5	15.0	-	-
Programa ABC	5.0	6.0	6.0	2.0	7.5	11.0	6.0	12
Moderagro	1.3	6.9	7.0	2.8	6.9	10.1	7.0	10
Pronamp	0.3	6.0	6.0	1.8	6.9	8.1	6.0	8
Inovagro	6.0	6.0	6.0	4.9	8.2	10.1	6.0	10
Moderinfra	7.0	7.0	7.0	5.0	6.4	7.1	7.0	10
Moderfrota	7.5	7.5	7.5	5.0	6.4	7.1	7.5	7
PCA	5.3	5.5	6.0	7.0	9.1	10.1	6.0	15

Figure 31.
Interest rate analysis from the rural credit resources allocated to recover degraded lands in the Cerrado - 2018/2019 crop-year by program (% per year)

Source: Central Bank of Brazil and MAPA (2018). Elaborated by Agroicone.

Note: Does not include Pronaf.

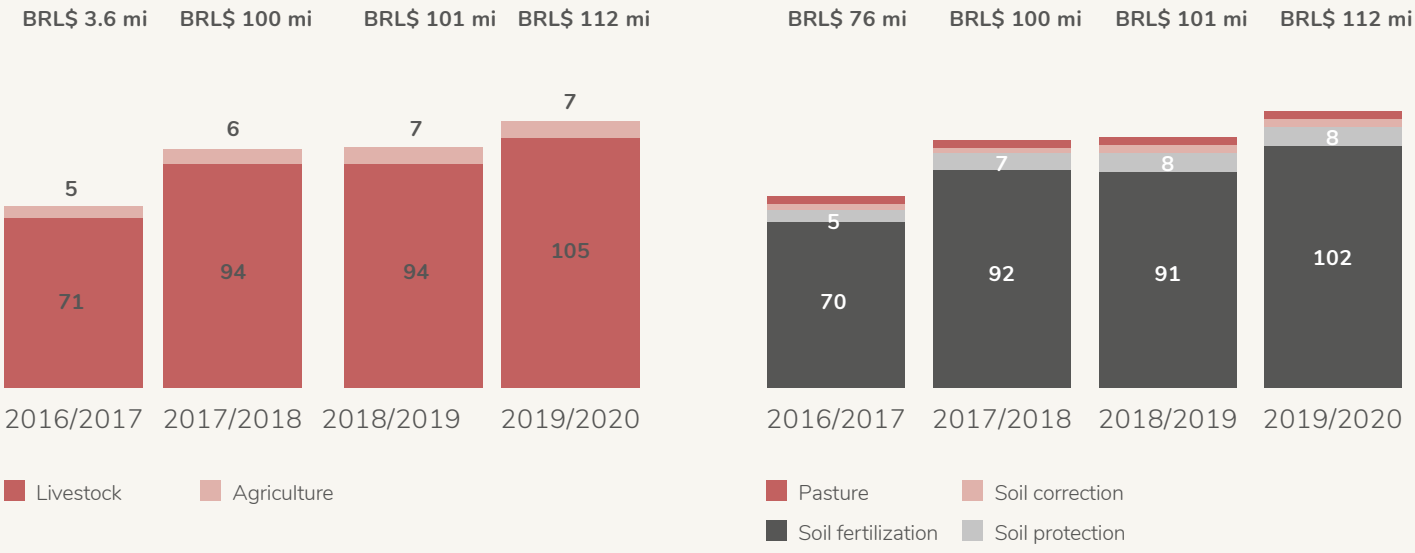


2.3 Rural credit resources allocated for investments in general and in land recovery - family farmers program (PRONAF)

Considering Pronaf data, resources borrowed to recover degraded land in the Cerrado increased by 48% from 2016-2017 to 2019-2020 crop-years. In this last year, it represented BRL$ 112 million (23% of Brazil's total resources allocation for soil recovery through Pronaf in the country), mostly accessed by livestock activity, mainly to recover pastures ***(Figure 32)***.

Figure 32.
Rural credit resources investment for soil recovery in the Cerrado through Pronaf - by activity (left) and by product (right)

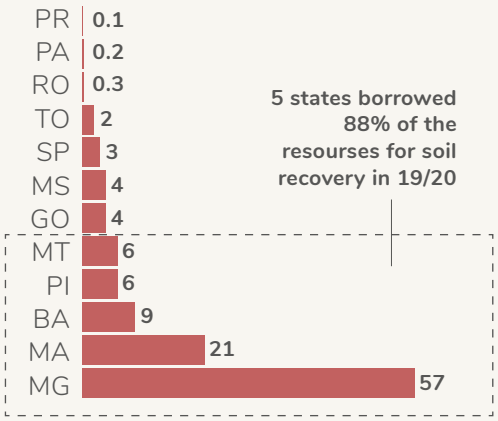
Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.



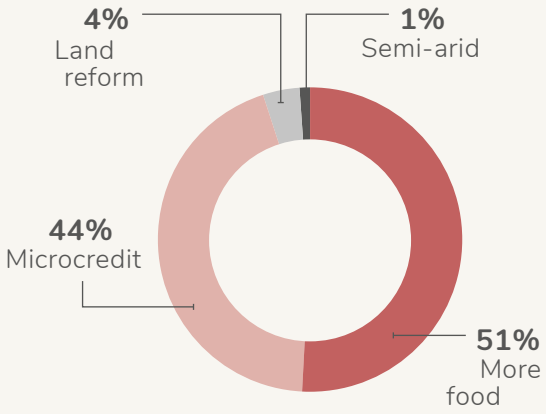
It is important to note that, the states ofMinas Gerais, Maranhão, Bahia, Piauí and Mato Grosso were accessing most part of the resources for degraded land recovery. In 2019/2020, these states borrowed 88% of Pronaf resources in the Cerrado for this purpose,

Figure 33.
Rural credit resources investment for soil recovery in the Cerrado through Pronaf - by state in 2019/2020 (left) and by subprogram in 2019/2020 (right)

Source: Central Bank of Brazil – SICOR. Elaborated by Agroicone.



which represented BRL$ 98.6 million **(Figure 33)**. Also, Pronaf has an important role in the agricultural frontier region (MAPITOBA).



In 2019/2020, BRL$112 million were borrowed to invest in degraded lands recovery in the Cerrado through Pronaf.

Regarding the interest rate charged on the resources allocated for degraded lands recovery through Pronaf[14], it was possible to observe that the average rate charged for livestock (0.8% p.a.) was lower than for agriculture (1.12% py), and the payment term was similar for both, 3.4 years and 3.7 years, respectively. As previously verified for the other rural credit programs, the average area and average value financed by contract for agriculture were greater than for livestock, which may reflect the di ference in interest rates charged between the two activities.

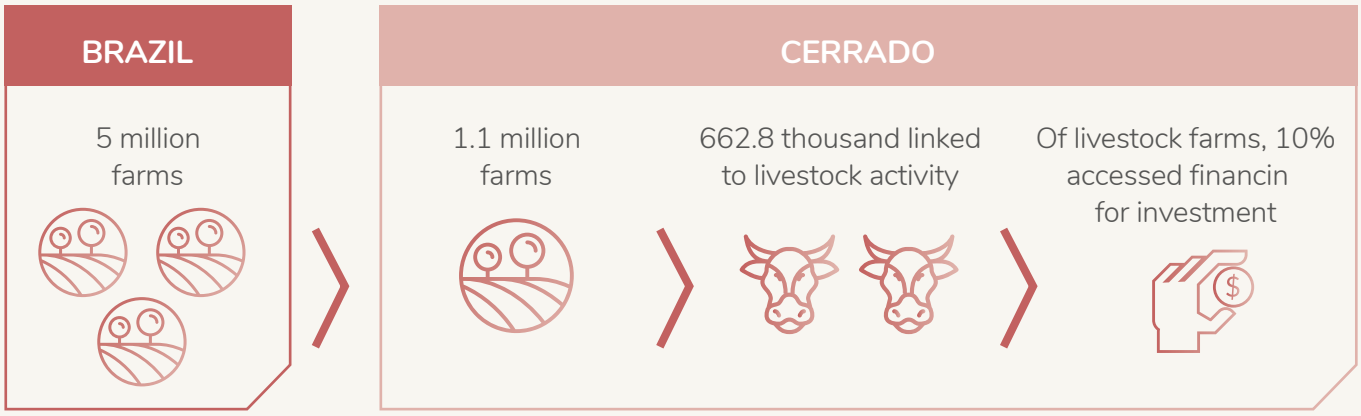
[14] Family Farming Haverst Plan 2017-2020 (Plano Safra da Agricultura Familiar) established maximum interest rate for investments according to Pronaf subprograms that may vary from 0,5% to 4,5%.

2.4 Brazilian farms access to rural credit

According to data from IBGE - Agricultural Census (2017), the number of agricultural properties that obtained financing in 2017 ere analyzed. It was found that the country had 5 million properties, of which 1.1 million (21%) were in the Cerrado. Only 15% (784.5 thousand) of the total number of properties in the country obtained financing, either to costing, investment or commercialization. Considering the total of 1.1 million properties in the Cerrado, 662.8 thousand (63% of the total in the biome) were linked to livestock activity. Within this activity, 98.2 thousand accessed financing, of hich 67.9 thousand accessed financing or investment, which represents only 10% of the number of livestock properties in the Cerrado in 2017 ***(Figure 34)***.

Figure 34.
Livestock farms' access to rural credit for investments in theCerrado in 2017

Source: IBGE - Agricultural Census (2017). Elaborated by Agroicone.



Also, according to data from the Agricultural Census, livestock properties accessing resources from rural credit for investment were financed, largely, by banks, either through public or private resources. Other producers financed investments by the government (federal, state or municipal) and also through credit cooperatives, which have an increasingly relevant role in financing national agricultural activity in recent years ***(Figure 35)***.

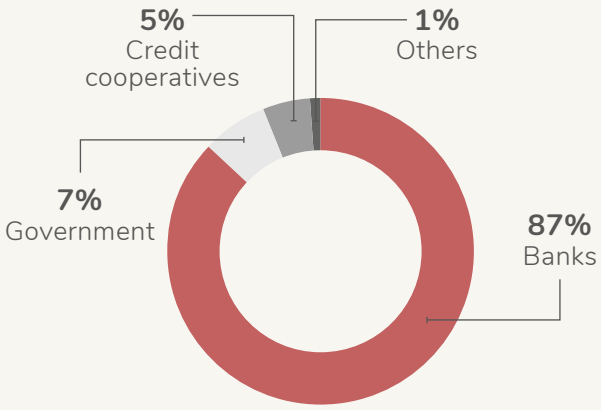


Figure 35.
Livestock farms' access to rural credit investment resources in 2017 - by financial agent

Source: IBGE – Agricultural Census (2017). Elaborated by Agroicone. Note: "Others" means input suppliers, other financia institutions (except banks and credit cooperatives), nonprofit o ganizations, relatives or friends, other agents

Despite the increase in investments borrowed by the Cerrado's producers, a small percentage of farms in the biome obtained financing to in est in their activity. This scenario was not just found in the biome but, in general, throughout the whole country.

2.5 Determinants of credit demand by rural producers

A previous study carried out by Agroicone sought to evaluate the determinants of credit for investment taken by cattle ranchers in Mato Grosso[15]. The research used an econometric model to assess which variables (factors) are more significant and which determine the credit resources demand, mainly for investment.

The model was based on information from 141 municipalities in Mato Grosso (the Cerrado, Amazon and Pantanal biomes) to ascertain the importance of issues such as technical assistance and environmental and land regularization on the volume of investment finance for livestock activities in the state.

According to the results obtained, the number of financial in titutions in the municipality had an important impact on the demand for investment credit in Mato Grosso, and for each additional financial in titution, there was an increase of BRL$ 3.4 million in the amount investment finance in the state. In turn, technical assistance was also of great importance, and for each additional property

[15] Study not yet published.

receiving technical assistance in Mato Grosso, there was an increase of BRL$ 207.7 thousand in the total financed by the property. Land and environmental regularization were also significant as determinants for borrowing. For each regularized property, there was an increase of BRL$ 45.6 thousand and BRL$ 30.3 thousand, respectively, in the total financed resources. Based on this information, this project would seek to validate through the questionnaires that would be applied to rural producers, producer associations and financial institutions what are the factors they consider to be decisive to take credit for investment, especially for pasture recovery. We would expect to have those answers by the end of October 2020.

CHAPTER 3

Agricultural funding structure - the case of soybeans in Mato Grosso

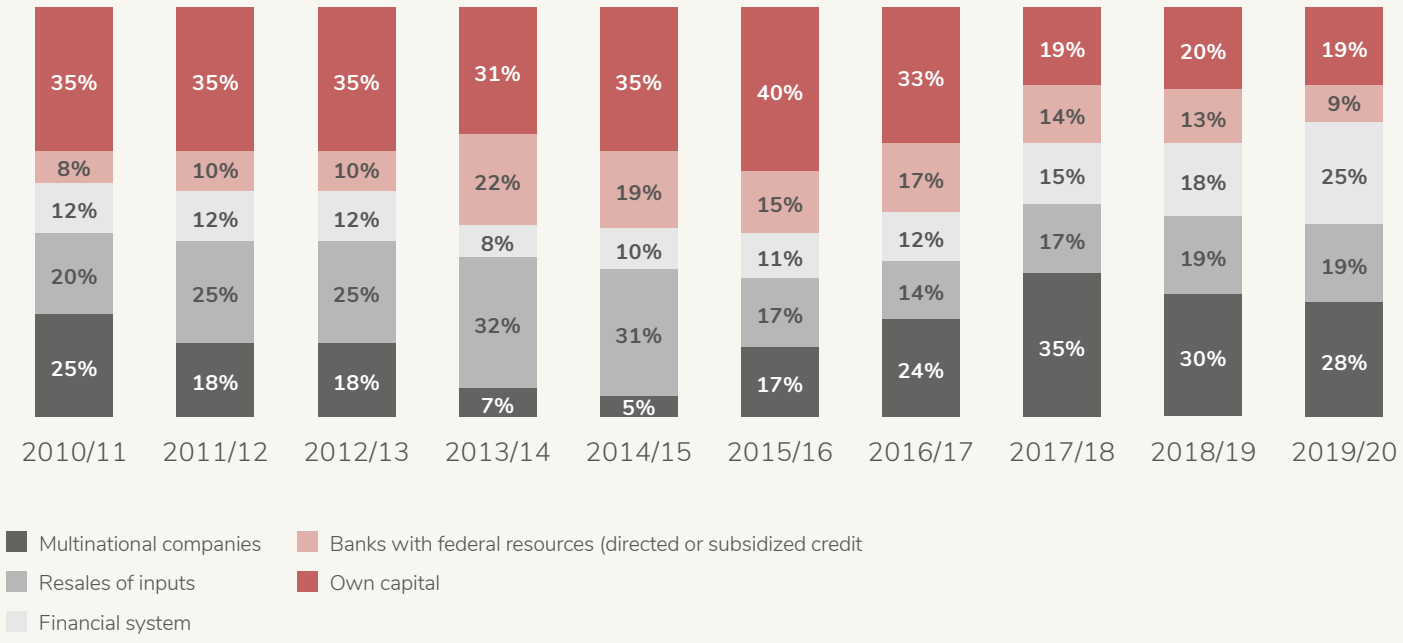
Although rural credit is the main public policy instrument for financing agricu ture, rural producers, in this case the non-family farming producers, may have other ways to finance their agricu tural activities and necessary investments. The case of soybeans is an example where sources of financing are accessed by producers for operational costs.

From 2010 to 2019, the subsidized rural credit's funding share of soybeans costs in Mato Grosso varied by 8% to 22% of the total soybean cost ***(Figure 36).*** The multinationals' share in the soybean supply chain, producers' own capital and input resale had a significant role too. Soybean producers had a high degree of leverage with their own capital to cover costing - around 19% to 40% (in Mato Grosso). In general, during the last two crop-years, the financial system and banks with federal resources were the largest financiers of soybean costing in Mato Grosso.

It coud be said that market (not subsidized) credit has funded costs for both production and agricultural expansion. It is worth mentioning that this differs according to producer profile, especially y property size, as well as by region. This does not apply, for example, in the southern region, where producers are more dependent on official and subsidized rural credit, given the characteristics of producers (smaller properties than in Mato Grosso), and the preference for official credit over other mechanisms in that region's market. In Mato Grosso and in MATOPIBA regions there are large companies producing grains (soybean, cotton and corn) and taking credit directly from the financia market and from investors (investment funds).

Figure 36.
Funding structure for soybean production costs in Mato Grosso

Source: IMEA.
Elaborated by Agroicone.



Subsidized credit for costs can be covered by private credit markets, mainly for large producers, since the national interest rate (SELIC interest rate) has been declining during recent years. However, this is not the case when related to investment credit, which incurs in long term financing and higher risks from the financial institution's perspective.

Currently, the Brazilian credit market is not able to offer long-term credit to the agricultural sector (individual producers) efficiently and with conditions that are consistent with the returns on the projects, especially considering the high risk and uncertainties regarding the funded project, as well as a result of the country's macroeconomic instabilities.

However, related to investment funding for the livestock sector or in soil recovery, data availability is very restricted, emphasizing the importance of applying questionnaires to rural producers aimed at understanding their access to finance for these purposes.

CHAPTER 4

Agribusiness sector confidence in the national economy and business environment

Investments made by producers are linked to several factors, but mainly to their perception of the economic scenario, which may be favorable or not. Based on this aspect, the ICAGRO (Agribusiness Confidence Ind x)[16] is analyzed in this section. The Index is released by FIESP (Federation of Industries of the state of São Paulo), and it presents information on the economic perception of Brazil and agribusiness by agricultural producers, cooperatives and industries connected to the sector. Additionally, the confidence ind xes of agricultural and livestock producers, CI Agriculture[17] and CI Livestock, respectively, are evaluated.

[16] Calculated quarterly, the Agribusiness Confidence Index (ICAGRO) measures, through a set of variables, the expectations of the sector's agents related to their business and the economic environment in general. The Index has a scale ranging from 0 to 200 points, where 100 points indicate neutrality. Values below 100 points indicate dissatisfaction / pessimism and above 100 points, satisfaction / optimism of the sector with the business situation and with the general conditions of the economy. Other information regarding the methodology can be found at <http://icagro.fies .com.br/resources/download/2t20/metodologia_icagro.pdf>.

[17] In this context, "CI Agriculture" represents the crop producers confidence index and "CI Livestock" represents the cattle ranchers confidence index.

Since the beginning of the historical series, there have been fluctuations in the indexes analyzed, but a tendency for growth over time ***(Figure 37)***. In general, evaluating the periods with a fall in the confidence indexes, the reports issued by FIESP for each quarter point to the negative perspective in relation to the Brazilian economy and political scenario. In addition, increases in the price of agricultural inputs, low expectations regarding future commodities prices, reduced availability of credit to finance production and a disadvantaged business environment, factors that negatively impact the sector's confidence. Also important to note, in the 2020 first quarter the index had a dropped due to the Covid-19 pandemic crisis, which affected Brazilian economy and created a strong feeling of uncertainty in the country, even in the agricultural sector.

On the other hand, greater confidence (periods of rising indexes) occurred when the sector perceived economic recovery, greater political stability, positive expectations about commodity prices, better credit conditions together with lower interest rates and increases in production productivity.

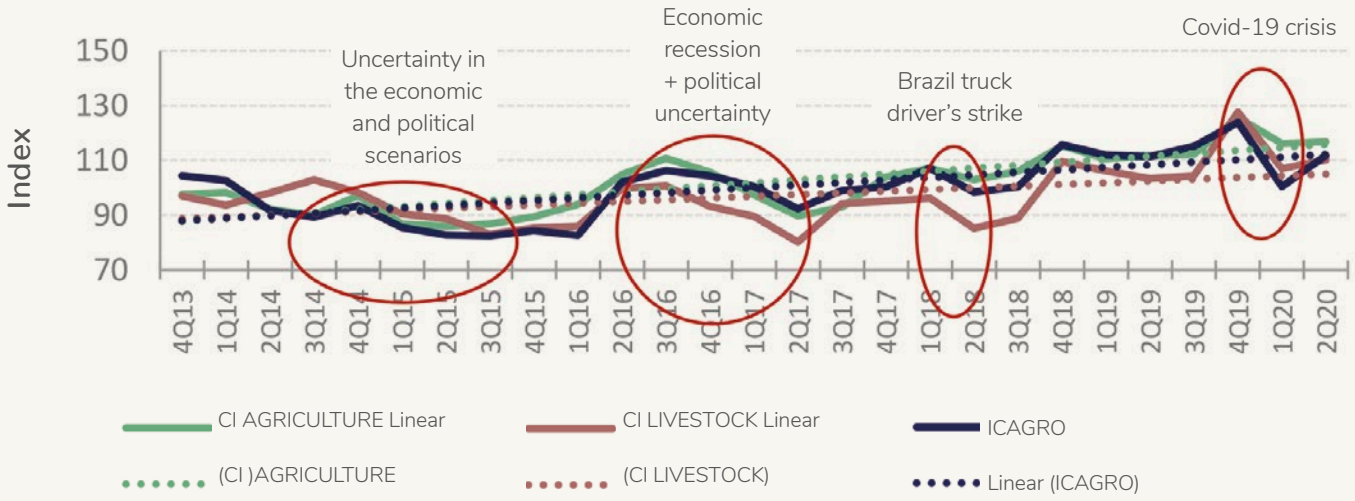


Figure 37.
Agribusiness confidence indexes

Source: FIESP.
Elaborated by Agroicone.

Comparatively, for much of the analyzed period, the CI Livestock has been, for much of the analyzed period, below the CI Agriculture, showing that the ranchers have less confidence and / or they are more pessimistic in comparison to agricultural farmers. In addition, a characteristic of ranchers linked to what was mentioned, as their greater risk aversion. In this respect, a lower level of confidence and greater risk aversion tend to lead to lower investment levels in the activity by these producers.

Another point is about the standard deviation[18] observed for the CI Agriculture and the CI Livestock. The first one presents a greater deviation (11.0) than the second (10.5), that is, the confidence of anchers in relation to the economy and the business environment tends to oscillate less than agricultural farmers.

[18] Standard deviation is a statistic that measures the dispersion of a dataset relative to its mean. A low standard deviation indicates that the values tend to be close to the mean of the set, while a high standard deviation indicates that the values are spread out over a wider range.

CHAPTER 5

Investment intention by cattle ranchers

In addition to the confidence ind xes analyzed previously, FIESP also releases the investment intention panel[19], a research developed in specifi periods to monitor the producer's intent to invest in machinery, farm infrastructure, productivity, technology and people management.

The main survey question to producers is whether they intend to invest in a certain area. Regarding livestock producers, the panel identifies, among the investments in technology, whether they intend to allocate resources for pasture recovery.

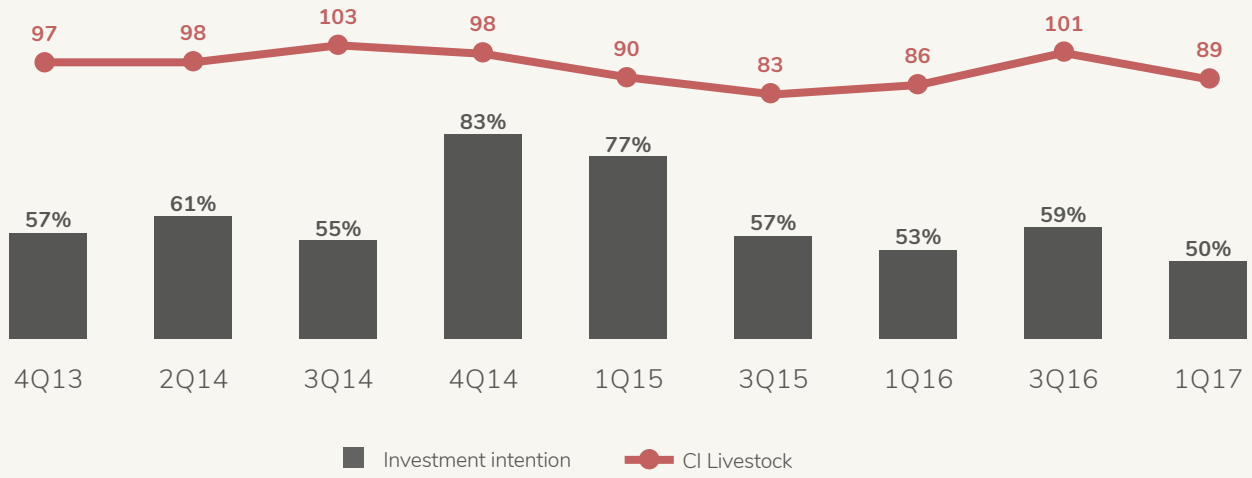
Figure 38 shows the percentage of ranchers interviewed who stated they intended to invest in pasture recovery in that period, and also the CI Livestock, representing the confidence of anchers in the economy and in the agribusiness sector.

[19] Important to note that Investment Intention data series is not continuous and it is available until the first quarter of 2017.

Especially from the fourth quarter of 2014 onwards, it is more evident that, if the ranchers have a positive outlook regarding the economic environment (CI Livestock increasing), their intent to invest in pasture recovery grows. The opposite is also observed when producers have a negative perspective leading to lower intention to invest.

Figure 38.
Investment intent by cattle ranchers - Percentage of ranchers interviewed that intended to invest in pasture

Source: FIESP.
Elaborated by Agroicone.



Thus, considering the information analyzed, the rural producers' perception of the environment is important for their investment decision. In this case, political and economic scenarios that allow a positive business environment are prominent factors for agents' decision making.

CHAPTER 6

Initial perceptions about farmers' decision on expanding production over new areas including degraded lands

In studies previously developed by Agroicone, interviews were carried out with rural producers in the Cerrado region to understand the expansion of the agricultural area and about the conversion of pastures (with low productivity) into areas for soybean cultivation.

The pattern of agricultural expansion is different between regions in the Cerrado and depends on the need for soil correction. In some cases, when correction is necessary, especially in the MATOPIBA region (sandy soils), the period for the crop to reach its ideal productivity level is longer.

Similar difficulty occurs in the expansion over pasture, especially if it presents degradation or little correction of limestone, plaster and other

inputs. The costs of conversion and correction of the soil are equivalent in relation to the expansion over the Cerrado (native vegetation), differing only by the fact that there is no need to clear (deforest) the area.

Historically, as for the financing of the expansion, this took place mainly with the producers' own capital, especially to purchase areas. Some investments in soil correction and purchase of machinery were financed by bank credit (official rural credit for individual producers and credit lines for companies). Today there is no official credit for financing to purchase areas, regardless of current use. The form of payment for the areas depends on each case, they can be paid according to the price of a bag of soybeans, and the quantity of bags per hectare is fixed. In some cases, land is paid over an average of five years.

Until 2019, before the COVID-19 pandemic, there was demand for areas that were suitable for cotton planting, due to the good results of this crop in recent years. Producers implement crop rotation between soybean, corn and cotton, especially in Mato Grosso and MATOPIBA (in this region, mainly in irrigated areas).

Producers' decision to expand the area is related to different factors, such as increase of the productive scale and formation of patrimony, production

profitability and land valuation, and climate risk management, operating in different regions.

According to producers interviewed, the future expansion of agriculture should be based on already cleared areas, some with pastures (as in Tocantins), others with agricultural production (as in Bahia) and some areas of vegetation with aptitude for grains (especially in Maranhão and in Piauí).

In Mato Grosso, the main expansion model is land lease, whether agricultural or pasture, for the production of soybean and / or cotton. A similar model is found in the southern region of the Cerrado (as in Goiás state and Minas Gerais). For the expansion of soybean in cleared areas (as pasture), the main bottlenecks identified were:

- High investments are necessary to convert pastures. In the case of leased areas, these investments may become unfeasible.

- Lack of pasture areas available in some regions, such as Bahia, Maranhão and Piauí.

- Traditionally livestock regions do not have infrastructure for grains, making expansion in these regions difficu t or the need for higher investments (warehouses, silos, etc.). The lack of qualified labor was also identified,

either for grain production or as operators of agricultural machinery in the case of converting pastures into agriculture areas.

- Smaller gains on the price of land when acquiring and converting pastures compared to native vegetation.

- Farms in need of environmental compliance to the Forest Code.

Among the incentives to expand agriculture over cleared areas, they can be divided between economic and financial incentives and those linked to the production system.

The main incentive to guide the expansion of agriculture would be to reduce bureaucracy and provide long-term credit to finance investments in conversion of cleared areas, with differentiated conditions (such as longer grace periods, payment, interest rates, etc..
In addition, financing the purchase of areas could also encourage expansion over cleared areas, since they do not exist today or have impeditive conditions.

Regarding incentives related to production and production systems, to expand over cleared areas (pastures), there neeeds to be to investment in infrastructure, technical assistance and qualifcation of labor, especially in traditional livestock production regions.

CHAPTER 7

Assessment of why ranchers are not taking credit / implementing land recovery practices

As part of this study, between October and November/2020, we conducted meetings and undertook questionnaires to address the following:

- For all four agriculture practices, why are farmers not implementing practices to recover degraded pastures? What other barriers producers face to implement agronomic systems oriented to recover degraded pasture lands, such as technical assistance, input access, among others? What are the associated risks?

- Is it because the business model is not profitabl / practical? Are the Ãfinancing terms not attractive? What are the barriers to access credit? What are the associated risks? What other credit barriers do producers face to invest on degraded pastures recovery? Are access to credit, conditions and/or availability the main barriers?

- What mechanisms or incentives are capable of changing producers' behavior in order to adopt agronomic systems to recover degraded pastures? What kind of supply chain arrangement is needed? What kind of arrangement among producers is needed?

Three groups were interviewed:

A)

- 11 producers in Mato Grosso do Sul;
- 1 Association from Guariroba River basin in the Cerrado biome

B)

- 4 Entities and Associations in Mato Grosso;
- 8 rural producers (1 from Mato Grosso – the Cerrado and 7 from Mato Grosso – the Amazon);
- 35 technical assistants (acting in Mato Grosso, in both biomes)

C)

- 1 slaughterhouse (meatpacker);
- 2 financial institutions

We questioned the groups about how cattle ranching activity is conducted in their region, the adoption of techniques llike pasture recovery, access to rural credit, compliance to the environmental legislation and perceived the impact of Covid-19 on the farms/ activities.

We questioned the associations, financial institutions and technical assistants, we questioned them about the main difficulties and limitations that the rancher faces to access credit and adopt sustainable systems and techniques in cattle ranching.

It is important to highlight that, due to the period of the year, we had difficu ty contacting several producers (for the both groups above) because they were in high production demand, that is, they did not have enough time (or did not want) to answer the questionnaire or attend the meetings.

For the questionnaire undertaken with the Guariroba cattle ranchers, we relied on the Association for Recovery, Conservation and Preservation of the Guariroba basin (ARCP) to access the producers.
The information collected from this group (A), helped us to build a business case based on pasture recovery in Guariroba region (next section).

7.1 ▸ Group A: Interviews with Guariroba Basin rural producers and association

7.1.1 Rural producers' interviews (in Mato Grosso do sul state)

We conducted interviews with eleven producers in Mato Grosso do Sul state, associated to Guariroba ARCP association or participated in the *Programa Nascentes* coordinated by WWF. Òn average, ranchers from group A had farms of 564 hectares, with 223 hectares of pasture and 895 cattle herd per farm.

Most were cattle ranching the main activity in the farm, undertaking breeding or breeding and raising cattle productive cycles.

Extensive activity was the most common in the region, and only three producers said they do not have access to technical assistance. Among the agricultural practices in the region, the most adopted were soil collection with limestone, fertilization and the use of paddock rotation on pasture, although there were still degraded pasture areas on the properties. However, as we were informed by ARCP association, many farmers still do
the recovery and rotate pasture incorrectly.

Among the producers who declared they had degraded areas on their properties (five of them), all stated they intended to recover the soil during the next three years.

However, for pasture recovery, the difficulties encountered were mainly the high investment required and lack of own financial resources. Other points still observed according to the responses obtained were the lack of public policies to encourage the producer to adopt pasture recovery, difficulty to access credit and difficulty to maintain the quality of pasture after the recovery.

As for the difficulties encountered by producers to implement integrated systems, in particular there was

a lack of personal financialresources and a need for high investments to implement the systems. Other difficu ties mentioned, but less frequent, were the lack of technical assistance, lack of public policies that encourage producers to adopt the systems, deficient infrastructure in the region, lack of knowledge about the techniques and the region's low aptitude for crops. In general, only three producers stated that they were interested in implementing integrated systems on their property. Most of them were focused on pasture recovery and improving livestock activity itself.

As incentives for pasture recovery and the adoption of integrated systems, producers mentioned the importance of a higher catlle sale price, in order to have more financial resources for investment, since many do not access rural credit. Others mentioned the need for a greater offer of technical assistance and the possibility of arrangements with producers, slaughterhouses and the government.

Five producers stated they had access to credit to costs and/or investment, and the financial institutions used were Sicredi and Banco do Brasil. Specifically , for investments, the rural credit programs accessed were Finame / BNDES, Pronamp, Programa ABC and Pronaf, to finance pasture recovery and improving infrastructure on the property.

Of the total resources used for costs and/or investment in the cattle ranching activities, these producers had financed a maximum of 50% of their resources via rural credit, although very few have reached this limit. Thus, most of them still have not accessed rural credit mainly due to risk aversion, financing the activity with their own capital, as confirmed by ARCP association.

As the producers declared, the guarantee required by financial institutions for financing is part of the animals and/or the title of the property. In addition, they mentioned that the main difficulties in accessing credit were the lack of knowledge about credit lines, difficulty in presenting guarantees to the bank, interest rates charges and sales matched by the institutions. Regarding compliance with the environmental legislation, all eleven producers reported that they had the Rural Environmental Registry (CAR), and all of them had a Legal Reserve area on their properties, with only one having a Legal Reserve deficit. Still, nine of the eleven had aPermanent Preservation Area (APP), and only one had an APP deficit. Regarding the impacts of Covid-19 on livestock production, producers said that they had not perceived negative impacts from the pandemic in the region, and only one of them stated that the pandemic changed his decision to take investment financing

7.1.2 Guariroba basin association (ARCP) interview

ARCP Association was founded in 1996 and has been working to promote the restoration of Legal Reserves and of Permanent Preservation Areas in the Guariroba basin, Campo Grande region, capital of Mato Grosso do Sul state. The association also started to support ranchers with technical assistance for pasture recovery and for better productive organization on their farms.

According to the association, producers do not have knowledge / information on cost / revenue control (management) or herd productivity indexes about their farms. Most of the pastures in the Guariroba region are not completely degraded, but there is still a lack of incentives for producers to make investments and to incorporate best practices, with the adoption of new techniques, as integrated systems. In this respect, it is important to raise awareness among producers on the importance of recovery as a way of increasing livestock productivity.

In general, producers access credit for the purchase of animals (short term), but not for investment into pastures or for long term investments. Many of them are risk averse in taking credit, because they are afraid they will be unable to pay the financing.

One of the reasons for this is due to the fact that, for many years, in the producers' perception, the selling price of the animals was low, which has changed in recent years (higher price), which may reflect in greater confidence of the producer in the market from the producer and, thus, may motivate them to take more credit.

Still in relation to credit, as informed by ARCP Association, the animals or farmland on the property are the first guarantee requested by the bank when granting finance.

7.2 Group B: Interviews with producers, associations, technical assistants and NGOs in Mato Grosso state

7.2.1 Producers in Mato Grosso state

In general, out of a total of eight producers, three are small producers with a total area varying between 12 and 48 hectares and cattle herd between 30 and 170 heads, and five are medium/large producers with an area between 2,114 hectares and 5,500 hectares and herd between 1,750 and 5,500 heads. Only one producer declared to have degraded pastures on the farm and most of the small producers have not receive technical assistance.

The main technology used for pasture maintenance is grazing rotation, followed by soil correction with lime, fertilization and machinery. All the producers interviewed made investments in the last years, for pasture recovery, fences, cattle acquisition, genetic improvement and improvements in the farm.

Regarding access to rural credit, both medium and small producers said that environmental and land requirements were limiting factors to access credit. In addition, financial institutions own difficulties to offer credit were also mentioned.

High investments, lack of own resources and lack of technical assistance were also highlighted as difficulties in adopting techniques to recover pastures, some even reported a lack of knowledge of the techniques, especially integrated systems and agroforestry systems.

Related to the Covid-19 impacts on cattle ranching, most producers reported that the pandemic generated little or no impact on the activity. Only two producers reported medium impact and only one reported the pandemic changed the expectations regarding future investments.

7.2.2 Technical assistant agents

Regarding productive structure, technical assistants said that, in their perception, rural producers had been looking to recover pastures on their farms, and lime, fertilizer and of paddock grazing rotation were the main strategies adopted to recover pastures. However, high investment, lack of own resources and difficu ty of access to credit were limiting factors to recover pastures.

According to the agents, main limitations for cattle ranchers accessing credit were unproductive habits, lack of technical assistance, farmland and environmental regularization requirements, financing conditions including guarantees. So, the main changes that were necessary to make credit access better were improvements on financing conditions (interest, terms and guarantees) and reduction of bureaucracy.

On average, technical agents indicated that, producers generally finance their investments via rural credit policy, especially Pronaf (small farmers), but also via their own resources.

Related to Covid-19 impacts on cattle ranching activity, agents believe that there have been small or no impact on livestock activity in the state.

7.2.3 Entities, associations and local NGO

Interviewed ranchers' association in the east of Mato Grosso state evaluated integrated systems with great expectation, but admitted that it is harder for cattle ranchers to work with crops than the agriculture producers to work with cattle. Therefore, land leasing strategies between ranchers and crop producers to recover pastures could be the solution. A mechanism, to guarantee liquidity to finance the systems (credit), needs to be combined with a strong approach of technical assistance and monitoring. Bureaucracy in credit analysis and lack of environmental regularization are the main challenges.

According to IMAC – Mato Grosso Meat Association, Integrated systems are increasingly important but still represent several challenges for producers whose farms are not well managed.

The main challenges for producers to access credit and adopt techniques are their aversion to risk and resistance to new technologies, environmental and land requirements and the low family succession in livestock activity.

Due to market conditions, (high export demand of meat and advantageous prices), IMAC believes that it is a good time to promote investments in cattle ranching.

The institute of Agropastoril Economy in Mato Grosso(IMEA) observes an unprecedented change in cattle ranching activity in the state of Mato Grosso, determined by high cattle prices and high demand for meat (exports to China). Recently, integrated systems and cattle ranching intensification better productivity conditions) have been increasing.

Breeding is the most vulnerable activity, as it presents low profitability, low support capacity in pasture and low investments. Solutions proposed: technical assistance and access to rural credit, but environmental requirements may have a negative impact.

The local NGO in Mato Grosso State, stated that medium-scale producers access less rural credit in Alta Floresta region. Not all producers are able to get credit (for environmental regularization) and it is often quite simple to solve and would take many producers out of “illegality”. The main actions are in the field, with training producer in farm management, technical assistance for technology adoption and technology dissemination.

7.3 Group C: Interviews with meatpackers and financial institutions

7.3.1 Financial institutions

We interviewed two financial institutions with an important share on rural credit in the Cerrado: a commercial bank and a credit cooperative.

The commercial bank pointed out that producer resistance to new techniques and credit, coupled with low quality of technical assistance are the main problems for credit access.

Cattle ranchers seek more short-term investments, preferring to invest in cattle because income is more immediate, while investments in which income is dispersed over time (long-term) are less preferred.

For producers able (certified) to access rural credit, there is no lack of financing and there is no difficulty in presenting guarantees (mortgage or guarantee). Eligibility assessment of the bank is based on historical credit rating. The bank has captive clients, so minimal efforts to allocate investment resources is needed.

According to the credit cooperative interviewed, producers face difficulties in accessing credit, like:

i. lack of adequate technical assistance

ii. difficulties faced by the financial in titutions themselves in dealing with more complex financing p ojects (such as integrated system)

iii. the requirement for land and environmental regularization

iv. other bureaucracies

The credit cooperative understands that the producers who wants to acess credit do not face difficulties with guarantees, but a guaranteed instrument (in financial resources and not real assets) would be essential for financial institutions. The cooperative does not have its own resources for funding investment credit in the rural sector, thus depending on the rural credit policy.

7.3.2 Meatpacker

The meatpacker interviewed believes that it is a big mistake to marginalize the producers who do not comply with environmental and land requirements, and it is important to find strategies to include them in the formal supply chain and in the financial system, subject to their legal compliance .

The meatpacker interviewed is engaged in several actions and strategies to strenghten sustainable intensification of cattle ranching in Mato Grosso. Promotion of credit is one of these possible strategies. The meatpacker intends to use its own resources for pilot projects, which are scalable, but understands that the company must not finance the producer.

However, it is necessary to define protocols, requirements and production standards that consider productivity, sustainability and social aspects so that producers have technological packages and pre-defined indicators. The meatpacker has been using these protocols for green financing cattle acquisition.

CHAPTER 8

Business cases for pasture recovery

8.1 Business case for cattle intensification in Guariroba basin

The Guariroba river basin is located in the municipality of Campo Grande, capital of Mato Grosso do Sul (MS) state, 40 km away from the city center, it is the main source of water supply for the city. Part of the Paraná basin, the Guariroba Basin is located in the Cerrado.

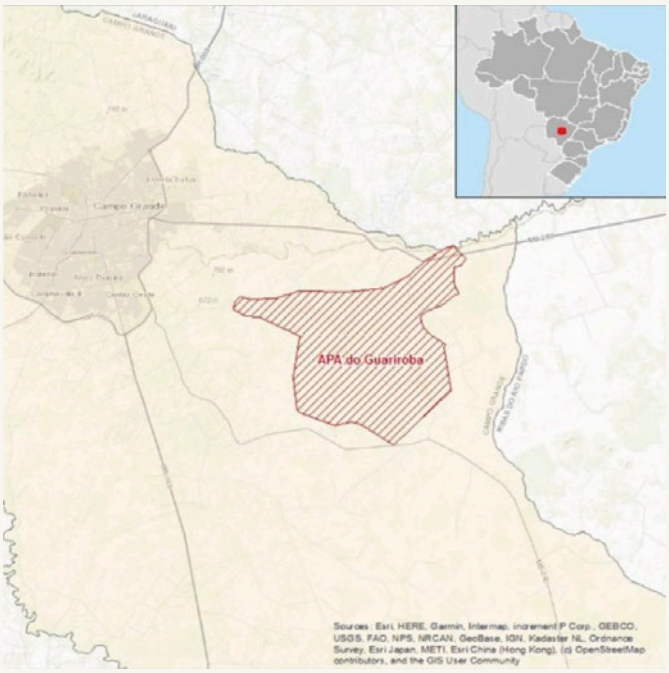


Figure 39.
Location of Guariroba River Basin region

Source: IBGE (2019).

With approximately 36,194 hectares, the predominant productive activity in the basin is extensive beef cattle production. With 65 rural properties, the predominant land tenure characteristic of the basin is small, medium and large properties (mostly the last two profiles), with sizes between 48 and 5,480 hectares.

In this region, the Association for Recovery, Conservation and Preservation of the Guariroba basin (ARCP) operates. It works with rural producers to promote compliance with environmental legislation, raise joint solutions to address environmental degradation problems and claim technical support from environmental agencies. Since 2010, WWF-Brasil has been a partner of ARCP through the Água Brasil Program, seeking to disseminate and encourage good agricultural practices, such as soil conservation, pasture recovery and environmental compliance, to ensure the hydrological security.

The business case aims to assess the financial performance of cattle ranching producers in line with the source of their returns: productive activity and land appreciation. The financial models were built based on a real case and with the perspectives of livestock production in the Guariroba.

Based on the producer's perspective and conclusions drawn from the questionnaires different scenarios were considered. The main objective was to evaluate financial indicators of these scenarios and understand the profitability if the producer adopts pasture recovery on his property.

Figure 40.
Business case for pasture recovery in Guariroba basin

Source: Study results.

HYPOTHESES

- Cattle ranching production models that adopt pasture recovery have higher productivity and thus have better financial eturns
- Financing costs and investment in cattle ranching permit rural producers to have an improved cash flow
- Real price of land increases by 2.5% p.a.

ASSUMPTIONS

- Breeding cycle of beef cattle ranching (medium farm size)
- Project period: 15 years
- There is no purchase of area, nor expansion of productive area
- Financing costs(working capital) annually only in the scenario B: 70% with own capital (6% p.a. nominal) and 30% through rural credit (8% p.a. nominal)
- Financing investment for pasture recovery and property improvements (B): 29% with own capital (6% p.a.) and 71% through rural credit (ABC Program) (6% p.a.)
- Financing investment for machinery purchase (B): 15% with own capital (6% p.a.) and 85% through rural credit (similar to Moderfrota) (8% p.a.)

	Scenario	Productive area	Stocking rate	Description
BAU	**Business As Usual**	Pasture area (242 ha)	1.49 heads/ha in year 1 1.49 heads/ha in year 5 1.49 heads/ha in year 15	Degraded pastures on farm that are not restored. Cattle ranching with low stocking rates and low productivity. Producer does not invest in the activities and continues to produce as usually. Producer does not access rural credit.
A	**Recovery of degraded pastures – no access to credit**	Pasture area (242 ha)	1.49 heads/ha in year 1 3.58 heads/ha in year 5 3.58 heads/ha in year 15	There are investments to restore degraded pastures and to improve farm infrastructure during the first 5 years. Cattle ranching with growth in stocking rates until year 5, then it remains constant with higher productivity. Producer does not access credit to finance for costs and investments in cattle ranching activity. 100% of own capital to finance the activities and investments.
B	**Recovery of degraded pastures – with access to credit**	Pasture area (242 ha)	1.49 heads/ha in year 1 3.58 heads/ha in year 5 3.58 heads/ha in year 15	There are investments to restore degraded pastures and to improve farm infrastructure during the fi st 5 years. Cattle ranching with growth in stocking rate until year 5, then it remains constant with higher productivity. Producer access credit to finance annually for costs and investments in cattle ranching activity.

Table 3.
Scenarios considered (with and without land price appreciation)

Source: Study results.

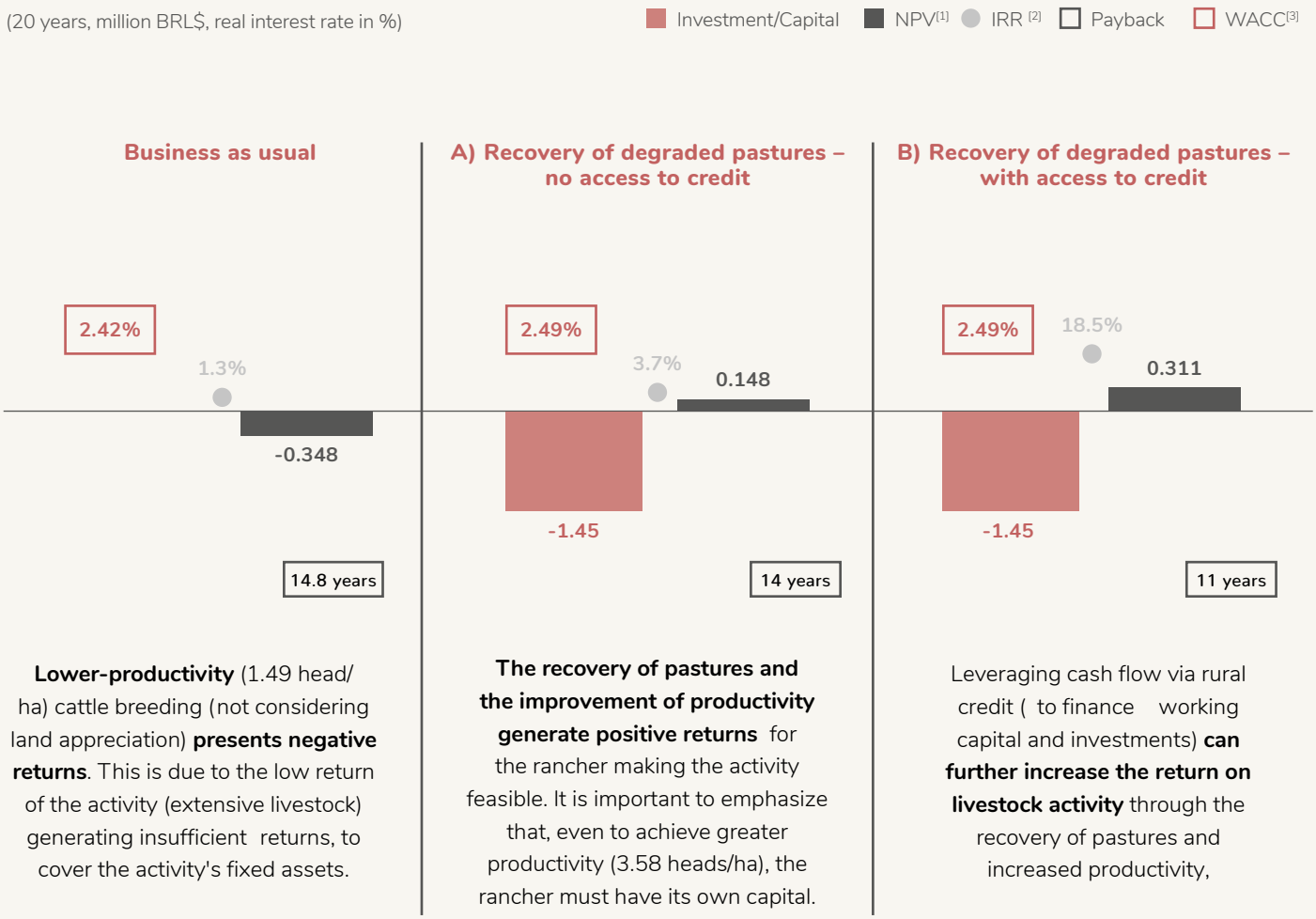
The results presented in the ***Figure 41*** show that extensive cattle ranching activity, with low productivity and pasture quality is not profitable. However, if the ranchers invest in recovering pastures, the financial results are positive, especially when they access credit for investments.

Figure 41.
Business case results for pasture recovery and cattle intensification (without land appreciation) - Guariroba basin

Source: Study results.

CATTLE RANCHING IN GUARIROBA REGION I NO LAND APPRECIATION

(20 years, million BRL$, real interest rate in %)



Lower-productivity (1.49 head/ha) cattle breeding (not considering land appreciation) **presents negative returns**. This is due to the low return of the activity (extensive livestock) generating insufficient returns, to cover the activity's fixed assets.

The recovery of pastures and the improvement of productivity generate positive returns for the rancher making the activity feasible. It is important to emphasize that, even to achieve greater productivity (3.58 heads/ha), the rancher must have its own capital.

Leveraging cash flow via rural credit (to finance working capital and investments) **can further increase the return on livestock activity** through the recovery of pastures and increased productivity,

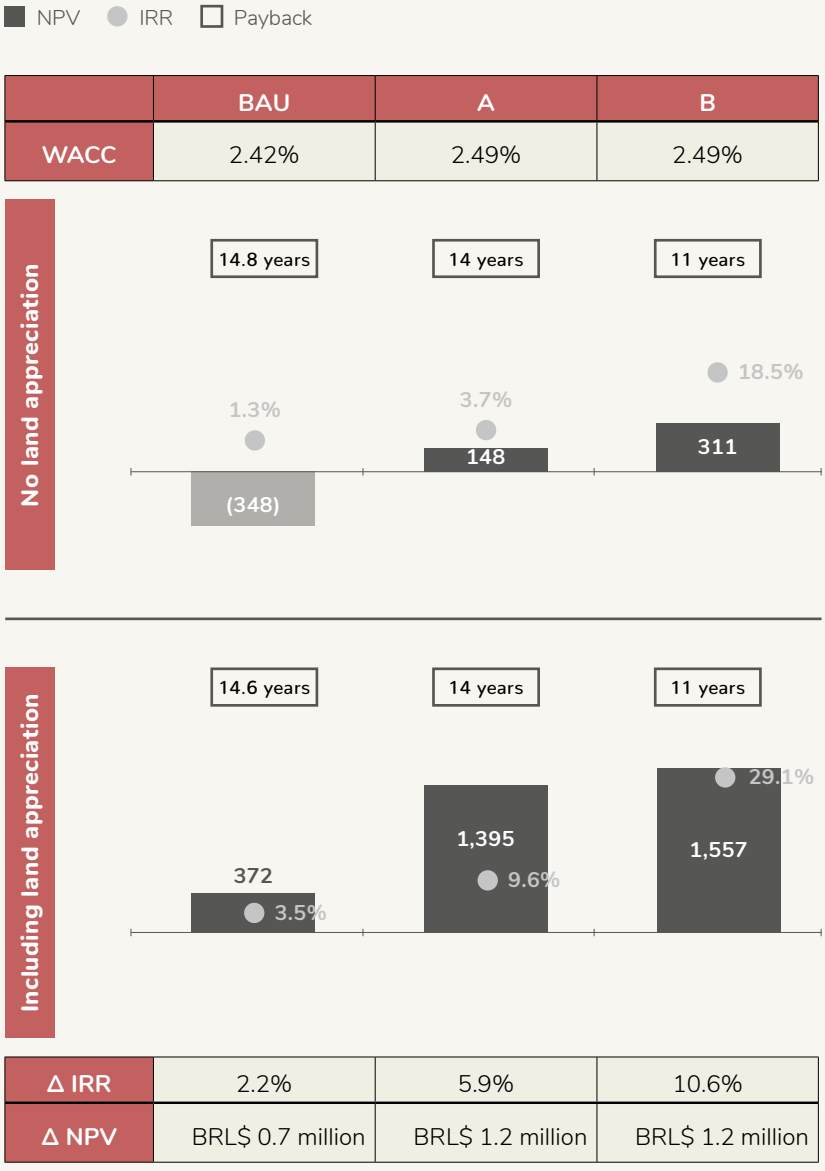
[1] NPV - Net Present Value
[2] IRR - Internal Rate of Return
[3] WACC - Weighted Average Cost of Capital

Figure 42.
Business case results for Guariroba basin, with and without land price appreciation

Source: Study results

Note: The scenario without land appreciation refers to land prices in constant Braazilian Reales throughout the project, while the scenario with land appreciation considers growth of 2.5% per year above the inflatio rate and the effects of change in land use.

(15 years, thousand R$, real interest rate in %)



	BAU	A	B
WACC	2.42%	2.49%	2.49%
Δ IRR	2.2%	5.9%	10.6%
Δ NPV	BRL$ 0.7 million	BRL$ 1.2 million	BRL$ 1.2 million

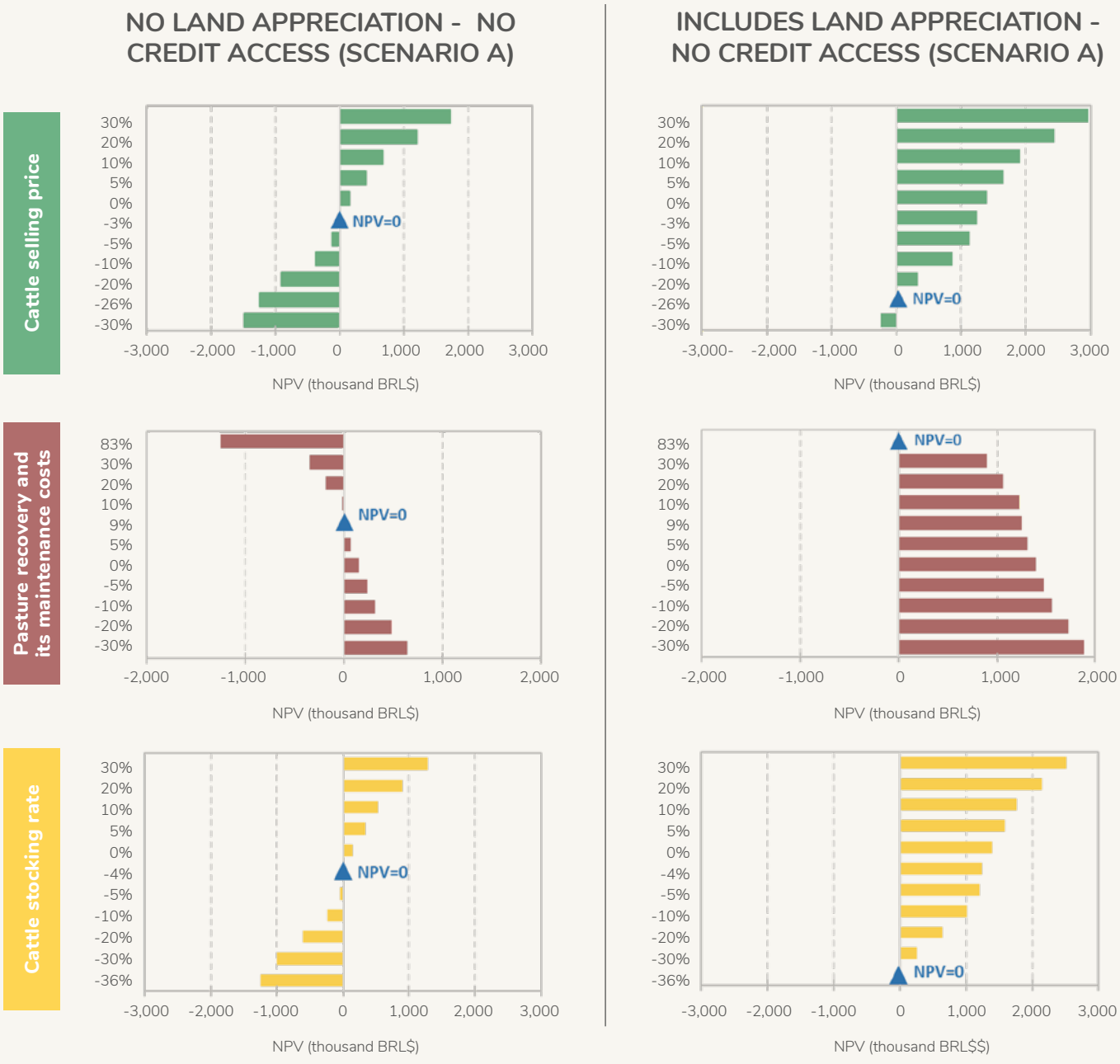
The traditional breeding cycle for beef cattle production, where there is no investment to improve pasture (BAU) and productivity, shows negative NPV (IRR <WACC). Only when land appreciation is included does it become profitable, despite being very low (IRR = 3.5%).

Pasture recovery allows the producer greater productivity, and consequently greater profitabil ty, since it produces more animals for sale (scenarios A and B), whether or not land appreciation is included. In other words, rhe activity alone becomes more profitable than the traditional model (BAU) (in scenarios A and B, IRR>WACC).

Access to credit allows the producer to leverage cash flow (scenario B), financing the cost of livestock activity and the investments necessary to recover pasture, to improve the farm's infrastructure and purchase machinery. The result shows higher profitability of livestock activity, whether or not it considers land appreciation. Currently in Brazil, the rural credit interest rate is in lower levels, although higher than the Selic rate (the economy's general interest rate), favoring credit contracting for costs and investment.

Figure 43.
Business case sensitive analyses results – Guariroba basin

Source: Study results



Cattle selling price has an expressive impact on cattle ranching activity returns. A price drop of more than 3% in the price means a negative NPV and a negative return in the model (no land appreciation)

A positive variation higher than 9% in **pasture recovery costs and maintenance** can compromise cash flow, making the activity unfeasible (no land appreciation).

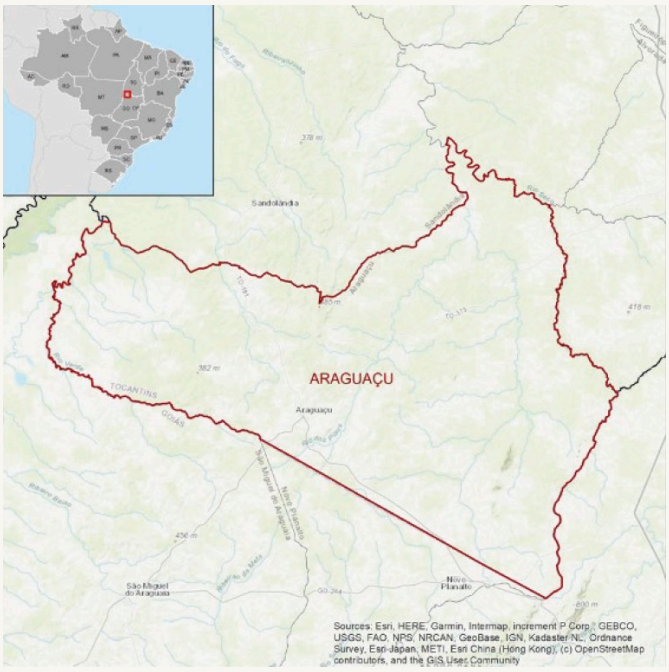
A reduction in the **stocking rates** creates an expressive negative impact on cattle ranching activity returns, since fewer animals would be produced for sale. The opposite for an increase in stocking rate.

8.2 Business case for cattle intensification in Araguaçu

Araguaçu is a municipality located in the south Tocantins state. It is characterized by cattle ranching activity, focused on the breeding system. According to data from LAPIG, the municipality has approximately 199 thousand hectares of degraded pasture.

Figure 43.
Location of Araguaçu

Source: IBGE (2019).



Based on this information and in line with the study's purpose, the following were developed:

a) a business case in reference Araguaçu's cattle ranching producers according to the source of their returns: productive activity and land appreciation.

Financial indicators for these scenarios were evaluated and the profitability understood based on whether the producers adopted pasture recovery on their properties, or they leased part of their pasture area for soybean expansion.

b) A business case for Araguaçu's soybean producers, according to the source of their returns: productive activity and land appreciation. Financial indicators for these scenarios were evaluated, observing the profitability when the producers expanded soybean production over new areas.

Figure 44.
Hypotheses and assumptions based on cattle ranching activity in the Araguaçu.

Source: Study results.

HYPOTHESES

- Cattle ranching production models that adopt pasture recovery have higher productivity and thus have better financial returns
- Financing costs and investment in cattle ranching allows rural producers to have an improved cash flow
- Leasing part of pasture area for soybean production can increase the financial returns of the farm
- Real price of land increases by 2.5% p.a.

ASSUMPTIONS

- Breeding cycle of beef cattle ranching (medium farm size)
- Project period: 15 years
- There is no purchase of area, nor expansion of productive area
- Cattle ranchers' own capital is used for activity costs in the scenarios BAU, A1 and B1.
- Cattle ranchers' own capital is used for investments in pasture recovery and infrastructure in the scenarios A1 and B1.
- Financing costs(working capital) annually only in the scenarios A2 and B2: 70% with own capital (6% p.a. nominal) and 30% through rural credit (6% p.a. nominal).
- Financing investment for pasture recovery and property improvements (A2 and B2): 29% with own capital (6% p.a.) and 71% through rural credit (ABC Program with 4 years of grace period) (6% p.a.)
- There is no investment for machinery acquisition in all scenarios, as producers already have it on their farms.

Table 4.
Scenarios considered – Cattle ranching in Araguaçu

Source: Study results.

	Scenario	Productive area	Stocking rate in pasture area	Description
BAU	**Business As Usual**	Pasture area (250 ha)	1.24 heads/ha in year 1 1.24 heads/ha in year 5 1.24 heads/ha in year 15	Degraded pastures on the farm are not recovered. Cattle ranching presents low stocking rate and low productivity. Producer does not invest in the activity and continues to produce as usually. Producer does not access rural credit.
A1	**Recovery of degraded pastures – no credit access**	Pasture area (250 ha)	1.24 heads/ha in year 1 3.58 heads/ha in year 5 3.58 heads/ha in year 15	There are investments to recover degraded pasture and to improve farm infrastructure during the fi st 5 years. Cattle ranching presents growth in stocking rate until year 5, then it remains constant with higher productivity. Producer does not access rural credit to finance costs and investments in cattle ranching activity. 100% of their own capital to finance the activities and investments.
B1	**Recovery of degraded pastures and leasing area for soybean – no credit access**	Pasture area (125 ha) Leased area for agriculture (125 ha)	1.24 heads/ha in year 1 3.58 heads/ha in year 5 3.58 heads/ha in year 15	Cattle rancher leases 50% of his/her pasture area (125 ha) for soybean producer over the total period of the project. 50% pasture remains, cattle rancher invests to recover degraded pasture and to improve farm infrastructure during the fi st 5 years. Cattle ranching presents growth in stocking rate until year 5, then it remains constant with higher productivity. Producer does not access rural credit to finance costs and investments in cattle ranching activities. 100% of own capital to finance the activities and investments.
A2	**Recovery of degraded pastures – including rural credit access**	Pasture area (250 ha)	1.24 heads/ha in year 1 3.58 heads/ha in year 5 3.58 heads/ha in year 15	There are investments to recover degraded pasture and to improve farm infrastructure during the fi st 5 years. Cattle ranching presents growth in stocking rate until year 5, then it remains constant with higher productivity. Producer accesses rural credit to finance costs and investments in cattle ranching activity.
B2	**Recovery of degraded pastures and leasing area for soybean – including rural credit access**	Pasture area (125 ha) Leased area for agriculture (125 ha)	1.24 heads/ha in year 1 3.58 heads/ha in year 5 3.58 heads/ha in year 15	Cattle rancher leases 50% of his/her pasture area (125 ha) for soybean producesr over the total period of the project. 50% pasture remaining, cattle rancher invests to recover degraded pasture and to improve farm infrastructure during the fi st 5 years. Cattle ranching presents growth in stocking rate until year 5, then it remains constant with higher productivity. Producer accesses rural credit to finance costs and investments in cattle ranching activity.

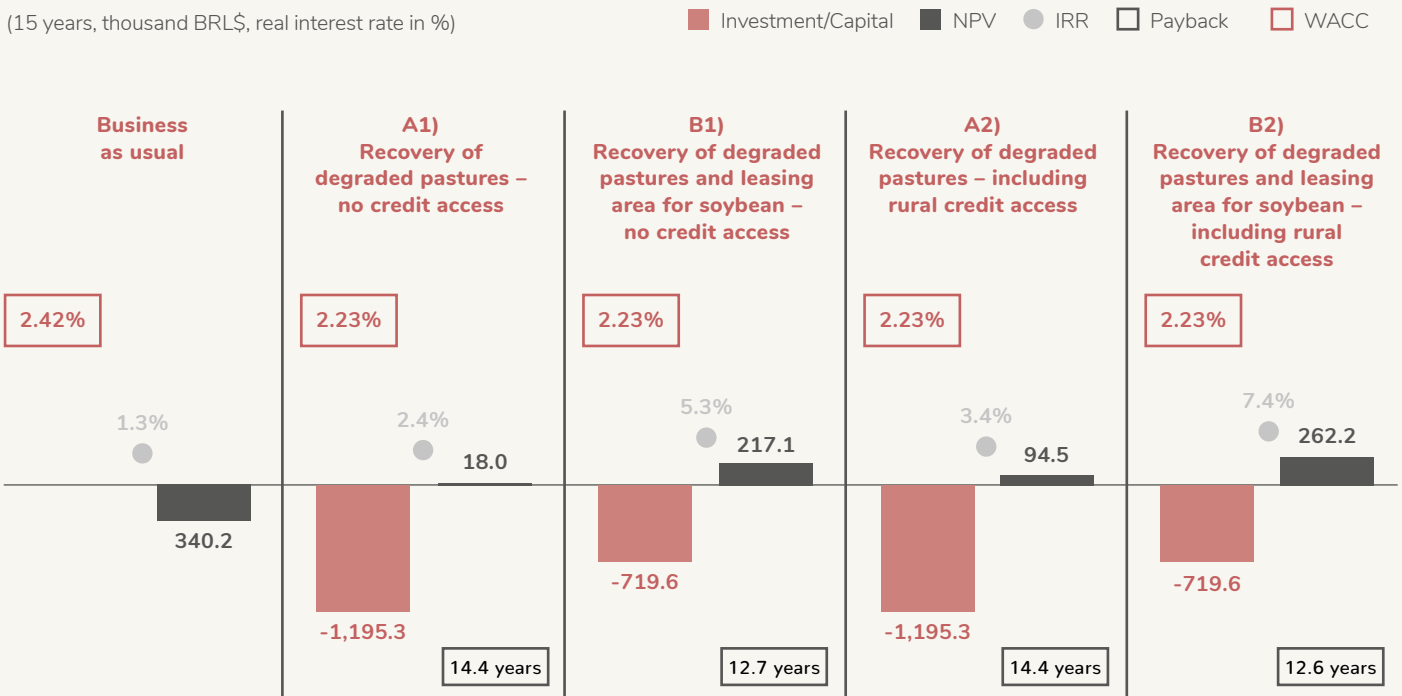
The results presented in the Figure 45 below show that investing in pasture recovery is a way forthe producer to obtain higher productivity and better financial eturns. When leasing pasture area, IRR is even higher due to the revenue obtained, which can then be allocated to support investments in the farm.

Figure 45.
Business cases results for cattle ranching in Araguaçu region

Source: Study results.

CATTLE RANCHING IN ARAGUAÇU REGION | NO LAND APPRECIATION

(15 years, thousand BRL$, real interest rate in %)



Lower-productivity (1.24 head/ha) cattle breeding (not considering land appreciation) **presents negative returns**. Extensive livestock that generates insufficient returns, insufficient to remunerate the fixed assets of the activity.

The recovery of pastures and the improvement of productivity generate positive returns to the rancher and make the activity feasible. Even to achieve greater productivity (3.58 heads/ha), the rancher needs to have capital..

Leasing area for soybean expansion is a way to get revenue that can be allocated to support investments in the farm using own capital. In this case, financial return is higher then in scenario A1.

Leveraging cash flow by financing working capital and investments through **rural credit can further increase the financial return of cattle ranching activities compared to scenario A1**. This is the best option for the producers who do not intend to lease areas for agriculture.

Besides the revenue obtained from leasing areas for soybean expansion, **leveraging cash flow can present financial returns higher than scenario B1**, in which rural credit is not accessed.

Figure 46.
Business case results for Araguaçu – cattle ranching

Source: Study results.
Note: The scenario without land appreciation refers to land prices in constant Reais throughout the project, while the scenario with land appreciation considers growth of 2.5% per year above the inflation ate and the effects of change in land use.

(15 years, thousand BRL$, real interest rate in %)

	BAU	A1	B1	A2	B2
WACC	2.42%	2.23%	2.23%	2.23%	2.23%
Δ IRR	2.2%	6.1%	11.7%	7.3%	13.1%
Δ NPV	0.7	1.1	2.7	1.1	2.7

Land appreciation is an important factor that impacts on the business model's financial returns and on the producers' decision to invest in their farms. Ranchers achieve higher returns when lease part of theirpasture for agriculture.

Extensive beef cattle activity(breeding cycle) shows negative NPV (IRR <WACC), mainly due to low productivity and inefficient use of cap tal. When land appreciation is included, the scenario becomes profitable, desp te the low returns.

Pasture recovery and an improvement in productive conditions with higher productivity generate a positive return for cattle ranching (A1) (IRR = 2.4%), since the activity is carried out more intensively with greater use of the capital. In the case of the producer leasing part of the pasture area for soybean expansion (B1), the return is greater in relation to the previous scenario (A1), this is because the revenue obtained from the lease can be allocated to finance part of the investments to recover pasture.

Access to credit allows the producer to leverage the cash flow (scenarios A2 and B2), financing the cost of livestock activity and the investments necessary to improve the farm's infrastructure, resulting in even higher profitability for cattle

ranching activity, whether or not land appreciation is considered, with a lower payback period.
Also, land appreciation impacts significantly on the financial returns, especially on scenarios B1 and B2, where there is conversion of pasture into crop land, which has a higher price than pasture, and hence land appreciation is higher.

It is important to note that financial returns are different for other beef cattle productive systems and for different pasture area/stocking rates due to the production scale obtained. Also, costs incurred in the activity are distinct between Brazilian regions. For these reasons, solutions to recover degraded pasture must be evaluated regionally.

Based on scenario A, cattle price and cattle stocking rates are the variables that most impact on returns **(Figure 47**). When land appreciation is considered, the impact on cash flow is substantially lower for all variables considered. **Figure 48** shows the hypothesis and assumptions for the soybean producer business case.

Figure 47.
Business case sensitive analyses results – Cattle ranching in Araguaçu region

Source: Study results

Cattle selling price has an expressive impact on cattle ranching activity returns. A price drop of more than 0.3% means a negative NPV and a negative return in the model (no land appreciation). This risk reduces significantl when land appreciation is considered in the model.

A positive variation higher than 1.27% in **costs of pasture recovery and its maintenance** can compromise cash flow, making the activity unfeasible (no land appreciation). It does not affect when land price is included.

A drop in the **stocking rate** creates a negative impact in cattle ranching activity return, since fewer animals would be produced for sale (lower revenue). The opposite for an increase in stocking rate.

Figure 48.
Hypotheses and assumptions based on soybean expansion over the last years in the Cerrado

Source: Study results.

HYPOTHESES

- The models of agricultural activity with soybean have good profitability, showing returns higher than other activities, such as livestock. For this reason it has been losing area to soybeans.
- Land appreciation is a factor that drives agricultural expansion.
- Occupation of pasture areas is a way to direct the expansion of soy in the Cerrado, avoiding native vegetation conversion.

ASSUMPTIONS

- Project period: 15 years
- Financial sources for funding annual costing (all scenarios):
  - 32% official ru al credit (6% p.a. nominal)
  - 24% barter (12% p.a. nominal)
  - 44% own capital/equity (6% p.a. nominal)
- Financing investment for conversion area into agriculture:
  - scenarios D, F and G (pasture into agriculture): 71% official ru al credit (ABC Program with 4 years of grace period / 6% p.a. nominal) and 29% own capital/equity (6% p.a. nominal)
  - scenarios C and E: there is no conversion of area
  - scenarios A and B (native vegetation into agriculture): own capital/equity (6% p.a. nominal)
- Financing machinery investments in scenarios A to G
- 85% official ru al credit (Moderforta with 1 year of grace period / 7.5% p.a. nominal)
- 15% own capital/equity (6% p.a. nominal)
- No investments in machinery on BAU scenario
- Payment term of the acquired area
- 5 years on scenarios B to F: 20% own capital/ equity (6% py nominal) and 80% financed y the previous land owner/vendor (7.5% p.a. nominal)
- no acquisition of area on scenarios BAU, A and G
- Leasing area: own capital/equity (6% p.a. nominal) and amount paid annually corresponding to 12 months of land use
- Prices paid for:
  - Leasing area: BRL$ 738/ha
  - Native Vegetation land: BRL$ 3,000/ ha Pasture land: BRL$ 3,750/ha
  - Agriculture land: BRL$ 12,000/ha

Table 5.
Scenarios evaluated - Soybean expansion in Araguaçu

Source: Study results.

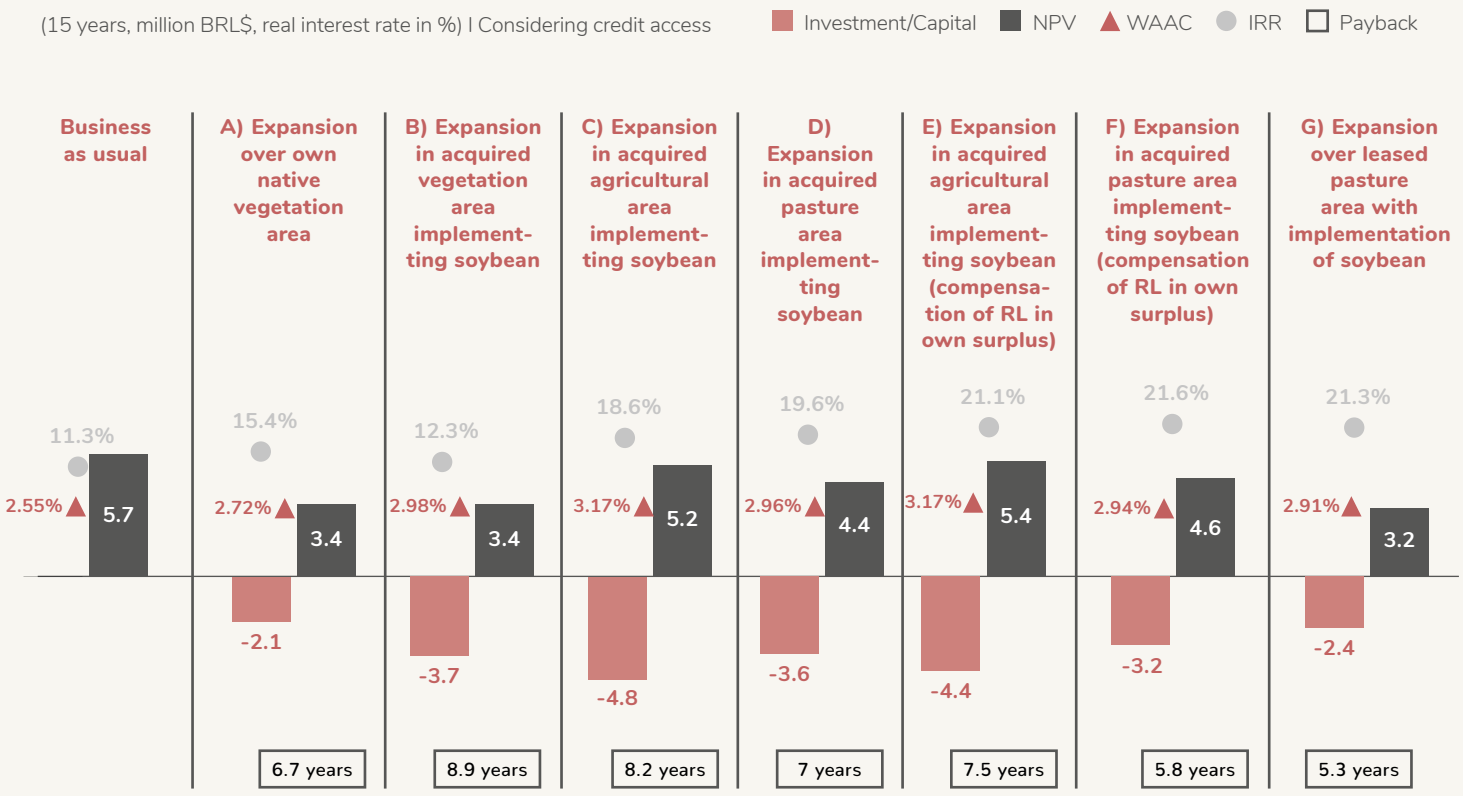
	Scenario	Total area	Productive area	Productivity	Description
BAU	**Business As Usual**	Consolidated area (250 ha) + Surplus of Legal Reserve - LR (463 ha) = 713 ha	Consolidated area (250 ha)	3.32 ton/ha. Growth rate: 0.53% p.a.	Producer already have necessary infrastructure and machinery to undertake soybean activity. Consolidated area with full productivity. Costs are financed annually through official rural credit and *barter*.
A	**Expansion over own native vegetation area**	Own LR area = 329 ha (214 ha of productive and 115 ha of LR)	Expansion area (214 ha)	Initially 1.66 ton/ha and reaches BAU rate at year 6. Growth rate: 0.53% p.a. after year 6	Producer expands over own native vegetation area (LR surplus), but being in compliance with the Forest Code. There are investments in machinery and in land conversion. Costs are financed annually through official rural credit and *barter*.
B	**Expansion in acquired vegetation area implement-ting soybean**	Acquisition of area with native vegetation = 385 ha	Expansion area (250 ha)	Initially 1.66 ton/ha and reaches BAU rate at year 6. Growth rate: 0.53% p.a. after year 6	Producer expands soybean production acquiring an area with native vegetation. There are investments in machinery and in land conversion. Costs are financed annually through official rural credit and *barter*.
C	**Expansion in acquired agricultural area implementing soybean**	Acquisition of agriculture area (250 ha) + LR (135 ha) = 385 ha	Expansion area (250 ha)	3.32 ton/ha. Growth rate: 0.53% p.a.	Producer expands soybean production acquiring a crop area, land conversion is not necessary. There are investments in machinery. Costs are financed annually through official rural credit and *barter*.
D	**Expansion in acquired pasture area implementing soybean**	Acquisition of pasture area (250 ha) + LR (135 ha) = 385 ha	Expansion area (250 ha)	Initially 1.66 ton/ha and reach BAU rate at year 4. Growth rate: 0.53% p.a. after year 4	Producer expands soybean production acquiring a pasture area. There are investments in machinery and in land conversion. Costs are financed annually through official rural credit and *barter*.
E	**Expansion in acquired agricultural area implement-ing soybean (compensa-tion of LR in own surplus)**	Acquisition of agriculture area = 250 ha (does not include Legal Reserve)	Expansion area (250 ha)	3.32 ton/ha. Growth rate: 0.53% p.a.	Producer expands soybean production acquiring a crop area, which not includes Legal Reserve, so there is compensation of LR in own consolidated area (BAU). Land conversion is not necessary. There are investments in machinery. Costs are financed annually though official rural credit and *barter*.

	Scenario	Total area	Productive area	Productivity	Description
F	**Expansion in acquired pasture area implement-ting soybean (compensation of LR in own surplus)**	Acquisition of pasture area = 250 ha (does not include Legal Reserve)	Expansion area (250 ha)	Initially 1.66 ton/ha and reaches BAU rate at year 4. Growth rate: 0.53% p.a. after year 4	Producer expands soybean production acquiring pastures, which does not include Legal Reserve, so there is compensation of LR in own consolidated area (BAU). There are investments in machinery and in land conversion. Costs are financed annually through official rural credit and *barter*.
G	**Expansion over leased pasture area with implementation of soybean**	Leasing of pasture area (250 ha)	Leased area (250 ha)	Initially 1.66 ton/ha and reaches BAU rate at year 4. Growth rate: 0.53% py after year 4	Producer expands soybean production leasing a pasture area. There are investments in machinery and in land conversion. Costs are financed annually through official rural credit and *barter*.

Not considering land appreciation, soybean expansion over pasture and over agriculture are the most profitable scenarios ***(Figure 49)***. ***Figure 50*** shows the results comparing the scenarios with and without land price appreciation.

Figure 49.
Business cases results for soybean expansion in Araguaçu

Source: Study results.



BAU) Soybean activity shows **positive returns**, with NPV of BRL$ 5.7 million, remunerating the fi ed capital. This explains the expansion of soybean activity in recent years.

A) **Expansion over own native vegetation presents the lowest investment necessary with positive returns.** Financial return is limited due to the lower productivity in the area during years.

B) **Expansion over acquired native vegetation area shows the lowest IRR**, since productivity is lower in the fi st six years, reducing the gains compared to the other scenarios (no land appreciation considered).

C) Although the highest investment (BRL$ 4.8 million), **expansion over crop area (conversion not necessary) allows higher financial returns** when compared to expansion over acquired native vegetation (B) due to high productivity throughout the project period.

D) **Expansion over acquired pastures presents lower returns than expansion over acquired agriculture area (C),** due to necessary investments (lower land price for acquisition and conversion costs).

E) **Expansion over acquired crop land with compensation of LR achieves higher financial returns**, since only productive area is acquired, not being necessary to buy the portion of LR.

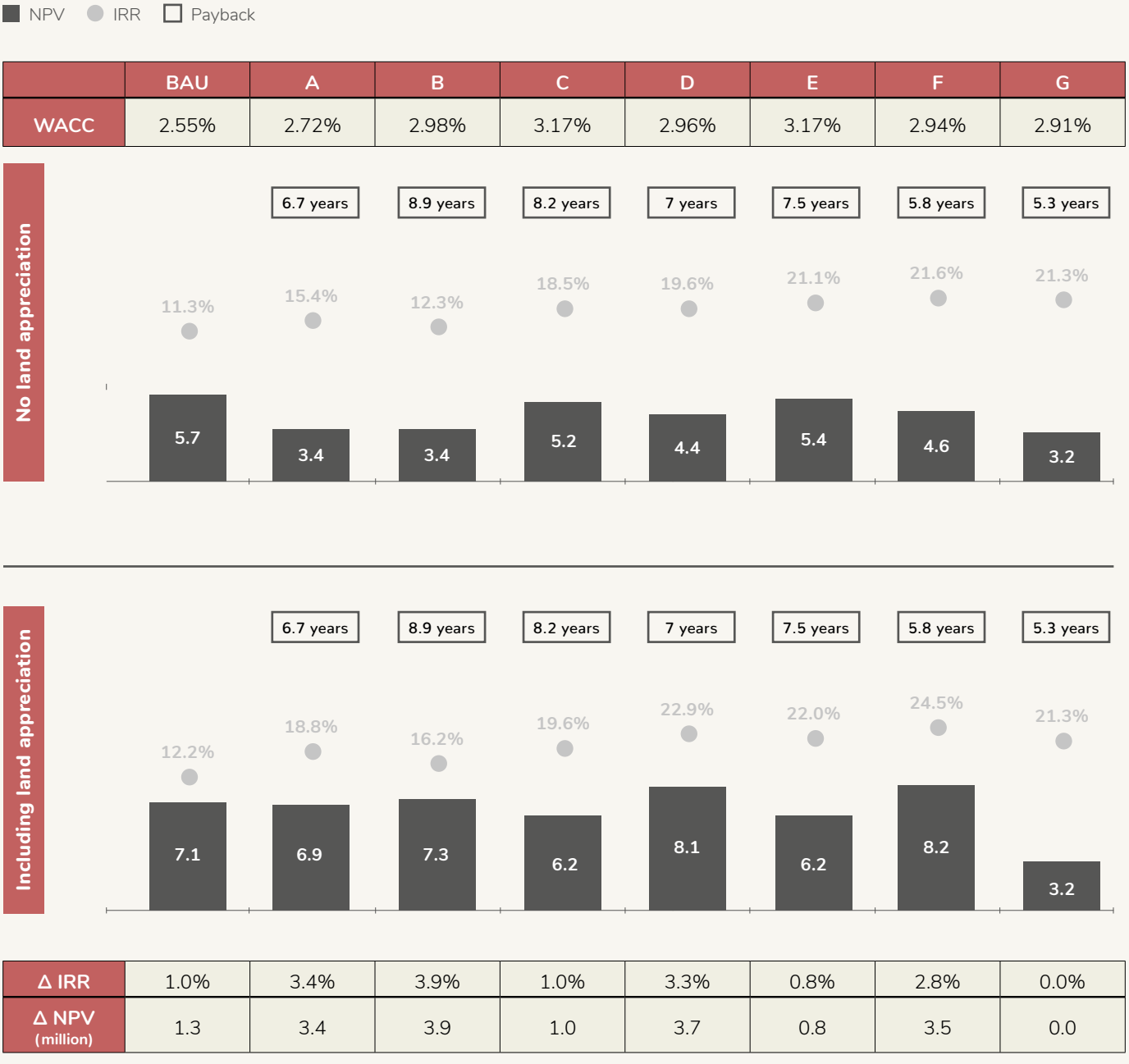
F) **Expansion over acquired pasture area with compensation of LR also presents high financia returns.** In this case, lower investment is needed compared to scenario E.

G) **Soybean is profitable enough to pay for the area lease and for the necessary investments to convert it into agriculture.** Soybean producer does not assume the difference on land prices after conversion.

Figure 50.
Business case results for Araguaçu – Soybean expansion

Source: Study results.

(15 years, million BRL$, real interest rate in %) I Considering credit access



	BAU	A	B	C	D	E	F	G
WACC	2.55%	2.72%	2.98%	3.17%	2.96%	3.17%	2.94%	2.91%
Δ IRR	1.0%	3.4%	3.9%	1.0%	3.3%	0.8%	2.8%	0.0%
Δ NPV (million)	1.3	3.4	3.9	1.0	3.7	0.8	3.5	0.0

Positive returns from soybeans activity makes expansion viable in all scenarios, with or without land appreciation. The appreciation of the land brings significant inc emental gains, except when leasing, where the producer does not appropriate it.

Expanding over acquired native vegetation (B) shows the lowest IRR (without land appreciation), as investments in acquisition and area conversion are needed and it is slower to reach maximum productivity than other expansion models. In this case, expansion over own LR surplus (A) presents higher financial returns.

Comparing IRR, expansion over acquired crop area (C and E) or pasture area (D and F) presents the higher returns for soybean activity.

Leasing pastures (G) has positive returns and also it is a profitable optionfor the soybean producer (important to note that this conclusion was observed when the producer accessed credit), however the rural producer does not appropriate gains over land appreciation.

The land appreciation has a relevant impact on the returns for each scenario, mainly for expansion over native vegetation (A and B) (IRR with variation of 3.4 percentage points for the A and 3.9 percentage points for scenario B).

As well as over pasture (IRR varies by 3.7 percentage points in scenario D and by 3.5 points in scenario F), as areas are converted into agriculture, which does not occur in the other scenarios (C and E, and in scenario G when there is lease and no purchase of area).

Considering the availability of degraded pastures in Araguaçu, and looking at the returns for soybean activity (both NPV and IRR reached), to the land prices and to the gain with appreciation of the land, the expansion of soybean over acquired pasture is the most profitable option or the soybean producer (scenarios D and F). This can also be explained by the fact that pasture prices in Araguaçu are much lower compared to crop land prices and not as high when compared to native vegetation land prices, and soybean productivity can be achieved faster than when expansion occurs over native vegetation area.

8.3 Business cases - Integrated system in Canarana

Canarana is a municipality located in the east of Mato Grosso state, characterized by agriculture and cattle ranching activities, with degraded pastures that could be recovered and/or converted for soybean expansion.

Figure 51.
Location of Canarana

Source: IBGE (2019).

Based on this information and in line with the purpose of this study, a business case was developed referencing cattle ranching and soybean activities carried out in the same area, composed of a crop-livestock integrated system (ICLS). Financial indicators were evaluated and profitability understood when the producer adopts ICLS to recover pasture in their properties, which composes the producer's perspective.

We conducted this analysis aligned with a land development company in Brazil, whose main business is to acquire areas, lease it for soil recovery and crop production, then, sell the land over a long-term period, obtaining land appreciation gains. During this period, the company leases the area to a rural producers or to other companies linked to agriculture production.

For this business case, the area evaluated in Canarana represents a potential business for the company. For this reason, we also developed scenarios to explore the gains obtained by the company on land appreciation, which includes the land owner perspective.

Figure 52.
Hypotheses and assumptions based on the adoption of an integrated systems (cattle ranching and soybean) to recover degraded pastures in the Cerrado

Source: Study results.

HYPOTHESES

- Pasture recovery that adopts integrated systems is feasible, providing positive financial returns.
- Land price and Land appreciation are factors that drive agricultural expansion in the Cerrado, through the acquisition of areas or leasing them.
- Occupation of pasture areas is a way to direct the expansion of soybean in the Cerrado, avoiding native vegetation conversion.

ASSUMPTIONS

PRODUCER'S PERSPECTIVE SCENARIOS

- Project period: 15 years
- Financial sources for funding annual costs (all scenarios): 100% own capital, 6.5 p.a. nominal
- Financing investment for pasture recovery, for conversion area into agriculture (scenarios A and B) and beginning cattle stock (scenario A): 6.5 p.a. nominal with a payment term of 7 years including 1 year of grace period
- Leasing area (all scenarios): own capital/equity (6.5% p.a. nominal) and amount paid annually corresponding to 12 months of land use
- Price paid for leasing area when achieving full yields (all scenarios): BRL$ 841/ha/year

LANDOWNER'S PERSPECTIVE SCENARIOS

- Project period: 15 years
- Financing investment for area acquisition (all scenarios): 100% own capital, 6.5 p.a. nominal, paying for it over 4 years
- Price paid for acquiring agriculture area: BRL$ 21,538/productive hectare
- Price paid for acquiring pasture area: BRL$ 11,538/productive hectare
- Price received for leasing the area when achieving full yields (all scenarios): BRL$ 841/ha/year
- Land appreciation: considers growth rate of 2.5% per year above the inflatio rate (scenario BAU, A and B) the effects of change in land use (scenario A and B)

Table 6.
Scenarios evaluated - Integrated systems in Canarana

Source: Study results.

Perspective		Scenario	Total area	Productive area	Productivity	Period	Description
Rural producer / tenant	BAU	**Leasing crop area for soybean expansion**	8,264 ha, being 2,892 of Legal Reserve	5,372 ha (soybean area)	Soybean: 57 bags/ha and reaches 64 bags by 6. Growth rate: 2% per year	15 years	Producer leases a cropland for soybean expansion. There is no investment in area conversion since it is already in good conditions for soybean production. There is no access to credit line/financing. The main goal is to identify the feasibility to lease land exclusively for soybean production, since this activity is the main competitor for land in Canarana.
	A	**Leasing pasture area for implementation of integrated system (ICL – cattle ranching + soybean) including pasture recovery**	8,264 ha, being 2,892 of Legal Reserve	3,872 ha of ILP + 1,500 ha of pasture exclusive for cattle ranching	Soybean: Initially 0 ton/ha and reaches 65 bags/ha by year 6. Growth rate: 2% per year Cattle: initial of 0.9 unit animals (UA)/ha and reaches 1.5 UA/ha by year 4.	15 years	Producer leases degraded pastures, invests in pasture recovery exlusively for cattle ranching exclusively (1,500 ha), invests to convert part of pastures (3,872 ha) into cropland/ICL and invests to acquire the initial cattle stock. Investments are financed by a credit line that charges 6.5% p.a. nominal with a payment term of 7 years including 1 year of grace period. Annual Costs are financed through own capital. The main goal is to identify the feasibility of the productive system designed in this scenario over a 15 years project from the perspective of the agricultural producer (land operator).
	B	**Leasing pasture area for soybean expansion**	8,264 ha, being 2,892 of Legal Reserve	5,372 ha	Soybean: Initially 0 ton/ha and reaches 65 bags/ha by year 6. Growth rate: 2% per year	15 years	Producer leases a degraded pastures, invests in conversion of the area (5,372 ha) into cropland for soybean expansion. Investments are financed by a credit line which charges 6.5 % p.a. nominal with a payment term of 7 years including 1 year of grace period. Annual Costs are financed through own capital. The main goal is to identify the feasibility of soybean in this scenario over a 15 years-project from the perspective of the agricultural producer (land operator).

Perspective		Scenario	Total area	Productive area	Productivity	Period	Description
Land owner	BAU	**Acquisition of crop area by the company/ land owner and leasing it**	8,264 ha, being 2,892 of Legal Reserve	5,372 ha (leased soybean area)	n/a	15 years	Land owner acquires a crop area with own capital, leasing it to a rural producer, which buids its revenue over the project period. In the year 15, the company sells the area, with land appreciation gains. The main purpose of this scenario is to evaluate the financial returns obtained by the land owner while buying, leasing and selling the land.
	A	**Acquisition of pasture area by company/ landowner and leasing it**	8,264 ha, being 2,892 of Legal Reserve	5,372 ha (leased area for ICL)	n/a	15 years	Landowner acquires a degraded pastures with own capital, leasing it to a rural producer, which builds its revenue over the project period. The rural producer makes investments to convert the pastures into agriculture and recovery of the remaining area of pasture (as in scenario A and B from the rural producer's perspective). In the year 15, the company sells the area, facing the land appreciation. The main purpose of this scenario is to evaluate the financial returns obtained by the landowner while buying, leasing and selling the land.

From the rural producer's perspective, leasing a crop area for soybean expansion (BAU) is the most profitable scenario, as investments to convert the area once the land is already has the appropriate conditions for soybean cultivation are not necessary (no land use transition and investment is needed). In this case, it is possible to reach an IRR about 17.7% ***(Figure 53)***.

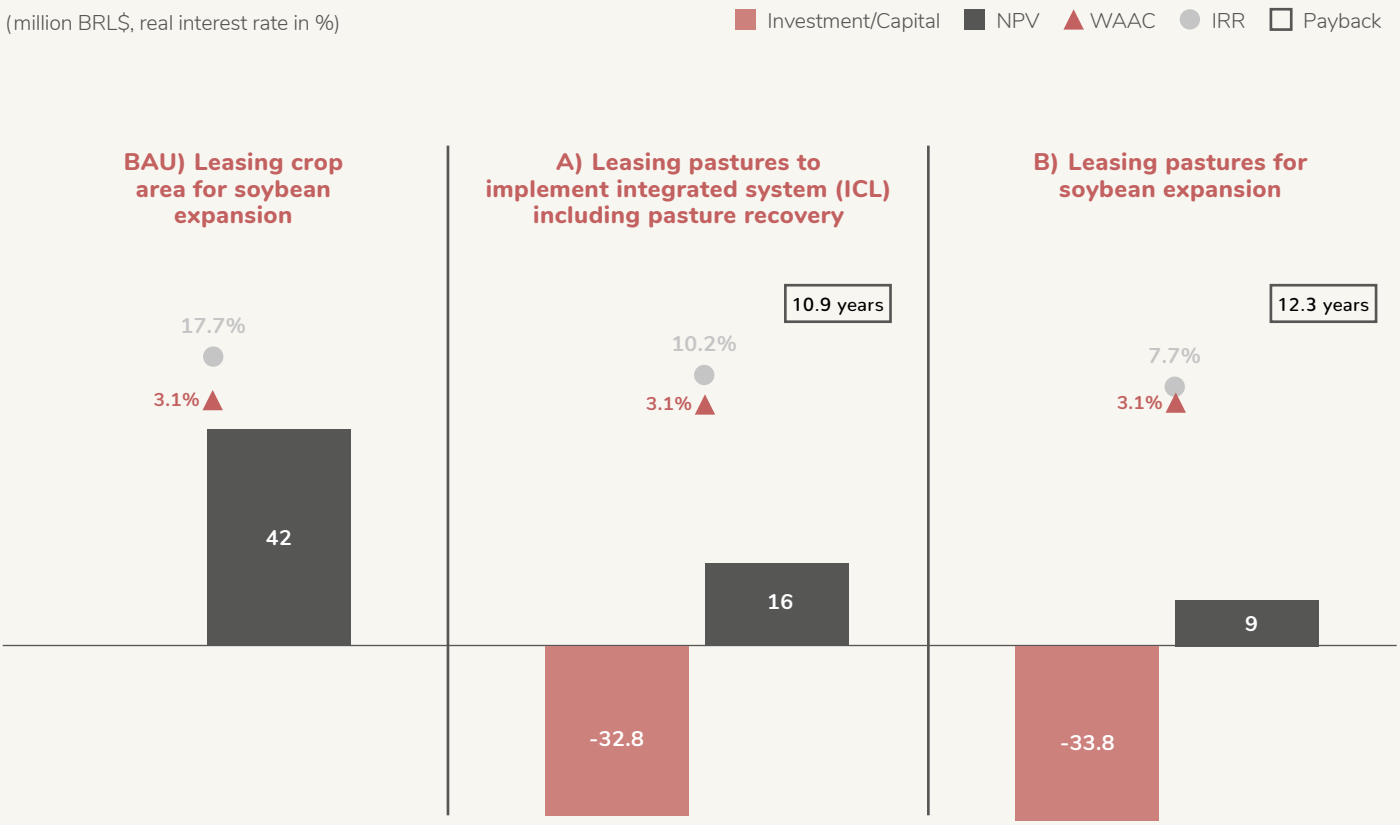
Regarding leasing pastures(scenarios A and B), the producer's most profitable option is to implement an integrated system, which achieves an IRR of 10.2%. Under these circumstances, an investment about BRL$ 32.9 million is estimated to recover part of the pastures, convert the remaining pastures into agriculture (soybean) and to acquire an initial cattle stock for cattle ranching activities. Combining cattle ranching with soybean activity (ICL) generates higher NPV and IRR compared to scenario B, where the area is exclusively for soybean activity. Other than that, investments are higher in scenario B.

In summary, all scenarios present positive returns. However, producers' decisions of whether to expand only for soybean or to implement an integrated system is impacted by the need for investments to convert and recover areas. The importance of these systems for the producer is not only due to the recovery of the area, but also to the diversification of the productive activity.

Figure 53.
Business case results - Integrated system
in Canarana region – Rural producer's perspective

Source: Study results.

INTEGRATED SYSTEM IN CANARANA – PRODUCER'S PERSPECTIVE



Analyzing the landowner's perspective, acquire a pastures (scenario A), lease it to a rural producer (agricultural operator) and sell it in a long-term period is more profitable than acquiring a crop area (BAU). In this case, the investment to pay for cropland acquisition (BRL$ 116 million) is much higher than for pastures (BRL$ 62 million), generating lower NPV

and IRR. Additionally, when an area is converted from pasture to agriculture land appreciation is greater, which makes scenario A more profitable as the IRR achieves 11.6% (Figure 54).

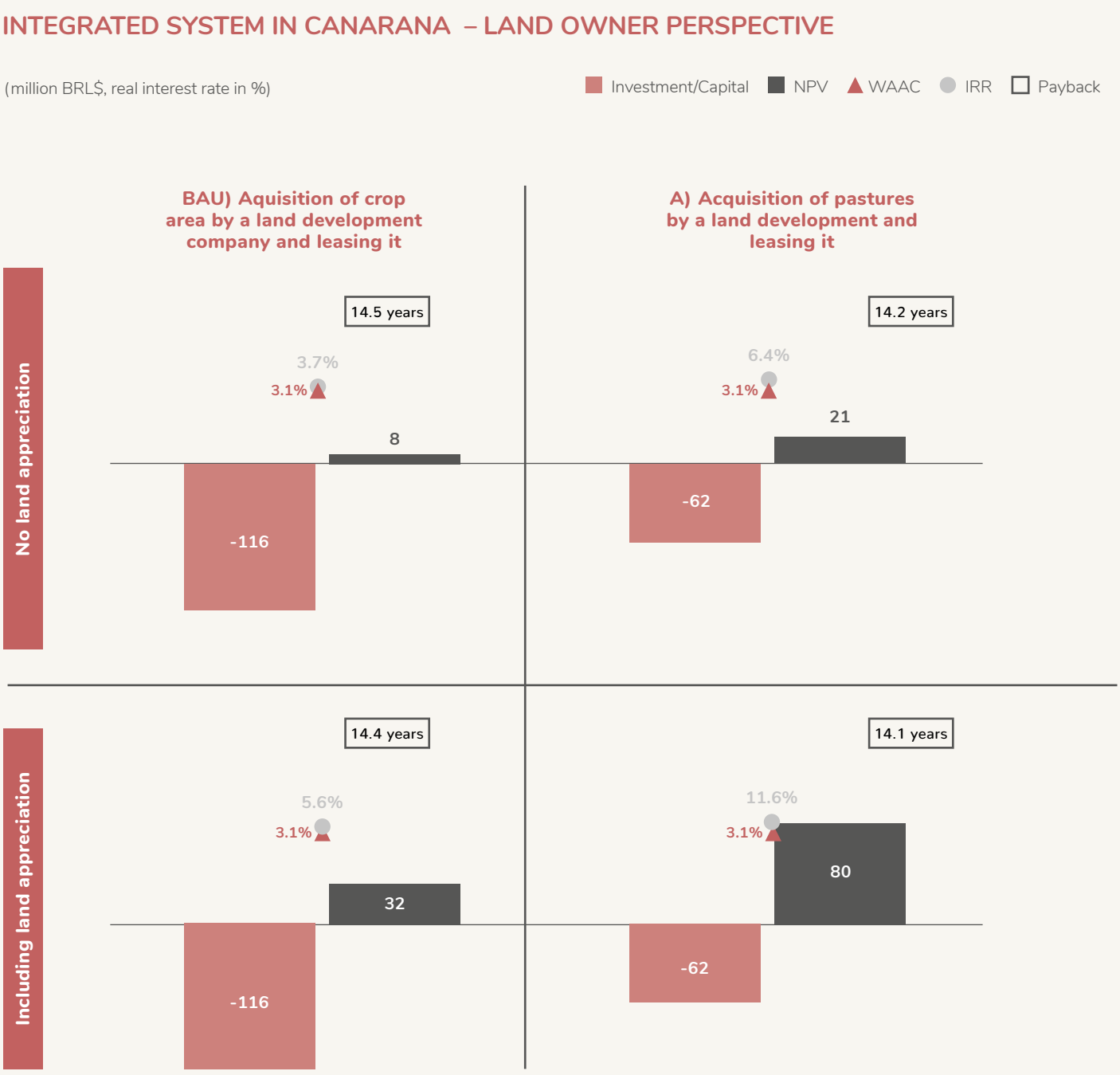
It is important to note that between the scenarios, earnings from the leasing area are not so different. For scenario A it is slightly lower because in the first years the rural producer invests in soil recovery, which during those years is partially discounted from the price paid to the landowner for leasing. Although there are lower earnings from leasing areas in scenario A compared to BAU, the difference in CAPEX needed and in land price appreciation are key decision-factors.

Besides the feasibility of both scenarios, their financial returns may be not appealing enough to convince a land development company to invest in this business. This will depend on its strategies and whether its objectives for desired gains are to be achieved in the short, medium and long term.

Figure 54.
Business case results - Integrated system in Canarana – Land owner perspective

Source: Study results.

Note: The scenario without land appreciation refers to constant land prices in Brazilian Reals throughout the project, while the scenario with land appreciation considers growth of 2.5% per year above the inflation r ate and the effects of change in land use.



CHAPTER 9

Final remarks and recommendations

This study shows that combined **territorial and economic analysis** is important to **drive actions** towards converson-free and sustainable production in the Brazilian Cerrado.

There are 23.7 million hectares (Mha) of degraded pastures and/or pastures with low productivity in the Cerrado, representing 38% of total pasture area.

There are at least 10 million hectares (out of almost 24 Mha) of degraded pastures that could be recovered for important supply chain expansion, combined and/or isolated in the short term (near industrial plants and near current land use).

The zoning developed in this study presented the areas with the best opportunities for recovery of those degraded areas. Different production systems can be implemented to recover these pastures, with **monoculture, intensifying livestock production and/or implementing integrated or**

agroforestry systems. In summary, there are:

- **5.6 Mha** of degraded pastures that can be intensified for raising beef cattle, near slaughterhouses and **4.3 Mha** potential for dairy production near dairy plants.

- **5 Mha** of degraded pasture with suitability for soybea production, near silos, warehouses, current soybean areas and with minimum 100 ha of continuous degraded pastures.

- **3.8 Mha** of degraded pasture to supply the commercial forests industries and **6.1 Mha** to supply other agricultural industries.

- **10.8 Mha** of degraded pastures potential to implement integrated systems.

- **2.5 Mha** of degraded pastures to implement agroforestry systems in small properties.

To take advantage of the opportunities offered by degraded pasture recovery, **all stakeholders need to be organized and collaborate** with each other (academia, public and private sectors, civil society).

The integrated and agroforestry systems are very interesting options for degraded pastures recovery,

with agronomic, environmental and possibly economic benefit . However, technical assistance and rural extension are key for implementation success.

The forestry component brings additional challenges for the rural producer: the need to deal with perennial crops with medium- and long-term returns, requires greater property management and a systemic view.

Technical assistance, combined with long-term finance are needed to implement agronomic systems to recover degraded pastures, **requiring public policies and incentives.**

Brazilian agricultural policy was built with rural credit as the main instrument to develop the national agricultural sector. Evaluating the last four crop years, both in Brazil and in the Cerrado, there was an increase in the contracted value of credit resources, mostly oriented towards costs and investments.

Specifically, credit contracted for investment in the Cerrado has been allocated to purchase animals and for the acquisition of machinery. **Investments to recover degraded areas and pastures have grown in recent years, but still represent a small share of the total credit** (14% in the last crop-year).

Despite the growth in credit contracting, the data from the Agricultural Census observed that in the Cerrado, **the number of livestock properties that have recently accessed finance for investment is still small.** Going deeper into this point, **the factors that determine the credit are the access to technical assistance and land and environmental regularization of the rural properties**, both determinants confirmed in the interviews. As it is known, in certain regions of Brazil (less so in the Cerrado), many farmers have difficulties to accessing finance since they do not have land tenure, which represents a lack of guarantee for financial institutions offering credit resources.

Based on the presented analysis, **the producer's confidence in the economic scenario and in the agribusiness sector are relevant in guiding their investment decisions.** Perceptions regarding economic retraction and political instability are factors that negatively impact the rural producer's investment decisions. Other issues such as expectations of future prices, the market availability of credit and variation in the price of inputs also influence the willingness to invest.

According to the interviews conducted, there are important factors that impact producers' decisions about degraded land recovery.

Mainly, a lack of infraestructure that would accomodate agricultural production expansion over pastures, a lack of rural extension and technical assistance to support producers with the transformation and recovery of degraded areas . Producers' risk aversion (mainly cattle ranchers) to adopt technology and/or finance sustains the low productivity of pastures, increasing degradation and native vegetation land conversion.

The business cases analyzed for rehabilitation of **pastures showed that both pasture recovery for cattle intensification and or for soybean production has positive returns**, although expanding over native vegetation is also profitable, mainly due to land price appreciation after conversion.

Specifically, in the Canarana case, analyzed in partnership with a land development company, the objective was to evaluate the implementation of an integrated system for soil recovery. It was found that an important factor that drives decisions to expand agriculture over cropland (non-conversion needed) or over pastures is the need for investment. Renting cropland areas is the most profitable scenario for rural producers, who intend to expand activities to include soybean production. In the case of expansion over leased pasture, the greatest return is made

In the case of expansion over leased pasture, the greatest return is made when an integrated system is adopted. For the land company, although the business is feasible, the financial returns obtained may not be as high as expectated.

Based on real data and in all simulated models, **investments for pasture recovery is high and has a long payback period**, (more than 6 years for soybean and up to 14 years for cattle ranching intensification). **Long term credit with differentiated financing conditions** (like grace period, interest rates and payment terms) **is essential**, not only to increase the projects' returns, but also to allow effective implementation of necessary investments,

In the Cerrado, inorder to address them and accelerate pasture recovery, a set of actions are needed, with different complexity levels are needed. Starting with **public policies, direct rural credit to degraded pasture recovery and include producers who are not taking credit for this purpose are key. Solutions for environmental legislation compliance** are also needed, and, in most cases, not complex to address (like lack of smallholder CAR registry of smallholders). **Private sector can also incentivize pasture recovery or rehabilitation for soybean**, but as there are no long-term contracts in most of the supply chains (except planted forests), economic incentives are harder to address.

It is importante to differente producers, at least with **environmental legislation compliance** and with **private protocols for sustainable sourcing.** Addressing the **lack of technical assistance** is also key, and could be incentivized by the private and public sectorsm, and civil society. However, it is also a more complex solution at the large scale.

Credit and/or financial mechanisms per se ill not conserve the Brazilian Cerrado. They need to be combined with **technical assistance, implementation of environmental compliance, sustainable sourcing protocols and long-term land use monitoring.**

Finally, **land development companies could be large-scale drivers for soil recovery in the Cerrado**, however it must be aligned with their strategies and business goals. In addition, other companies like meatpackers or traders could create protocols or programs to foment or, at least, advise producers connected to them, about the importance of soil recovery and adequate pasture maintenance, once these organizations reach large numbers of farmers in Brazil.

Recommendations on how to increase farmer uptake of credit / adoption of practices

Considering all the analysis and interviews undertaken, in order to change landscape and reduce land degradation and native vegetation conversion in the Ceerrado, the folllowing actions are needed:

1. Greater dissemination of pasture recovery and integrated systems to producers, highlighting the benefits, necessary investments, how they can be implemented and create more pilot projects regionally that raise awareness of these techniques.

It is important that the rural producers have access to the relevant information for decision-making, like hoe to adopt and implement these techniques, as well as their real gains and benefits. Many rural producers, especially cattle ranchers, have an aversion to adopt new techniques and make investments, and in these cases access to the correct information about ways to produce is a crucial factor to change their mindsets,

Also, it is important to disseminate the feasibility of implementing integrated systems and pasture recovery.,

As seen in the business cases developed, these techniques present positive financial returns for rural producers, offsetting the investments made to adopt them. These sort of conclusions must be disclosed to support producers' investment decisions on their farms, especially in soil recovery.

Support from agricultural research organizations (Embrapa) and others with leadership in the implementation of integrated systems and pasture recovery projects and integrated systems are relevant to achieve this objective, and can also help with the implementation of pilot projects.

Pilot projects characterized by the implementation of pasture recovery and/or integrated systems in a portion of a farm area, reffered to as technical demonstration units, are of great value in disseminating information and convincing the rural producers of the benefits and gains that can be obtained when these techniques are adopted.

2. Technical assistance and rural extension to producers are essential to increase productivity and improve cattle ranching activities. In addition, they may help producers to: a) employ property management techniques; b) learn more about rural credit financing; c) correctly adopt new techniques in their farm.

Since cattle ranchers are more risk averse than crop producers and, for this reason, they mostly apply traditional production techniques even with low or negative returns, it is necessary to work on changing their mindset to show the economic benefits of recovering degraded pastures (as mentioned in the fi st recommendation). Producers are not convinced only by environmental issues, but mainly on learning new techniques and financial results in practice.

There are already pilot projects implemented for this purpose. Technical demonstration units ion real farms are the first step to enable fields visits and producer training. Once producers are convinced about the techniques, technical assistance is key for its effective implementation on the farm and for access to credit. In addition, it is also key to address environmental compliance, together with farm management solutions, as farms need to be considered isystemically to secure long term results.

Among others, examples of projects are: Programa Novo Campo (in Alta Floresta region, Mato Grosso state, the Amazon), Liga do Araguaia (in the Araguaia region, Mato Grosso state, the Cerrado). Embrapa has several demonstration units of integrated crop-livestock-forestry systems in the Cerrado , Rural Sustentável Project (already

Rural Sustentável project (already implemented in the Amazon and the Atlantic Florest, starting in the Cerrado).

The key challenges of these pilots is the short term of their implementation, as interventions needs time for financial returns and in gereral producers need to offered constant high quality technical assistant.

3. Improve investment resources through rural credit.

As seen in the business cases developed, high investments are necessary to conduct pasture recovery and to implement integraded systems. The larger the area, the more investment capital is needed.

It is important that sufficient resources for investments are made available through rural credit, as official rural credit (subsidized by the government) has more attractive conditions for contracting.

One example is the ABC program credit line, which aims to encourage the adoption of low carbon techniques in agriculture, which in recent years has had a rapid depletion of resources released in each crop year. It is important to mention that in this period where the Brazilian economic scenario has lower interest rates, this could encourage producers to access credit at these **attractive** costs, and boost investments in good agricultural practices.

An alternative to public credit is green finance with private investors, but this needs to be oriented to pasture recovery and have the correct instrument to engage rural producers.

4. Reduce legal uncertainty regarding environmental and productive issues. This includes effective implementation of the Forest Code, ensuring rural producer are compliant with environmental legislation and that it is not constantly reevaluated, which can cause some uncertainty about the Forest Code[20].

Also, it is important to ensure the right to property (reducing land insecurity), as in many situations the regularization of rural properties is needed, in terms of landownership by the producer. This is often associated with legal bureaucracies and slowness of government agencies to analyze and deliberate on such cases. Moreover, it is difficult to regularize landownership because, in some regions, there has been disorganized occupation of agricultural expansion areas.

In orther to create appropriate conditions for agricultural production, it is important to reduce other issues like beaurocracy to produce (such as a license or production autorization).

[20] Native Vegetation Protection Law n. 12.651/2012. Available at: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm

5. Support to associations and cooperatives: undertaking actions with associations, cooperatives and rural unions is a way to have a communication channel with rural producers, and thus disseminate knowledge about pasture recovery and integrated systems, hold lectures and field visits on the subject. In general, rural producers have greater acceptance of information received through this associations and producer cooperatives.

6. Divide producers into three distinct groups in order to establish how the financial mechanisms will affect each group:

i. **the marginalized (no credit access)**: a group that imposes greater risks and costs, should be seen from an inclusion perspective of inclusion, promoting their land and environmental regularization. However, they should have a greater counterpart in the financial mechanism

ii. **certified non-borrowers:** they must also be viewed from tan inclusion perspective. The challenge with these producers is to convince them and provide technical assistance to them in order to reduce their aversion
to new techniques and to reduce their risk aversion for credit (debt, management and market). This group represents a moderate risk since it does not have a well-defined credit profile. As such, they must also pay a premium for the risk sharing of the financial mechanism

iii. certified borrowers: they must be seen as an enhancer of the best techniques. As they represent less risk to the credit operation, and, by hypothesis, they are the least risk averse and with a greater appetite for new practices, they should be provided with resources and guarantees for those projects with the greatest productive and environmental impact. Consequently, the counterpart in the financial mechanism should be the smallest among the groups.

As a result of all the analysis presented in this study, we conclude that there is a clear **trade-off between the insertion of new producers into the credit system** (with greater risks and less chances of successful ventures) **and the promotion of credit taken for sustainable techniques for those who are already inserted in the system** (and who represents lower risks and greater chances of successful ventures).

However, in order to have higher impact in terms of reducing deforestation and conversion and more degraded land recovery, the suggestion is to work with the three groups, with different approaches.

The “marginalized” group and the “certified non-borrowers” should be the main focus of the technical assistance and stratagies to convince / disseminate / communicate,

in addition for the need of a guarantee mechanism (lack of collateral to offer to banks and/or higher risks for not having credit rating). The suggestion is that they implement less complex (and consequently cheaper) techniques. Their participation in a guarantee mechanism is greater in these ventures, but they include a counterpart from the producer.

The group of producers “certified borrowers”, on the other hand, demand less need for the risk-sharing. As they already have a credit history, the risks involved in the operations are lower, which would allow the use of a guarantee mechanism to improve conditions to finance the techniques . Based on the assumption that these producers are less risk averse and with a greater appetite for innovation, it is suggested that this group be prioritized with regards to more ambitious technical projects, possibly with higher costs but with greater impacts, both in productive and in environmental issues.

Projects with integrated systems would be the most interesting for the latter group. Still under the assumption above, implementing more complex techniques may attract the supply chain attention (especially slaughterhouses) with regard to the adoption of specific technological packages in these ventures. With clear protocols for good agricultural practices, productivity, sustainability and business predictability, the slaughterhouses may give purchase preference

cattle from those suppliers (as Carbon Neutral Beef). The slaughterhouses (and also their clients) can access green finance or this sourcing, as is already in place with the Marfrig's "Green CPR" (CPR – Agroindustry Product Note), which also has a brand for the Carbon Neutral Beef.

A possible strategy is to implement projects with incentives and actions for degraded pasture recovery, after having a governance structure with all interested stakeholders (producers, cooperatives, associations, financial in titutions, NGO, technical assistants, etc.). Eligibility criteria for producers to participate, clear technical and environmental indicators and technological packages need to be defined.

If the "marginalized" group of producers are considered, the eligibility criteria need to be lenient, since they might need environmental compliance (such as CAR registry) and face problems with land tenure. If only the "certified-borrowers" group of producers are included, eligibility criteria can be strengthened, and technological packages more complex. The "certified-non borrowers" group can have eligibility criteria less lenient than marginalized, but still may need environmental compliance. And they represent the majority of producers in the Cerrado.

Finally, financial mechanisms need to be adapted or each of the groups, providing de-risking, collateral, and financing together with long-term technical assistance and monitoring.

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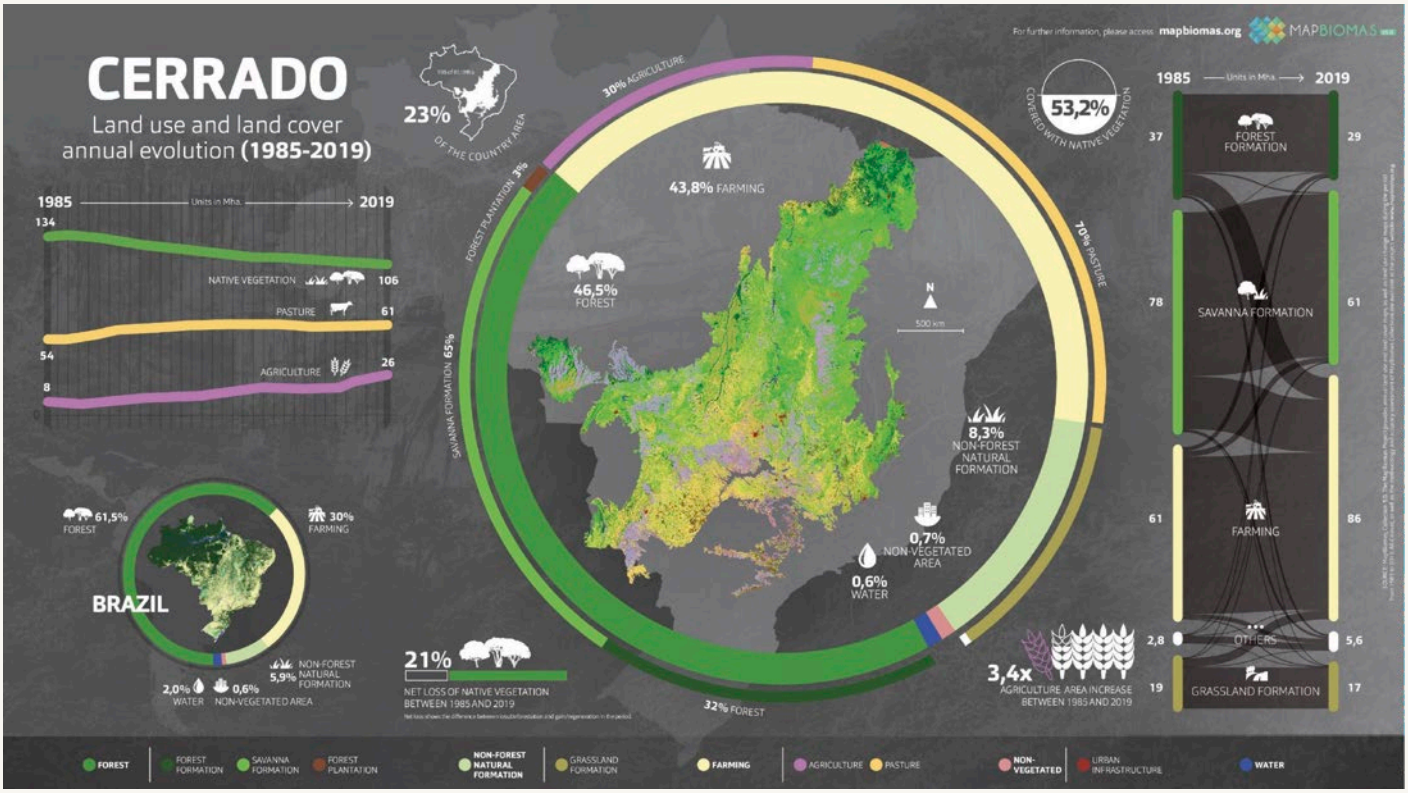
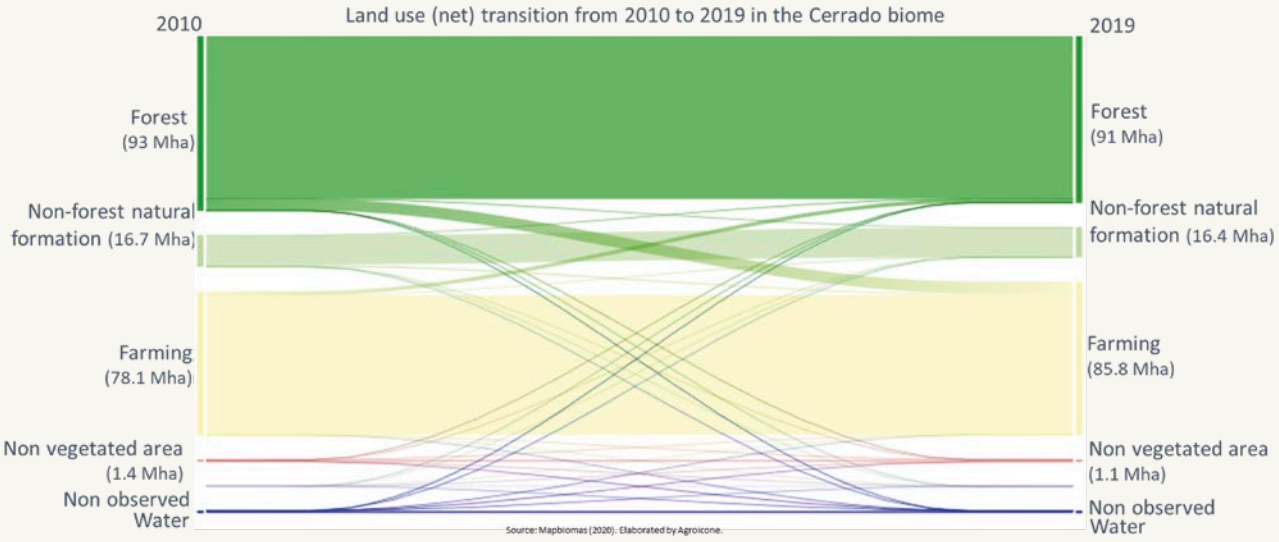
Annex 1 - Land use and land cover in the Cerrado



Annex 2 - Land use (net) transition from 2010 to 2019 in the Cerrado



Annex 3 - General information about agricultural policy credit lines that finance land recovery investment

Producer profil	Credit Line / Program	Interest rate (py)	Payment term	Grace period	Funding limit	Description
Family farmer	Pronaf	2.75% to 4%	10 years	3 years	BRL$ 330 thousand	Pronaf, the National Program to Strengthen Family Farming, aims to stimulate income generation and strengthen the activities developed by the family producer through the financing of its agricultural activities and services, being considered as the main national public policy for the promotion of family units. Established in the 1990s, it meant an advance in terms of public policy directed at this category. In general, the beneficiaries of Pronaf are farmers and rural producers with an annual gross family income of up to BRL$ 415 thousand, with at least 50% of this income coming from agricultural activities. In addition, the property must have up to 4 area tax modules. The Program has sub-programs that are aimed at specific financing objectives. Degraded land recovery is financed by the following sub-programs: Pronaf Mais Alimentos, Pronaf Semiárido, Pronaf Mulher, Pronaf Jovem, Pronaf Microcrédito, Pronaf Reforma Agrária and Pronaf Eco. It is important to note that Pronaf shows the lower interest rates to finance rural producers in Brazil.

Producer profil	Credit Line / Program	Interest rate (py)	Payment term	Grace period	Funding limit	Description
Non family farmer	ABC Program	4.5% to 6%	12 years	8 years	BRL$ 5 million	The ABC program offers credit to rural producers and cooperatives in order to reduce deforestation and GHG emissions in agriculture. It is divided into sub-programs: pasture recovery, no-tillage, integrated systems (ILPF), organic production, environmental suitability, planted forest, nitrogen fi ation and waste treatment. Each sub-program finances a set of items that make up the production system: increasing productivity, productive resilience and adopting sustainable practices, including the mitigation of greenhouse gases. Although the ABC program is directed at financing techniquess that reduce GHG emissions in agricultural production, some of these techniques are also financed indirectly by programs. Pasture restoration, for example, is also financed by the lines of Pronaf (family farming), Pronamp (medium producers) and by the own resources of the banks operating rural credit.
	Moderagro	6%	10 years	3 years	BRL$ 880 thousand	Moderagro (Program for the Modernization of Agriculture and Conservation of Natural Resources) aims to support and encourage the sectors of production, processing, industrialization, packaging and storage of agricultural products. The Program supports soil recovery through financing or the acquisition, transport, application, incorporation of agricultural corrective agents, soil conditioners.
	Pronamp	6%	8 years	3 years	BRL$ 430 thousand	Pronamp is focused on medium size producers, who must have up to BRL$ 2 million as annual Gross Production Value in the property to access the credit line. Pronamp's finance elements include the cost of agricultural crops and cattle ranching, as well as investment in the formation or recovery of pastures and soil, forestry, reforestation, improvements in infrastructure on the farms and purchase of machinery and equipment. There are no sub-programs within Pronamp, allowing the allocation of resources more broadly between different purposes, and not necessarily between sub-items of the credit line.

Producer profil	Credit Line / Program	Interest rate (py)	Payment term	Grace period	Funding limit	Description
Non family farmer	Inovagro	6%	10 years	3 years	BRL$ 1.3 million	Inovagro (Incentive Program for Technological Innovation in Agricultural Production) is a credit line designed to support investments necessary for the incorporation of technological innovation in rural properties, aimed at increasing productivity, the adoption of good agricultural practices and the management of rural properties, and the competitive insertion of rural producers in different consumer markets.
	Moderinfra	6%	10 years	3 years	BRL$ 3.3 million	Moderinfra (Incentive Program for Irrigation and Production in a Protected Environment) aims to offer credit to support the development of sustainable, economic and environmental irrigated agriculture, to promote the use of structures for production in a protected environment and to protect fruit production from hail in temperate regions.

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This material is part of a three-study collection developed by GTPastagens and shows that it is possible to intensify and scale up the rehabilitation of degraded pastures in the Cerrado, boost their economic performance, and reduce the impact of production, and at the same time reduce the pressure for more deforestation.

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ABOUT GTPASTAGENS

A multi-stakeholder working group composed of academics and members of the civil society and private sector with a single focus: rehabilitate degraded pastures in the Cerrado.

WWF

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