Brazil's Independently Determined National Contribution as an example of sustainable agricultural intensification

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Leading the way in Agriculture and Rural Research, Education and Consulting

Brazil's "Grand Challenge": the livestock-deforestation-climate Nexus (aka Sustainable Agricultural Intensification - SAI)

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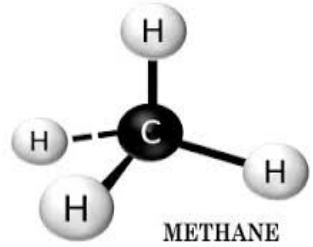
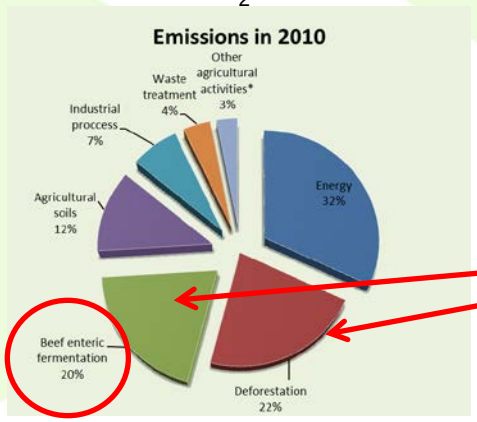
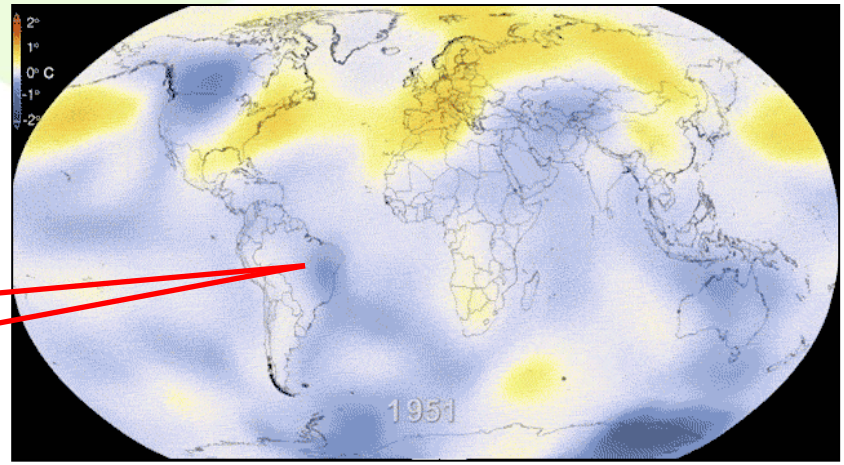
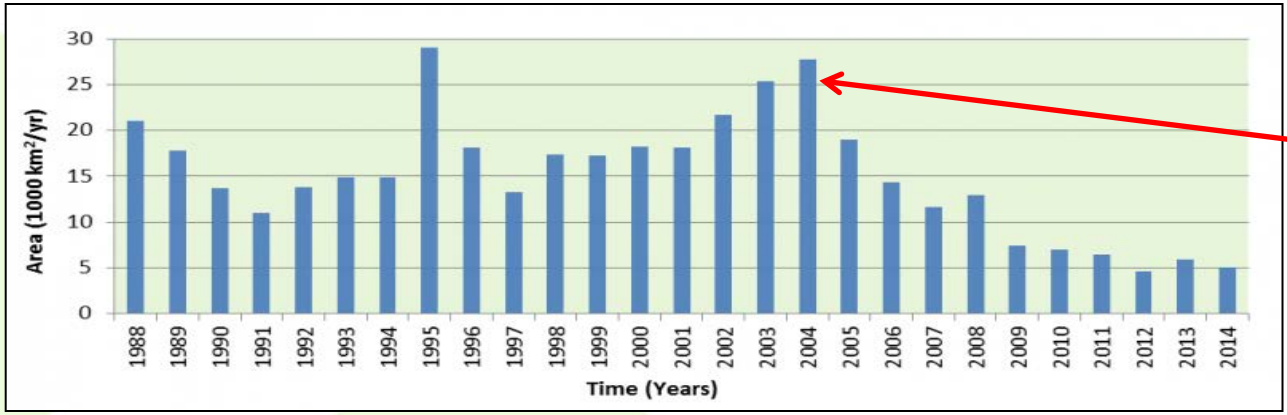


~ 1.3 G t CO_2-e





Livestock and deforestation in Brazil



What happened here?

Fig. 1: Annual deforestation rates in the Amazon (Prodes, INPE)

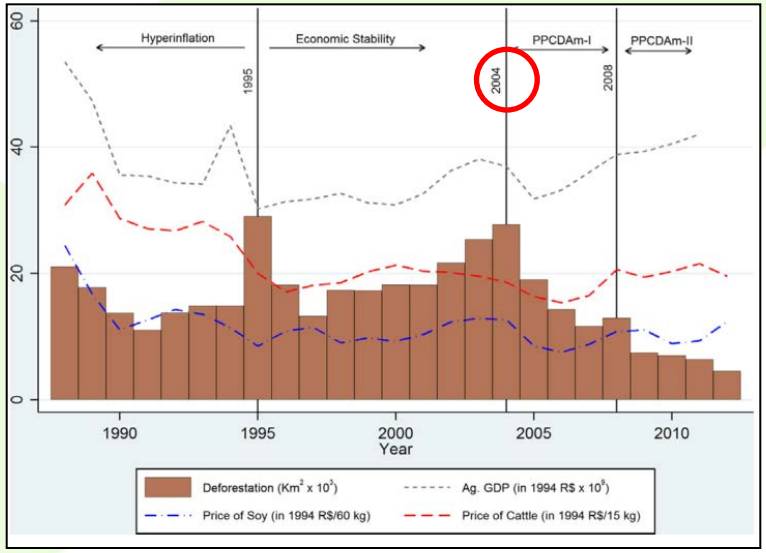


Fig. 2: Amazonian deforestation rates, price of soy, price of cattle, and agricultural GDP from 1988 to 2012, Brazil.
Sources: IEA, SP and IBGE. (Arima, 2014)

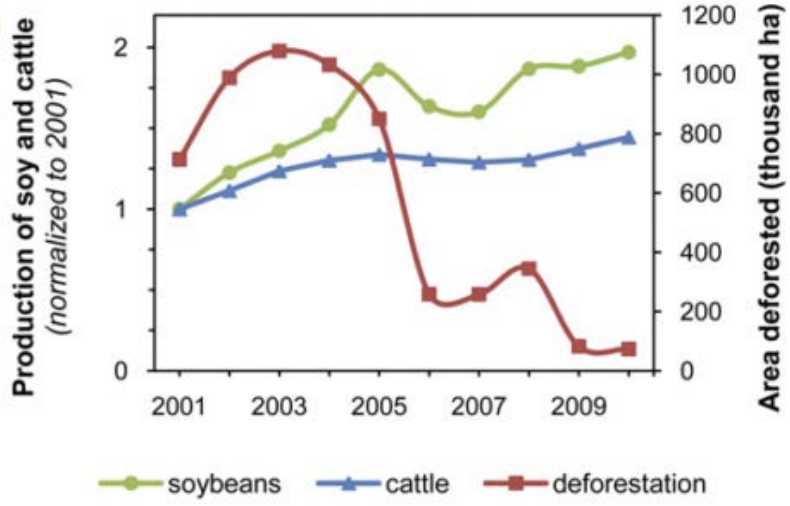
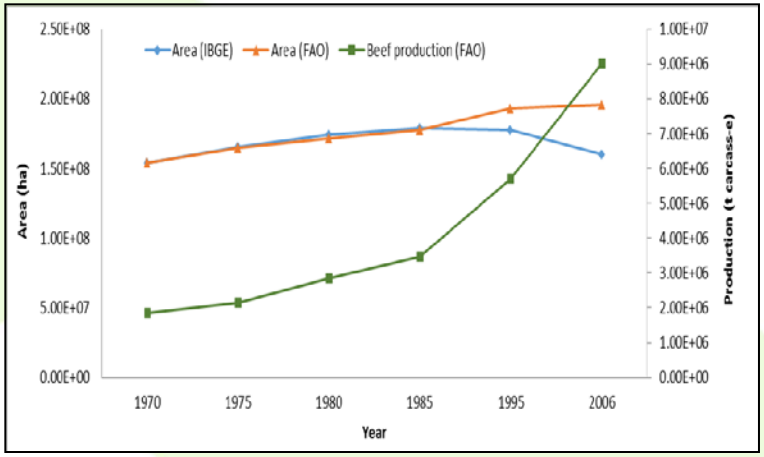


Fig. 3. Deforestation in Mato Grosso, tons of soy produced, and number of heads of cattle produced (16) from 2001 to 2010. (Lapola, 2014)

Quantifying demand driven deforestation

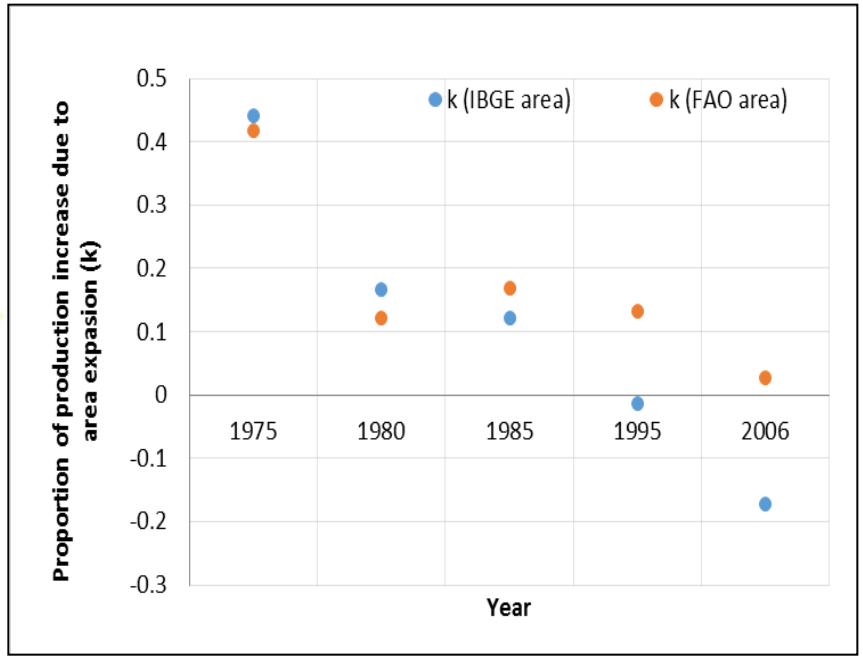
Let *k* be a parameter representing the percentage variation of pasture area in relation to changes in demand.



+

$$\frac{\Delta A_t}{A_t} = k_t \frac{\Delta D_t}{D_t} \Rightarrow k_t = \frac{\left(\frac{A_t}{A_{t-1}} - 1\right)}{\left(\frac{D_t}{D_{t-1}} - 1\right)}$$

=



K ranges from **0.4** to 0 (FAO), or **-0.2** (IBGE)

COP21 - Brazil's Intended Determined National Contribution (INDC) as an example of sustainable agricultural intensification

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COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

COP21, also known as the 2015 Paris Climate Conference

To achieve a legally binding and universal agreement on climate, with the aim of keeping global warming below 2˚C.

INDCs: Mitigation targets and actions to reduce GHG emissions by 2030 (2020-2030)

reduction of GHGs by 37% below 2005 levels by 2025 and 43% by 2030.

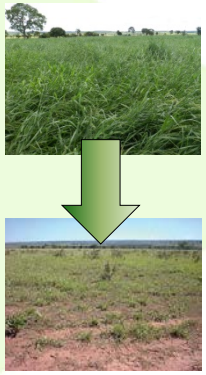
Zero deforestation in the Amazon by 2030!

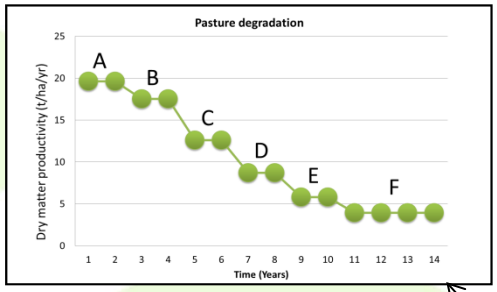
How?

Through the restoration of 15 M ha (2020-2030)

Modelling Sustainable Agricultural Intensification

Economic Analysis of Greenhouse Gases from Livestock Emissions (EAGGLE) model (De Oliveira Siva et al., 2015)





Pasture degradation

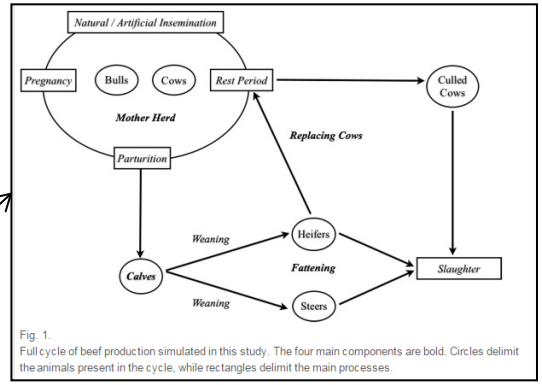


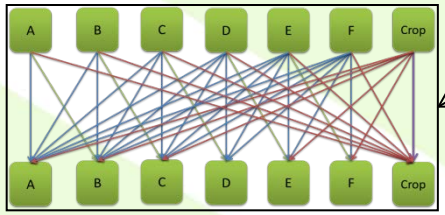
Fig. 1.
Full cycle of beef production simulated in this study. The four main components are bold. Circles delimit the animals present in the cycle, while rectangles delimit the main processes.

$$\text{Max } z(x) = c^T x$$

$$\text{s.a} \quad Ax \leq a$$

$$x \geq 0$$

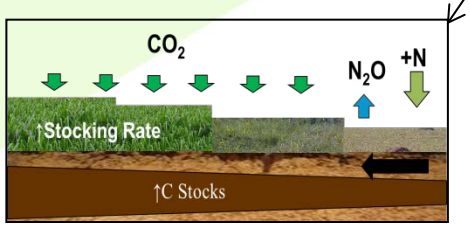
whole cycle (cow–calf, stocking and finishing)



Pasture restoration

GHGs

(a) CH4 and N2O from cattle;
(b) N2O from N fertilization;
(c) CO2 from deforestation
(d) CO2 from pasture degradation (sequestration);
(e) LCA factors for inputs and farm operations applied in land use change and restoration practices.



Soil organic carbon dynamics

Regional scale

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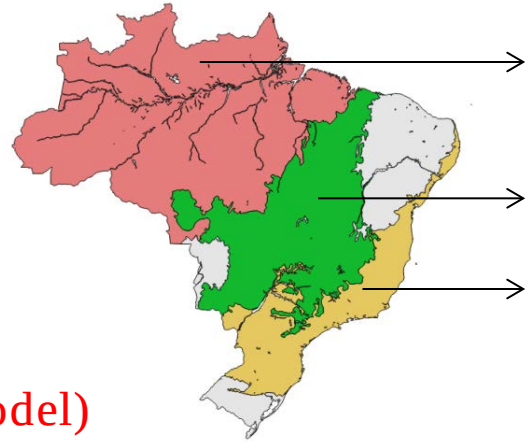
But where did the 15 Mha come from?

$$R = \frac{\left(\frac{\alpha_D}{\alpha_C} - 1\right) N_i - \lambda_d \Delta A}{\lambda_r - \lambda_d}$$

90% of national beef production:



Amazon (28.5%)

Cerrado (37%)

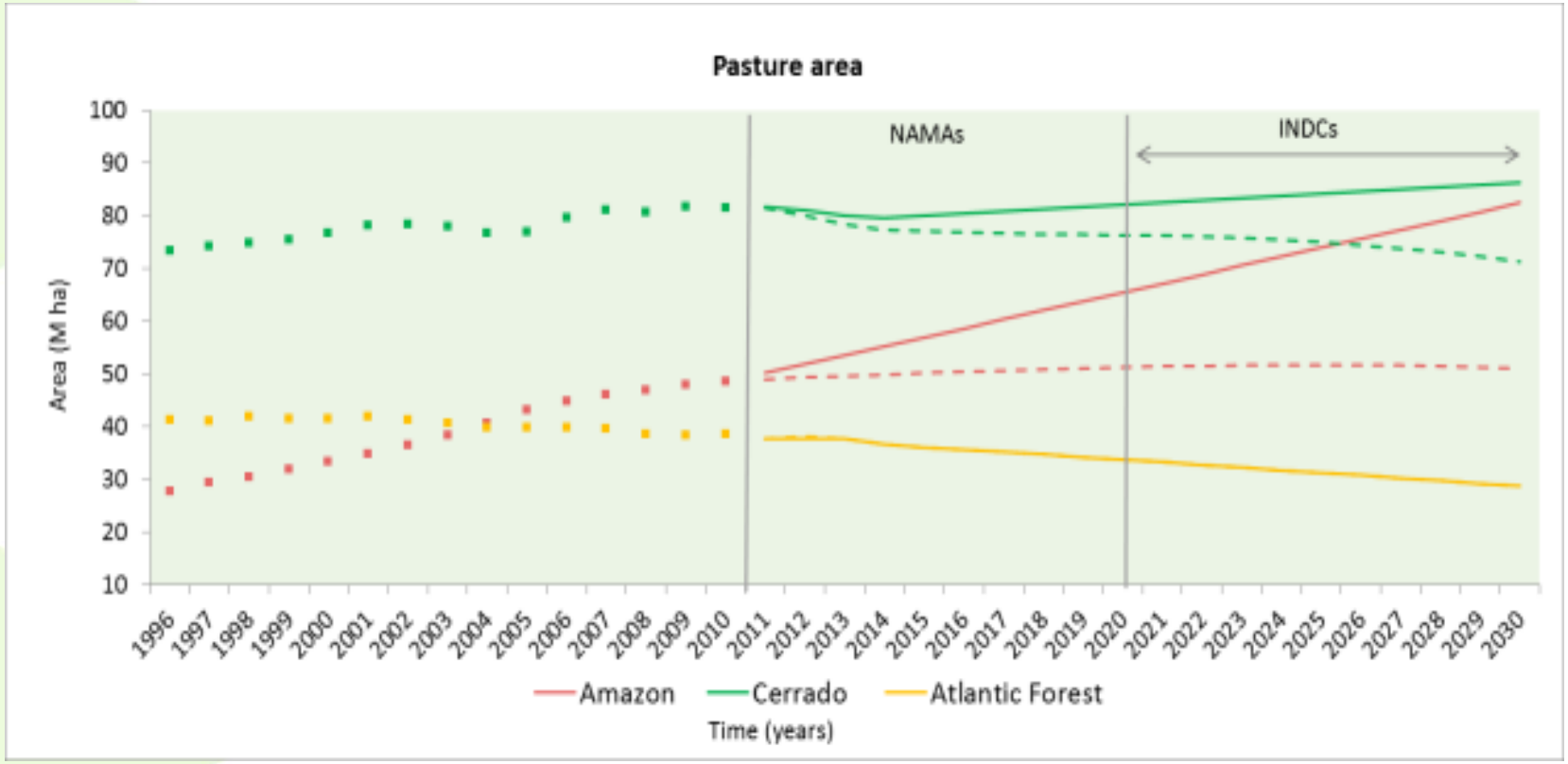
Atlantic Forest (23.5%)

How is restoration defined? (EAGGLE model)

Table 1: Description of pasture type formation (level of technology) and productivity (dry matter per area).

Pasture	Pasture formation (short description)[1]	Cost (US$ 2012 per hectare)	Productivity (tonnes of dry matter per hectare)[1]	Soil carbon equilibrium (tonnes per hectare)
A	mowing+dolomitic limestone + single phosphate + brachiaria seeds + micronutrients + 90kg of N	767	19.6	84.3
B	mowing+dolomitic limestone + single phosphate + brachiaria seeds + micronutrients + 45kg of N	617.1	17.6	82.7
C	mowing+dolomitic limestone + single phosphate + brachiaria seeds	367.7	12.6	62.3
D	mowing +dolomitic limestone + single phosphate	137.1	8.7	45.2
E	Mowing	42.5	5.8	32.4
F	No intervention	0	3.9	26.1

Land use scenarios

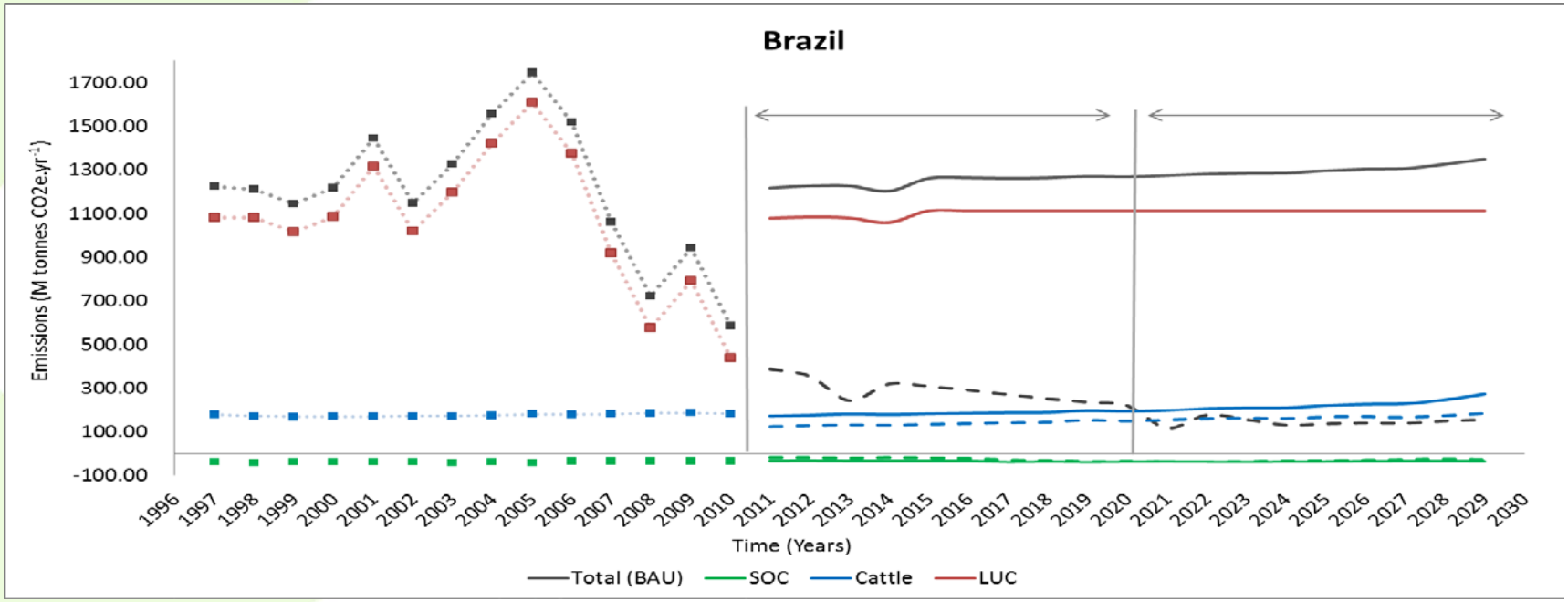


Pasture area observed data (1996-2010) and projected pasture expansion (2011-2030) for the baseline and INDCs scenario fort the Amazon, Cerrado and Atlantic Forest.

Results

Mitigation potential: 80% of sector emissions (85% in the Amazon and 43% cut in the *Cerrado*).

From 1.13 G t CO_2e to 165 M t CO_2e (avg 2011-2030)



Estimates and projections of livestock land use area and GHG emissions prior and post NAMAs and INDC implementation

Results: restoration area

Area and demand (main models inputs) and results comparing DCRA and EAGGLE models.

	Main model inputs[1]				Result
Model	Area 2020 (Mha)	Area 2030 (Mha)	Demand 2020 (Mt)	Demand 2030 (Mt)	Recovered area (M ha) from 2020-2030
DCRA	157.5	146.5	11.43	13.15	15.2
EAGGLE	157.5	146.5	11.43	13.15	18.2

The decoupling story

- Brazil has 160-200 M ha of pastures with average stocking rates of ~1 heads/ha

- More effective monitoring (PRODES – real time images from Amazonia)

- Market regulation and product certification (e.g., the Brazilian Supermarket Association announced new requirements for a certificate of origin from suppliers)

- Ban on rural credit for farmers producing on recently cleared areas

- Law enforcement

Conclusions

- The country is able to meet ambitious demand while reducing deforestation (NAMAs and INDCs)

- Our estimates provided the underlying bases for the livestock contribution to Brazilian INDCs.

- The costs for the period, ~ 1.023 Billion per year Brazilian reals are also in accordance to the 1.0 Billion per year budget from ABC program.

- Empirical evidence (e.g., FAOstat, IBGE) supports the feasibility of this challenge.

Thanks!

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