

A photograph of a herd of cattle grazing in a lush green field. The cattle are in the foreground, and a dense forest of tall trees and large-leafed plants is in the background. The text is overlaid on the right side of the image.

Cattle ranching
intensification as a
key role on sustainable
agriculture expansion in
Brazil

ABOUT THE INPUT PROJECT

The Land Use Initiative (INPUT - Iniciativa para o Uso da Terra) brings together Agroicone with Climate Policy Initiative (CPI) in Brazil. It counts on a dedicated team of leading economists, lawyers, mathematicians, geographers and agronomists who work at the forefront of how to increase environmental protection and food production.

INPUT engages stakeholders in Brazil's public and private sectors and maps the challenges for a better management of its natural resources. Also, it mobilizes agents of the productive chains in order to promote compliance with the new Forest Code. In addition, the project aims at analyzing and influencing the creation of a next generation of low-carbon economy policies in Brazil.

In this project, besides from generating information about the alternatives for restoration of native forests and compensation of Legal Reserve areas, Agroicone is responsible for engaging the private sector in the challenges for compliance and creating sectorial solutions that enable large-scale implementation.

www.inputbrasil.org

ABOUT AGROICONE

Agroicone was founded in 2013 by a group of specialists from ICONNE - Institute for International Trade Negotiations. It resulted from 10 years of work by a cohesive team, which was responsible for the production of applied papers and studies, as well as qualified and skilled debates in global agricultural issues both locally and internationally.

The scope of Agroicone's work includes international trade negotiations, food security, public policies, land use change, market intelligence, sustainability, climate change, certifications, remote and satellite sensing technology and also the assembly of content and communication strategies for various value chains, especially: sugarcane, beef and dairy, grain commodities, perennial crops (planted forests and palm oil), bio-energy and those from smallholders.

www.agroicone.com.br

ABOUT THE PROJECT OF GORDON AND BETTY MOORE FOUNDATION

Through a Roadmap process with key actors of the chain, the project aims to build a long-term vision for the beef sector aimed at sustainable origination and reducing deforestation in the chain, including the challenges to promote the intensification of cattle ranching and the implementation of the Forest Code.

www.moore.org

Cattle ranching intensification as a key role on sustainable agriculture expansion in Brazil

São Paulo, October 2016.



**© CATTLE RANCHING INTENSIFICATION AS A KEY ROLE
ON SUSTAINABLE AGRICULTURE EXPANSION IN BRAZIL**

Agroicone, INPUT/2016

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CONTEXT

Cattle ranching intensification as a key role on sustainable agriculture expansion in Brazil

In Brazil, agribusiness is a significant activity with great importance in GDP, employment, income and inflows of foreign currencies through exports. More specifically, beef sector has great relevance in the country's exports, as well as in the domestic market.

In 2014, according to Brazilian Association of Beef Exporters - ABIEC (2015), beef production reached 10.1 million tons of carcass weight equivalent (CWE), out of which 2.1 million was exported, followed by technological improvements in cattle ranching, which have allowed production to increase using a smaller area, displaced by other activities.

Historically, the evolution of national cattle ranching has followed territorial occupation, expanding production and promoting economic development in several Brazilian regions. It is estimated that from 2010 to 2013, the areas allocated to pastures occupied 19% to 23% of the entire national territory, which represents between 164 to 198 million hectares, depending on the source considered.

Agroicone estimates point to a reduction in pasture areas by 4.1 million hectares between 1996 and 2013 in Brazil, however pasture areas in some regions of the country have increased, especially in the agricultural frontier regions (such as in the North region) and, hitherto covered by native vegetation.

Considering the importance of agribusiness in Brazil and recent efforts to reduce national deforestation, it is estimated the impacts of

Forest Code (Law n° 12.651 of May, 2012) implementation and deforestation reduction, considering long term expansion of the main agricultural activities in Brazil.

The Forest Code and the reduction of deforestation are unique opportunities for Brazil to combine production and environmental conservation, resulting in several economic, social and environmental benefits. The beef supply chain is at the forefront of these issues, especially considering the ongoing actions and the large scale production intensification opportunity, which is practically inexistent in other sectors. Mato Grosso state, as an example explored in this summary, launched the PCI – Produce, Conserve and Include program at COP 21 in December 2015, being in the forefront of a long-term goal to sustainable agriculture development.

This document aims to present a summary of three studies, resulting in the following key messages:

- a) **cattle ranching intensification is key to promote agriculture expansion, deforestation reduction and Forest Code implementation in the long term;**
- b) **cattle intensification is economically viable, but minimum scale is needed;**
- c) **expanding cattle activity over natural vegetation is economically feasible due to land price appreciation;**
- d) **low productivity pasturelands can be displaced by crops and vegetation restoration in order to optimize returns and for environmental compliance (Mato Grosso case studies);**
- e) **investments should be oriented to intensify cattle ranching activity located in production clusters aiming at sustainable origination.**



1

Long term vision for cattle ranching in Brazil: impacts of Forest Code implementation and deforestation reduction



Long term vision for cattle ranching in Brazil: impacts of Forest Code implementation and deforestation reduction

Long term and large scale implementation of the Forest Code increases the pressure on land use in Brazil, especially on beef cattle production. Three scenarios for 2035 were estimated using the Brazilian Land Use Model - BLUM¹: scenario without production area restrictions – Baseline Scenario; scenario with elimination of deforestation from 2020 – Scenario DZ; and scenario with implementation of the Forest Code combined with the elimination of deforestation from 2020 – Scenario CF (TABLE 1). In this last scenario, the possibility of a Legal Reserve compensation market was considered (through environmental serfdom in areas with remaining native vegetation), as proposed in the Forest Code.

In the baseline scenario (TABLE 1), an increase of 6.8 million hectares in the area allocated for agriculture was estimated in 2035 relative to 2010, considering continuous

decreases in deforestation rates. Cattle ranching should reduce pasture areas by 18.4 million hectares in the same period, being substituted by summer crops and planted forests and, thus, significantly reducing the need to incorporate new areas for production expansion. An important technological advance in cattle ranching might occur, reducing low productivity areas and increasing production per hectare by 58% in the same period. In the aggregate baseline scenario, it is estimated that cattle ranching will require annual investments of US\$ 5.7 billion in the next 25 years (from 2010 to 2035 in 2014 values; R\$/US\$ 3.10) in order to increase productivity.

In alternative scenarios, DZ and CF, the reduction of pasture areas might be even higher, 2.1 million and 11 million hectares more, respectively, compared to the baseline scenario in 2035. The economic dynamics explains this result: the low profitability of cattle ranching compared to crops' returns, which crops expansion displaced pasturelands and Forest Code compliance also pushed pasture and cattle ranching intensification, since land use expansion was restricted.

Beef production is estimated to reach 12 million tons in 2025 and 13.5 million tons in 2035, representing a 44% growth in 25 years. Similar results were found in alternative scenarios, with a small negative impact on beef production of up to 3% (in the case of the most restrictive scenario in terms of land use – CF), but with higher beef prices.

The annual investment in alternative scenarios for the period between 2010 and 2035 should increase in up to US\$ 387 million per year

TABLE 1. LAND USE RESULTS IN BRAZIL FOR SCENARIOS SIMULATED IN THE BRAZILIAN LAND USE MODEL - BLUM

Area in thousand ha/ Productivity in kg/ha Production (thousand tons)	Baseline			Difference			
	2010	2025	2035	DZ - Baseline		CF - Baseline	
				2025	2035	2025	2035
Summer crop areas ^a	46,444	61,104	66,896	-204	-291	-1,557	-2,114
Pasture areas	182,661	168,552	164,244	-271	-2,147	-5,521	-11,034
Land use (total area) ^b	235,855	240,281	242,716	-475	-2,438	-7,078	-13,148
Beef production (thousand tons)	9,365	12,111	13,506	-226	-3	-134	-286
Production of meat per hectare (kg/ha)	51.27	70.41	81.23	-1.23	1.07	1.61	4.06
Production of grains ^c (thousand tons)	148,892	261,130	322,363	-178	-364	-1,503	-2,778

Source: Agroicone/results of the study. **Notes:** a) Summer crops (or 1st harvest crops) considered: rice, beans (summer area), corn (summer area), soybeans, cotton and sugarcane; b) Land use is the sum of areas of 1st harvest crops, commercial forests and pastures; c) Winter crops (or 2nd harvest) considered: beans (winter area), corn (second harvest), wheat and barley.

1. The methodological description of BLUM can be found in ICONTE (2014). The scenario simulations with BLUM were carried out in June of 2015 and revised in April of 2016. <https://goo.gl/F2ujjq>

in cattle ranching productivity improvements compared to the baseline scenario (disregarding the losses of areas to other production activities).

Emissions and mitigations related to agriculture, forests and land use

TABLE 2 shows GHG emissions in the proposed scenarios according to the simulations projected by BLUM.

In the baseline scenario, emissions from agricultural sector increased around 18% between 2010 and 2035. This growth is largely due to the increase in cattle herd throughout the period, considering available methodology that does not consider carbon balance of pasturelands (Biomass and SOC – Soil Organic Carbon variations).

The variations between the scenarios in the emissions from the land use and forest sectors are significant. In scenario DZ, the emissions avoided due to deforestation control can reach 42 million tCO₂e/year, while in scenario CF, the restoration of native vegetation results in the absorption of approximately 80 million tCO₂e/year.

Final remarks

The results shown lead to the following conclusions and key messages:

- Cattle ranching intensification is necessary in order to increase the competitiveness of the activity, as well as to reach the long term environmental targets.
- The elimination of deforestation will only be possible if combined with cattle ranching intensification, incentive policies and private policies.
- Monitoring/traceability of cattle are also important for socioenvironmental risk management in agricultural value chains.
- It is necessary to develop a positive agenda for cattle ranching, which should be inclusive and transformative.

The successful implementation of the Forest Code and the reduction of deforestation by the Brazilian agricultural sector will depend on specific public and private incentive policies. Command and control policies shall be gradually substituted by promoting the adoption of practices that combine agricultural production and environmental conservation. Thus, Brazil can take advantage of the opportunity to take forward important global challenges, expanding markets and consolidating sustainable economic development.

TABLE 2. GHG EMISSIONS FOR SIMULATED SCENARIOS WITH THE BRAZILIAN LAND USE MODEL – BLUM

GHG Emissions (million tCO ₂ e) ¹	Baseline			DZ		CF	
	2010	2025	2035	2025	2035	2025	2035
Agriculture	406	447	480	449	479	448	482
Land use and forests	274	97	43	79	35	31	14
AFOLU (Total)	680	544	523	528	514	479	496

Source: Agroicone/ Results of the study. Based on: MCTI (2010); Gouvello (2010); IPCC (2006); Harris et al (2009). **Note:** 1) The BLUM model captures approximately 90% of emissions from the “agriculture” and “land use and forest” sectors reported in the national emissions inventory. This difference occurs mainly because the model analyzes only large agricultural crops and beef, swine and poultry in the livestock sector.

THE COMPLETE STUDY IS
AVAILABLE AT:
<https://goo.gl/uU8l0L>



2

What's the economic feasibility of cattle ranching expansion and/or intensification in the Amazon and Cerrado



What's the economic feasibility of cattle ranching expansion and/or intensification in the Amazon and Cerrado

As it was shown before, intensification of cattle ranching activity represents a huge opportunity to preserve native vegetation in Brazil, due to its capacity to release land for other agriculture activities, increase production per hectare, ensuring food security and conservation of natural resources through the decrease of deforestation and the GHG emissions.

ECONOMIC ANALYSIS OF INVESTMENT FOR THE CATTLE RANCHING EXPANSION

Considering the role of cattle ranching intensification on agriculture expansion and environmental compliance, it is important to present an economic analysis of it from the farmer's point of view, comparing various combinations of technologies and comparing possibilities for expansion of the agricultural frontier. These analysis also show in which conditions (size of the property, technology migration, biome) intensification is economically feasible; if the intensification of pastures in already cleared areas is more advantageous than clearing new areas of native vegetation; what is the implication of land appreciation in the profitability of the activity; and if it is possible to envisage the development of cattle ranching with environmental conservation.

These analyses were conducted for a period of 20 years of investment in a interest rate of 8.5% p.a. and 5.85% p.a. for the inflation rate, taking into account four different variables, such as shown in

FIGURE 1:

- **3 biomes:** Atlantic Forest (available in the complete study), Amazon and Cerrado;

- **2 sizes of hypothetical farms:** 300 hectares (small) and 3 thousand hectares (large);
- **4 different scenarios** of intensification and expansion of the productive area;
- **4 different productivity levels** (live weight per hectare per year): extractivist (productivity of 0-3@/ha/year), low (3-6@/ha/year), medium (6-12@/ha/year) and growing (12-18@/ha/year)².

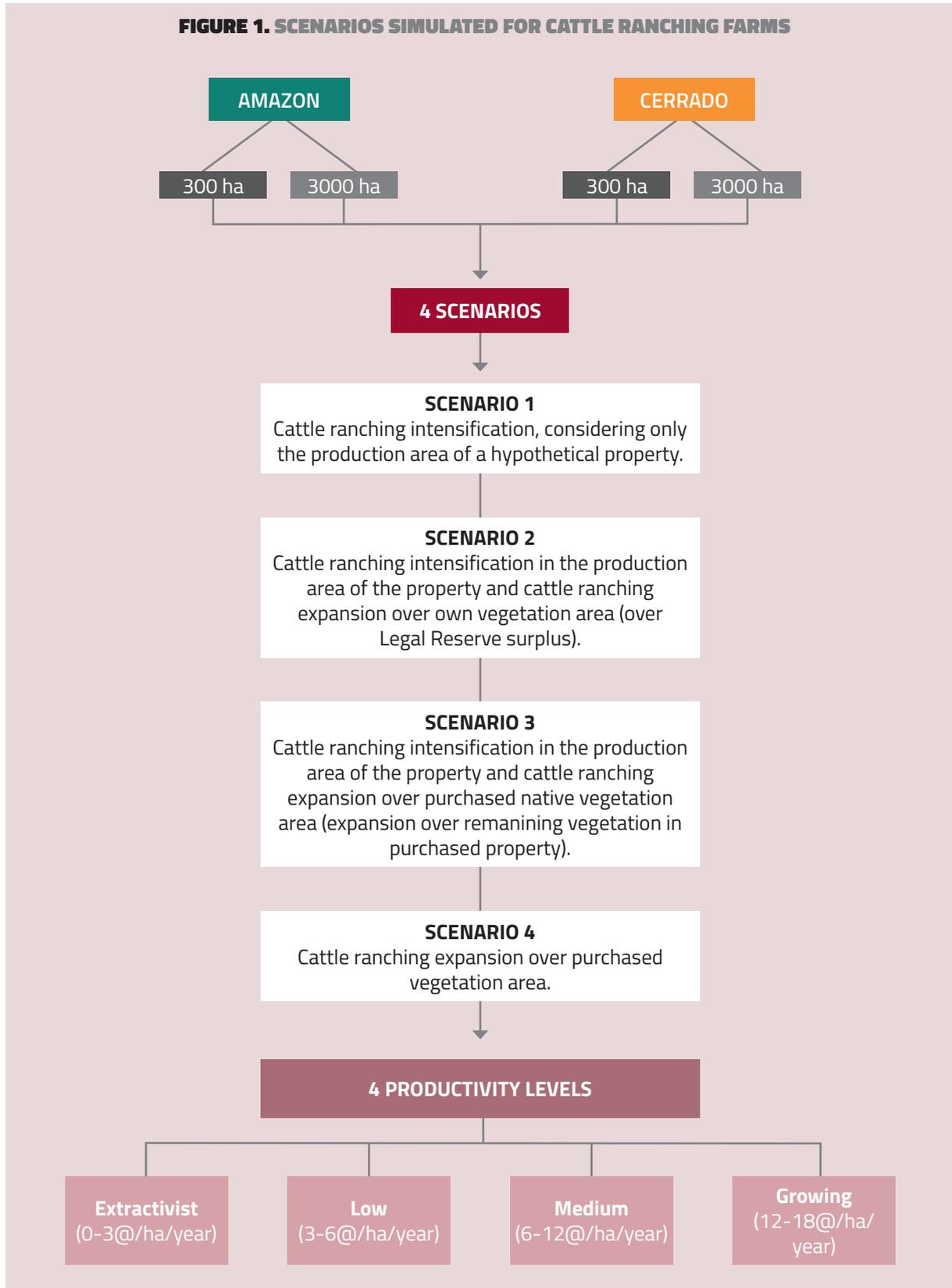
The return on investment calculation for cattle ranching was based on the value of investments made for production intensification (technology migration to higher levels of productivity), depreciation and profit (revenue minus cost). On the other hand, the appreciation of the land was included in the calculation of investment return considering the price of pastureland over the area of the property. For both cattle ranching and land appreciation, the results were adjusted to present value considering the inflation and interest rates in a period of 20 years and classified according to the Net Present Value (NPV), Internal Rate of Return (IRR) and payback (or period for the recovery of invested capital).

Results

The results were presented by biome and size of production property and detailed in the complete report and summarized in below. It is possible to conclude that due to economies of scale in cattle ranching, larger properties are able to achieve better economic returns through intensification compared to smaller properties.

². It is worth highlighting that the technology considered as "growing" in this study does not limit productivity to as much as 18@/ha/year, since it is below the potential productivity that the farm can achieve. The considered technology was based on the production on pasture with supplementary feeding.

FIGURE 1. SCENARIOS SIMULATED FOR CATTLE RANCHING FARMS



CATTLE RANCHING

	CERRADO		AMAZON	
SCENARIO 1 (intensification with use of 100% of productive area)	3,000 ha	All technology levels are economically feasible. The most profitable (highest relative NPV) and resulting in highest IRR to the cattle activity (22%) being the medium to growing technology.	3,000 ha	All technology levels are economically feasible. The highest return per ha was the migration from low to growing technology. However, the highest IRR in cattle activity (17.6%) occurs in the migration from medium to growing technology.
	300 ha	Cattle activity feasible for the migration from low and medium to growing technology. The most profitable and with highest IRR being the migration from medium to growing technology with IRR about 13.4% for the total project.	300 ha	All technology levels are economically feasible only due to the land price valuation. The highest IRR being the migration from medium to growing technology, 14.7% for the total project (9.8% for the cattle activity).
SCENARIO 2 (intensification of initial area + expansion in own area, representing 50% of final productive area)	3,000 ha	Feasibility in the migration from low and medium to growing technology, the most profitable being the migration from medium to growing with extractivist production in expansion area with IRR about 9.2% to the cattle activity.	3,000 ha	The most profitable level being the migration from low to growing and extractivist technology in the expansion area with IRR about 13.4% for the total project only due to the land price valuation.
	300 ha	Economically unfeasible	300 ha	Economically unfeasible
SCENARIO 3 (intensification of initial area + expansion in acquired area representing 50% of final productive area)	3,000 ha	It is economically feasible in a few combination of technologies, but only due to land price valuation. Medium to growing technology migration and expanding using low technology has IRR about 7.6%.	3,000 ha	It is economically feasible in a few combination of technologies, but only due to land price valuation. Low to growing technology migration and expanding using growing technology has IRR about 7%.
	300 ha	Economically unfeasible (highest IRR about 2.7%)	300 ha	Economically unfeasible (highest IRR about 5.0%)
SCENARIO 4 (expansion in acquired area representing 100% of productive area)	3,000 ha	Economically unfeasible (highest IRR about 4.5%)	3,000 ha	Economically unfeasible (highest IRR about 5.2%)
	300 ha	Economically unfeasible (highest IRR about 3.2%)	300 ha	Economically unfeasible (highest IRR about 4.6%)

Also, economic feasibility was higher in cattle ranching intensification projects in already cleared areas. The projects that include expansion over purchased native vegetation show that the return on investment is determined, exclusively, by land price appreciation due to the low prices of land with vegetation compared to those with pasturelands.

Nevertheless, in the agricultural frontier regions, deforestation is still attractive from land valuation perspective. In this context, command and control policies are necessary in order to contain deforestation, in addition to private policies, such as restrictions on purchase of cattle from illegal deforestation areas; as well as policies to promote the adoption of Good Agricultural Practices (GAP), differentiated prices

for quality of the carcass and greater inclusion of cattle ranchers in the formal beef market. In the same way, it's important to make investments in recovery and management of pastures within properties to increase productivity and avoid expanding in new areas. The necessity of rural extension and technical assistance are essential in order to implement sustainable intensification projects in the properties. This is one of the gaps faced by producers, who often need to better understand the investments (and returns) and the necessary techniques, which can make them less reticent to the process.

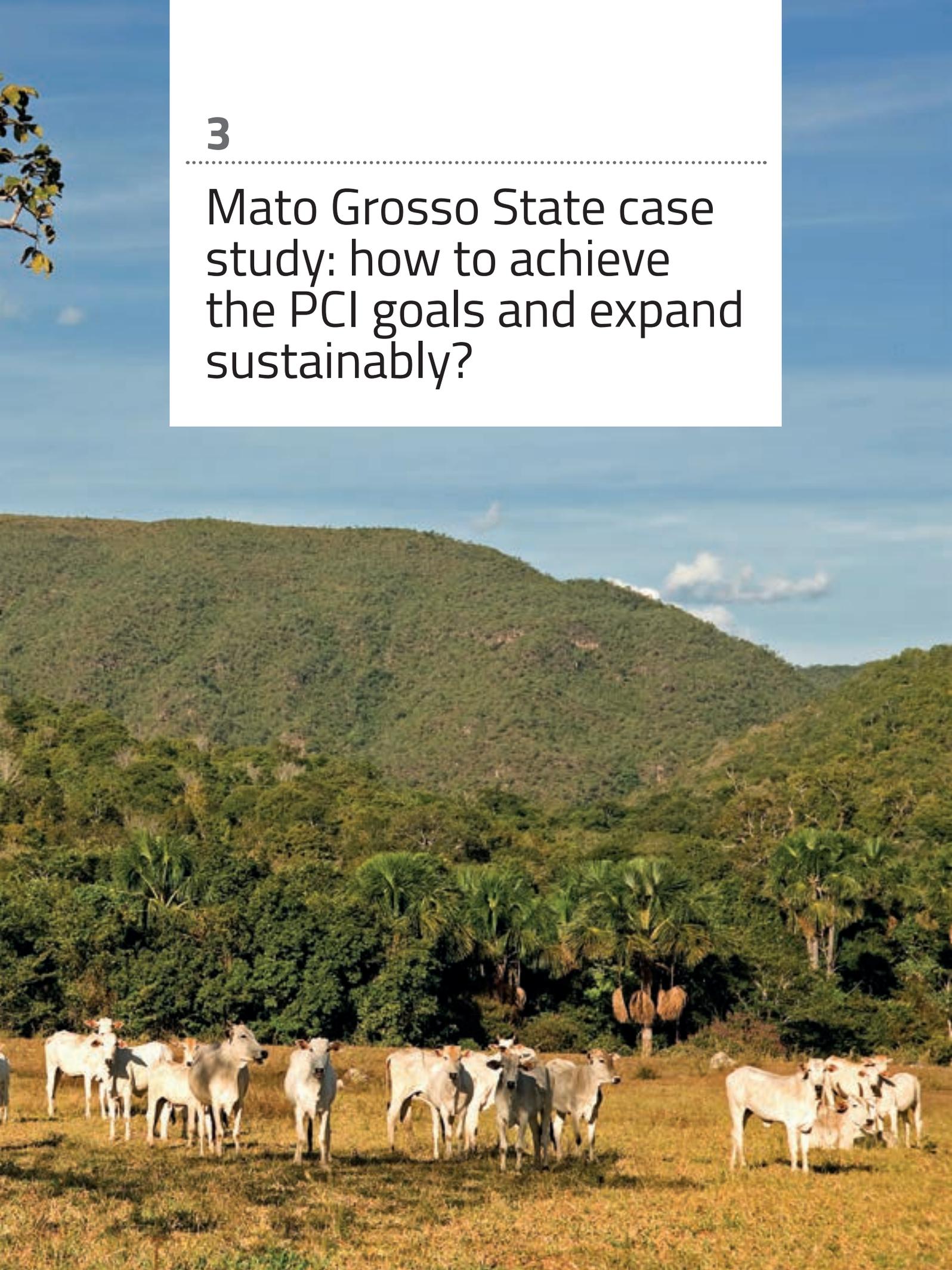
THE COMPLETE STUDY IS AVAILABLE AT:
<https://goo.gl/TaoEyG>





3

Mato Grosso State case study: how to achieve the PCI goals and expand sustainably?



Mato Grosso State case study: how to achieve the PCI goals and expand sustainably?

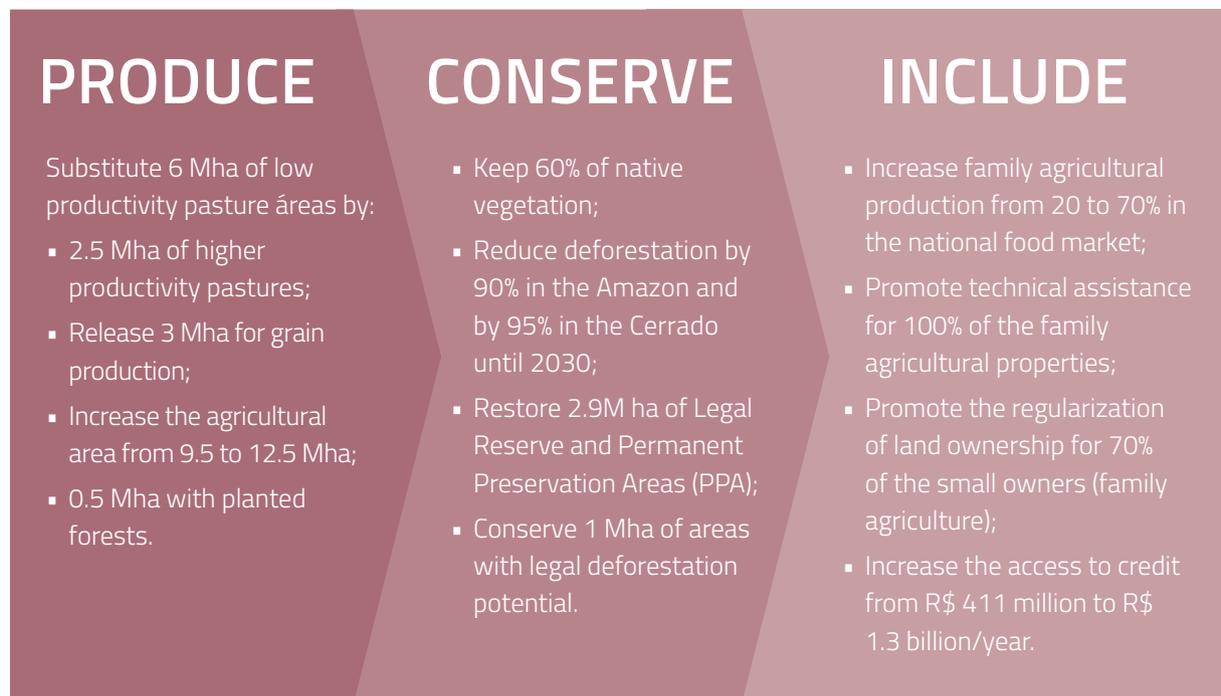
Due to Mato Grosso's huge representation in the Brazilian agricultural scenario, the state government, in partnership with several NGO's and private organizations, released at COP21, on September of 2015, several State goals in order to complement and customize the national goals (Brazilian NDCs) of the Paris Agreement, called PCI Strategy: Produce, Conserve and Include. These goals aim to combine targets for cattle intensification and crop expansion, with environmental conservation (compliance to the Forest Code) and reduction of deforestation. Thus, agribusiness in Mato Grosso has the opportunity to be a step ahead of the goals set in Paris.

According to the Terra Class database, the state of Mato Grosso (MT), only considering the Amazon and the Cerrado biomes, has 53% of its territory covered by native vegetation (or 48 million ha), 12.5% of pasturelands (19.2 million ha) and 9.4% (8.7 million ha) of croplands.

The PCI strategy requires an integrated, long-term scenario analysis for MT, taking into account possible land use combinations in the State (analysis of projects in scale considering the goals of the PCI program). Most of the land use allocation will affect pasturelands and cattle ranching, requiring production intensification (increasing production per ha). Furthermore, environmental compliance in scale can generate economic opportunities for low productivity pasturelands.

Assuming properties with 3,000 hectares in cattle production (due to the economies of

GENERAL GOALS FOR PRODUCTION, CONSERVATION AND INCLUSION OF MATO GROSSO BY 2030



Source: Mato Grosso State Government. Elaboration: Agroicone.

scale), part of the stock of pasture areas will be converted into the following activities: cattle ranching with higher productivity, forest restoration for environmental compliance of the farm, forest restoration for compensation of Legal Reserve areas (for other producers to compensate) and leasing areas for crops (mainly soybean) production.

The following assumptions were considered in this analysis:

1. The productivity levels (production in live weight per hectares per year) adopted were (considering that 1@= 15 kg of live weight): Extractivist (productivity of 0-3@/ha/year); Low (3-6@/ha/year), Medium (6-12@/ha/year) and Growing (12-18@/ha/year).
2. Concerning the financial variables for this analysis, a real interest rate of 2.5% p.a. was adopted and the restoration costs were based on the Direct sowing technique ("semeadura direta", also known as "muvuca de sementes", in Portuguese) for the Cerrado and Active natural regeneration (minimum intervention) for the Amazon.
3. For land allocation, the State's surplus of native vegetation was initially allocated to agricultural producers for regularization of the total Legal Reserve deficit, totaling 1.96 million hectares. The remaining native vegetation area was allocated to cattle ranchers for compensation of part of their own deficit, which should be completed with on-site restoration.
4. For the remaining Legal Reserve deficit from cattle ranching, it was assumed that the low technology pasture areas (such as natural regeneration on pastures, "dirty" pastures) will be offered for Legal Reserve compensation to higher productivity cattle ranchers, who will seek environmental compliance through compensation outside

of the property instead of within their own properties (if economically viable). In this case, the cost of forest restoration is included in the cost of compensation.

In order to implement sustainable scale intensification projects in Mato Grosso, considering the Amazon and Cerrado biomes, an investment of US\$ 9.7 billion is estimated, out of which US\$ 7.3 bi³ for cattle ranching intensification, US\$ 1.3 bi for forest restoration and US\$ 1.1 bi for leasing areas (preparation of pasture areas for soybean production). The total NPV (Net Present Value) of the investment project totals US\$ 14.2 bi, or US\$ 707 million per year in 20 years. Regarding land allocation, it is estimated that the state will have about 10.9 million hectares of pasture areas and an increase in beef production by 42%.

For the Amazon biome in Mato Grosso, the financial analysis shows a positive NPV of the total project. Considering land allocation for cropland, restoration, compensation and cattle ranching intensification, investments may result in US\$ 6.2 bi of net returns, with 12.5% of IRR when migrating from extractivist to low technology, and 15% when passing from low to medium and medium to growing technology, with a payback period of 7 to 8 years.

The investments needed in MT Amazon for cattle ranching intensification, forest restoration and conversion of pasture into agriculture area sum up to US\$ 5.6 bi. Discounting the net profitability with compensation, the amount invested will be US\$ 5 billion.

Regarding the Cerrado biome in the state of Mato Grosso, the financial return was higher than in the Amazon scenario, since the first one has a lower Legal Reserve deficit to restore or compensate, which results in lower costs and investments.

3. Exchange rate: R\$ 3.10/US\$ in Oct 26th, 2016.

CATTLE RANCHING

Moreover, the area leased for soybean production in the Cerrado is larger, increasing the financial returns of the sustainable projects considered.

The NPV for the total project was about US\$ 8 bi, with IRR varying between 21% to 23% and payback from 5 to 6 years, depending on the technology level in cattle ranching, and the investment needed in MT Cerrado totals US\$ 4.1 bi.

Based on the results for MT Amazon and MT Cerrado, it is observed that the higher the productivity of cattle production, the greater the profitability of the project with this activity. The leasing for grain production is a way to ensure a higher income, especially for low-productivity farmers. Producers with extractivist and low technology levels tend to offer larger areas for the Legal Reserve compensation

market and for grain expansion, thereby achieving higher income compared to keeping the cattle ranching activity on their properties. For producers of medium and growing technology levels, cattle ranching would be the main source of income, since they would release smaller areas for grains and offset their Legal Reserve deficits in pasture areas with lower technology levels.

The analysis indicates a positive potential to implement a scale program in Mato Grosso state, combining production intensification, expansion of grains and beef production and environmental compliance. Additionally, it was possible to identify that allocating land use in an efficient way may result in positive returns associated to the compliance with the Forest Code and to the productive activities.

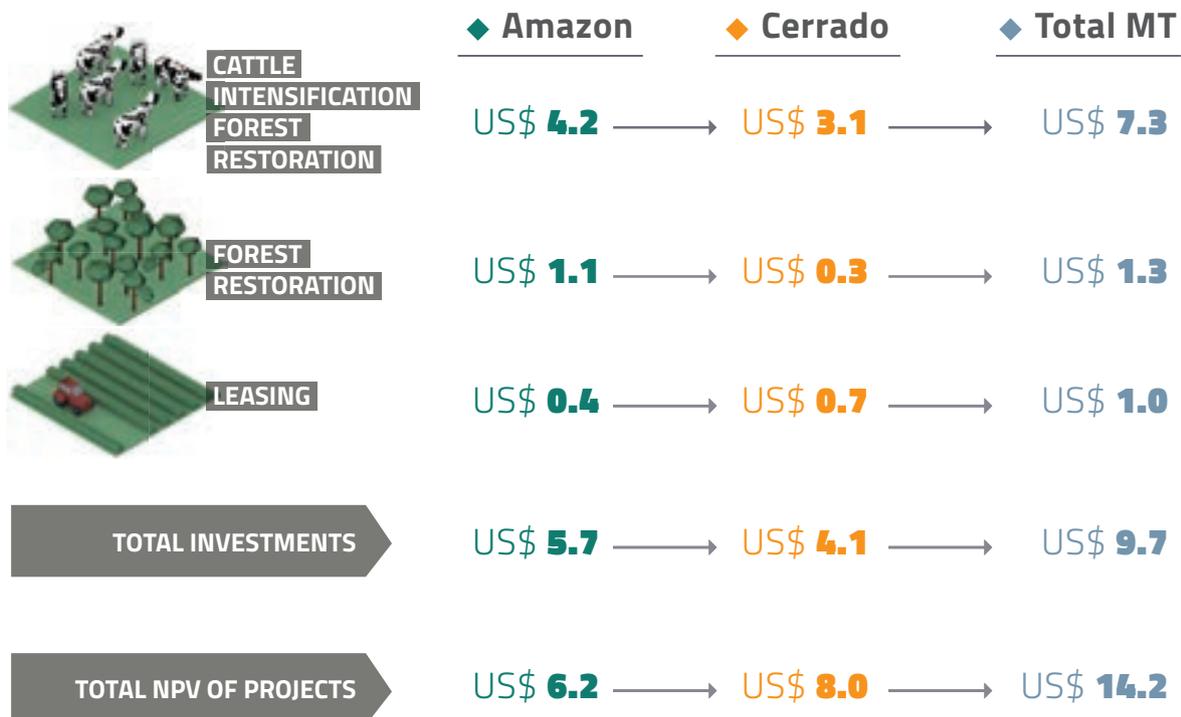
TABLE 3. LAND USE ALLOCATION RESULTS FOR SUSTAINABLE SCALE INTENSIFICATION OF CATTLE RANCHING

		AMAZON	CERRADO	MT
Current scenario (2014) before the intensification process	Pasture area (thousand hectares)	9,572	7,339	16,911
	Beef production (tons)	901,444	663,065	1,564,509
Projected scenario (2025) after intensification process	Pasture area (thousand hectares)	5,867	5,034	10,901
	Beef production (tons)	1,244,521	985,643	2,230,164

SUSTAINABLE CATTLE RANCHING IN MT: OPTIMAL LAND USE ALLOCATION IN CERRADO AND AMAZON (in ha)

	Current Legal Reserve Deficit, 2014 (thousand ha)	Total area freed for environmental compliance, 2025 (thousand ha)	Area freed for soybean leasing, 2025 (thousand ha)	Area freed for greater productivity in cattle ranching 2025 (thousand ha)
◆ Amazon	3,006	2,668	1,037	1,800
◆ Cerrado	834	342	1,963	1,800
◆ Total MT	3,840	3,010	3,000	3,600

INVESTMENT AND RETURN IN 20 YEARS (in billion US\$)



RESULTS OF INVESTMENT PROJECTS FOR SUSTAINABLE INTENSIFICATION OF CATTLE RANCHING IN MATO GROSSO (20-year time horizon)

Productivity achieved in cattle ranching (@/ha)	AMAZON			CERRADO		
	Profitability (production area) US\$/ha/year	IRR (at constant prices)	Payback	Profitability (production area) US\$/ha/year	IRR	Payback
6.8	21	12.5%	7 years and 2 months	44	21.2%	5 years and 7 months
13.3	39	15%	8 years and 3 months	49	21.1%	5 years and 7 months
18.0	59	15%	8 years and 3 months	74	22.7%	6 years and 0 month

A. SUSTAINABLE ORIGINATION CLUSTER FOR BEEF PRODUCTION: OPTIMIZING THE IMPLEMENTATION OF THE FOREST CODE, PRODUCTION EXPANSION AND DEFORESTATION REDUCTION

The construction of a general overview of the state of Mato Grosso in the context of the possibilities and needs for cattle ranching intensification, aligned to land use dynamics and the goals set forth by the State for sustainable production was possible due to the development of the previously shown analysis. However, it is necessary to identify priority regions for the scale solutions found. The sustainable origination cluster was developed as a possible solution for the implementation of cattle ranching intensification in Mato Grosso, guaranteeing the origin of the animals, that is, certifying that these animals are not from deforestation areas, aligned to the long-term view of deforestation reduction in the State.

Therefore, sustainable origination clusters are defined as the areas under the economic influence of slaughterhouses, where cattle ranching intensification and environmental compliance should occur, with guarantee of sustainable production and verification of the origin of the meat. The main goal of this analysis is to allocate land use efficiently considering the need for environmental compliance with the Forest Code, the need to expand beef and soybean production and, consequently, the need for beef cattle intensification (PCI goals).

After the analysis of several criteria for the selection of a cluster, such as the concentration of slaughterhouses, deforestation risk, concentration of cattle herds and pasture areas, potential for agricultural expansion, among others, the north region of the State was chosen.

The selected cluster includes eight slaughterhouses that totalized 1.51 million slaughtered animals in 2014, covering a total

area of 19.9 million hectares. This area is occupied 56% by native vegetation, 27% with pastures and 5% with agriculture. For compliance with the Forest Code, cattle ranching within the cluster has a Permanent Preservation Area deficit of 106.6 thousand hectares and a Legal Reserve deficit of 1.18 million hectares (based on Soares-Filho et al., 2014).

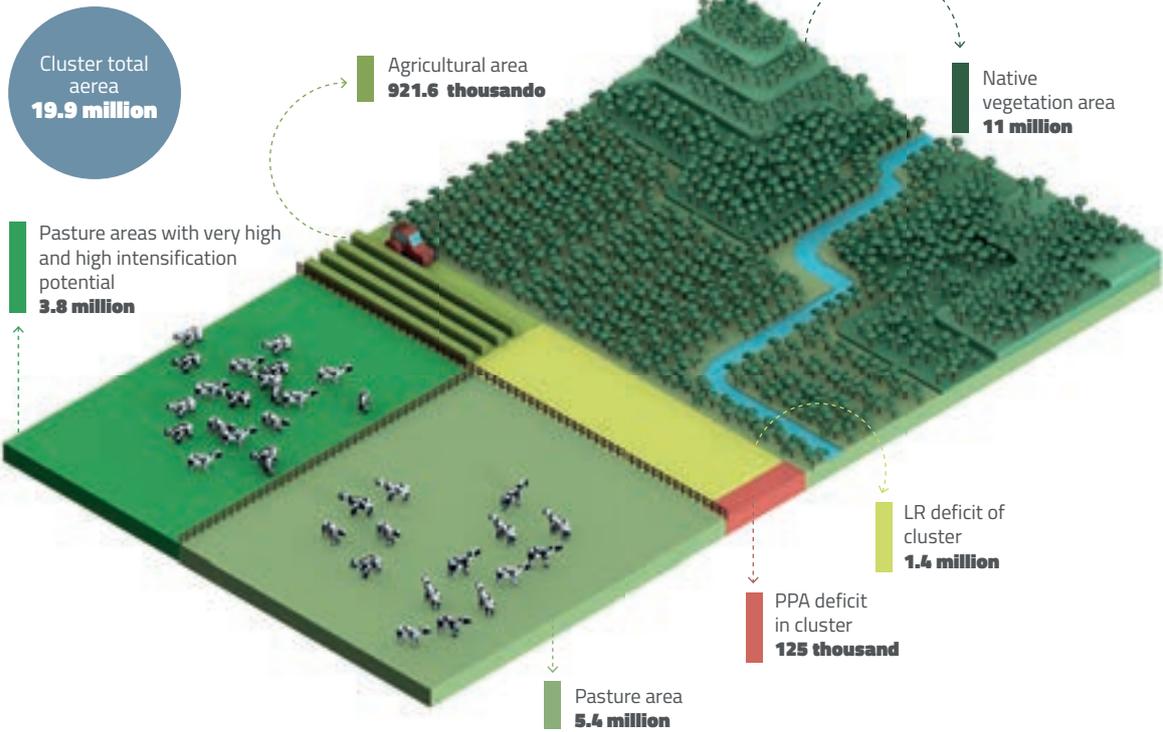
The adopted premises were similar to those used in the integrated scale analysis for Mato Grosso, as described in the previous section, and also considered a period of 20 years.

With the intensification process, cattle ranching inside the cluster would free 1.42 million hectares, out of which 900.5 thousand for forest restoration and 515 thousand ha for expansion of soybean production (considering that the cattle rancher would lease the land for the production of soybeans).

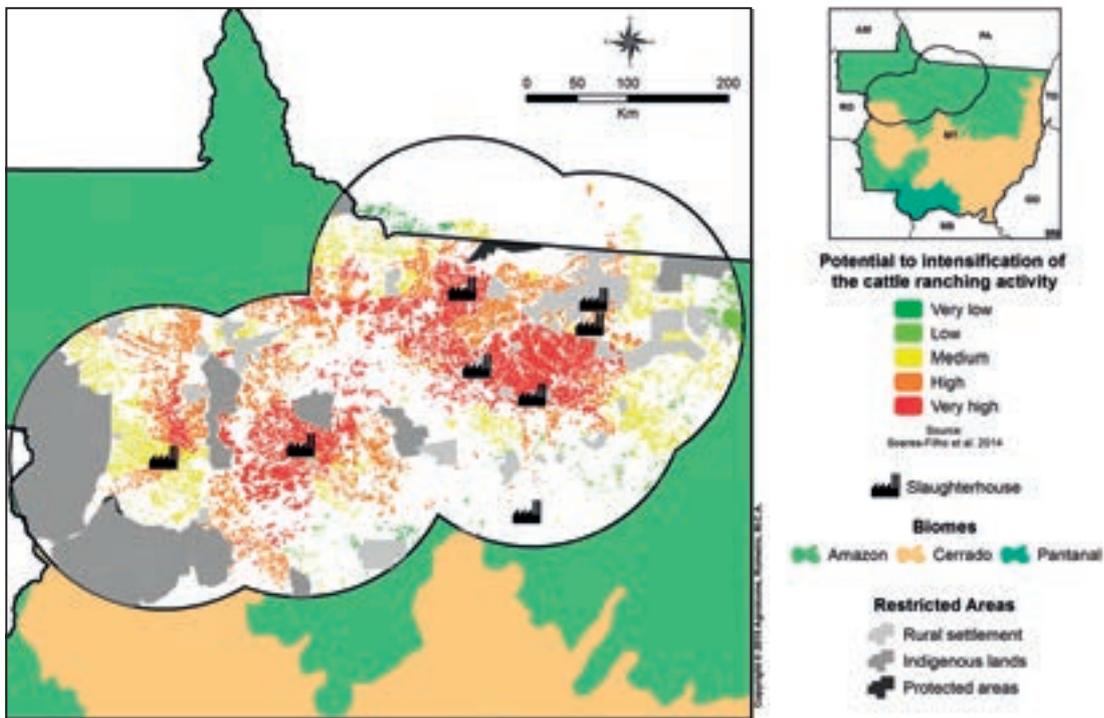
The cattle ranching activity, in turn, would intensify 757.4 thousand hectares, out of which 84.2 thousand hectares with low technology would migrate to medium technology (6 to 12 @/ha), while 673.3 thousand hectares would migrate from medium (6 to 12 @/ha) to growing technology (above 12 @/ha). The range with extractivist technology would abandon most of the cattle ranching area for forest restoration and compensation, which explains the lack of intensified cattle ranching. Medium productivity would increase from 5.8@/ha to 11.2@/ha, while meat production would increase from 451.7 thousand to 635.7 thousand tons. Additionally, cattle ranching intensification would allow an expansion in the soybean production area by 515 thousand hectares.

For the sustainable intensification of cattle ranching in the cluster of north of Mato Grosso, the necessary investment is estimated at US\$2.9 billion. This value includes US\$2.4 billion for

SUSTAINABLE ORIGATION CLUSTER (in ha)



MAP 1. CATTLE RANCHING INTENSIFICATION POTENTIAL IN THE NORTH MATO GROSSO CLUSTER



Source: Agrosatélite, Soares-Filho et al. (2014). Elaboration: Agroicone.

CATTLE RANCHING



1

MT CLUSTER TOTAL PASTURE AREA IN 2014: 5.2 M/ha

4.96 M/ha with high or medium intensification potential

2

SUSTAINABLE INTENSIFICATION

INVESTMENTS OF US\$ 2.44 BILLION IN SUSTAINABLE INTENSIFICATION

84.2 thousand hectares of low technology would migrate to medium productivity (6 to 12 @/ha)

673.3 thousand hectares would migrate from medium (6 to 12@/ha) to growing technology (above 12 @/ha)

Medium productivity migrating from 5.8@/ha to 11.2@/ha

Increasing of beef production from 451.7 k to 635.7 k tons

3

PASTURE RELEASE 1.42 M/ha AND INTENSIFY 0.76 k/ha

900.5 k/ha to forest restoration > investment of US\$ 290.58 M

515 k/ha to soybean expansion (leasing) > investment of US\$ 176.22 M

cattle ranching intensification, US\$290.6 million for forest restoration and compliance with the Forest Code and US\$176.2 million with areas leased for soybeans. The compensation market would move more than US\$1.1 billion among the cattle ranchers themselves, given the supply and demand for Legal Reserve compensation.

General conclusion

Above all, the analyses showed the need for and viability of intensification as a way of increasing productivity and competitiveness of cattle ranching compared to other activities. This is a result of the low technology and extensive production systems used in Mato Grosso and in most of Brazil, which results in low economic results.

Furthermore, cattle ranching intensification is necessary for compliance with the Forest Code, reduction of deforestation and as a way of achieving the long-term objectives set forth by the Brazilian and Mato Grosso governments during COP21.

In this context, the compensation market presents itself as an instrument capable of generating income for producers that have surplus vegetation areas and for low technology cattle ranchers to earn more than they do with current activities. Leasing areas for soybean production is also an opportunity to increase the income of these producers.

In general, producers need to know the financial returns of their farms in order to make consistent investments in their properties in the context of cattle intensification. In that way, in case the initial productivity is low, it would be viable to lease the land and/or offer the areas for environmental compensation instead of continuing with the activity. For those who remain

in cattle ranching, investments for the recovery of pastures are necessary in order to achieve higher productivity, as well as the implementation of Good Agricultural Practices (GAP) and financial management of the property.

Additionally, mechanisms for compliance with the Forest Code, as well as for limiting expansion of agricultural areas over native vegetation, are necessary for the successful implementation of sustainable projects.

The combination of three factors is recommended. The first is to work on sustainable cattle ranching intensification programs in priority regions like, for example, production areas close to slaughterhouses (sustainable origination clusters) with concentration of pastures and herds and high risk of deforestation. The second would be to spend efforts to create appropriate conditions for the scale implementation of investment projects. The third would be to continuously monitor this analysis, evaluating the impact of changes to goals, premises and market conditions.

THE COMPLETE STUDY IS AVAILABLE AT:
<https://goo.gl/KMOhHn>

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