Projections of Methane Emissions by the Brazilian Beef Sector and Alternatives for Mitigation
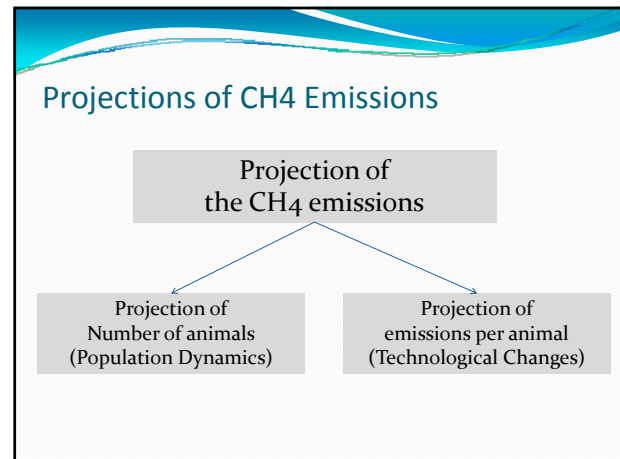
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Embrapa Cerrados
Brazil

Projections of CH4 Emissions

Projection of
the CH4 emissions

Projection of
Number of animals
(Population Dynamics)

Projection of
emissions per animal
(Technological Changes)

Projection of the Number of Animals

Projections of Animal Numbers

- Assumption: Meat Supply and Demand converge in long term (per unit product approach).
  - If technical coefficients are constant, animal numbers and emissions would change proportionally to production.
  - If there are technology changes over time, animal numbers, herd composition and emissions are not proportional to production

Technological changes in the Brazilian Beef Sector
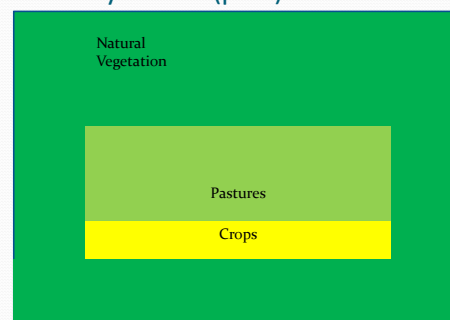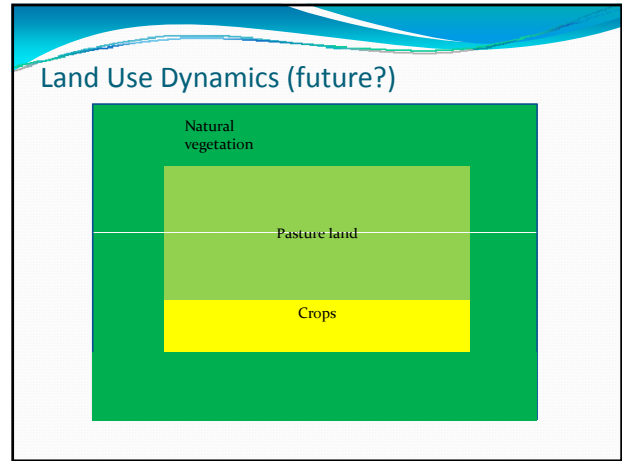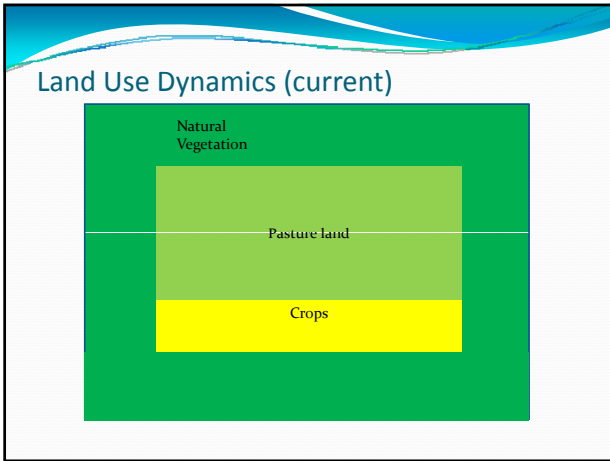
A brief analysis

Traditional extensive systems

- >90 % of number of animals;
- National Market: low demand;
- High land availability, low prices;
- Land and Animals as reserve of value;
- Land Ownership;
- Low Input (low dependence on infrastructure);

The context is changing…
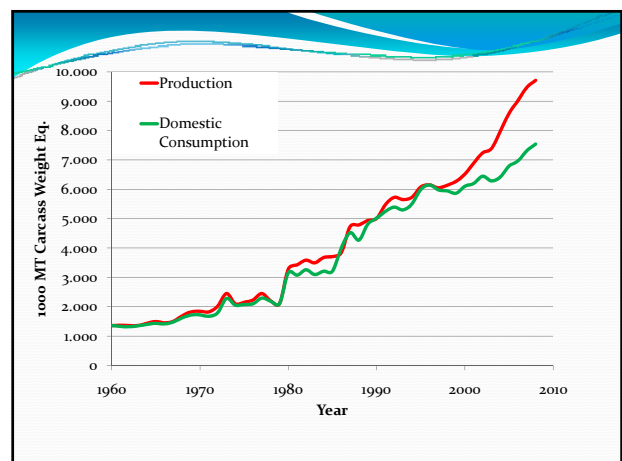
- Land Use and Value

Land Use Dynamics (past)

Natural Vegetation

Pastures

Crops

Land Use Dynamics (current)

Natural
Vegetation

Pasture land

Crops

Land Use Dynamics (future?)

Natural
vegetation
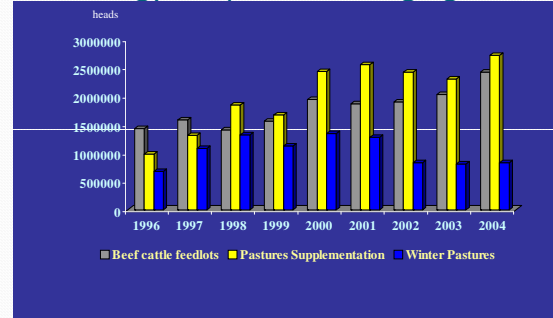
Pasture land

Crops

The context is changing…

- Increasing demand
- International market

The context is changing…

- Economic stabilization
  - Land and Animals as production factors;
- Land Ownership
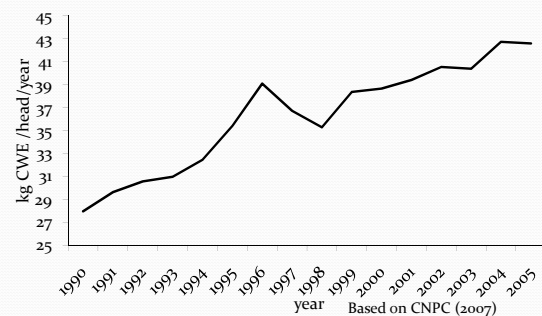 - Better regulation and control
- Improving infrastructure

Technology adoption is changing

Production systems are changing…

Animal Performance is changing…


Based on CNPC (2007)

Modelling Approach

- Developing a simple population dynamics model
  - Non steady state population
  - Stocks were defined by age, gender and reproductive capacity of the animals
- There was no system tipification, so just overall national levels of animal performance and feed quality
  - Despite large heterogeneity in production systems there was no detailed data available about the proportion or management practices in those systems up to date

Modelling Approach

- Technological changes were addressed by changing linearly the technical coefficients over time:
  - Calving rates
  - Liveweight gain (and respective rates of transfer of animal between age categories)
 - Feed quality compatible with liveweight changes
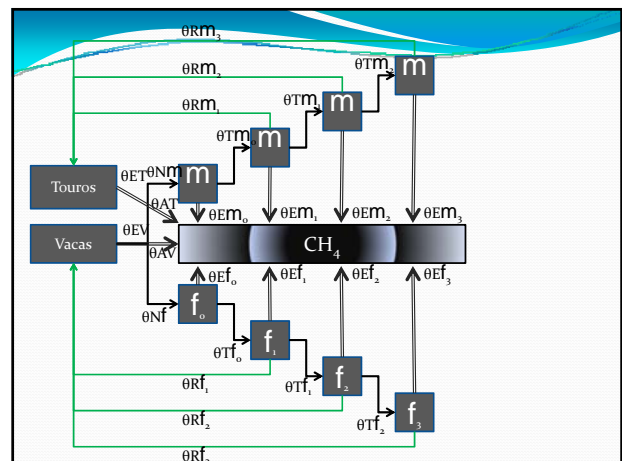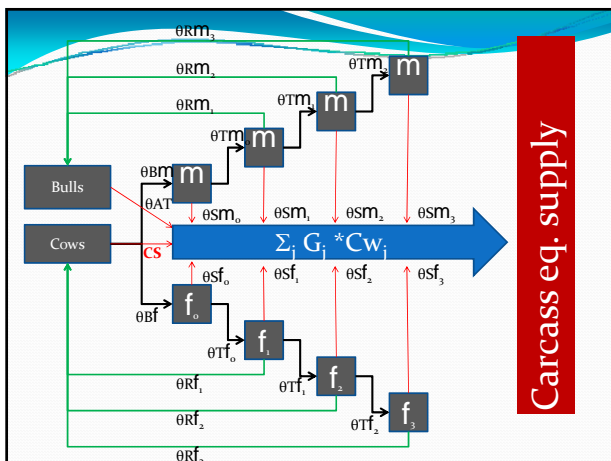
Model Assumptions

- Meat supply and demmand converge in long term
- CH4 emissions can be adequately estimated from overall levels of animal performance and feed quality
- Cow numbers are enough to allow for sustainable slaughter (i.e. calves produced >= slaughter + losses)
- Proportion females alocated for replacement remain constant.

Analytical procedures

- Simulations used difference equations and 1 yr time step
- Technical coefficients were adjusted from animal numbers in each category and slaughter statistics in the period 2000 - 2007 (FNP, 2007; IBGE,2007)
- Slaughter weight for each category was calculated based on overall rates of LWG for each year, except for cows and 4 yr olds which were kept constant (variation in LWG?)
- No production cycles were considered data on demand produced by the Brazilian Ministry of Agriculture did no account for that)
- Fitting of supply and demand was made by changing cows slaughter numbers using GRG algorithm
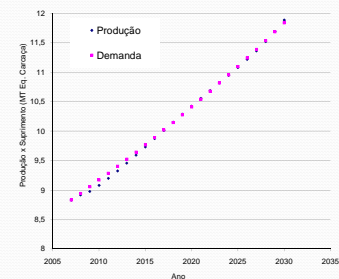
Bovine Meat Demmand projection
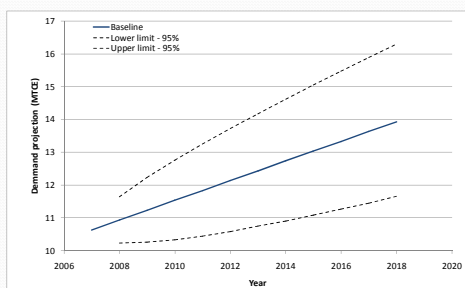
Ministry of Agriculture
(Jan 2008)

Fitting supply and demand by changing annual cow slaughter

$$min \sum_{y=2008}^{2030} \left(D_y - S_y \right)$$

$$S_y = \sum_j G_{yj} * CW_j$$

Baseline scenario assumptions

|	
Cow reproductive performance	Average natality rates increasing from 60% to 65%
Mortality	Decreasing from 8% to 6% per year for calves, 2% per year for all other categories
Feed Quality	Increasing 2 percent units in diet digestibility due to the combined effect of genetic improvement/species substitution, supplementation and migration of livestock production to areas with shorter dry season and improved pasture management.

Projection of Methane emissions per animal

Preliminary Results

Year	Cow number (million)	Animal number (million)	Slaughter (million)	Meat production (MMTCE)	Methane emission (MMTCH$_4$)	CH4/CWe
2007	64.3	208.0	43.0	8.83	9.56	1.08
2011	63.3	209.8	45.1	9.20	9.55	1.04
2015	63.0	214.0	48.0	9.73	9.65	0.99
2019	62.6	217.9	51.1	10.29	9.74	0.95
2023	62.1	221.4	54.1	10.81	9.80	0.91
2025	62.0	223.4	55.6	11.08	9.84	0.89
Variation	-3.6%	7.4%	29.3%	25.4%	2.9%	-18.0%

Final remarks

- Model and analysis: Next Steps
  - Include 2008 projections of Beef Demand
  - Include 2007 Census data
  - Include production systems tipology
  - Improve productivity and feed quality projections
  - Build up alternative scenarios

Mitigate by increasing the efficiency of production systems?

Preliminary Results
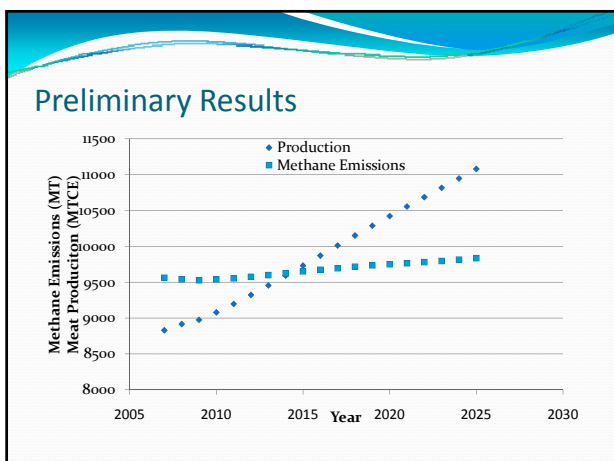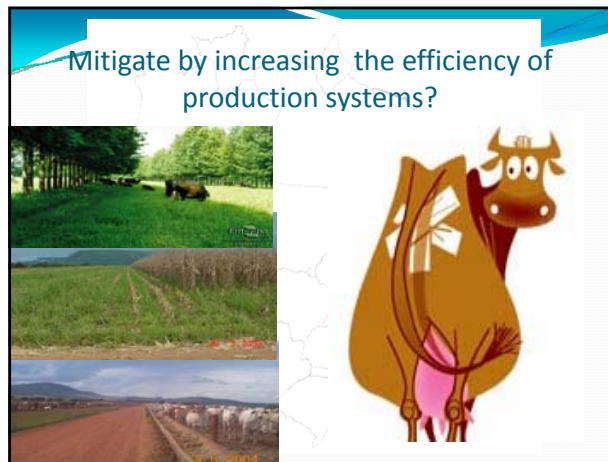
How much are we going to intensify?

Variável/Ano	Cenário	2008	2018	Dif
Produção (t eq. carc. X 1000)	Base	9.7	13.0	+34%
	Intensif.		14.5	+49%
Área (10^6 ha)	Base	175	175	0%
	Intensif.		160	-9%
Produtividade (kg eq. carc./ha)	Base	55.4	74.3	+34%
	Intensif.		90.6	+63%

1996-2006:
20% increase in animal performance (kg carc eq./animal),
10% increase in stocking rates (animals/ha)