

EXECUTIVE SUMMARY

SUSTAINABLE INTENSIFICATION OF CATTLE RANCHING IN MATO GROSSO

Leila Harfuch

Gustavo Palauro, Luciane C. Bachion, Karine Costa,
Mariane Romeiro, Iara Yamada Basso and Willian Kimura



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São Paulo, April 2017.

ABOUT THE INPUT PROJECT

As the world responds to food security and climate change, Brazil holds a unique position of strength. Thanks to technological advances in agricultural practices and the recent success in curbing deforestation, land use is shifting towards more sustainable practices. Increasing its agricultural production needs while promoting environmental regularization and the conservation of its natural resources is a challenging agenda that brings huge opportunities to the country and to the productive sectors.

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 sectoral solutions that enable large-scale implementation.

www.inputbrasil.org

ABOUT AGROICONE

Agroicone was founded in 2013 by a group of specialists from ICONE - 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

We thank IDH (The Sustainable Trade Initiative), through the Initiative for Sustainable Landscapes (ISLA), for supporting the initial phase of this work.

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IN MATO GROSSO**

Agroicone, INPUT/2017

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According to Agroicone estimations (apud GTPS, 2015), 66% of the Brazilian territory is covered by native vegetation, located, mainly, in private properties, in addition to the area occupied by agriculture (70 million ha) and cattle ranching (from 170 to 178 million ha).

In light of the Forest Code, which is one of the main milestones for environmental protection in the country, Soares-Filho et al., 2014 estimate that the native vegetation deficit in Brazil is of 25 million hectares of Permanent Preservation Areas (PPAs) and Legal Reserve. In the Amazon biome, due to the strict conservation requirements established (50% to 80% of the property for Legal Reserve), the authors estimated a forest deficit of 9.1 million hectares.

Cattle ranching followed territorial occupation in the Brazilian inlands, expanding production and promoting the economic development of several regions. With a herd of 212 million heads (IBGE, 2015), the activity is of great importance for agribusiness (including family farming), and exports of 20% of the national production, placing Brazil as one of the largest meat exporters in the world, having reached 1.4 million tons in 2015 (ABIEC, 2015).

The state of Mato Grosso, in turn, strongly represents Brazil in the production of beef cattle and grains, which are strong pillars of the State's economy, considering that it concentrates the largest cattle herd and is the main soybean producer in Brazil. It is worth highlighting that the state has 53% of its total area covered by remaining native vegetation (or 48 million hectares in the Amazon and in the Cerrado, according to data from Terra Class, 2012), 12.5% by pastures, 9.4% in crop areas and 2.5 million hectares in secondary vegetation in the Amazon.

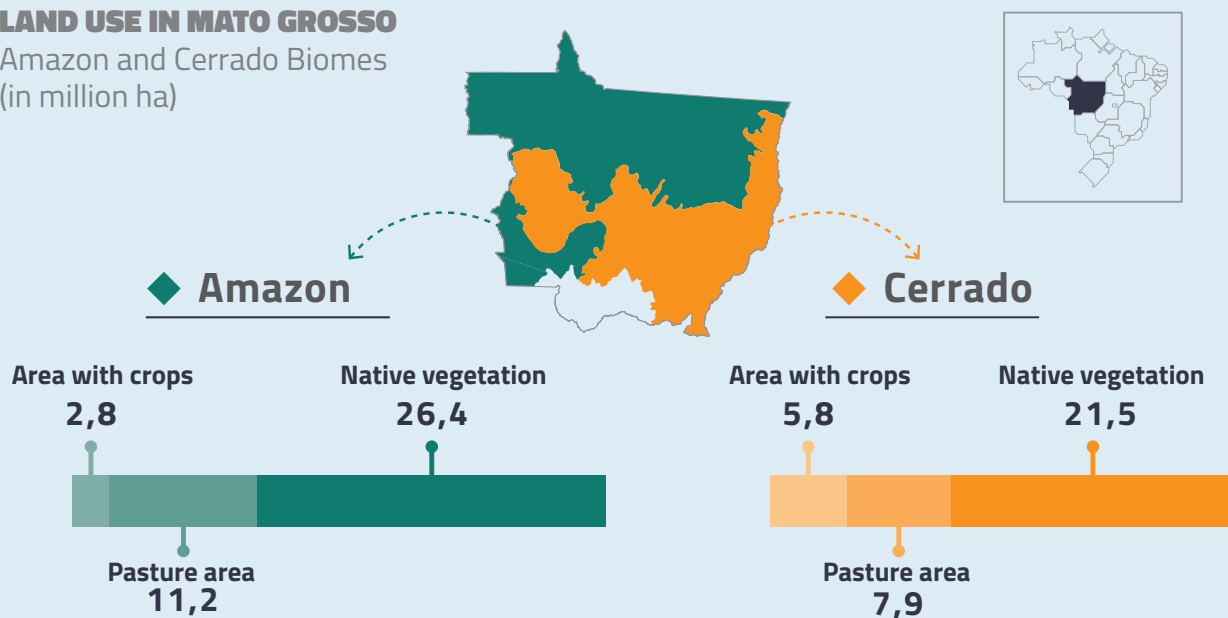
Economic development combined with agricultural expansion led to the deforestation of vast areas in this region. The state of Mato Grosso, for example, had a total of 20.7 million hectares deforested until 2014 (INPE – Prodes, 2015). Since 2004 annual deforestation indexes have fallen significantly, while the number of animals in the cattle herd continues to increase. This is a result of the increase in the productivity of cattle ranching, which is favored by the agronomic and climatic conditions of the state. Additionally the state government has adopted targets for reduction of pastureland and crop area expansion together with environmental conservation (Forest Code compliance) and deforestation reduction (Programa PCI – Produzir, Conservar e Incluir, presented at COP21 in Paris, in 2015).

Thus, the aim of this study is to evaluate the possibilities and needs to promote the sustainable intensification of cattle ranching in the state of Mato Grosso, in order to achieve the PCI Program goals, compliance to the Forest Code and end deforestation, highlighting the importance of sustainable beef production from three different perspectives:

- (i) Analysis of investments in sustainable intensification of cattle ranching from the producer's perspective (farm level), considering environmental compliance scenarios combined with the expansion of cattle and grain production;
- (ii) Analysis of the of the goals defined by the PCI program for the state as a whole and for each biome in order to efficiently allocate land use considering production expansion, environmental compliance and the elimination of deforestation;
- (iii) Case study for sustainable production of beef in the north of Mato Grosso (approach of sustainable sourcing cluster).

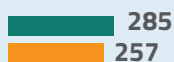
LAND USE IN MATO GROSSO

Amazon and Cerrado Biomes
(in million ha)

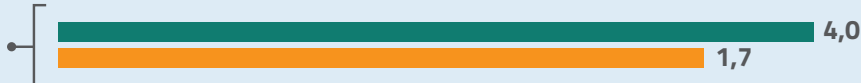


SOURCE: INPE/TerraClass Amazônia (2012), INPE/TerraClass Cerrado (2013). SOARES-FILHO, B. *et al.* (2014).

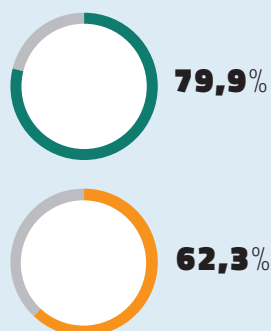
PPA deficit
(in thousand ha)



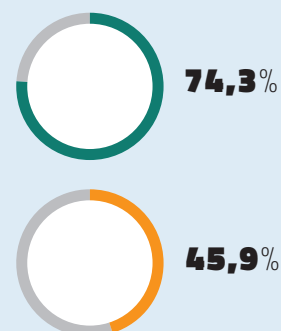
Legal Reserve
deficit
(in million ha)



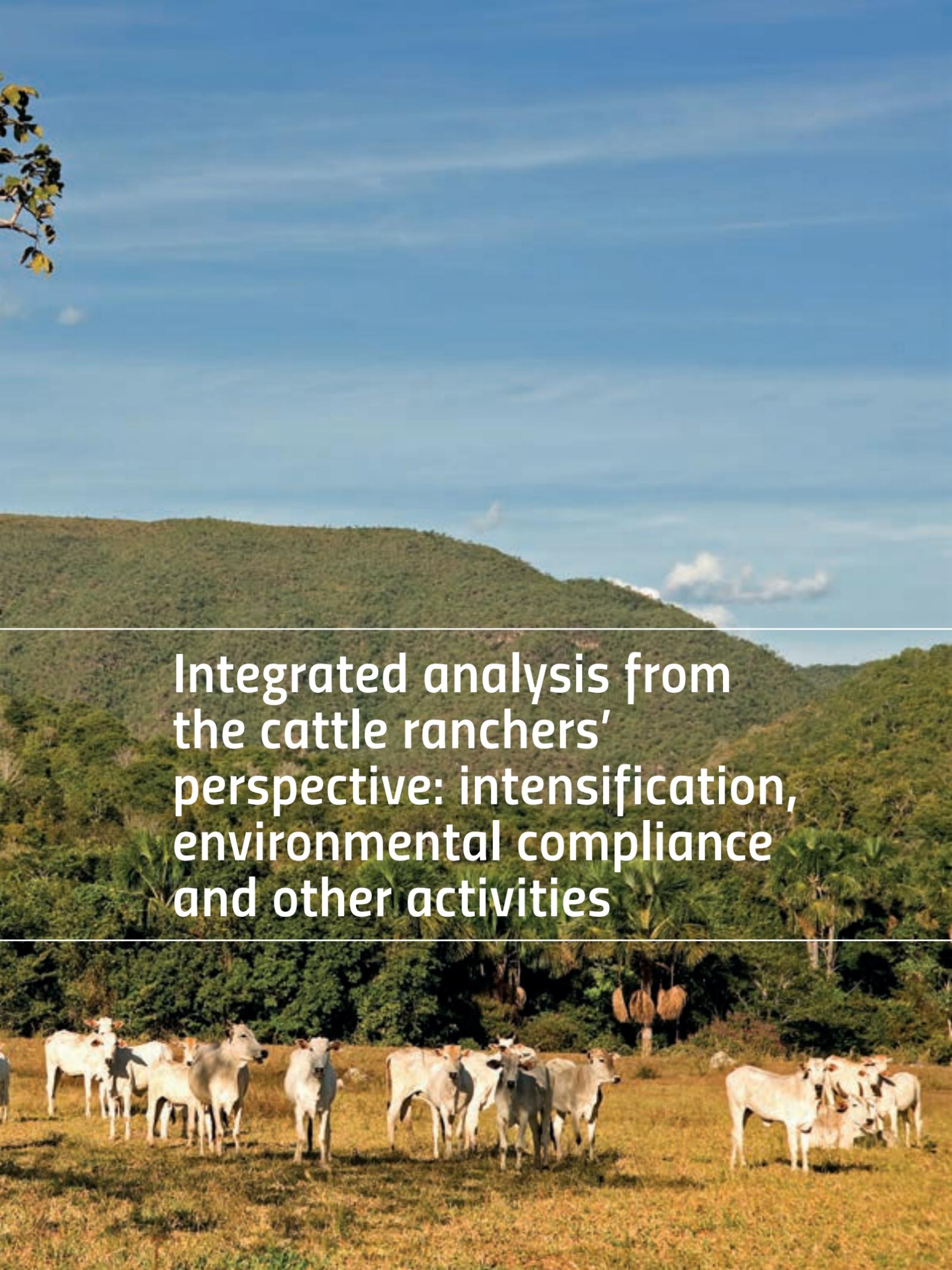
PPA deficit
in pastures
relative to total
PPA deficit



Legal Reserve deficit
in pastures relative
to total Legal
Reserve deficit



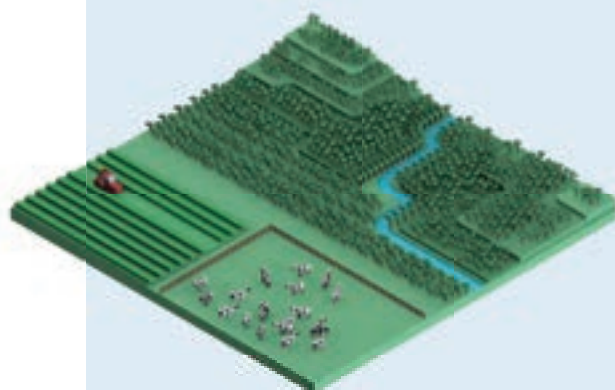




Integrated analysis from
the cattle ranchers'
perspective: intensification,
environmental compliance
and other activities

In order to achieve the proposed objective, three hypothetical scenarios were constructed in farms with different sizes and productivities for a period of 20 years relative to the Cerrado and Amazon biomes within the State of Mato Grosso:

HYPOTHETICAL SCENARIOS FOR CATTLE RANCHING IN PROPERTIES



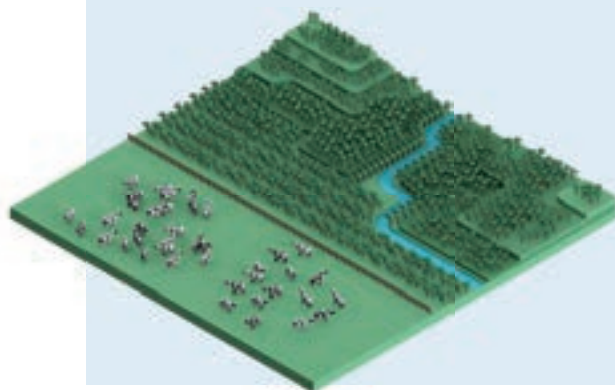
1 CATTLE INTENSIFICATION + SOYBEANS + LEGAL RESERVE OFFER + ENVIRONMENTAL COMPLIANCE

The producer implements cattle intensification in the property, destines a part of the area for Legal Reserve compensation and another part for soybean production through leasing, besides from own compliance to the Forest Code.



2 ENVIRONMENTAL COMPLIANCE + SOYBEANS

The producer implements environmental compliance and decides to lease all productive area for soybeans.

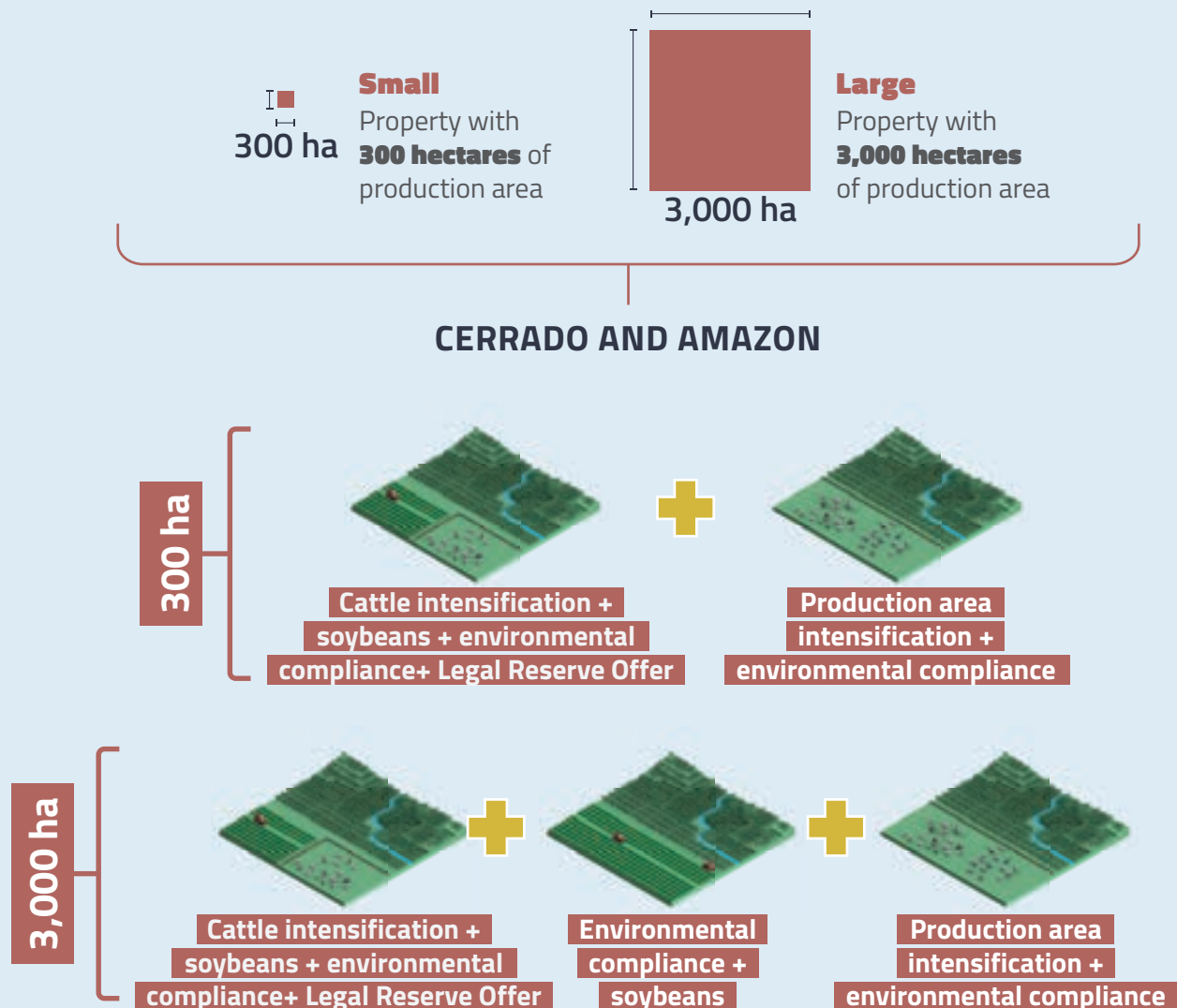


3 INTENSIFICATION OF PRODUCTION AREA + ENVIRONMENTAL COMPLIANCE

Producer chooses production area intensification and implements compliance to the Forest Code.

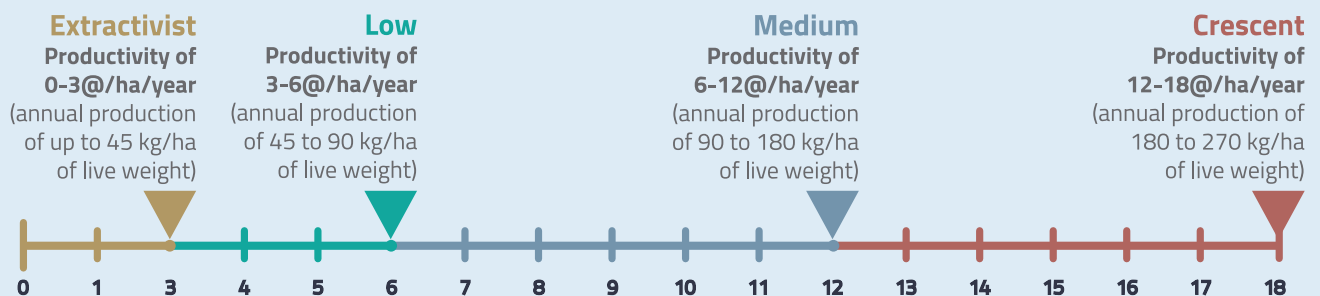
For each scenario, hypothetical complete cycle (breeding, rearing and fattening) farms were evaluated, considering three possible productivity levels (*see next page*).

FOR EACH SCENARIO, THE STUDY EVALUATED TWO CASES OF HYPOTHETICAL FARMS:



PRODUCTIVITY LEVELS WERE ADOPTED

(Production in live weight per hectares and per year)



As premises of the financial analysis, the following annual rates were used: 5.85% p.a. for the inflation rate and 8.5% p.a. for the interest rate, resulting in a real interest rate of 2.5% p.a. (considered for 20 year period). Possible revenues from the farm considered: sale of the animals after the end of the production cycle, which was calculated as the price of the arroba (=15kg of live weight) multiplied by the productivity ($R\$/@ \times @/ha = R\$/ha$); revenue from leasing pasture areas for soybean production; revenue from areas that will be offered for third-party Legal Reserve compensation. For the costs related to forest restoration, the following techniques were considered: direct sowing ("semeadura direta, also known as *muvuca de sementes*, in Portuguese"), active natural regeneration (with minimum intervention), planting native seedlings with and without economic returns and compensation, besides considering restoration of areas for Legal Reserve compensation.

The results showed that **Scenario 1 in the Amazon** is economically feasible for **small properties** (300 ha) only when the cattle rancher leases part of the area for soybean production and for Legal Reserve compensation. In all other cases, when the producer achieves 9.66@/ha or 15@/ha, the profitability of the investment project is negative, considering that the technological migration to full cycle requires minimal production scale in order to become profitable. This means that in small properties, the producer must have alternative uses for beef cattle (in this case, the complete cycle) with higher profitability. In the same scenario, but for the farms with **3,000 hectares** of production area, with Internal Rate of Return (IRR) varying from 13% to 23%, the investment project became profitable, increasing with the cattle ranching productivity level achieved by the producer and according to the land use allocation defined. In this case, the Net Present Value (NPV) of the project can reach R\$ 167/ha/year (US\$ 54/ha/year) with a payback of seven years.

In **Scenario 2**, on the other hand, the result for farms with **3,000 hectares** resulted in a relative NPV of R\$ 322/ha/year (US\$ 104/ha/year) for the 20-year period, where the leasing by itself, considering the necessary investment for soil correction and preparation for soybean cultivation, results in a IRR of 49%, which explains the feasibility of the project.

In **Scenario 3**, when the property has cattle ranching activities and carries out forest restoration of Legal Reserve using the active natural regeneration technique (for environmental compliance), combined to the increase in cattle productivity, profitability was only observed in large properties, that is, with **3,000 hectares** of production area. Still considering **Scenario 3**, but with productivity of 15@/ha, the relative NPV is of R\$ 162/ha/year (US\$ 52/ha/year) which is smaller than the profitability of the restoration and lease for soybean project (R\$ 322/ha/year; US\$ 104/ha/year). This is one of the reasons why cattle ranchers have been sparing areas for

1. Premises similar to those adopted in the study "Economic analysis of investment projects for the expansion of cattle production" are available at <https://goo.gl/TaoEyG>

2. The specific restoration analyses are available (only in Portuguese) at: <https://goo.gl/YyLZbc>

3. Exchange rate used in the study: R\$ 3.10/US\$

the production of grains in the State, requiring a profitability higher than 15@/ha/year to be competitive with soybeans.

For **Scenario 1 in the Mato Grosso Cerrado**, the following were considered: cattle ranching intensification, forest restoration with direct sowing, and offer of native vegetation in the property for third-party Legal Reserve compensation and leasing for soybeans. That is, in the case of the Cerrado, based on estimations from Soares (2014), there is no need for restoration of native vegetation over pasture areas for Legal Reserve compensation since there are enough remaining areas (and with low suitability for agriculture). The results demonstrate that the **small property** with total area of 300 hectares will only be profitable when leasing large part of the area for soybeans, which makes investments in cattle ranching intensification economically unfeasible. Still considering **Scenario 1**, but for properties with **3,000 hectares** of production area, the return on investment is positive regardless of the cattle ranching productivity achieved by the producer, with an IRR that can vary from 20% to 25%. With higher productivity, that is, 15 @/ha, the project reaches a total NPV of R\$ 12 million (US\$ 3.9 million), or R\$ 189/ha/year (US\$ 61/ha/year) in the 20-year period, which is a result similar to that found in Mato Grosso Amazon.

In **Scenario 2**, on the other hand, considering a property with **3,000 hectares**, with production areas leased for soybeans and forest restoration, the result was of R\$ 320/ha/year (US\$ 103/ha/year) for the 20-year period with a project IRR of 43%.

In **Scenario 3**, with cattle ranching intensification and forest restoration, the profitability of the project is positive for properties with **3,000 hectares**, where the IRR varies from 5% to 18% according to the productivity level achieved by the producer, which is a result similar to that found in the same scenario in the Amazon biome. In this context, it is also possible to verify that the relative NPV of leasing areas for soybeans is higher on return investments in intensification of the cattle ranching activity, resulting in values of R\$ 320/ha/year (US\$ 103/ha/year) in the first case and of R\$ 193/ha/year (US\$ 62/ha/year) in the second. In small properties (**300 ha**), considering the profitability achieved and activities proposed in this scenario, it is better for the producer to lease his property than to continue with cattle ranching. It is important to highlight that in **Scenario 3**, both for the Amazon and for the Cerrado (in Mato Grosso), the producer with area of **3,000 hectares** has difficulty to comply, considering that the IRR is lower than the Minimum Attractive Rate of Return (MARR) of 8.5% when the cattle productivity level transitions from extractivist to low and from low to medium technology. This occurs because the return on investment gradually increases towards higher productivity levels, thus enabling investments in forest restoration. It was possible to verify that the producer who reaches an average of more than 12@/ha tends to continue in the cattle ranching activity, considering that the business is more profitable than for those with lower technology levels. For the latter, land use allocation efficiency is achieved through leasing production areas for soybeans and also through the offer of areas for third-party Legal Reserve compensation to support environmental compliance of properties that have deficit.



Integrated scale analysis to achieve PCI goals: intensification, compliance and other productive activities



An integrated scale analysis for Mato Grosso was carried out considering the possible combinations of land use in the state for the Amazon and Cerrado biomes (analysis of scale investment projects considering the PCI Program goals), and assuming that part of the stock of pasture areas will be converted for the following activities: higher productivity cattle ranching, forest restoration for environmental compliance in own property, forest restoration for third-party Legal Reserve compensation and leasing of pasture area for soybean production. The assumptions adopted were those described in the previous section, but taking into consideration the property with 3,000 hectares of production area, considering that the investment projects are carried out in scale. The returns of the intensification project were calculated along with the land use changes: leasing of pasture areas for soybean production, forest restoration by cattle ranchers for compliance to the Forest Code and forest restoration for third-party Legal Reserve compensation. The estimated costs with restoration were of (i) R\$ 876/ha (US\$ 283/ha) in pasture areas with some degree of natural regeneration (pastures under regeneration and dirty pastures) and identified by INPE/TerraClass; and (ii) R\$ 2,342/ha (US\$ 755/ha) for all other cases.

In order to allocate the areas to be used for compliance with the Forest Code, the native vegetation surplus of the state was initially allocated for the regularization of the total Legal Reserve deficit from agriculture, totalizing 1.96 million hectares. The remainder of this vegetation was allocated for cattle ranching to meet part of their deficits, with the rest being met by restoration in situ – results of the lands for compensation model carried out by Agroicone.

In order to meet the rest of the Legal Reserve deficit from cattle ranching, it was assumed that low productivity pasture areas will be offered to higher productivity cattle ranchers for compensation of Legal Reserve, allowing them to purchase compensation quotas instead of having to free production areas within their properties for environmental compliance. In this case, the cost of forest restoration is included in the cost of third-party compensation. The result of land use allocation in Mato Grosso per biome is shown in the infographic on page 19. The necessary investments for the implementation of sustainable intensification projects in Mato Grosso are estimated at R\$ 30.1 billion (US\$ 9.7 billion), out of which R\$ 22.8 (US\$ 7.3) are for cattle intensification, R\$ 4.1 billion (US\$ 1.3 billion) for forest restoration and R\$ 3.2 billion (US\$ 1 billion) in leasing for grain production (preparation of pasture areas for soybean production). The total NPV of the investment projects sums R\$ 44 billion (US\$ 14 billion) or, to simplify, R\$ 2.2 billion (US\$ 710 million) per year for 20 years. The result of land use allocation in Mato Grosso is shown on page 19.

The necessary investments for the implementation of a sustainable intensification project in Mato Grosso are estimated at R\$ 30.1 billion (US\$ 9.7 billion), out of which R\$ 22.8 billion (US\$ 7.3 billion) are for cattle intensification, R\$ 4.1 billion (US\$ 1.3 billion) for forest restoration and R\$ 3.2 billion (US\$ 1 billion) in leasing for grain production (preparation of pasture areas for soybean produc-

tion). The total NPV of the investment projects sums R\$ 44 billion (US\$ 14 billion) or, to simplify, R\$ 2.2 billion (US\$ 710 million) per year for 20 years. For the Amazon biome (in Mato Grosso), the financial analysis points to a positive project NPV with an IRR of 12.5% when transitioning from extractivist to low technology, and of 15% when transitioning both from low to medium and medium to growing technologies, with a payback of 7 to 8 years. The annual relative NPV of the project was of R\$ 67 (US\$ 21), R\$ 122 (US\$ 39) and R\$ 184 (US\$ 59) for the final productivities of 6.84@/ha/year, 13.32@/ha/year and 18@/ha/year, respectively, and the total result of the project (NPV) of R\$ 19.21 billion (US\$ 6.2 billion).

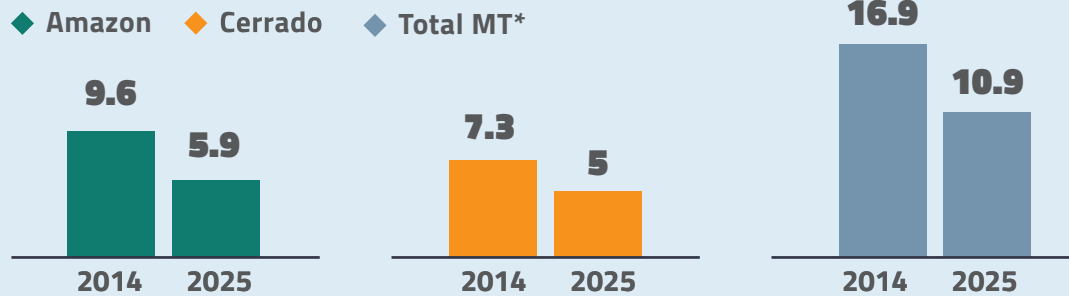
The investments made in the Amazon biome for cattle intensification, forest restoration and conversion from pasture to crops sum R\$ 17.5 billion (US\$ 5.6 billion). By discounting the net profitability from compensation, which amounts to R\$ 1.71 billion (US\$ 550 million), the invested value would be of R\$ 15.8 billion (US\$ 5.1 billion). This scenario considers an increase in meat production in tones of carcass equivalent of 38%, passing from 901 thousand tons to 1.2 million tons in the Amazon. As for the Cerrado (in Mato Grosso), the financial return proved to be bigger than that in the Amazon scenario since the first has a smaller LR deficit for restoration, which results in lower costs for the project. Additionally, the area leased for soybeans in the Cerrado is larger than that in the Amazon, which increases the financial return.

The total NPV of the project was of R\$ 24.9 billion (US\$ 8.03 billion) or, in hectares/year, was of R\$ 136 (US\$ 44), R\$ 152 (US\$ 49) and R\$ 231 (US\$ 74) for the final productivities of 6.84 @/ha/year, 13.32@/ha/year and 18@/ha/year, respectively. The IRR, in turn, varies from 21% to 23% and the payback from 5 to 6 years, according to the technology level, and the investments in MT Cerrado totaled R\$ 12.6 billion (US\$ 4.1 billion). Considering only the compensation market for cattle ranchers, the generated NPV is of R\$ 341 million (US\$ 110 million). Such profitability in this biome is lower than in the Amazon since the first has a smaller Legal Reserve deficit to be restored.

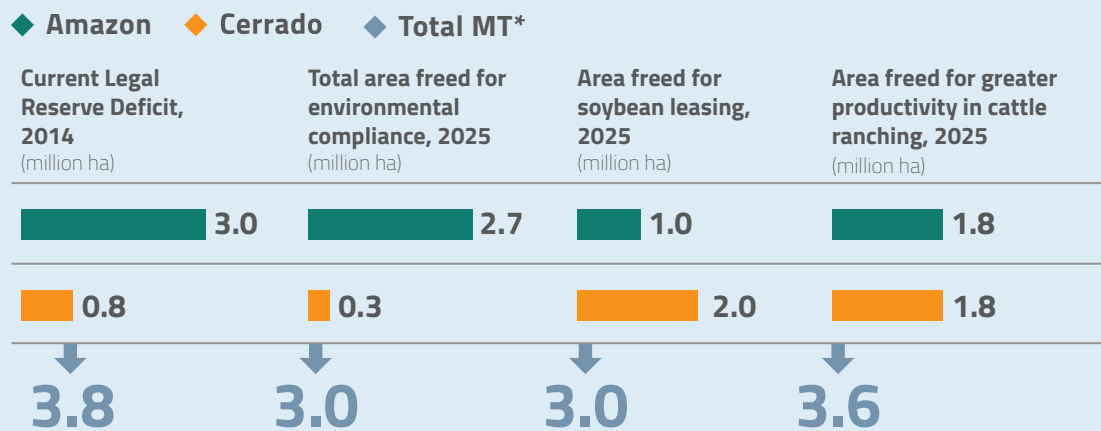
Based on the results for the two biomes, it is possible to observe that the higher the productivity of cattle ranching, the greater the profitability of the project with this activity. Leasing areas for the production of grains is a way to ensure greater income, especially for low productivity cattle ranchers. The producers with extractivist and low technology levels tend to offer more areas for the compensation and grains markets, allowing them to have a higher income than if they continued with the cattle ranching activity in their properties.

The analysis indicates potential for the implementation of a scale program in Mato Grosso that combines production intensification, expansion of grains and meat and environmental compliance. The analyses show that, by allocating land use in an economically efficient way, it is possible to achieve positive returns aligned to Forest Code compliance and production activities in the entire state of Mato Grosso.

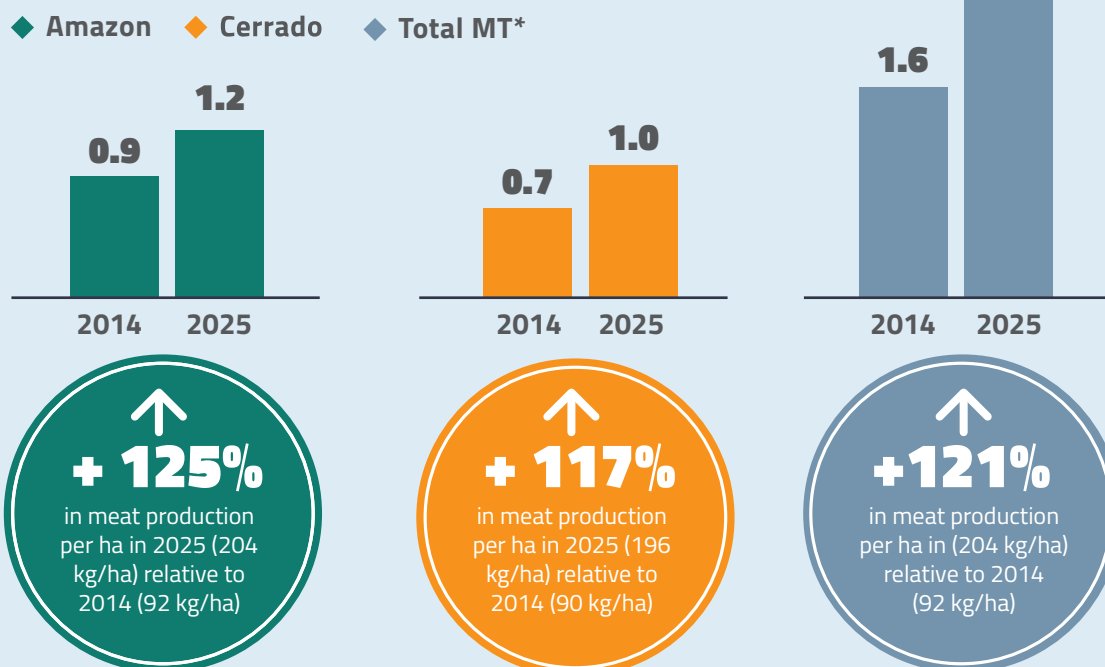
PASTURE AREA 2014 X 2025 (in million ha)



SUSTAINABLE CATTLE RANCHING IN MT: OPTIMAL LAND USE ALLOCATION



MEAT PRODUCTION 2014 X 2025 (in million tons)

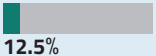
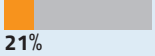
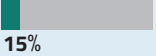
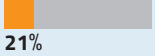
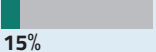
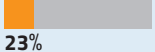


*Total does not include Pantanal biome.

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

	◆ Amazon	◆ Cerrado	◆ Total MT
 CATTLE INTENSIFICATION	US\$ 4.2	+	US\$ 3.1 = US\$ 7.3
 FOREST RESTORATION	US\$ 1.1	+	US\$ 0.3 = US\$ 1.3
 LEASING	US\$ 0.4	+	US\$ 0.7 = US\$ 1.0
TOTAL INVESTMENTS	US\$ 5.7	+	US\$ 4.1 = US\$ 9.7
TOTAL NPV OF PROJECTS	US\$ 6.2	+	US\$ 8.0 = US\$ 14.2

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

	AMAZON			CERRADO		
Productivity achieved in cattle ranching (@/ha)	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%	5 years and 7 months
13.3	39	 15%	8 years and 3 months	49	 21%	5 years and 7 months
18.0	59	 15%	8 years and 3 months	74	 23%	6 years and 0 month

Greenhouse gas (GHG) emissions and removals

Cattle ranching intensification promotes a significant positive effect on the balance of greenhouse gas (GHG) emissions. By integrating technology in the production system, it is possible to produce the same amount of meat with a smaller herd, to free areas for the production of other crops and/or to restore native vegetation, as well as to promote the removal of carbon through the soil by improving the quality of pastures.

For this analysis, a reference scenario was outlined in which the deforestation rate was kept constant, considering as baseline the 2015 rate (INPE, 2016; LAPIG, 2016) and marginal efficiency gains in technical production coefficients for cattle ranching. Considering these premises, it was possible to estimate the necessary increase in herd and area to meet the proposed demand (meat and soybeans).

By increasing the productivity of cattle ranching (Intensification Scenario), considering the PCI goals, which include the increase in the production of grains, meats and environmental compliance, it is possible to meet the proposed demand without expansion over native vegetation (assuming expansion through productivity gains).

Conversely, in the Reference Scenario, in order to meet the same production volume with some productivity gains in cattle ranching, it is necessary that part of the production expansion take place over native vegetation, thus worsening the emissions balance when compared to the Intensification Scenario (in addition to the need for a larger herd in the first scenario compared to the second).

The general GHG emissions balance points to a reduction close to 80% in the Intensification Scenario compared to the Reference Scenario for the period until 2025. The net emissions (removals) related to LULUCF (Land Use, Land Use Change and Forestry) are the key factor for this difference. The Intensification Scenario resulted in a reduction of 203% compared to the Reference, which means that it promotes a removal of carbon, while in the Reference Scenario there is emission of carbon.

In the Intensification Scenario, the net removal of GHG was possible due to the restoration of native vegetation over pasture areas, as a result of the land use allocation. For compliance with the Forest Code in the coming years, 2.67 and 0.34 million hectares in the Amazon and Cerrado biomes in the State of Mato Grosso, respectively, should be restored, resulting in an accumulation of over 760 million CO₂ equivalent.

By producing more meat per hectare, it is possible to have a smaller final stock of animals in the herd in the intensified system (with increase in the off-take rate, reduction in the slaughter time, among other performance rates considered). Thus, emissions from enteric fermentation and cattle manure are smaller than in the Reference Scenario. The smaller number of cattle head in the Intensification Scenario at the end of the period allows emissions to be 6.55% lower in comparison to the Reference Scenario. The table below shows the balance of GHG emissions for both scenarios.

Regarding the estimated emissions for agriculture and LULUCF for the state of Mato Grosso in the year of 2014⁴ (based on SEEG, 2016), while the Reference Scenario showed an increase of 42% relative to the 2014 emissions balance considering the annual emissions balance in the period from 2014 to 2025, the Intensification Scenario showed a reduction of 78% for the same comparison.

Balance of GHG emissions in the Reference and Intensification scenarios (million tCO₂e)

	Reference				Intensification				Variation
	Amazon	Cerrado	Total	Total (annual)	Amazon	Cerrado	Total	Total (annual)	Total
Herd	565.3	457.4	1,022.6	85.2	522.4	433.3	955.7	79.6	-6.6%
LULUCF	452.7	161.2	613.9	55.8	-683.2	53.1	-630.1	-57.3	-202.7%
Recovery of pasture	-5.1	-4.4	-9.4	-0.9	-28.7	-11.2	-39.9	-3.6	-322.6%
Restoration of native vegetation	0.0	0.0	0.0	0.0	-721.7	-45.0	-766.6	-69.7	-
Expansion of soybeans	67.2	109.2	176.4	16.0	67.2	109.2	176.4	16.0	0.00%
Expansion of cattle ranching	397.9	62.0	459.8	41.8	0.0	0.0	0.0	0.0	-
TOTAL	1,017.9	618.6	1,636.5	141.0	-160.9	486.4	325.5	22.4	-80.1%

Obs.: Positive values represent emissions and negative values represent removals. The emissions from the herd refer to enteric fermentation (CH₄) and cattle manure (N₂O). The LULUCF emissions were weighted for the period of the project. For the production of soybeans, "Biological nitrogen fixation" and "No Till System" were considered.

Source: IPCC (2006); Harris, N et al. (2009); Gouvello, C et al. (2010); Leite et al. (2012); Observatório ABC (2013); Soares-Filho, B. et al. (2014)

4. Net LULUCF emissions, enteric fermentation and manure management.

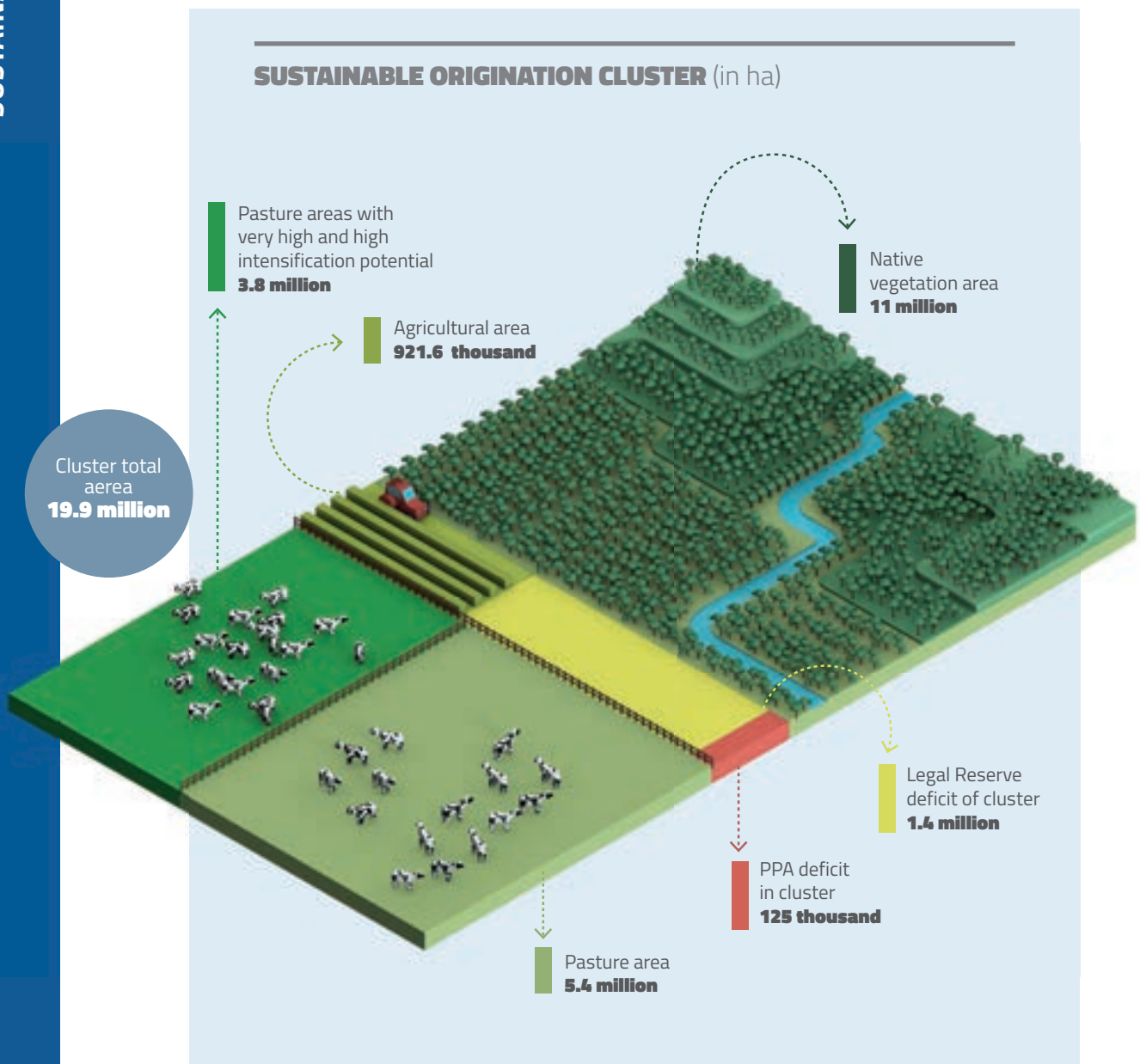




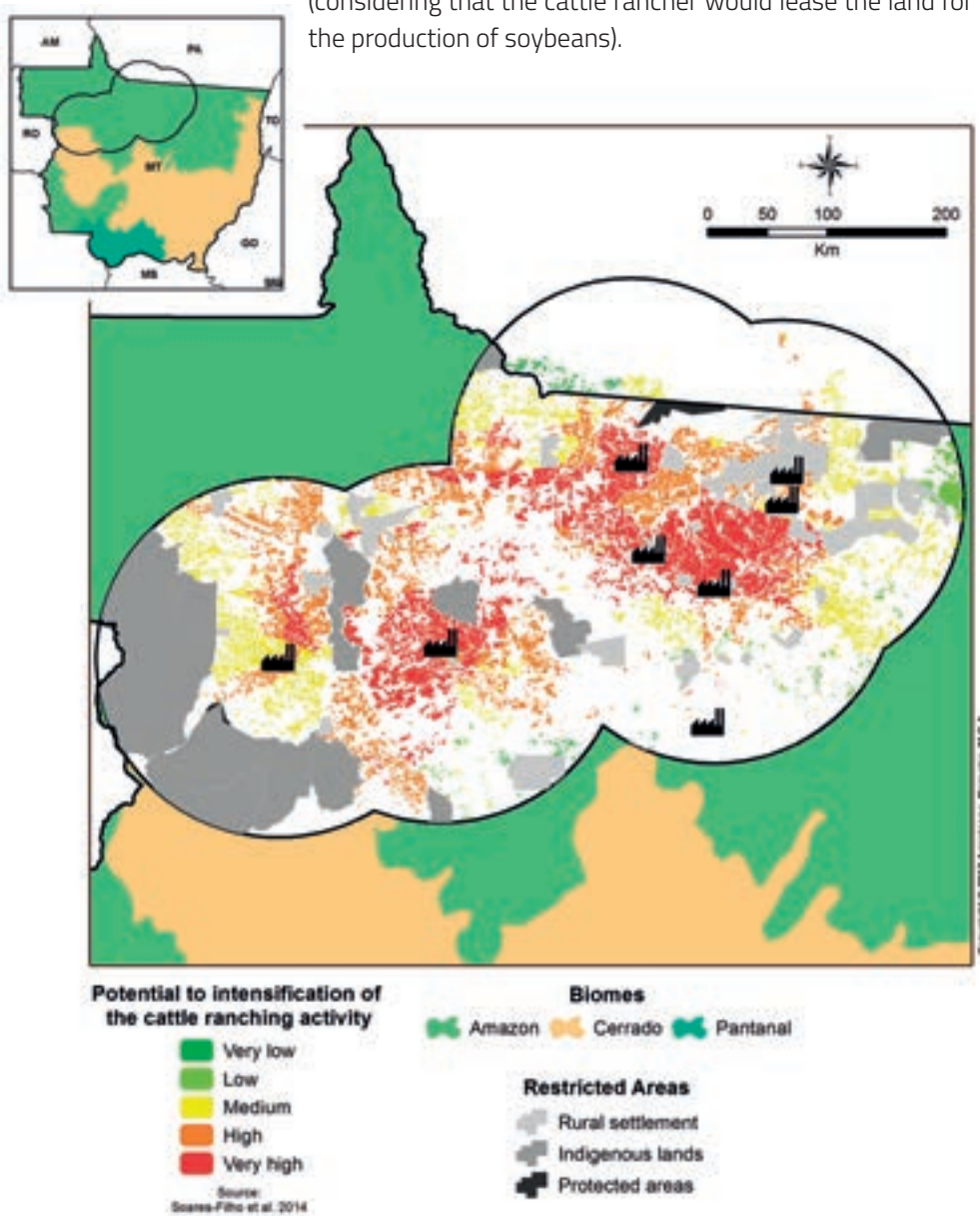
Sustainable sourcing cluster

Sustainable origination clusters are defined as the areas under the economic influence of slaughterhouses, where cattle ranching intensification and environmental compliance should be prioritized, guaranteeing sustainable production, meat quality and verification of the origin of the meat.

Certain criteria were determined for the territorial delimitation of the cluster, such as: concentration of animals and pasture areas, concentration of slaughterhouses, deforestation risk in the region, potential for agricultural expansion and cattle intensification, needs related to environmental compliance (Forest Code balance) and pre-arranged institutional arrangements.

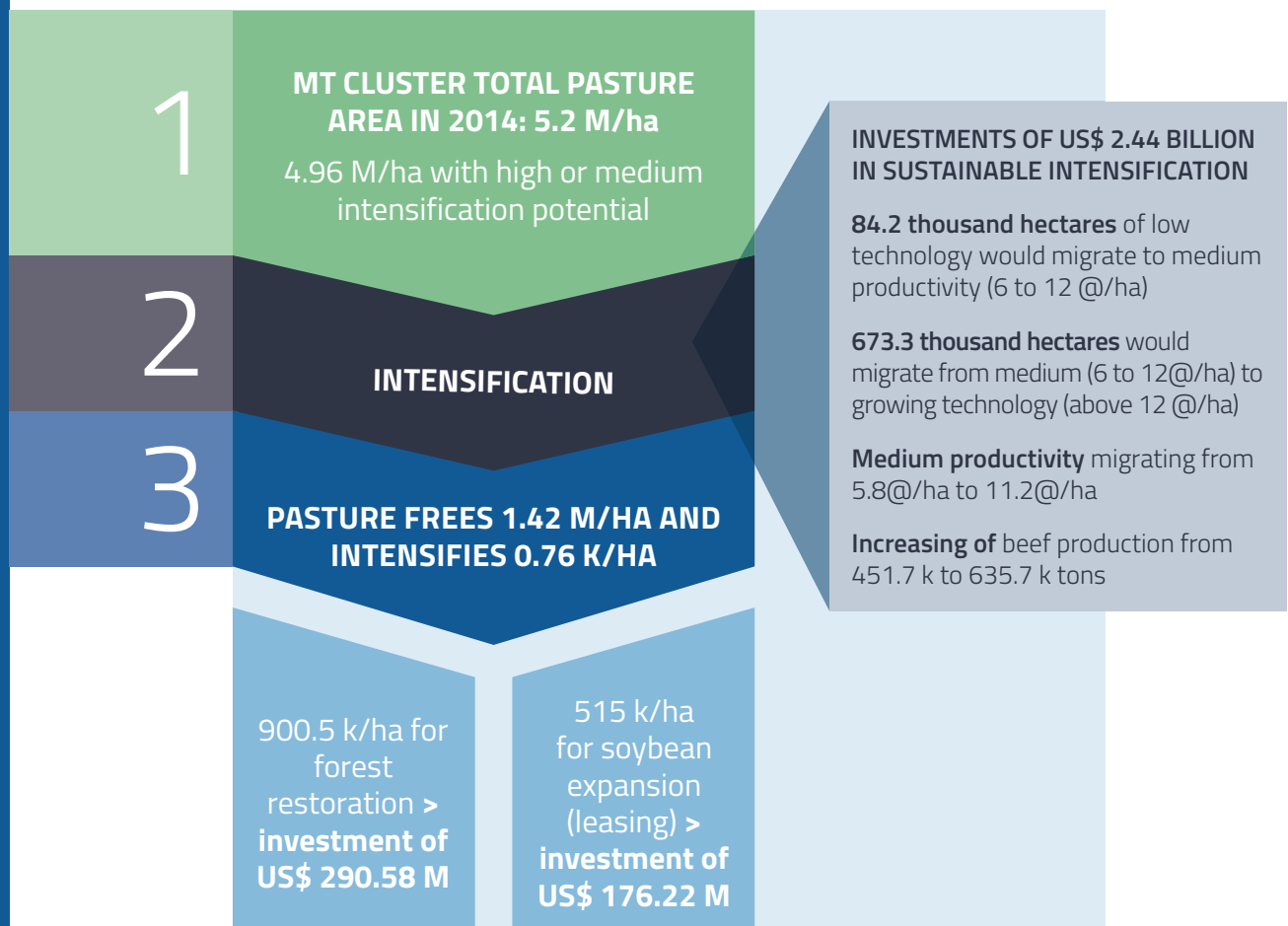


The selected cluster in the Northeast of the state of Mato Grosso includes eight slaughterhouses that totalized 1.51 million slaughtered animals in 2014, covering a total area of 19.9 million hectares. This area is occupied 56% by native vegetation, 27% with pastures and 5% with agriculture. For compliance 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). Out of the total pasture area (5.2 million hectares), 4.96 million have high and medium potential for intensification, that is, geographic, soil and climate conditions, infrastructure and favorable distance to slaughterhouses. 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).

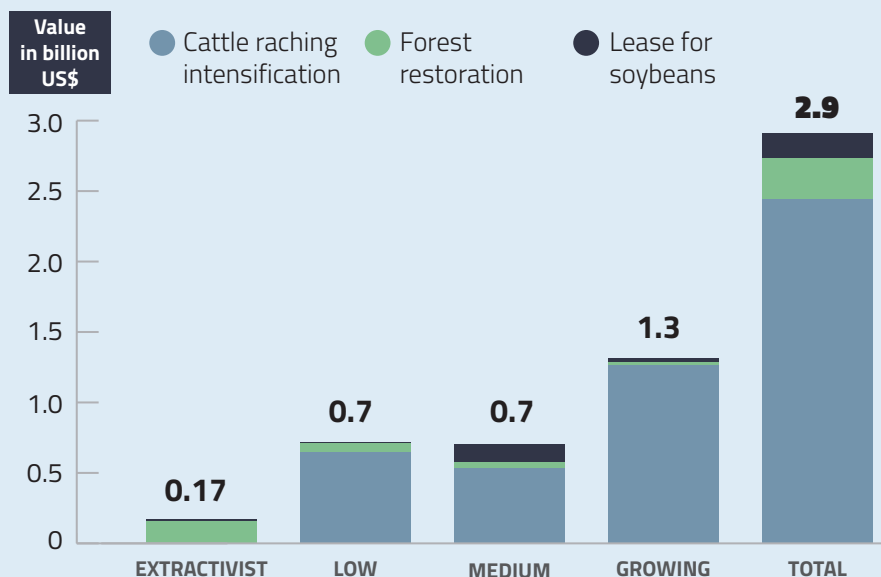


The cattle ranching activity, in turn, should intensify 757.4 thousand hectares, out of which 84.2 thousand hectares with low technology would migrate to medium technology (6 to 12 @/ha), while 673.3 thousand hectares would migrate from medium (6 to 12 @/ha) to growing technology (above 12 @/ha). The 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 technology 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 to occur in scale in the selected cluster located in the North of Mato Grosso, considering the same premises used for the construction of the integrated state analysis in the previous section, the necessary investment is estimated at R\$ 9.02 billion (US\$ 2.91 billion). This value includes R\$ 7.57 billion (US\$ 2.44 billion) for cattle ranching intensification, R\$ 900.8 million (US\$ 291 million) for forest restoration and compliance with the Forest Code and R\$ 546.3 million



ALLOCATION OF INVESTMENTS BY USE AND PRODUCTIVITY LEVEL OF CATTLE RANCHING IN 2025 IN THE CLUSTER



(US\$ 176 million) with areas leased for soybeans, where soil correction is necessary in order to expand agriculture in areas previously occupied with pastures (**Table 2**). In this scenario, the compensation market would move R\$ 3.58 billion (US\$ 1.15 billion) among the cattle ranchers themselves, given the supply and demand for Legal Reserve compensation. The total NPV of the investment in sustainable intensification, in turn, would reach R\$ 9.75 billion (US\$ 3.15 billion), where the medium and growing technology levels have the highest relative project NPVs of R\$ 121/ha (US\$ 39/ha) and R\$ 181/ha (US\$ 59/ha) and IRR of 14.2% and 14.8%, respectively.

TOTAL PROFITABILITY OF SUSTAINABLE INTENSIFICATION PROJECT





Final considerations



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 largely 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 December of 2015.

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 and substitute (at least partly) to the activity carried out. 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 for grains and/or offer the areas for environmental compensation, improving the financial return of the farm. 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.

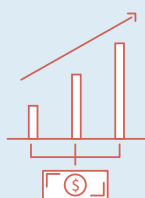
Additionally, regulation and effective implementation of the state Regularization Program (PRA) and regulation of the compensation market, as well as incentives to expand agricultural production over pastures, are necessary in order to ensure the success of sustainable cattle ranching intensification.

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 is to spend efforts to create appropriate conditions for the scale implementation of investment projects. The third is to continuously monitor this analysis, evaluating the achievement of PCI goals, premises and market conditions.

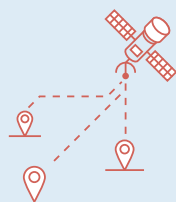
4. According to Embrapa, "refers to a set of rules and procedures to be followed by farmers that, besides from making the production systems more profitable and competitive, also ensure the supply of safe food, coming from sustainable production systems." Available at: <http://cloud.cnpgc.embrapa.br/bpa/>

The solution proposed in this study is the promotion of sustainable origination clusters in areas geographically close to slaughterhouses, with cattle intensification potential, and capacity for agricultural expansion, fostering environmental compliance. This is possible due to the engagement of the beef chain stakeholders, governments and civil society.

ENABLING CONDITIONS FOR PROJECT IMPLEMENTATION



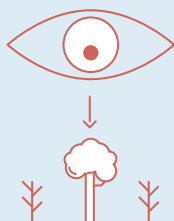
Market
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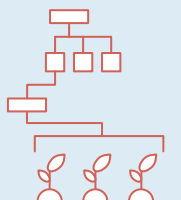
Monitoring
and traceability
systems



Input offer
and
enabling of
workforce



Identification of
priority areas for
intensification and
forest restoration



Rural
extension
and technical
support for
producers



Ease of
access to
rural credit



Effective
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Code

INPUT
Iniciativa para o Uso da Terra

AGROICONE

GORDON AND BETTY
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