SYNERGIES OF LOW CARBON TECHNOLOGIES AND LAND-SPARING IN BRAZILIAN REGIONS

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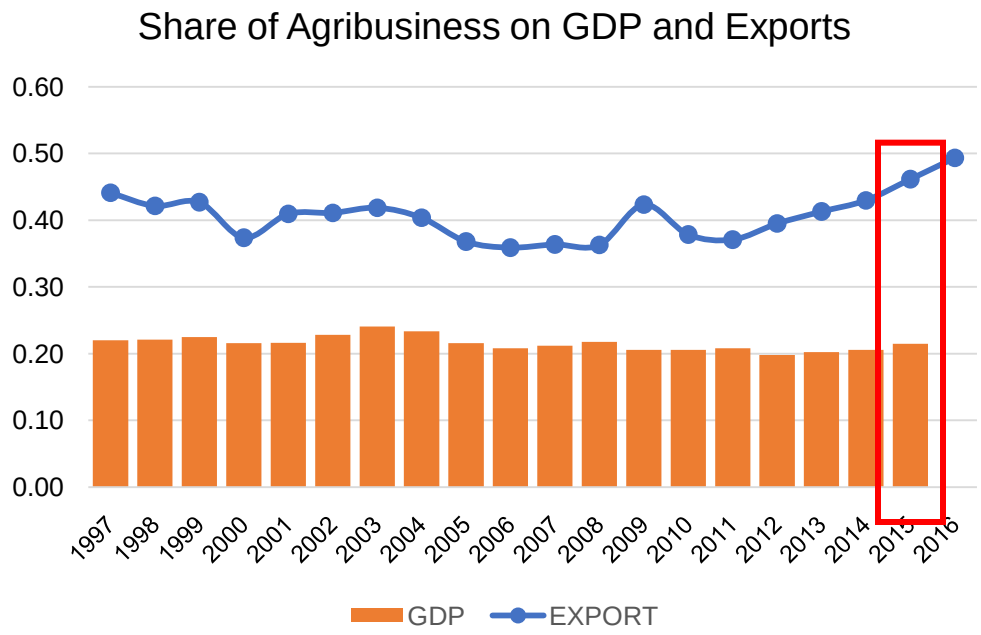
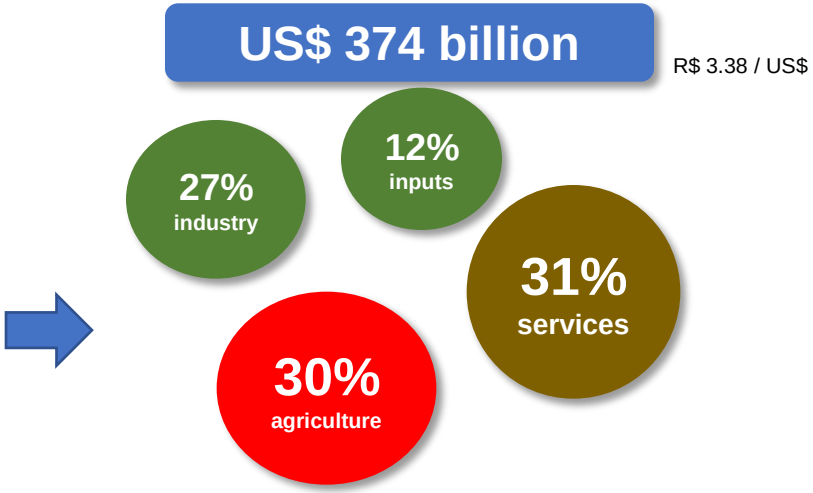
OUTLINE

1. Introduction and presentation
2. Motivation
3. Research objective
4. The BREA model v1.0
5. Outcomes
6. Conclusions

Motivation





Employment

~35%

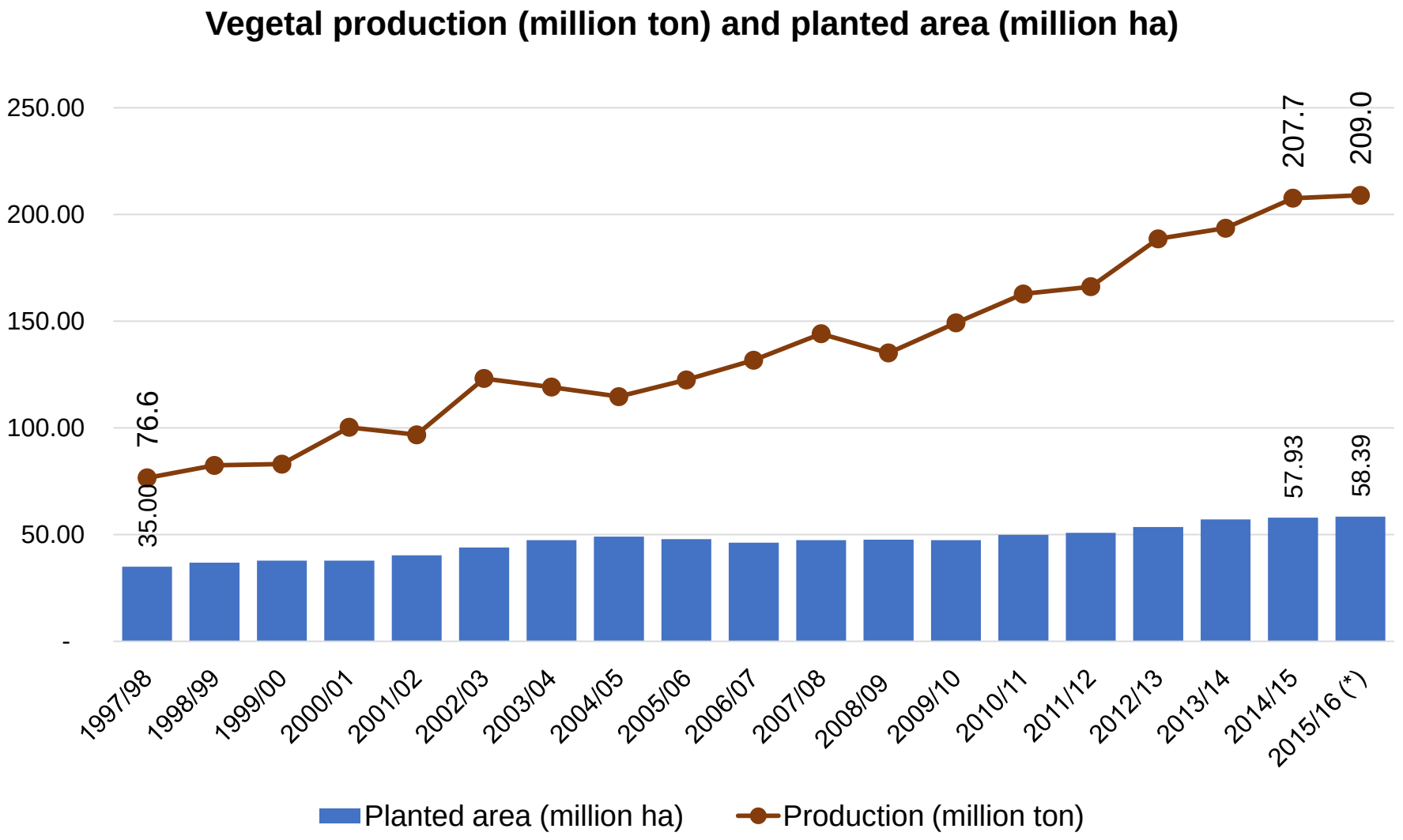
Exports

46.2%

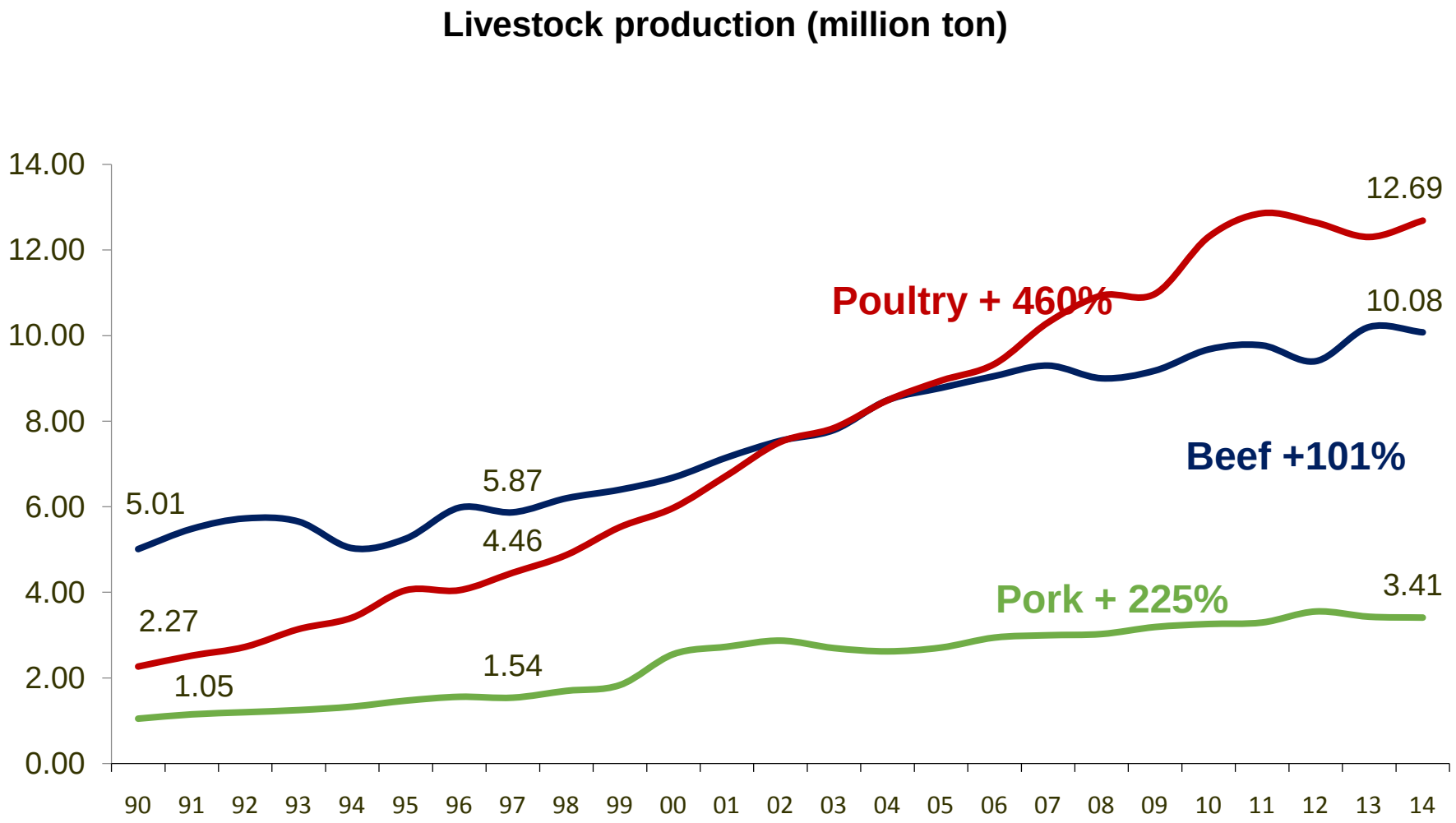
US$ 88.2 billion

Sources: CEPEA, CNA, MAPA, MDIC

Motivation


Vegetal production (million ton) and planted area (million ha)
250.00
200.00
150.00
100.00
50.00
-
76.6
35.00
207.7
209.0
57.93
58.39
1997/98
1998/99
1999/00
2000/01
2001/02
2002/03
2003/04
2004/05
2005/06
2006/07
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
2015/16 (*)
Planted area (million ha)
Production (million ton)

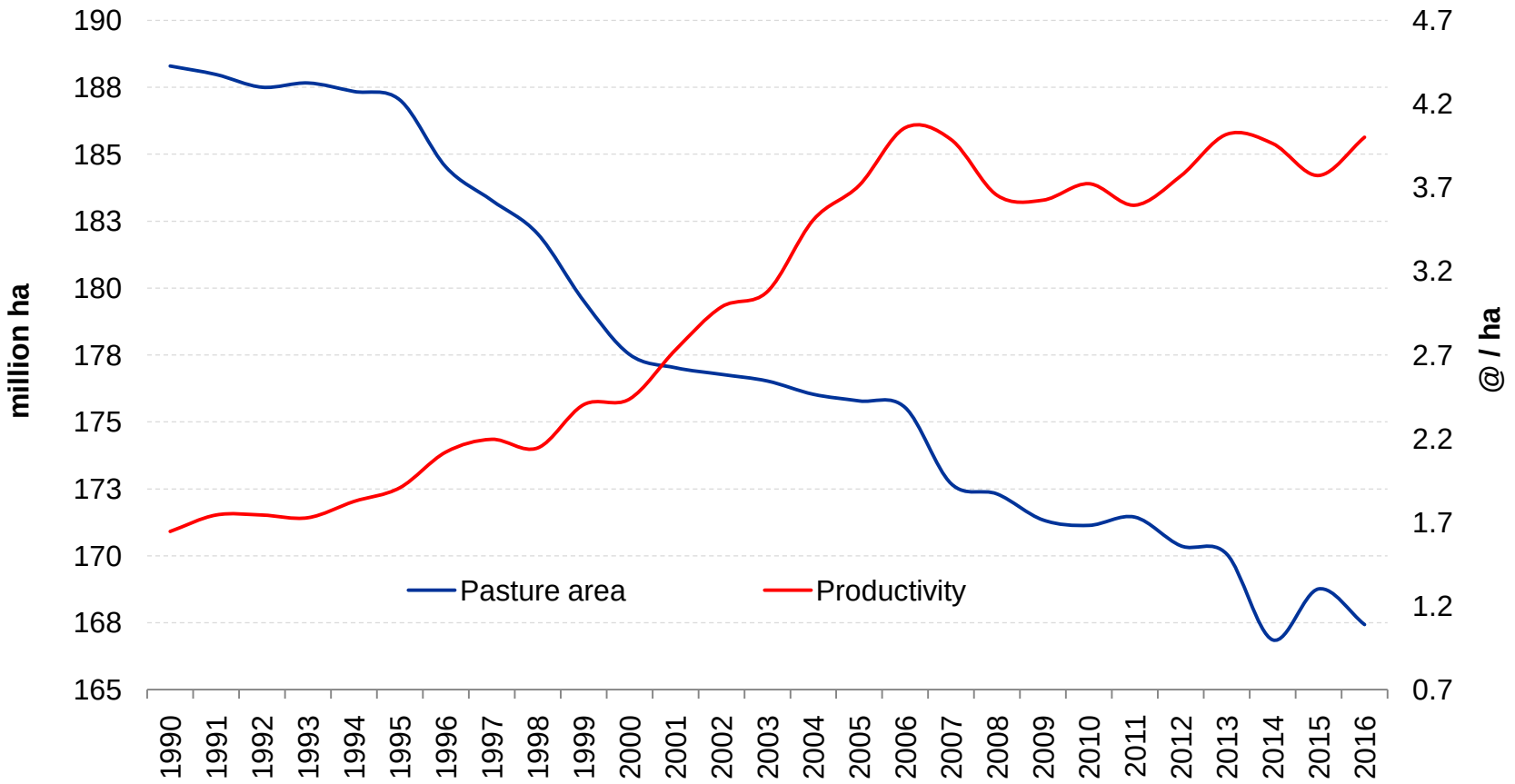
Motivation



Sources: ABIEC. ABPA. Nota: Suínos. valor estimado.

Motivation

Pasture area (Mha) and livestock productivity (@/ha) in Brazil (1990-2016)



Source: Agroconsult/IBGE

Brazil and climate change

2009

COP-15 Copenhagen – Denmark

Voluntary commitment to reduce GHG emissions

37% below 2005 levels in 2025
43% below 2005 levels in 2030

National Plan for Climate Change (PNMC) released in December, 2009

Several sectorial plans

ABC Plan (until 2020)
recover 15 Mha of degraded pasture
increase integrated systems in 4 Mha
other actions

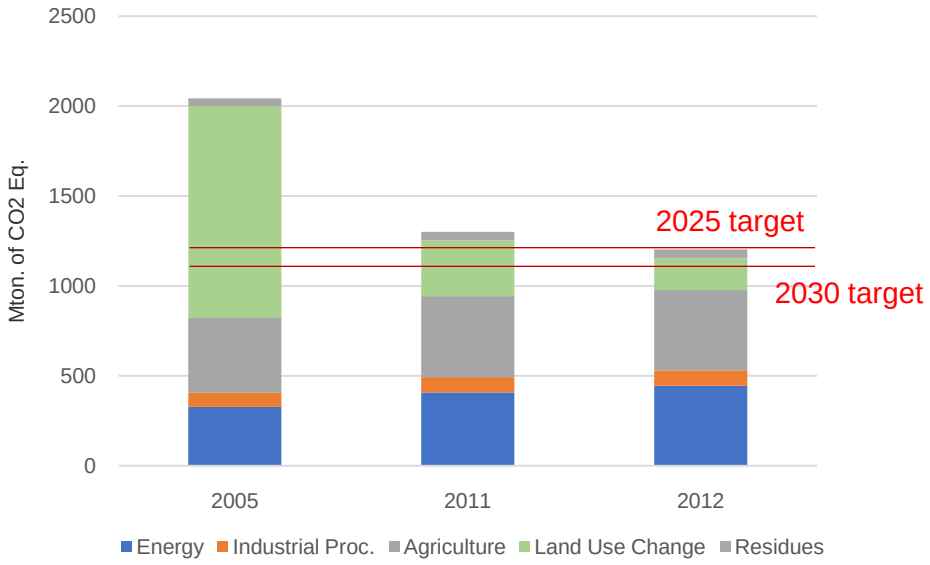
2015

COP-21 Paris – France

Brazilian iNDC reinforces the importance of low-carbon agriculture to reduce GHG emissions

Period 2020-2030

Recover +15 Mha of degraded pasture
Increase +5 Mha integrated systems



ABC Plan

- Agro-environmental policy
- Mitigate GHG emissions in agriculture, improve efficiency in the use natural resources and increase the resilience of productive systems and rural communities, as well as enable the sector to adapt to climate change
- Investments in sustainable technologies

ACTIONS

- recover 15 Mha of degraded pasture;
- increase the adoption of crop-livestock-forestry systems in 4 Mha;
- increase the no-till system in 8 Mha;
- increase the Biological nitrogen fixation in 5.5 Mha, substituting the nitrogen fertilizers;
- increase the planted forests in 3 Mha;
- expand the treatment of animal waste in 4.4 Mm3;

RESEARCH QUESTIONS

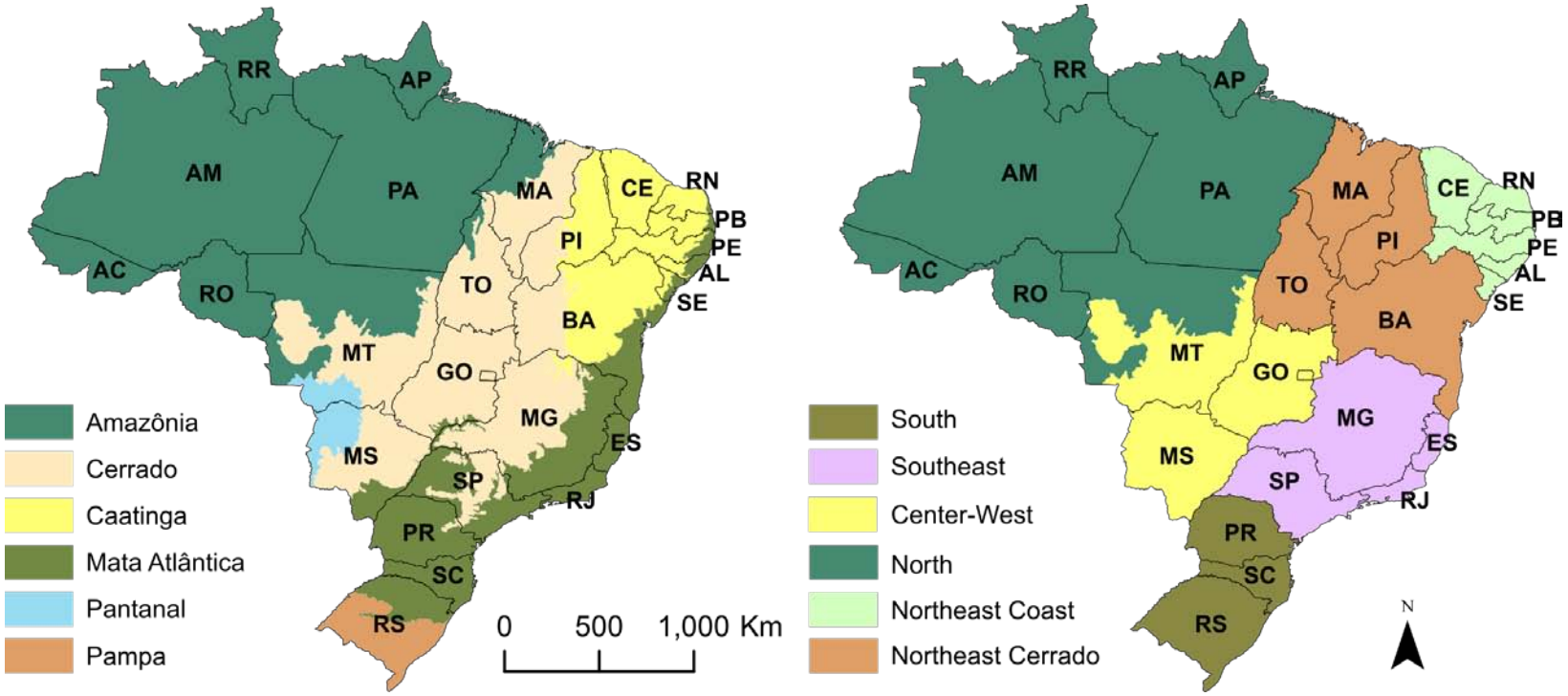
- What will be the effects of the ABC Plan for the economic growth in terms of welfare and aggregate production?
- What will be the impacts on sectoral production and their effects on other sectors and their trade flows?
- What will be the new pattern of land use and regional production given the large volume of degraded areas that will be recovered?

Brazilian Economic Analysis model

- Static computable general equilibrium model, base year 2009
- Multi-regional and multi-sector model
- Six regions: South, Southeast, Center-West, Northeast, Northeast Cerrado, and North
- Land-use in 8 categories: crops, pasture, degraded pasture, natural forest (public and private), managed forest, planted forest, natural areas, and unused*.
- The model is based on GTAPinGAMS nomenclatura
- MPSGE
- Solved as a nonlinear mixed complementarity problem in GAMS

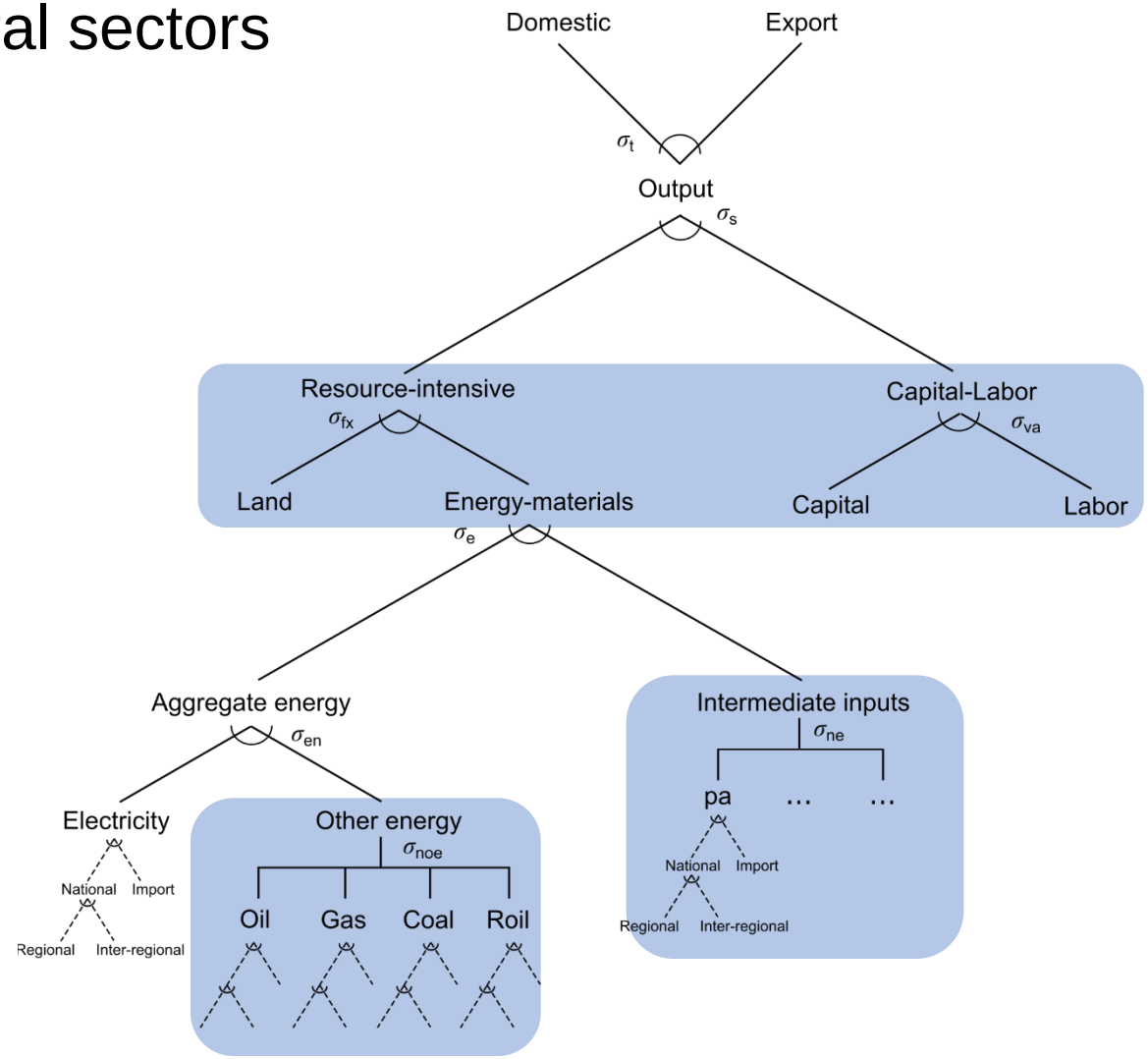
Brazilian Economic Analysis model

- Regional aggregation



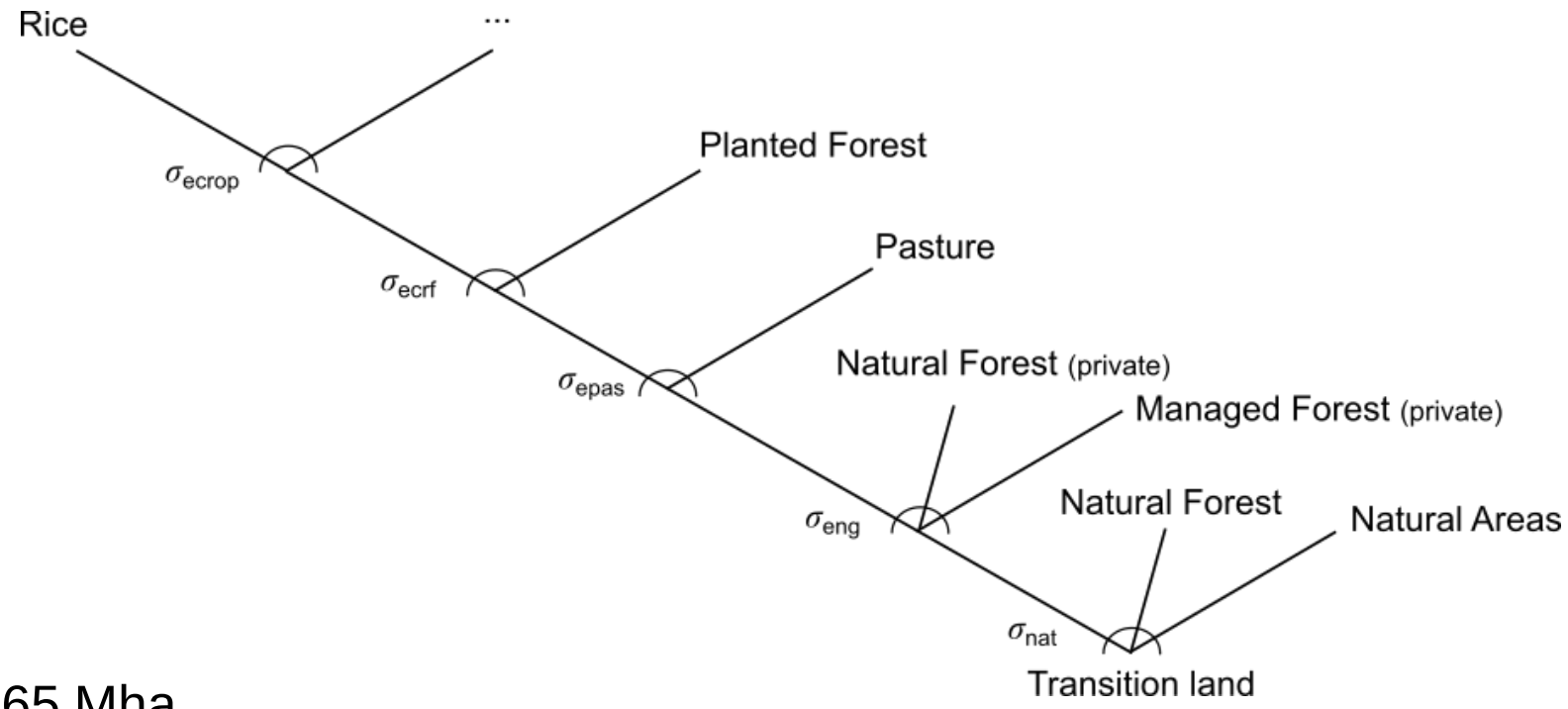
Technology representation

- Agricultural sectors



Land-use supply function

- CET function controls the land supply



~465 Mha

Total area in Brazil: ~851 Mha

Land-use dataset

- 2006 Agricultural Census
- 2009 PPM and PAM
- Total pasture and native vegetation from LAPIG
  - Degraded pasture: Observatório ABC

Pasture and degraded pasture areas in the base year.

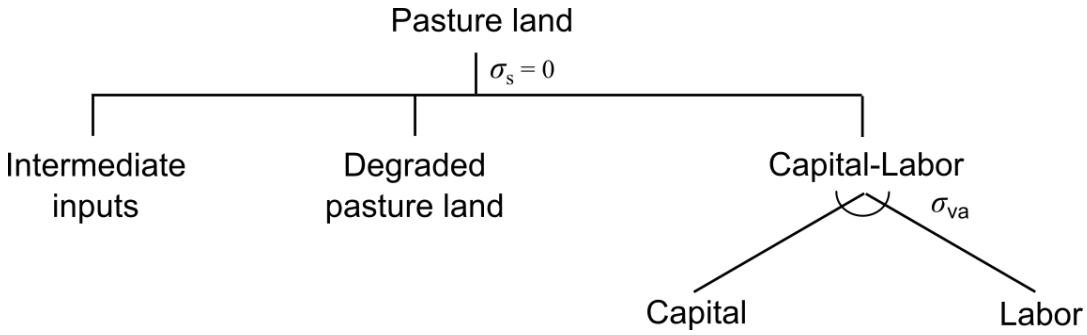
Regions	Pasture (1,000 ha)			Levels of degradation	
	Total	Degraded	Occupation rate	Very high	High
				0 <= or <= 0.4	0.4 < or <=0.75
South	17,740	5,663	0.59	403	5,260
Southeast	28,480	8,398	0.56	1,231	7,168
Center-West	37,743	1,232	0.65	10	1,222
North	34,325	1,834	0.54	461	1,373
Northeast	14,259	11,317	0.38	6,586	4,731
Northeast Cerrado	36,248	19,775	0.32	13,627	6,148
Total	**168,794**	**48,220**	**0.51***	**22,317**	**25,903**

* Average of all regions

Backstop technologies

- Pasture recovery

- CGE modelling representation



Backstop technologies

- Integrated systems (IS)

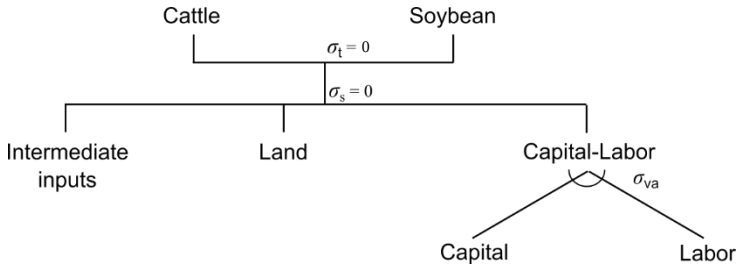
iCL - maize

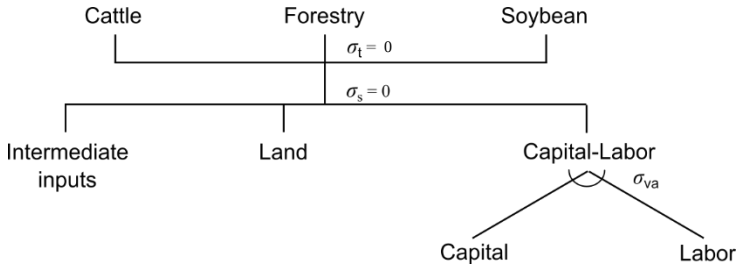
iSLF - forestry

iSL - soybean

Backstop technologies

- Modelling IS in a CGE framework





Regions	South	Southeast	Center-West	North	Northeast	Northeast Cerrado
Integrated soybean-livestock system						
Fertilizers	0.283	0.289	0.296	0.294	-	0.297
Defensives	0.367	0.375	0.384	0.381	-	0.385
Chemicals	0.069	0.070	0.072	0.071	-	0.072
Capital	0.014	0.015	0.015	0.015	-	0.015
Labor	0.199	0.203	0.208	0.206	-	0.209
Pasture	0.068	0.049	0.026	0.032	-	0.022
Integrated soybean-livestock-forestry system						
Fertilizers	0.293	0.293	0.298	0.299	-	0.298
Defensives	0.379	0.380	0.386	0.387	-	0.387
Chemicals	0.071	0.071	0.072	0.072	-	0.072
Capital	0.015	0.015	0.015	0.015	-	0.015
Labor	0.205	0.206	0.209	0.210	-	0.210
Pasture	0.037	0.035	0.020	0.017	-	0.017

Source: based on (SENAR, 2013) and own elaboration.

Scenarios

Non-priority

- recover 15 Mha of degraded pasture
- increase the integrated systems in 4 Mha
- freely movement of the investments in these technologies

Priority

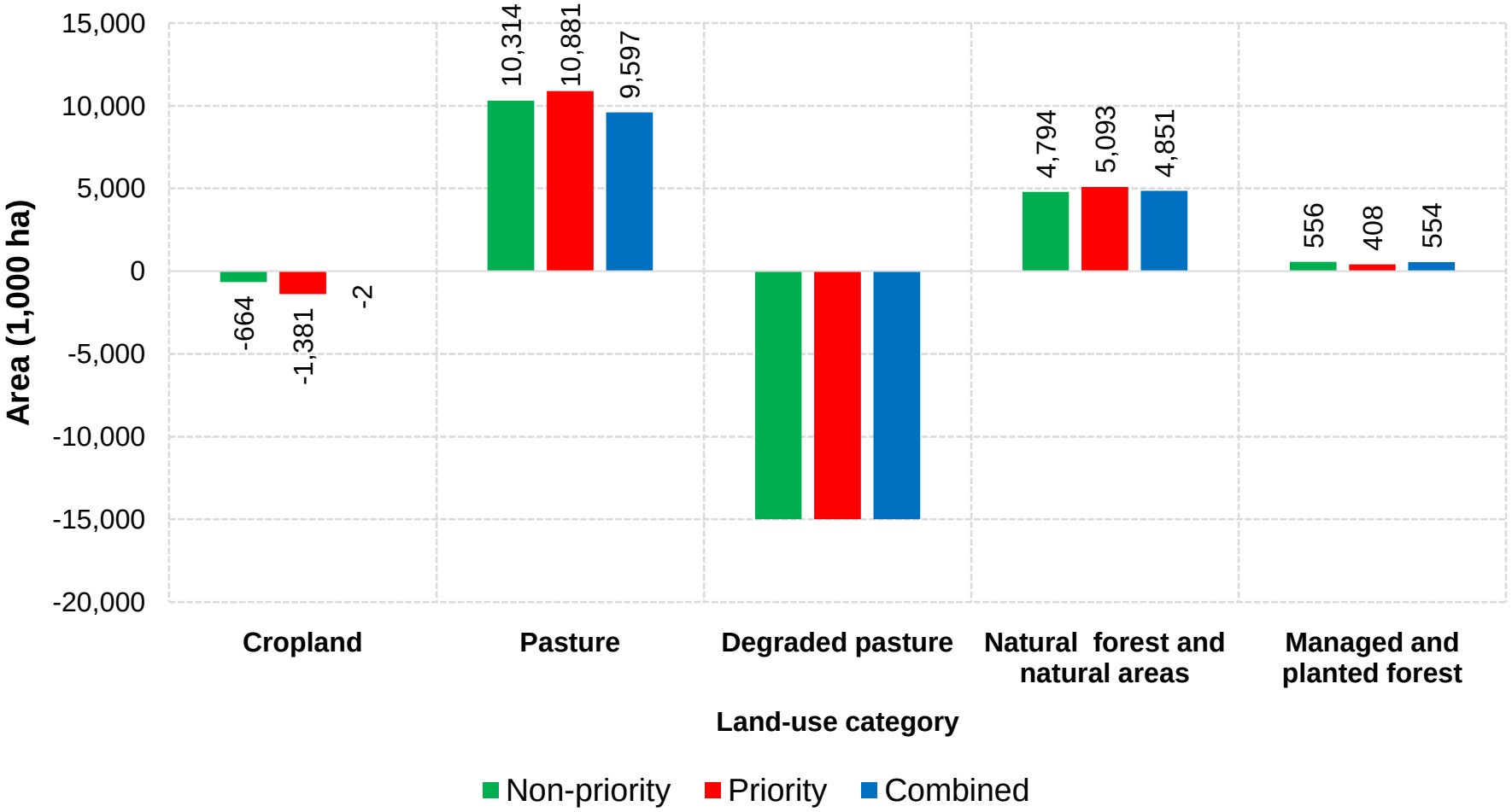
- recover 15 Mha of degraded pasture
- increase the integrated systems in 4 Mha (observed data)
- the technologies are strictly used in priority regions defined by the degraded pasture level in the model benchmark

Combined

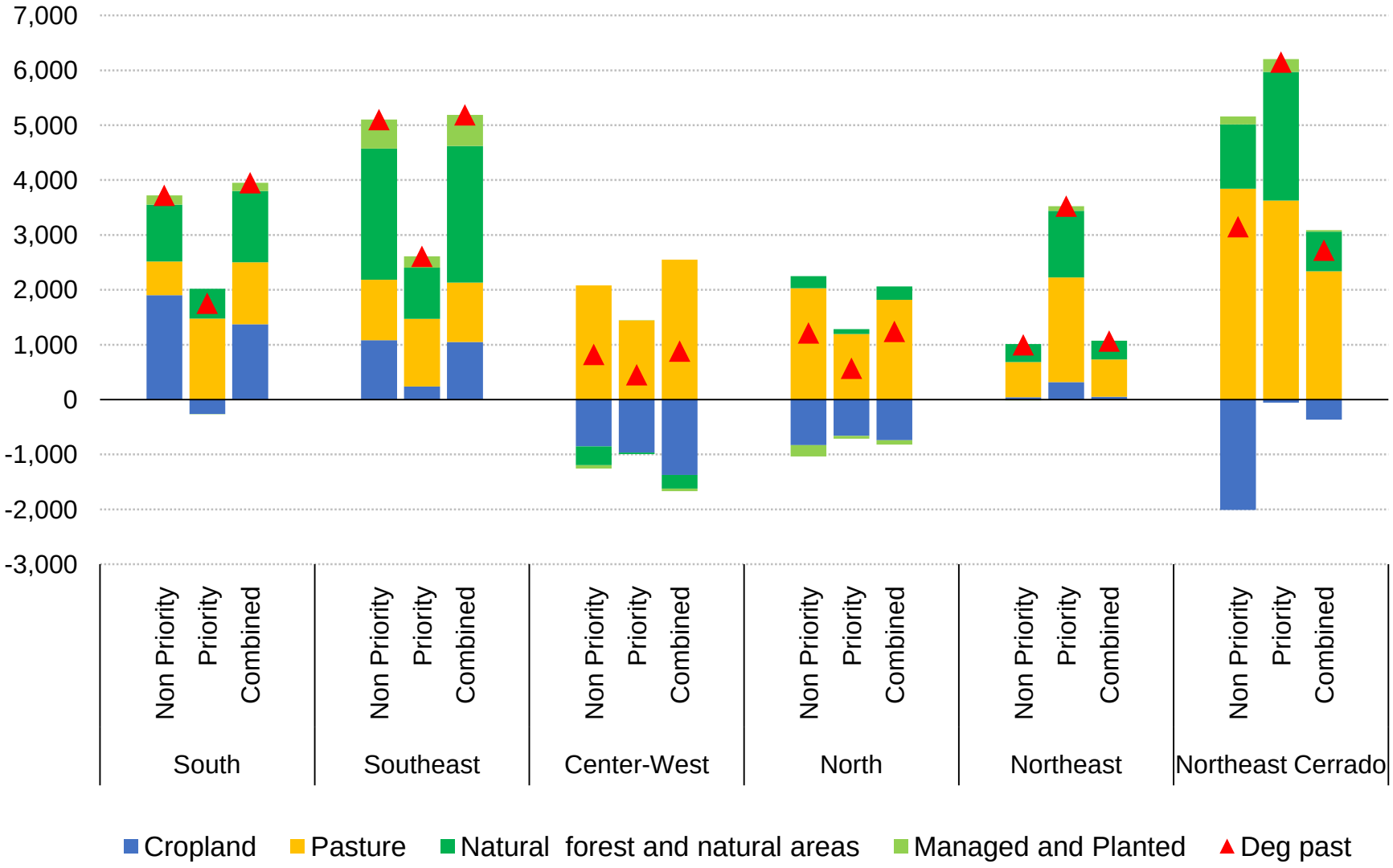
- recover 15 Mha of degraded pasture
- increase the integrated systems in 4 Mha (observed data)
- the assumption over priority areas is relaxed

Land-use changes

- Aggregated land-use changes under different scenarios.

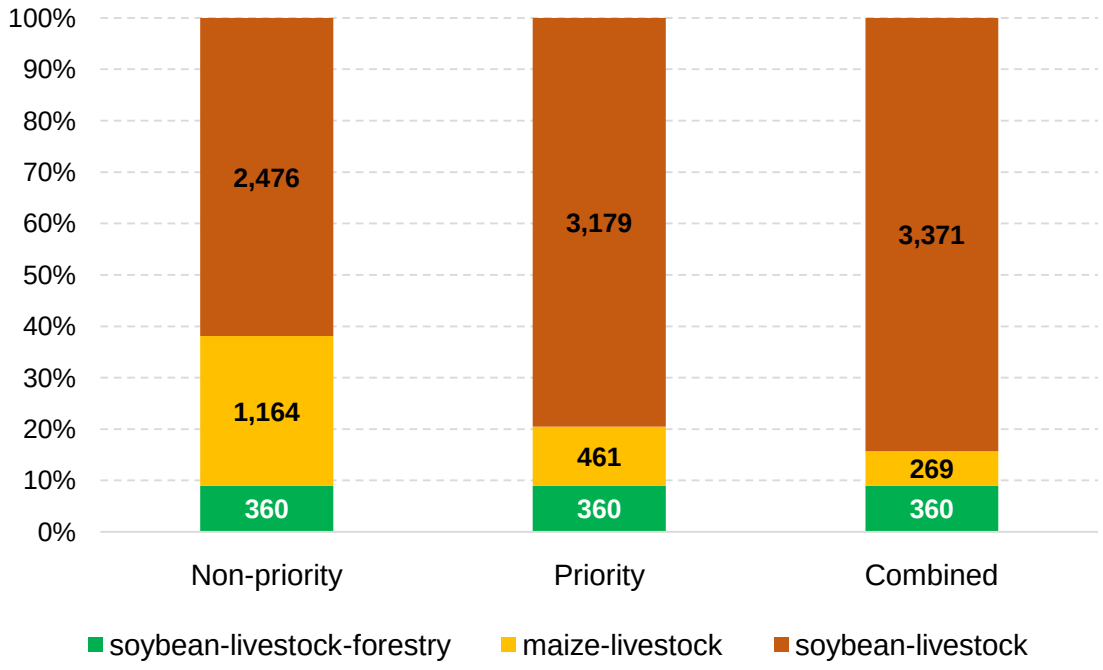


Regional land-use changes

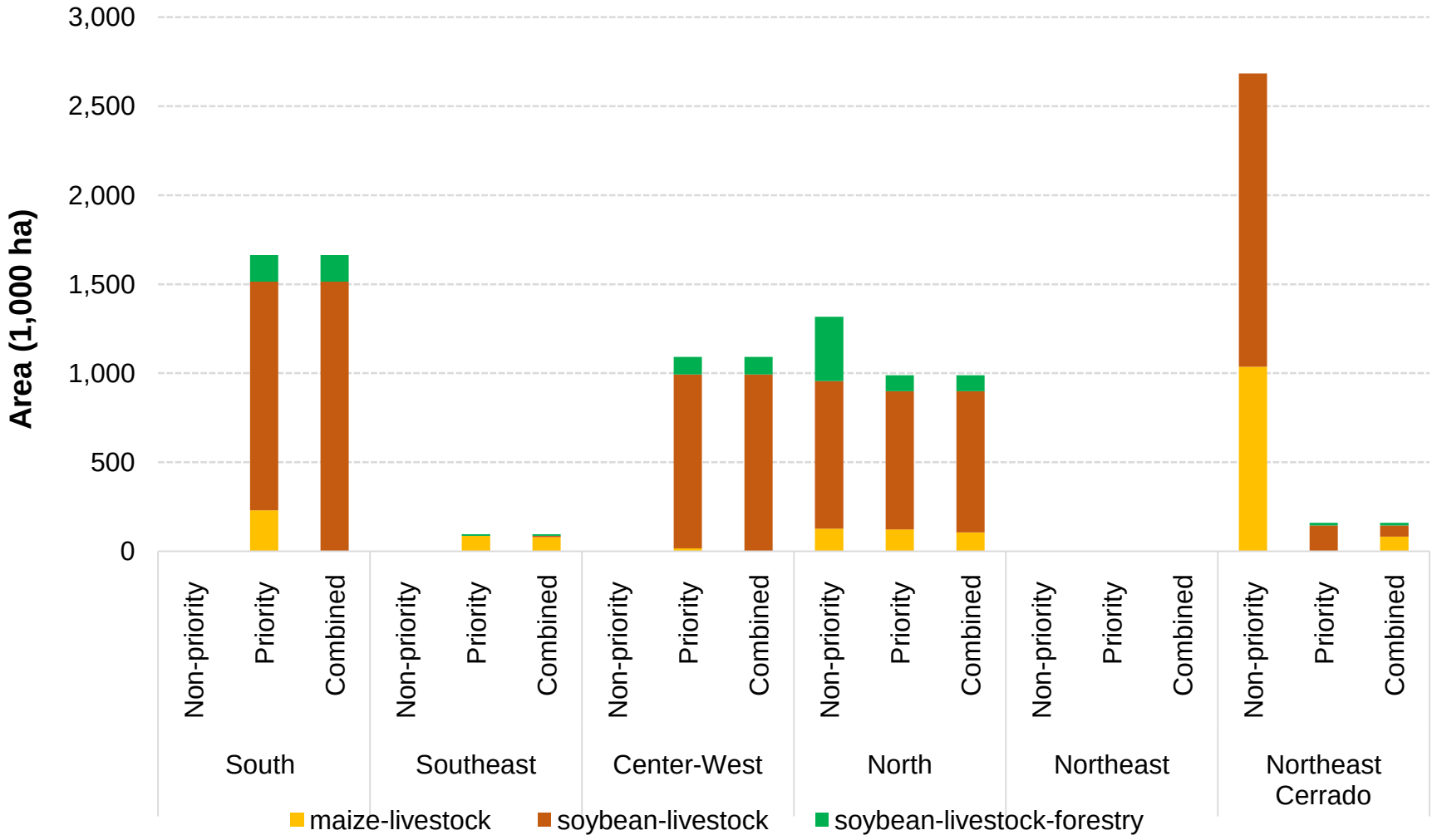


Land-use changes

- Area of each integrated systems under different scenarios (1,000 ha).



Area of integrated systems by region



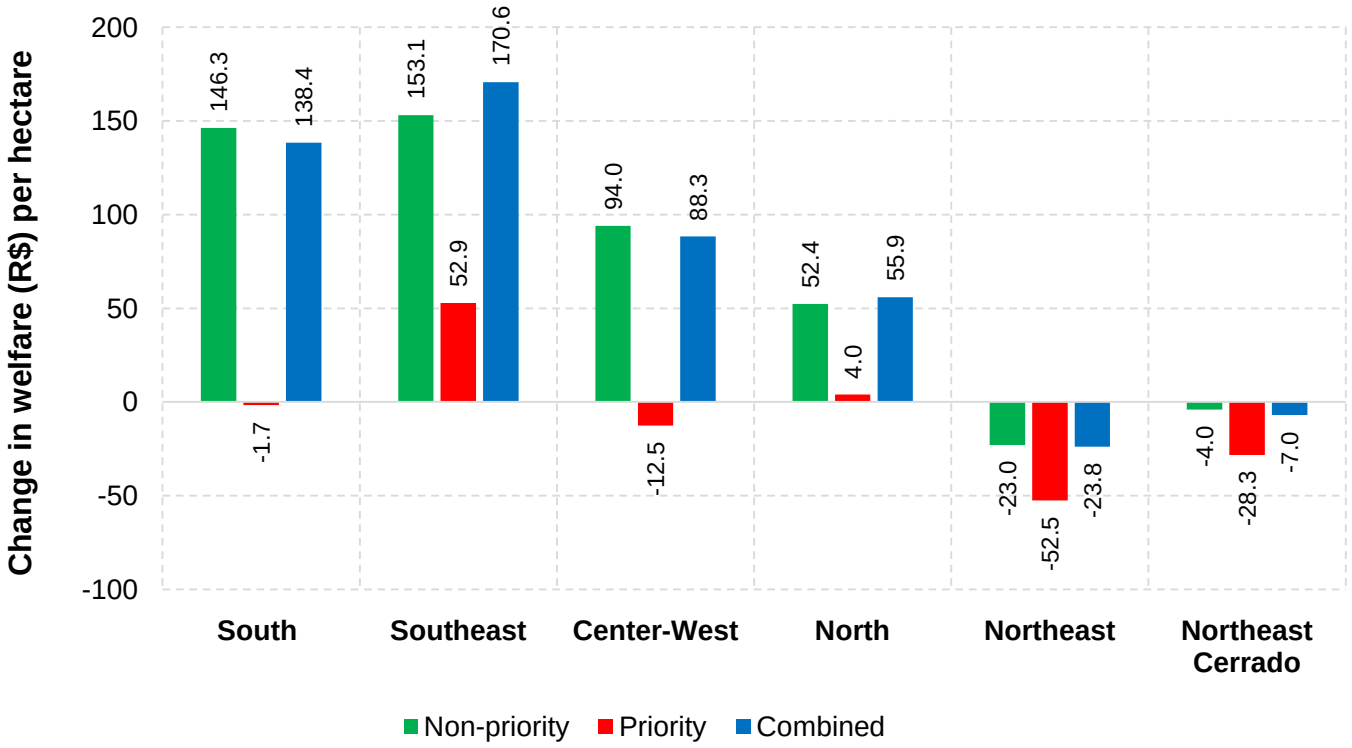
Integrated systems

- Index of production value per hectare by integrated systems compared to single production (*Combined Scenario*).

ICL technology	maize-livestock		soybean-livestock		soybean-livestock-forestry		
	maize	cattle	soybean	cattle	soybean	cattle	forestry
South	1.095	1.097	-	-	1.090	1.088	1.089
Southeast	1.023	1.021	1.018	1.017	1.024	1.025	1.023
Center-West	-	-	1.041	1.039	1.016	1.015	1.015
North	1.074	1.080	1.085	1.087	1.056	1.057	1.056
Northeast	-	-	-	-	-	-	-
Northeast Cerrado	1.181	1.182	1.188	1.185	1.195	1.197	1.194

Macroeconomic outcomes

- Welfare



Conclusions

- These results and the interests of different stakeholder groups can help adjust policies to improve their efficiency in achieving desired outcomes
- Policies which do not force the pasture recovery on specific geographical areas, but let the farmers choose where to implement it are more effective and less expense per hectare
- The results have shown that the pasture recovery associated to the IS technologies are land-saving technologies
- Great opportunity for livestock intensification as well as reduce the pressure to clear new natural areas
- Areas with natural vegetation and forests increase (Southeast and South), while reduce in the Center-West region (Cerrado biome) and North (Amazon biome)

Conclusions

- Greater specialization in crop production (Southeast and South) and livestock production (Center-West and North)
- IS with soybean has shown economic advantages across regions, specially without enforce policy
- The IS can improve the efficacy of investments, intensify land use, and provide a stable productive system (20% in the Northeast Cerrado region)
- Livestock integration the landholders have more options for diversification and consequentially additional income.
- Uncertainties concern credit data and investments destination, as well as the total areas already recovered and with IS
- The projections indicate the urgency to increase the rates of pasture recovery and IS to achieve the commitment until 2020

Conclusions

- Further work…
- Track volume of production and heads in livestock sector
- Track GHG emissions, specially in the IS systems
- Turn on double cropping representation
- Evaluate if the GHG emissions associated to the demand of chemicals sectors, as well as energy sectors could off-set the mitigation potential of these technologies

END

THANK YOU!

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