GTPastagens

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

SUMMARY

2

REHABILITATION OF DEGRADED AREAS

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INTRODUCTION

Agriculture is an important sector of the Brazilian economy, accounting for a fifth of the country's GDP. Historically, the production was concentrated in the Northeast, South, and Southeast regions of the country. However, over the past four decades, it has expanded to the Mid-West and North, replacing native vegetation. This expansion has resulted in large areas of pasturelands, which amounted to 167.5 million hectares in the country in 2019, according to MapBiomas – Collection 5 (2020). That makes up 65% of the farming area in Brazil.

The lack of good farming practices and pastureland management results in degraded lands and deforestation. As other crops (mainly soy) expand, they replace pasturelands and native vegetation.

OUR GOAL: TRANSFORM THE LANDSCAPE IN THE CERRADO!

It's important to foster the use of converted lands, mainly degraded ones, seeking to optimize their use and boost productivity, environmental conservation, and reduce pressure for clearing new lands.
Based on the aforementioned facts, Agroicone, in a study funded by WWF-Brasil, sought to understand the challenges around restoring degraded lands in the Cerrado and how to overcome them, considering both territorial and economic-financial analyses. The study is comprised of:

- **i.** Zoning of degraded pasturelands and the potential that some agricultural supply chains have to recover these areas in the Cerrado;

- **ii.** Rural credit in the Cerrado and the farmers' access to it; i

- **iii.** Analyzes and perceptions regarding the expansion of agricultural production in this biome, as well as the main reasons why these producers are not implementing land recovery practices; and

- **iv.** Business cases that sought to assess the economic and financial feasibility of restoring pasturelands. In the end, the necessary actions to promote this change are presented.

1

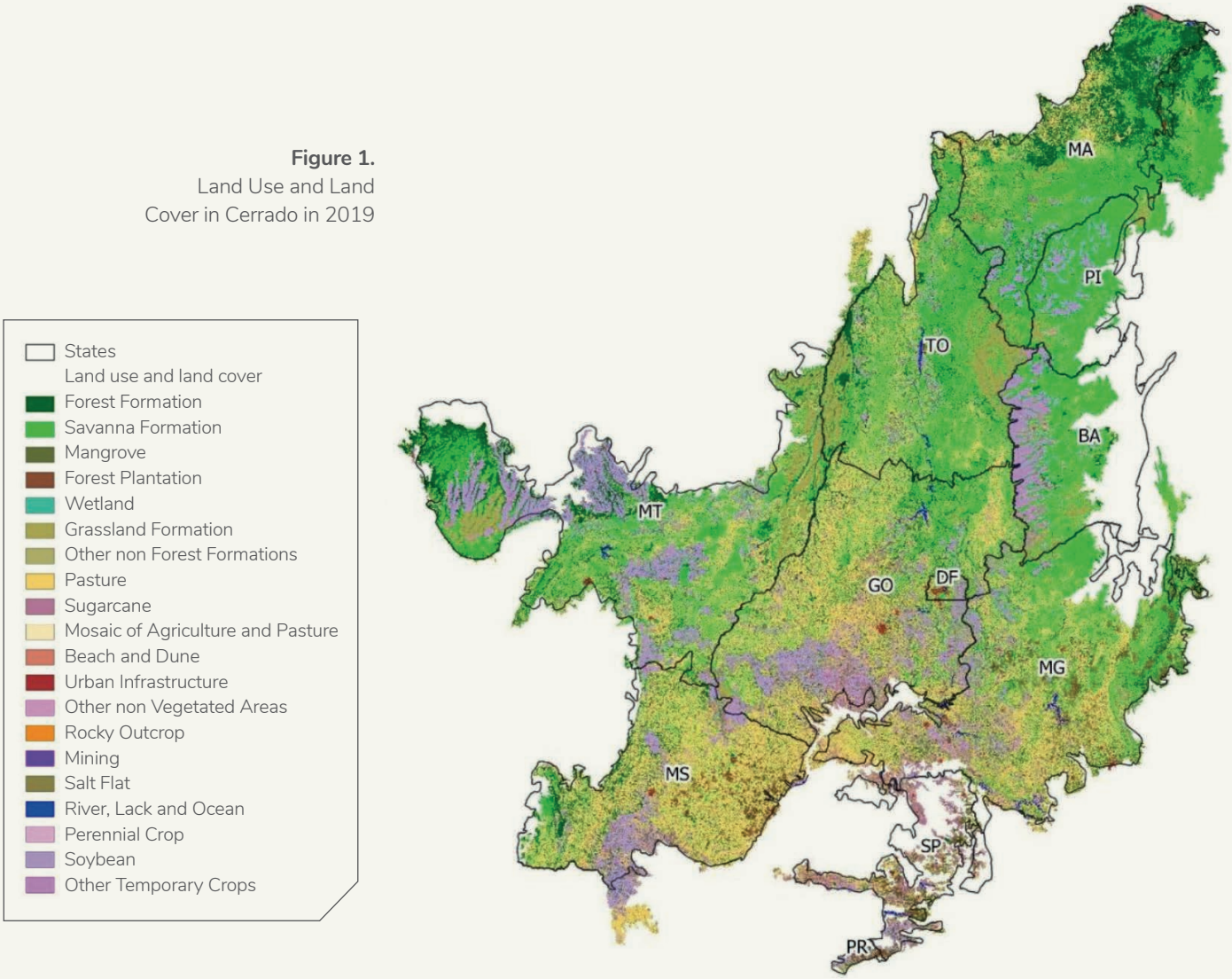
ZONING DEGRADED PASTURELANDS

About the Cerrado

The Brazilian Cerrado is the second largest biome in South America, with 200 million hectares, or 22% of Brazil's territory. This area is home to the sources of the three largest river basins in South America: Amazonas/ Tocantins, São Francisco, and Prata.

According to MapBiomas – Collection 5 (2020), in 2019, forests (including savannas and mangroves) covered 89.2 million hectares (46.5%) of the Cerrado. Farming activities amounted to 86.9 million hectares (43.8%), 25.9 of which dedicated to agriculture and 61 million to pasturelands (***Figure 1***). Additionally, according to the Image Processing and Geoprocessing Laboratory (LAPIG), in 2018, 23.7 million hectares of pasturelands showed some level of degradation.

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



The large stock of pasturelands and intensification of cattle ranching activities (increased cattle production yield using smaller pasturelands) allow agriculture to expand replacing pasturelands[1] or joining them. Based on that, there are several ways to recover pasturelands and make them productive. The choice will come down to the selected recovery technique, level of degradation, and future land use.

[1] Pasturelands considered in this study are fenced and covered by planted forage.

About agricultural supply chains and their potential for recovering degraded lands

BEEF INDUSTRY

In 2018, Brazil's bovine cattle herd amounted to 213.4 million heads, according to the Municipal Livestock Research – Brazilian Institute of Geography and Statistics (PPM – IBGE, 2018), 94 million (44%) of which in the Cerrado.

To identify degraded pasturelands with potential for intensification of cattle ranching, farms whose main activity was cattle ranching (at least 50% of land covered by pastures) were considered, as well as how close they were to slaughterhouses ***(Figure 2***).

The results show a 5.6-million-hectare (Mha) area of degraded pastures with potential for beef cattle ranching intensification, concentrated mainly in the states of Goiás (2 Mha) and Mato Grosso do Sul (1.3 Mha).

MILK INDUSTRY

According to the IBGE – Agricultural Census (2017), there were 3.7 million heads of milk cattle in the country. To assess degraded pasturelands with potential for intensification in the milk industry, farms whose main activity is cattle ranching close to dairies were selected; to that end, a 100-kilometer radius from dairies was generated.

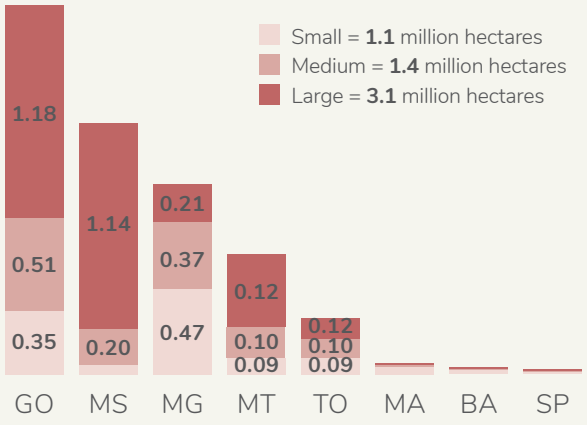
Within this radius, farms that had at least 50% of their land covered by pasturelands were selected ***(Figure 3)***. The result was 4.3 million hectares (Mha) of degraded pasturelands with potential for the intensification of milk cattle ranching, mainly in Minas Gerais (2 Mha) and Goiás (1.7 Mha).

Figure 2.
Degraded pasture with potential for livestock intensification

5.6 MILLION HECTARES

of degraded pasture for livestock intensification

Area of degraded pasture (million hectares)



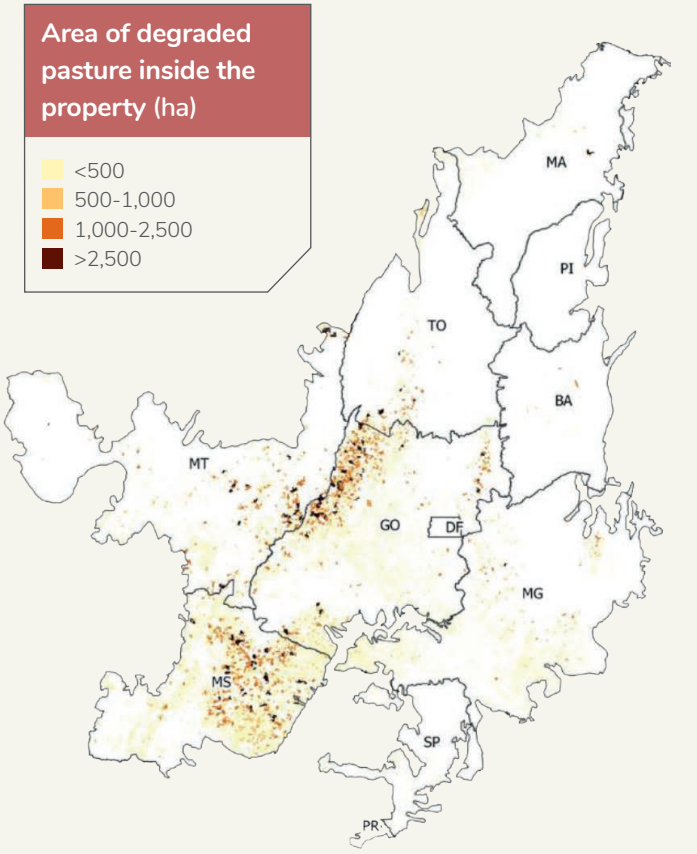
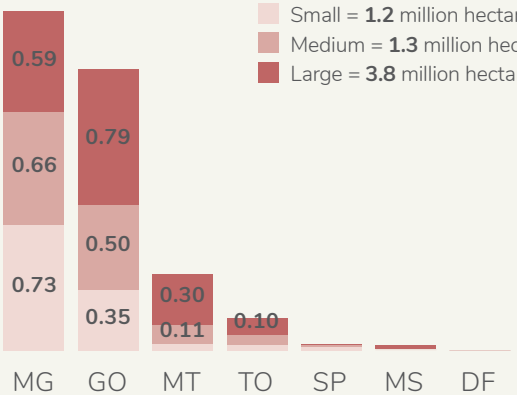


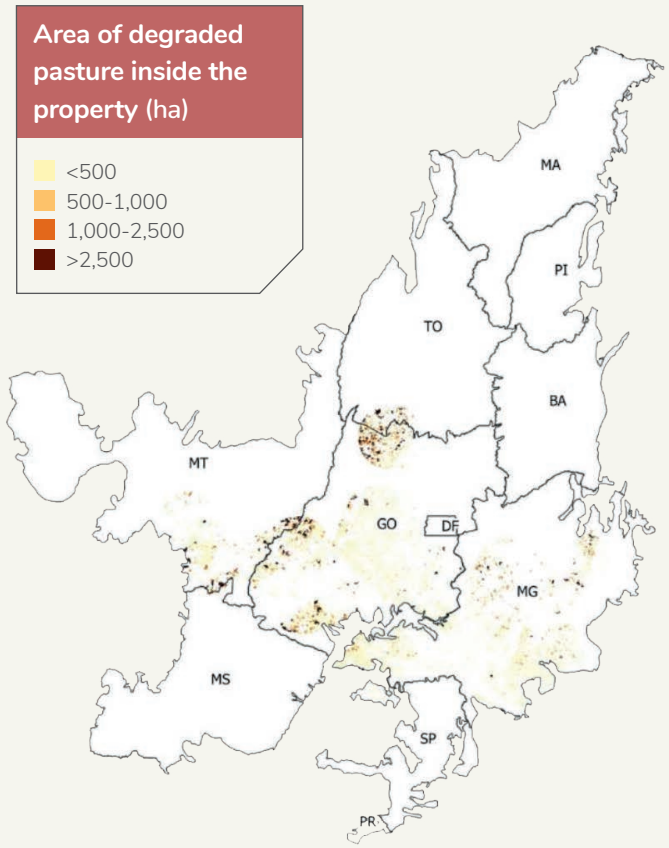
Figure 3.
Degraded pasture with potential for intensification of dairy farming

4.3 MILLION HECTARES

of degraded pasture for intensification of milk production

Area of degraded pasture (million hectares)





Source: Study results. Elaborated by Agroicone.

SOY INDUSTRY

In 2018, Brazil's planted soy area amounted to 34.8 million hectares, while production reached 117.9 million tons, 69.3 million (59%) of which came from the Cerrado.

To identify degraded pasturelands with potential for soy expansion, the following criteria were considered: agricultural suitability; proximity to silos and warehouses (20-kilometer radius); and proximity to soy crops (20-kilometer radius). Another filter was applied to lands larger than 100 continuous ha, since soy is primarily grown in medium and large farms.

Agrosatélite (2017) splits suitability into four categories (high, medium, low, and unsuitable) and four types of restrictions (altitude, slope, slope and altitude, and no restriction). For zoning purposes, "high" suitability was chosen (but not ruling out land whose restrictions could be partly overcome using technology). Data regarding degraded pasturelands and high agricultural suitability were cross-referenced, allowing to select those that are suitable for soy expansion.

According to these criteria, a 5-million-hectare area was found, enough to increase the planted soy area by 25% ***(Figure 4)***.

COMMERCIAL FORESTS

There are 8.6 million hectares of commercial forests in Brazil, according to MapBiomas (2019). In the Cerrado, they were 3.3 million hectares in 2018 (38.6% of the total area).

This study considered degraded pasturelands close to commercial forests that had been consolidated by 2018 (within a 20 km radius), allowing us to identify 3.8 million hectares with potential for expanding commercial forests.

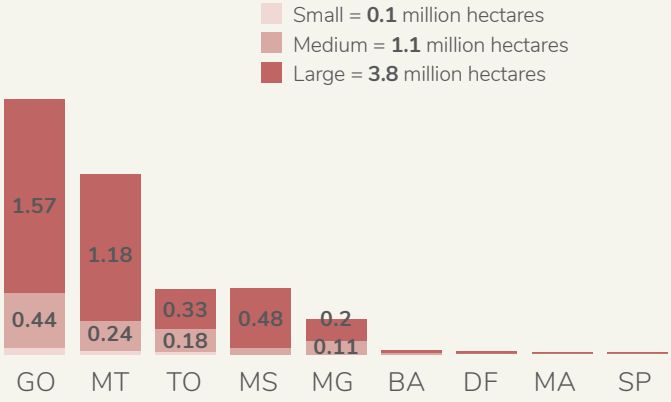
The analysis also comprehended proximity (150 km radius) to farming industries that make up the aforementioned supply chains, that is, slaughterhouses, silos, and warehouses, in addition to corn ethanol mills, which are powered by firewood. That allowed us to identify a 6.1 Mha area ***(Figure 5)***.

Figure 4.
Degraded pasture with potential for soybean expansion

5 MILLION HECTARES

of degraded pasture for soybean expansion

Area of degraded pasture (million hectares)



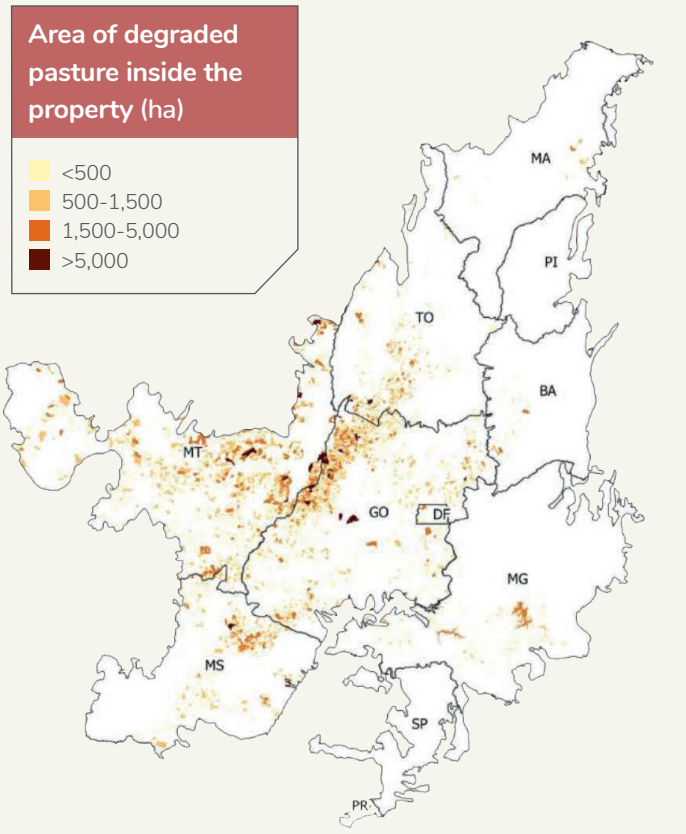
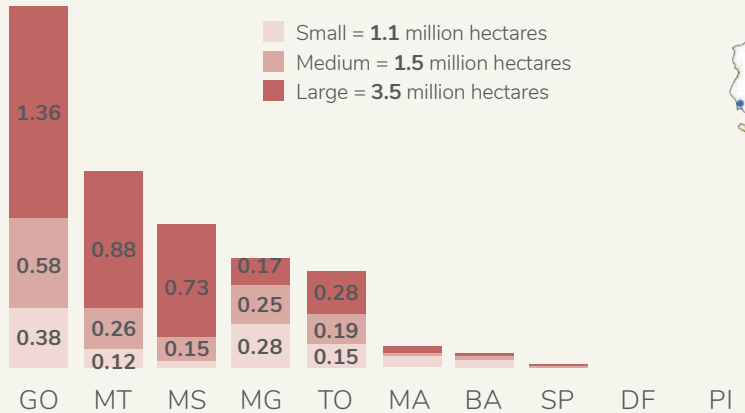


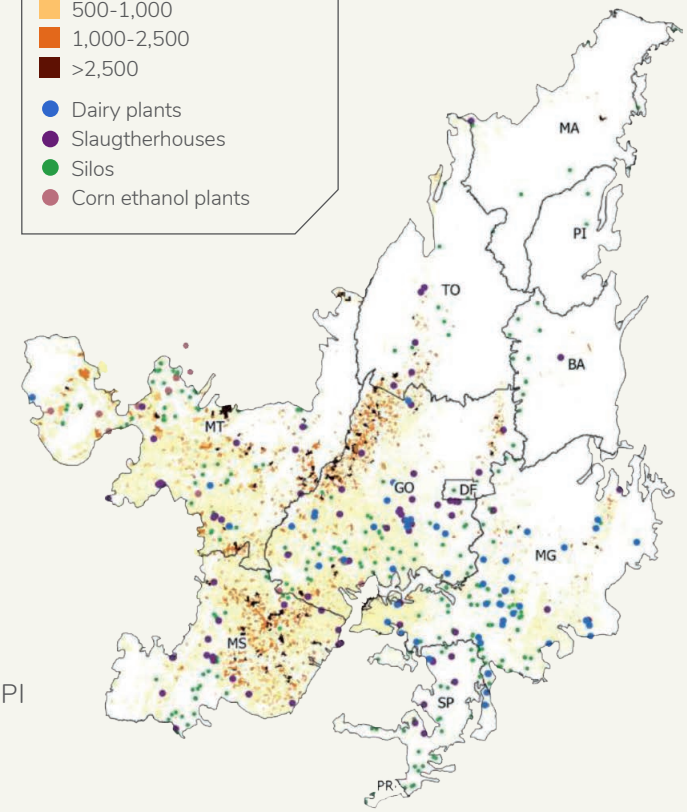
Figure 5.
Degraded pasture with potential for commercial forest - opportunities (million hectares)

6.1 MILLION HECTARES

of degraded pasture for commercial forest

Area of degraded pasture (million hectares)





Source: Study results. Elaborated by Agroicone.

About integrated systems

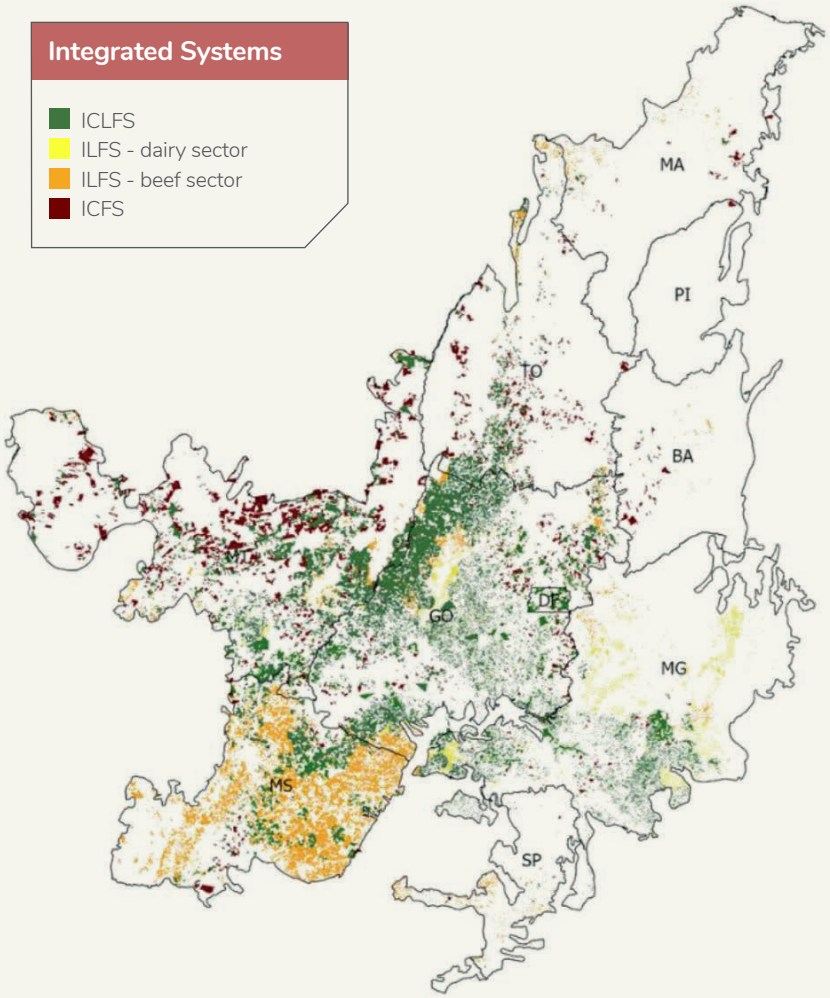
Embrapa defines an integrated system as involving "the production of grain, fibers, wood, energy, milk, or meat within the same land, using crop rotation, intercropping/consortium, or succession cropping." There are four types of integrated systems: integrated crop-livestock (ILP), integrated crop-forestry (ILF), integrated livestock-forestry (IPF), and integrated crop-livestock-forestry (ILPF).

To identify degraded pasturelands with potential for integrated systems (ILPF, ILP, ILF e IPF), the zoning carried out for the farming supply chains (previously presented for each chain) was cross-referenced, showing there are 10.8 million hectares of pasturelands with potential for integrated systems in the Cerrado, which is a great strategy to recover degraded pasturelands ***(Figure 6)***.

The system with the largest potential to recover degraded pasturelands is the integrated crop-livestock-forestry, with 5.1 million hectares (which can also be used in any combination of integrated systems), followed by integrated crop-livestock-forestry (milk cattle), with 2.6 Mha. The integrated livestock-forestry (beef cattle) amounted to 1.6 Mha, and integrated crop-forestry was 0.8 Mha. The states with the largest potential areas are Goiás, Minas Gerais, Mato Grosso, and Mato Grosso do Sul, respectively.

Figure 6.
Degraded pasture with potential for integrated systems

Source: Study results.
Elaborated by Agroicone.



AGROFORESTRY SYSTEMS

According to Embrapa, these are "production systems that may be based on ecological succession, similar to natural ecosystems, in which exotic or native trees are used in conjunction with crops, creepers, forage, and shrubs, according to a pre-defined spatial and temporal arrangement, with high diversity of species and interaction between them."

It's a good choice for small farms, helping to diversify production, boost profits, and minimize risks. There are 2.5 million hectares of degraded pasturelands in small farms in the Cerrado that could be recovered that way ***(Figure 7)***.

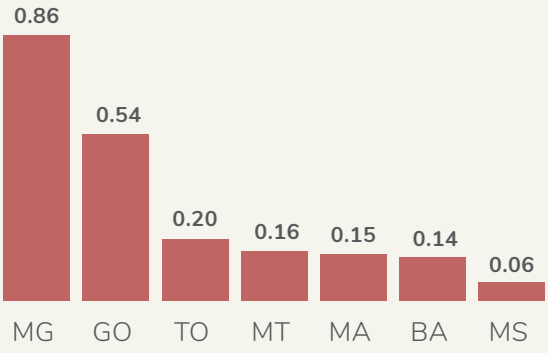
Figure 7.
Degraded pasture in small properties with potential for agroforestry systems' implementation

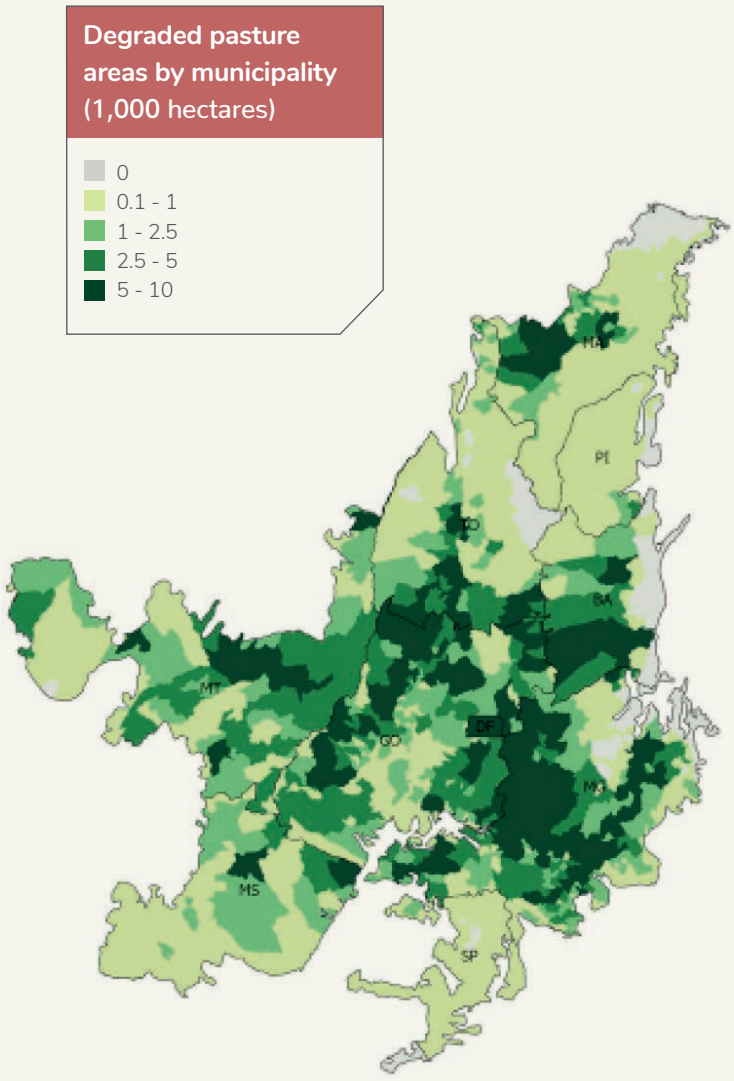
Source: Study results. Elaborated by Agroicone.

2.5 MILLION HECTARES

of degraded pasture areas in small properties which may have potential for agroforestry system implementation

Degraded pasture areas in small properties (Mha)





2

RURAL CREDIT IN THE CERRADO

The agricultural policy in Brazil has three key components: market price policy, subsidized crop insurance, and rural credit, the latter being the main support mechanism for this sector. The National System of Rural Credit directs credit to farmers with subsidized interest rates and accounted for 80% of all subsidies granted to this industry in 2019. Today, it's the main source of funding to recover degraded lands.

Municipalities in the Cerrado have a decisive role in the rural credit market, since 46% of the resources, on average, were directed to them over the past four crop-years[2]. Over that same period, the amounts borrowed in the biome increased 27%.

Most part of credit was borrowed for funding the production (61%) e for investments in the farm (24%). In addition, agriculture financed a more representative portion of the credit compared to the livestock activity.

[2] The 2016/2017 to 2019/2020 period was looked into.

Regarding to rural credit for investment in the farms[3], more than half (54%) of the funding in 2019/2020 in the Cerrado was directed to purchasing cattle, machinery, agricultural implements, and tractors. The share of funding used to recover degraded lands made up a mere 14% (R$ 2.95 billion), but increased 91% from 2016/2017 to 2019/2020 (R$ 1.54 billion) ***(Figure 8)***.

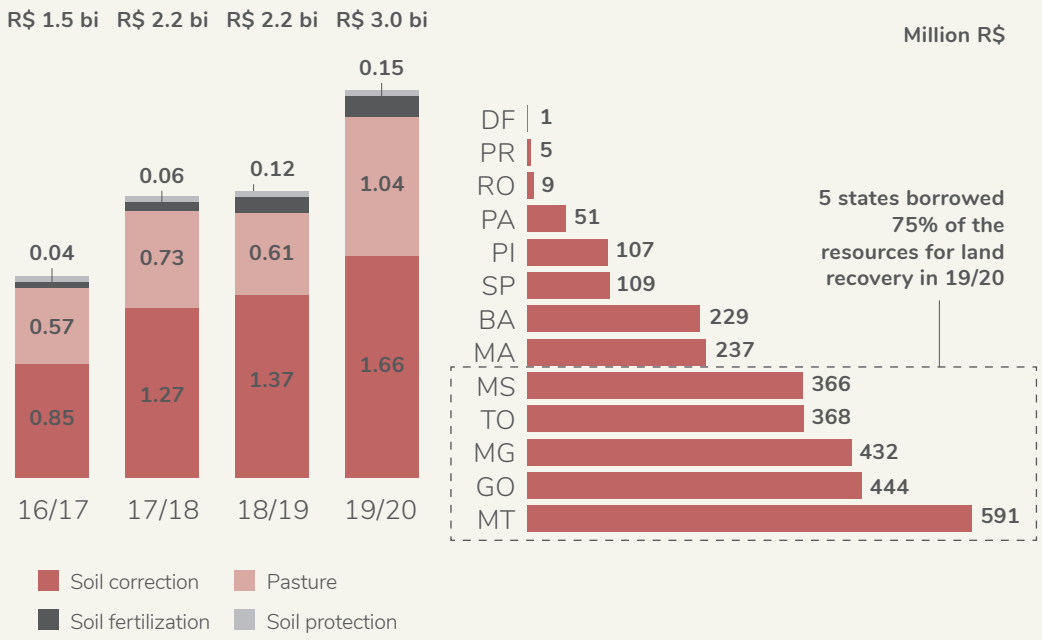


Figure 8.
Resources borrowed for investments in soil recovery in the Cerrado (left) and resources borrowed for investments in soil recovery by state in the Cerrado in 2019/2020 (right)

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

Note: Does not include Pronaf.

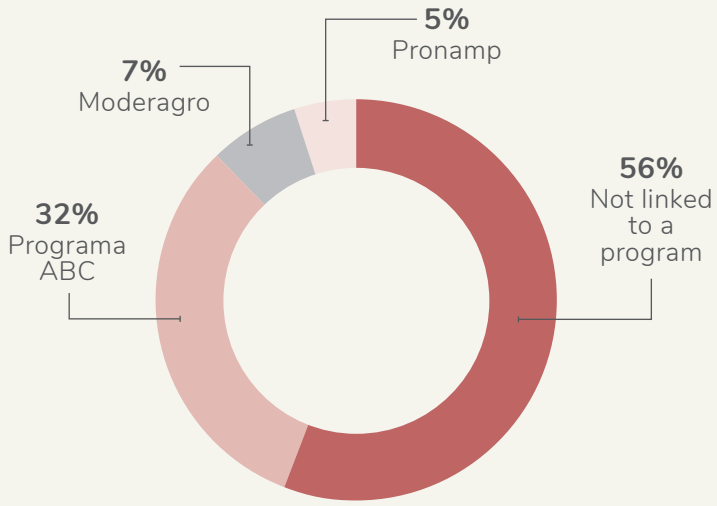
In the 2019/2020 crop-year, farmers had access to these funds through different public rural credit programs, like the Programa ABC (32%), Moderagro (7%), and Pronamp (5%). However, a substantial part (56%) was funded without any connection to a specific credit program ***(Figure 9)***.

[3] Doesn't include data from Pronaf.

Figure 9.
Rural credit resources for investment borrowed for recovering degraded lands in 2019/2020 in Cerrado by program

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

Note: Does not include Pronaf.



IN 2019/2020, R$3 BILLION WERE BORROWED TO INVEST IN DEGRADED LANDS' RECOVERY INTO THE CERRADO

Data from Pronaf (Brazilian Family Farming Strengthening Program), specifically, shows that funding for the recovery of degraded lands in the Cerrado rose 48% between the 2016-2017 and 2019-2020 crop-years. Over the latter period, it amounted to R$ 112 million (23% of the amount directed to soil recovery via Pronaf in the country). These resources are more frequently borrowed by cattle ranchers, primarily to recover pasturelands.

This shows how important the subsidized rural credit is for long-term investment in the recovery of pasturelands.

EDUARDO GARCIA FURTADO / SHUTTERSTOCK

Farms' access to rural credit

According to IBGE's Agricultural Census (2017), there were five million farms in the country, but only 15% (784,500) accessed rural credit, whether for costing the production, investment, or commercialization.

Out of the 1.1 million farms in the Cerrado, 662,800 (63%) are connected with cattle ranching. Out of those, 98,200 had access to credit and 67,900 used it for investment, that is, only 10% of cattle ranching farms, what shows that, despite an increase in investments made using credit borrowed by farmers in the Cerrado, a small share of farms borrowed credit to invest in their activity, much like what has been observed across the country.

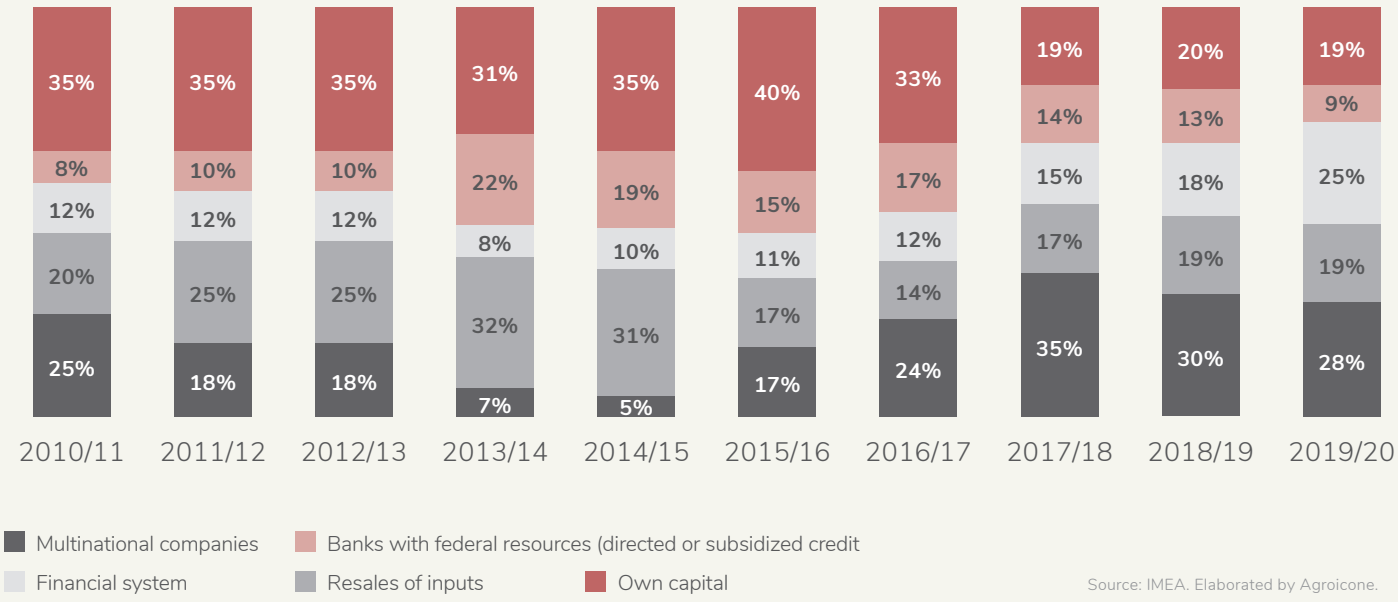
Agricultural funding structure – the case of soy in Mato Grosso

Although rural credit is the main public policy mechanism to fund agriculture, farmers have other ways to fund their activities, and the soy case is an example of that. Between 2010 and 2019, subsidized rural credit to fund soy crops in Mato Grosso ranged from 8% to 22% of its total cost ***(Figure 10)***. Over the past two crop-years, financial systems and banks that use federal resources were the main funders of soy production in the state.

The participation of multinational companies in the soy supply chain, the farmers' own resources, and the resale of inputs also play an important role. Soy producers in the state have a high degree of leverage using their own capital to fund costs – between 19% and 40%.

It can be said that the credit market (unsubsidized) funds both production and agricultural expansion. However, that varies depending on the farmer's profile (especially regarding farm size) and region.

Figure 10.
Funding structure for soybean production costing in Mato Grosso



Source: IMEA. Elaborated by Agroicone.

3

INITIAL PERCEPTIONS ABOUT THE FARMERS' DECISION TO EXPAND PRODUCTION TO NEW AREAS (INCLUDING DEGRADED LANDS)

In studies previously developed by Agroicone, interviews were carried out with farmers in the Cerrado region to understand the agricultural expansion and also the conversion of pastures (with low productivity) into areas for soy crops.

The pattern of agricultural expansion differs between regions in the Cerrado and depends on the need for soil correction. In some cases, when soil correction is necessary (especially in the MATOPIBA region), it takes each crop longer to reach optimal productivity.

Historically, the expansion has been funded by the farmers' own capital, especially for land

purchases. The farmers' decision to expand is related to different factors, such as increasing production scale and building wealth, production profitability and land appreciation, and climate risk management, operating in different regions.

According to producers interviewed, the future expansion of agriculture may be based on previously opened areas. For the expansion of soy in opened areas, the main bottlenecks identified are:

- High investment required to convert areas into pastures.
- Scarcity of pasturelands in some regions.
- Lack of grain infrastructure (e.g. silos) in cattle ranching regions, as well as a shortage of qualified labor for grain production.
- Lower land price gains when acquiring and converting pasturelands compared to native vegetation.
- The need of the farms to comply with the Forestry Code.

4

WHY RANCHERS ARE NOT TAKING CREDIT / IMPLEMENTING SOIL RECOVERY PRACTICES?

As part of this study, Agroicone's researchers held meetings with several different groups. The goal was to understand the barriers faced by farmers when they seek credit to invest in the recovery of degraded pastures and what measures would help them to adopt agronomic systems capable of recovering those lands.

Group A 1 consisted of 11 ranchers from the Guariroba basin, in Mato Grosso do Sul (more details about this region will be presented in the following section). Out of those, five said they have degraded lands in their farms and intend to recover the soil in up to three years. However, they mentioned the high investment required and insufficient private funds as barriers to implement this change. They also mentioned the lack of public policies that encourage farmers to recover pasturelands, difficulty

to access credit, and problems to maintain the quality of pastures after they have been recovered.

Group A 2 involved the Guariroba Basin Association. According to the entity, most of the region's pasturelands is not completely degraded, but there is a lack of incentives for producers to invest and adopt best practices. Many of them (mostly cattle ranchers in the region) are averse to borrowing credit, as they fear they might not be able to pay it back.

Group B 1 was comprised of eight cattle ranchers from Mato Grosso. They all had invested in recovering pasturelands, fences, purchasing cattle, genetic enhancement, and farm improvements. However, environmental and land requirements limited their access to rural credit. Other problems raised were: the need for high investment, and lacking funds and technical support.

Group B 2 included technical support agents. They think farmers want to recover pasturelands (lime application, fertilization, and crop rotation are the main strategies they employ for that purpose), but come across obstacles such as high investment, insufficient private funds, and difficulty to access credit.

Group B 3 included entities, associations, and NGOs. IMEA (Mato Grosso's Institute of Agricultural Economy) sees an unprecedented change in the state's cattle ranching activity thanks to soaring cattle prices and demand for beef. More farmers have been adopting integrated systems and intensifying their cattle ranching activity.

On the other hand, the association of cattle ranchers of Eastern Mato Grosso has high expectations for integrated systems, but admits it's harder for cattle ranchers to work with crops than the other way around. They suggest strategies like land-leasing arrangements between cattle ranchers and farmers for pastureland recovery purposes.

IMAC (Mato Grosso's Beef Institute) believes the timing is right to incentivize investments in cattle ranching. However, they draw attention to the producers' aversion to risk and resistance to new technologies, environmental and land requirements, and low level of family succession in the cattle ranching activity.

Group C consisted of financial institutions (a bank and a credit cooperative). For the bank, the farmers' resistance to new techniques and credit,

coupled with poor technical support, is the biggest barrier to borrowing credit. The cooperative points to the lack of adequate technical support, the difficulties faced by the financial institutions to deal with more complex projects (like an integrated system), and environmental and land requirements, among other legal matters.

5

BUSINESS CASES FOR PASTURELAND RECOVERY

The business cases presented below sought to assess the economic and financial feasibility of recovering pasturelands in different parts of the Cerrado from the farmers' perspective. To that end, cattle ranching and soy culture were selected as those that will recover degraded pasture to expand and/or improve their activities.

Business case for intensifying cattle ranching in the Guariroba Basin

The Guariroba river basin is located in Campo Grande, capital of the state of Mato Grosso do Sul. Extensive cattle ranching is predominant there, with 65 farms (mostly medium and large).

Since 2010, WWF-Brasil has partnered up with the Association for the Recovery, Conservation,

and Preservation of the Guariroba basin through Programa Água Brasil (Water Brazil Program), which seeks to promote good farming practices and ensure the basin's water security.

Figure 11.
Business case for pasture recovery in Guariroba Region Basin

Source: Study results.

Different scenarios were considered in order to understand the effects of pastureland recovery in the farmers' profitability ***(Figure 11 and Table 1)***.

HYPOTHESES

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

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 costing (working capital) annually only in the scenario B: 70% with own capital (6% py nominal) and 30% through rural credit (8% py nominal)
- Financing investment for pasture recovery and property improvements (B): 29% with own capital (6% py) and 71% through rural credit (ABC Program) (6% py)
- Financing investment for machinery purchase (B): 15% with own capital (6% py) and 85% through rural credit (similar to Moderfrota) (8% py)

	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 pasture in farm that are not recovered. Cattle ranching presenting 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.
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 recover degraded pasture and to improve farm infrastructure during the first 5 years. Cattle ranching presenting growth in stocking rate until year 5, from which remains constant with higher productivity. Producer does not access credit to finance costing and investments in cattle ranching activity. 100% of own capital to finance the activity 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 recover degraded pasture and to improve farm infrastructure during the first 5 years. Cattle ranching presenting growth in stocking rate until year 5, from which remains constant with higher productivity. Producer access credit to finance annually costing and investments in cattle ranching activity.

Table 1.
Scenarios considered (with and without land price appreciation)

Source: Study results.

The results ***(Figure 12)*** show that extensive cattle breeding (the most common type in this region), with low yield and poor pasture quality, is not profitable. However, if cattle ranchers invest in recovering pastures and other necessary improvements, they can secure positive financial results, since they will boost productivity. That result can be further improved by borrowing credit for investment, as doing so will enable ranchers to invest in their activity with a long-enough grace period to secure a financial return and start paying back their loan.

Therefore, borrowing credit enables ranchers to boost cash flow (scenario B), funding cattle ranching costs and investments necessary to recover pastures and improve their infrastructure. It should be noted that these conclusions were drawn whether land appreciation is considered or not, something farmers should take into account and which results from improvements made possible by investing in the farm.

Figure 12.
Business case results for Guariroba region, with and without land price appreciation

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 rate and the effects of change in land use.

Business case for intensifying cattle ranching in Araguaçu

Araguaçu is a municipality located in Southern Tocantins. It's characterized by the cattle ranching activity, focused on cattle breeding, and it has also witnessed the expansion of crop-growing areas. According to LAPIG, there are nearly 199,000 hectares of degraded pasturelands in the municipality. Therefore, scenarios to assess the recovery of pastures and expansion of soy crops in this region were devised.

ARAGUAÇU: FOCUS ON CATTLE RANCHERS

This business case sought to understand how recovering pastures or leasing part of them for soy expansion can be a profitable strategy for cattle ranchers. Here, the cattle breeding system was assessed, as it's predominant in this region ***(Figure 13 and Table 2)***.

Figure 13.
Hypotheses and assumptions based on cattle ranching activity in the Araguaçu region.

Source: Study results.

HYPOTHESES

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

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
- Own cattle ranchers capital for costing the activity in the scenarios BAU, A1 and B1.
- Own cattle ranchers capital for investments in pasture recovery and infrastructure in the scenarios A1 and B1.
- Financing costing (working capital) annually only in the scenarios A2 and B2: 70% with own capital (6% py nominal) and 30% through rural credit (6% py nominal).
- Financing investment for pasture recovery and property improvements (A2 and B2): 29% with own capital (6% py) and 71% through rural credit (ABC Program with 4 years of grace period) (6% py)
- There is no investment for machinery acquisition in all scenarios, since producers already have it in their farms.

Table 2.
Scenarios considered – Cattle ranching in Araguaçu region

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 pasture areas in the farm are not recovered. Cattle ranching presenting 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 first 5 years. Cattle ranching presenting growth in stocking rate until year 5, from which remains constant with higher productivity. Producer does not access rural credit to finance costing and investments in cattle ranching activity. 100% of own capital to finance the activity and investments.
B1	**Recovery of degraded pastures and leasing are 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 remaining, cattle rancher invests to recover degraded pasture and to improve farm infrastructure during the first 5 years. Cattle ranching presenting growth in stocking rate until year 5, from which remains constant with higher productivity. Producer does not access rural credit to finance costing and investments in cattle ranching activity. 100% of own capital to finance the activity 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 first 5 years. Cattle ranching presenting growth in stocking rate until year 5, from which remains constant with higher productivity. Producer access rural credit to finance costing and investments in cattle ranching activity.
B2	**Recovery of degraded pastures and leasing are 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 producer over the total period of the project. 50% pasture remaining, cattle rancher invests to recover degraded pasture and to improve farm infrastructure during the first 5 years. Cattle ranching presenting growth in stocking rate until year 5, from which remains constant with higher productivity. Producer access rural credit to finance costing and investments in cattle ranching activity.

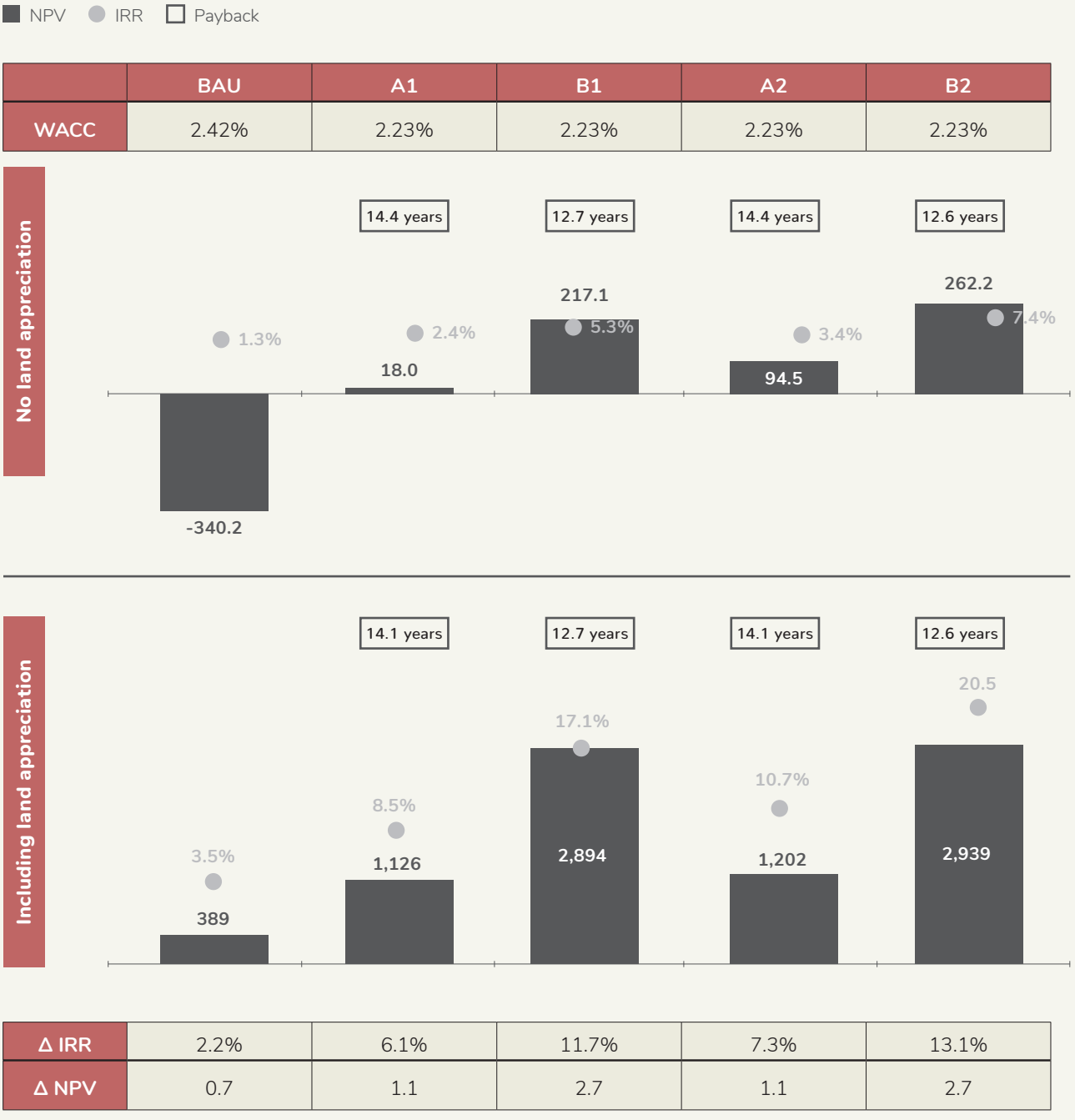
The results ***(Figure 14)*** had shown that recovering pastures and improving production conditions (improving farm infrastructure to support higher productivity levels) leads to positive results for cattle ranching (IRR = 2.4%), since the activity is conducted more rationally, making better use of capital and available pasturelands in the farm. However, if producers remain on a low-yield cattle ranching, the activity provides negative returns (not considering land appreciation).

If producers lease part of their pasturelands for soy crops, the return is even higher in the former scenario (IRR = 5.3%), since the income from leasing can be used to fund part of the investments in recovering pastures and improving the farm.

Figure 14.
Business case results for Araguaçu region – 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 rate and the effects of change in land use.

(15 years, thousand R$, 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

ARAGUAÇU: FOCUS ON SOY FARMERS

The study looked into different scenarios to identify what the financial return is when soy crops expand over new areas ***(Figure 15 and Table 3)***.

Figure 15.
Hypotheses and assumptions based on soy expansion over the last years in the Cerrado biome

Source: Study results.

HYPOTHESES

- The models of agricultural activity with soy have good profitability, showing returns higher than other activities, such as livestock. Reason why 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 rural credit (6% py nominal)
  - 24% barter (12% py nominal)
  - 44% own capital/equity (6% py nominal)
- Financing investment for conversion area into agriculture:
  - scenarios D, F and G (pasture into agriculture): 71% official rural credit (ABC Program with 4 years of grace period / 6% py nominal) and 29% own capital/equity (6% py nominal)
  - scenarios C and E: there is no conversion of area
  - scenarios A and B (native vegetation into agriculture): own capital/equity (6% py nominal)
- Financing machinery investments in scenarios A to G
- 85% official rural credit (Moderforta with 1 year of grace period / 7.5% py nominal)
- 15% own capital/equity (6% py 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 by the previous land owner/vendor (7.5% py nominal)
- No acquisition of area on scenarios BAU, A and G
- Leasing area: own capital/equity (6% py nominal) and amount paid annually corresponding to 12 months of land use
- Prices paid for:
  - Leasing area: R$ 738/ha
  - Native Vegetation land: R$ 3,000/ha
  - Pasture land: R$ 3,750/ha
  - Agriculture land: R$ 12,000/ha

Table 3.
Scenarios evaluated - Soy expansion in Araguaçu region

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	Consolida-ted area (250 ha)	3.32 ton/ha. Growth rate: 0.53% py	Producer already have necessary infrastructure and machinery to conduct soybean activity. Consolidated area with full productivity. Costing is 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)	Initial of 1.66 ton/ha and reach BAU rate at year 6. Growth rate: 0.53% py 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. Costing is 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)	Initial of 1.66 ton/ha and reach BAU rate at year 6. Growth rate: 0.53% py after year 6	Producer expands soybean production acquiring an area with native vegetation. There are investments in machinery and in land conversion. Costing is financed annually through official rural credit and *barter*.
C	**Expansion in acquired agricultural area implement-ting soybean**	Acquisition of agriculture area (250 ha) + LR (135 ha) = 385 ha	Expansion area (250 ha)	3.32 ton/ha. Growth rate: 0.53% py	Producer expands soybean production acquiring a crop area, not being necessary land conversion. There are investments in machinery. Costing is financed annually through official rural credit and *barter*.
D	**Expansion in acquired pasture area implement-ting soybean**	Acquisition of pasture area (250 ha) + LR (135 ha) = 385 ha	Expansion area (250 ha)	Initial of 1.66 ton/ha and reach BAU rate at year 4. Growth rate: 0.53% py after year 4	Producer expands soybean production acquiring a pasture area. There are investments in machinery and in land conversion. Costing is financed annually through official rural credit and *barter*.
E	**Expansion in acquired agricultural area implement-ting soybean (compensa-tion of RL 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% py	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. Costing is 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 RL in own surplus)**	Acquisition of pasture area = 250 ha (does not include Legal Reserve)	Expansion area (250 ha)	Initial of 1.66 ton/ha and reach BAU rate at year 4. Growth rate: 0.53% py after year 4	Producer expands soybean production acquiring a pasture area, which not includes Legal Reserve, so there is compensation of LR in own consolidated area (BAU). There are investments in machinery and in land conversion. Costing is 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)	Initial of 1.66 ton/ha and reach 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. Costing is financed annually through official rural credit and *barter.*

The analysis shows that expanding soy crops is viable with or without land appreciation. Considering no land appreciation, expanding over pasturelands and crops are the most profitable options in that region ***(Figure 16)***.

Expanding over purchased native vegetation areas provided the lowest IRR (not considering land appreciation), as the investment required to purchase and convert the land is higher and it takes longer to reach max productivity. In this case, the expansion over a producer's own surplus of Legal Reserve (LR) (A) provides a higher financial return.

Figure160.
Business case results for Araguaçu region – Soybean expansion

Source: Study results.

(15 years, million R$, 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

Expanding over crop areas or purchased pasturelands provides a high return, and leasing pasturelands has also proven profitable.

Considering the availability of degraded pasturelands in Araguaçu, the return provided by the soy activity (NPV and IRR), land prices, and land appreciation gains, it can be concluded that it is more profitable to expand soy crops over purchased pasturelands (scenarios D and F). That is because pasturelands are cheaper than croplands, but not much more expensive than what one would pay for land covered by native vegetation.

Business case - Integrated system in the Canarana region

Canarana is a municipality in the state of Mato Grosso where farming and cattle ranching are commonplace, and where degraded pasturelands can be recovered by adopting integrated systems.

The assessment was carried out in tandem with a land development company, whose main activity consists of purchasing land, leasing it for farming, and then selling it, profiting from land appreciation. The study looked into the financial result when farmers adopt the integrated crop-livestock system

Figure 17.
Hypotheses and assumptions based on adoption of an integrated systems (cattle ranching and soy) to recover degraded pasture in the Cerrado biome

Source: Study results.

(ILP – soy and beef cattle in the breeding and fattening system) to recover pastures and expand agricultural production ***(Figure 17 and Table 4)*** and, more specifically, leasing degraded pasturelands for that.

HYPOTHESES

- Pasture recovery with adoption of integrated systems can be feasible, presenting 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 soy in the Cerrado, avoiding native vegetation conversion.

ASSUMPTIONS

PRODUCER'S PERSPECTIVE SCENARIOS

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

LANDOWNER'S PERSPECTIVE SCENARIOS

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

Table 4.
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 soy expansion**	8,264 ha, being 2,892 of Legal Reserve	5,372 ha (soy area)	Soy: 57 bags/ha and reaches 64 bags at year 6. Growth rate: 2% per year	15 years	Producer leases a cropland to soy expansion. There is no investment in area conversion since it is already in good conditions for soy production. There is no access to credit line/financing. The main goal is to identify the feasibility to lease a land exclusively for soy production, since this activity is the main competitor for land in the region of Canarana.
	A	**Leasing pasture area for implementation of integrated system (ICL – cattle ranching + soy) 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	Soy: Initial of 0 ton/ha and reaches 65 bags/ha at year 6. Growth rate: 2% per year Cattle: initial of 0.9 unit animals (UA)/ha and reaches 1.5 UA/ha at year 4.	15 years	Producer leases a degraded pasture, invests in pasture recovery for cattle ranching exclusively (1,500 ha), invest to convert part of pasture area (3,872 ha) into cropland/ICL and invest to acquire the initial cattle stock. Investments are financed by a credit line which charges 6.5 py nominal with a payment term of 7 years including 1 year of grace period. Annual Costing is 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 soy expansion**	8,264 ha, being 2,892 of Legal Reserve	5,372 ha	Soy: Initial of 0 ton/ha and reach 65 bags/ha at year 6. Growth rate: 2% per year	15 years	Producer leases a degraded pasture area, invests on conversion of all pasture area (5,372 ha) into cropland for soy expansion. Investments are financed by a credit line which charges 6.5 py nominal with a payment term of 7 years including 1 year of grace period. Annual Costing is financed through own capital. The main goal is to identify the feasibility of soy 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 soy area)	n/a	15 years	Land owner acquires a crop area with own capital, leasing it to a rural producer, what composes its revenue over the project period. In the year 15, the company sells the area, having land appreciation gains. The main purpose of this scenario is to evaluate the financial return 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	Land owner acquires a degraded pasture area with own capital, leasing it to a rural producer, what composes its revenue over the project period. The rural producer will make investments to convert pasture area into agriculture and to recovery the remaining area of pasture (as in scenario A and B from the perspective of the rural producer). In the year 15, the company sells the area, facing the land appreciation. The main purpose of this scenario is to evaluate the financial return obtained by the land owner while buying, leasing and selling the land.

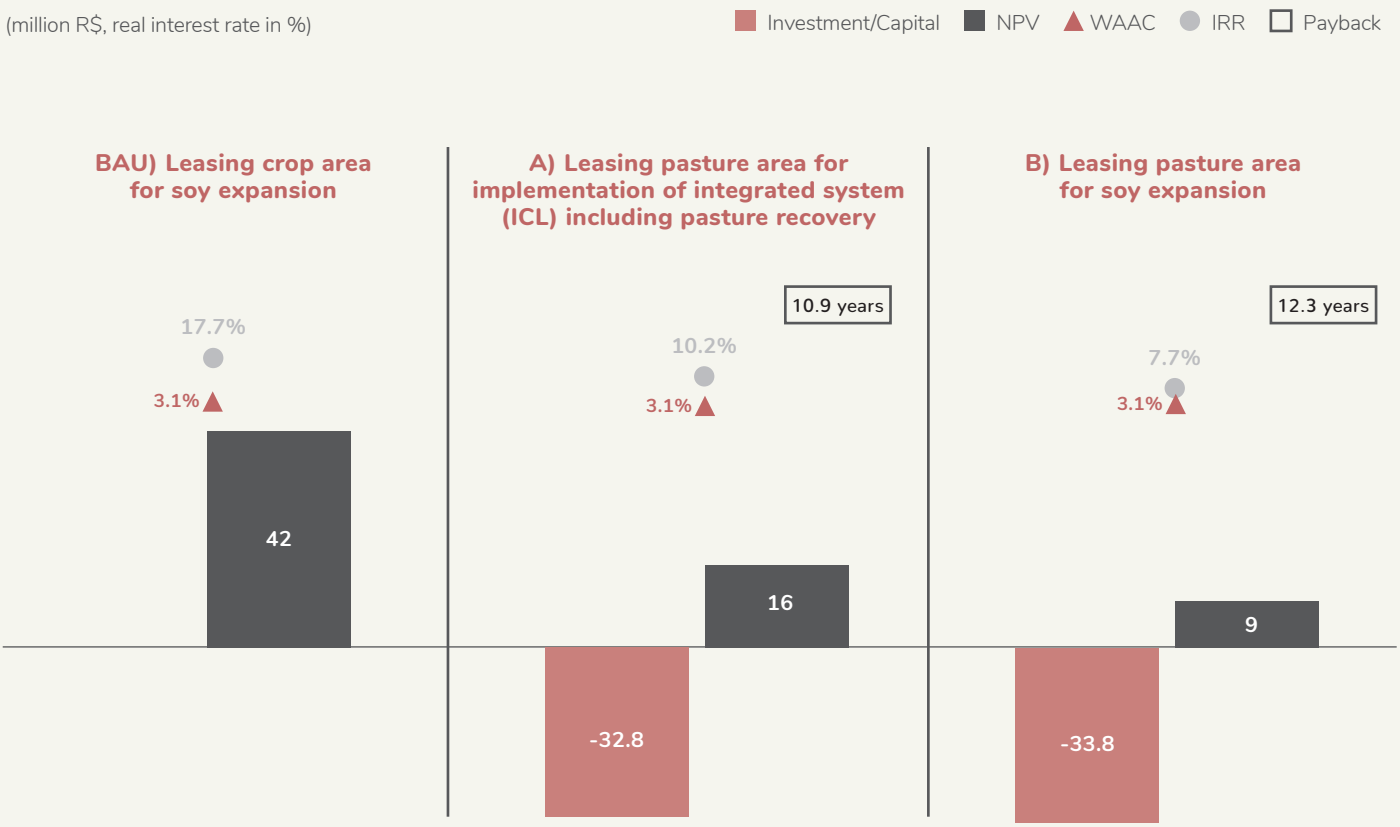
All scenarios have shown positive returns, but from the farmer's perspective, leasing croplands for soy expansion (baseline scenario) provides the best return, as the soil is suitable for soy crops and does not require investments in conversion and correction ***(Figure 18)***. However, if farmers choose to lease pasturelands, it's better to implement an integrated system, since they can make better use of the land in production and economic terms.

Figure 18.
Business case results - Integrated system in Canarana region – Rural producer perspective

Source: Study results.

Therefore, the farmer's decision to only expand soy crops or implement integrated systems will involve the need to invest in converting and recovering the area. For them, these systems are also important because they diversify their production.

INTEGRATED SYSTEM IN CANARANA REGION – PRODUCER'S PERSPECTIVE



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RECOMMENDATIONS

Combining territorial and economic analyses is important to stimulate actions aimed at sustainable production in the Cerrado. There are 23.7 million hectares of degraded and/or low-yield pastures in this region. Out of that total, the zoning carried out in this study found that at least 10 million hectares can be recovered for expanding different supply chains, combined and/or isolated in the short term.

The following actions are suggested to accelerate this process:

1. Promote the recovery of pastures and integrated systems, highlighting the required investments, how to implement them, and real gains. Pilot projects can raise awareness about these technologies among farmers.

2. Provide technical support and rural development to farmers, including compliance with environmental laws. Improving farm management is also key to secure long-term results.

3. Boost resources for investment through rural credit. An alternative to public credit is to obtain green funding from private investors, but that has to be directed to recovering pastures and there has to be an adequate mechanism to reach farmers.

4. Reduce legal uncertainties related to production and environmental matters. That includes effectively implementing the Forestry Code, ensuring farmers fully comply with environmental laws. The same holds true for the right to ownership, as it is necessary to legalize farms in terms of

land ownership by the farmers, which is usually associated with slowness and red tape. The paperwork required to produce (license or permit) needs to be reviewed.

5. Work together with associations, cooperatives, and rural unions to establish a communication channel with farmers.

6. Split farmers into three groups to establish the financial mechanisms targeted to each one:

i. marginalized (no credit access): they have to be seen from an inclusion perspective, promoting their land and environmental legalization. However, they should pay more for the financial mechanism.

ii. apt non-borrowers: they should also be seen from an inclusion perspective. They should be provided with technical support to reduce their aversion to new technologies and borrowing credit. They represent a moderate risk, so they should also pay more for sharing the risk of the financial mechanism.

iii. apt borrowers: as they represent a lesser risk for credit operations and, supposedly, have a larger appetite for new practices, they should be offered resources and collaterals for projects with larger productive and environmental impact. They should pay less for credit than the other groups.

The “marginalized” and “apt non-borrower” groups should be targeted by technical support and communication strategies, whereas “apt borrowers” should be prioritized in more ambitious projects, like integrated systems.

Finally, financial mechanisms have to be tailored for each group, offering collaterals, de-risking, and funding, as well as technical support and long-term monitoring.

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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.