New legume varieties and systems of introducing legumes into tropical pastures

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Brachiaria brizantha


Desmodium ovalifolium


Macrotyloma axillare


Arachis pintoi

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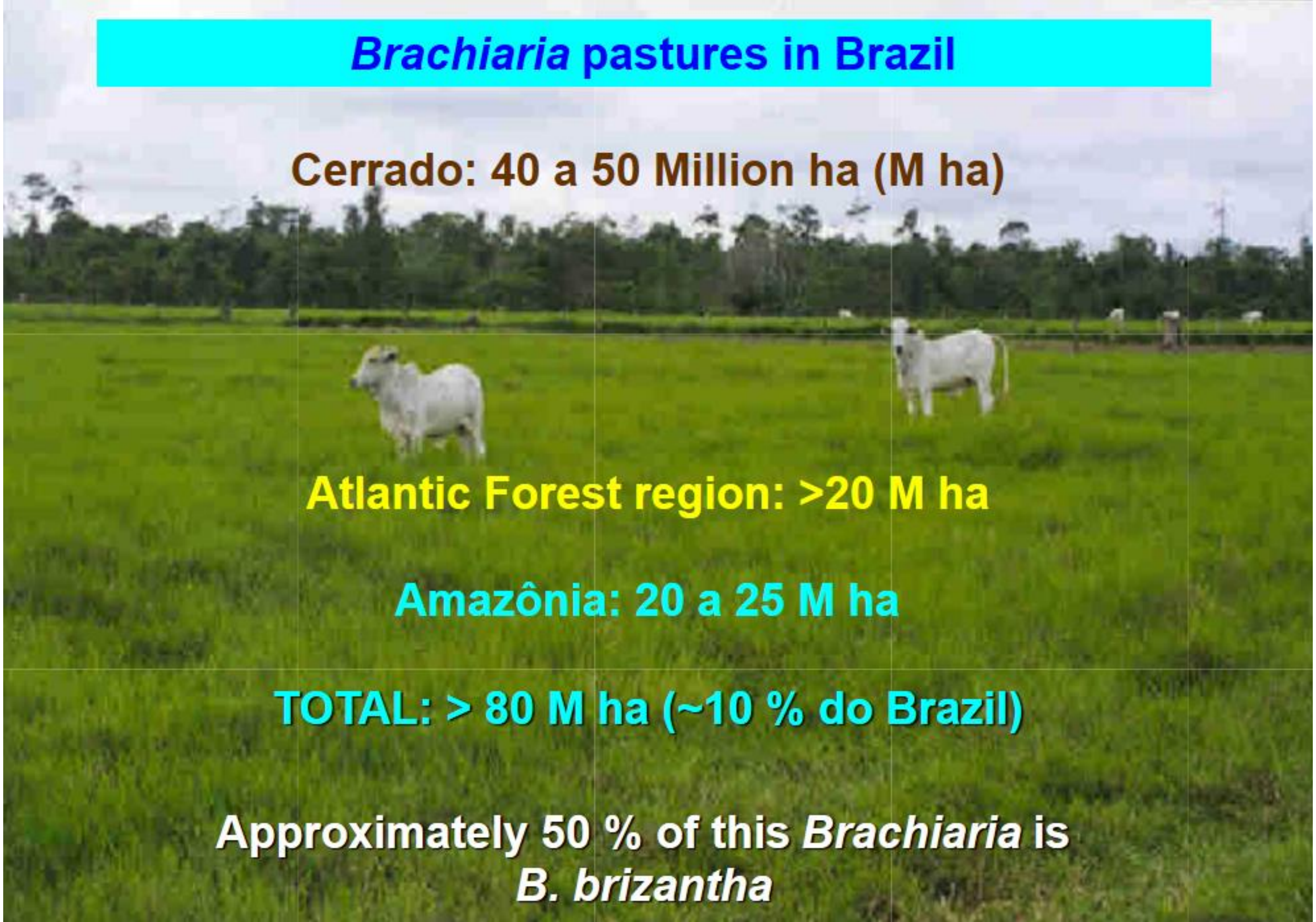
Brachiaria pastures in Brazil



Cerrado: 40 a 50 Million ha (M ha)

Atlantic Forest region: >20 M ha

Amazônia: 20 a 25 M ha

TOTAL: > 80 M ha (~10 % do Brazil)

Approximately 50 % of this *Brachiaria* is *B. brizantha*

So what would be the impact of "intensification" of beef production on improved pasture?

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Five simulations all based on one herd structure

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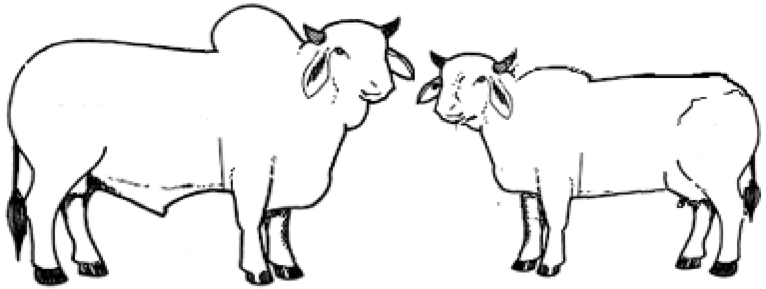
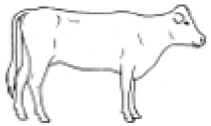
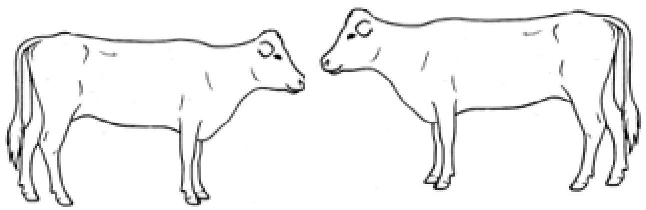
16 Bulls with 400 cows – ratio 1 a 25



Calves - zero to 1 year



Steers/heifers– 1 to 2 years



Adults for fattening>2 years

1. Degraded pasture
Slaughter at 460 kg
Stocking rate 0.5 AU* ha^{-1}

2. Low input
Slaughter at 470 kg
Stocking rate 1.0 AU* ha^{-1}

3. Mixed G/L pasture
Slaughter at 470 kg
Stocking rate 1.7 AU* ha^{-1}

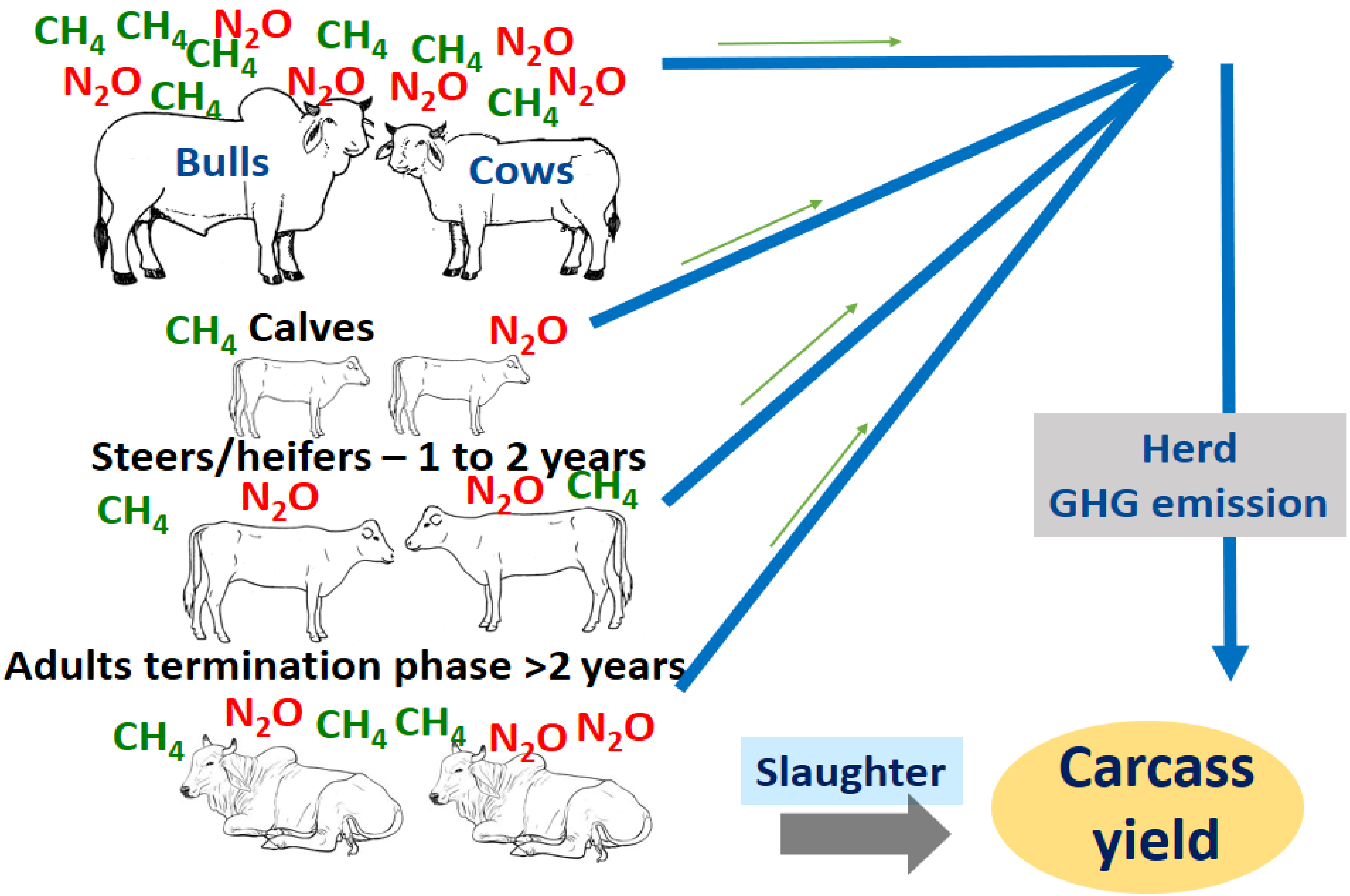
4. Panicum + 150 kg N/ha
Slaughter at 470 kg
Stocking rate 2.5 AU* ha^{-1}

5. Panicum + 150 kg N/ha
Slaughter at 470 kg
Stocking rate 2.75 AU* ha^{-1}

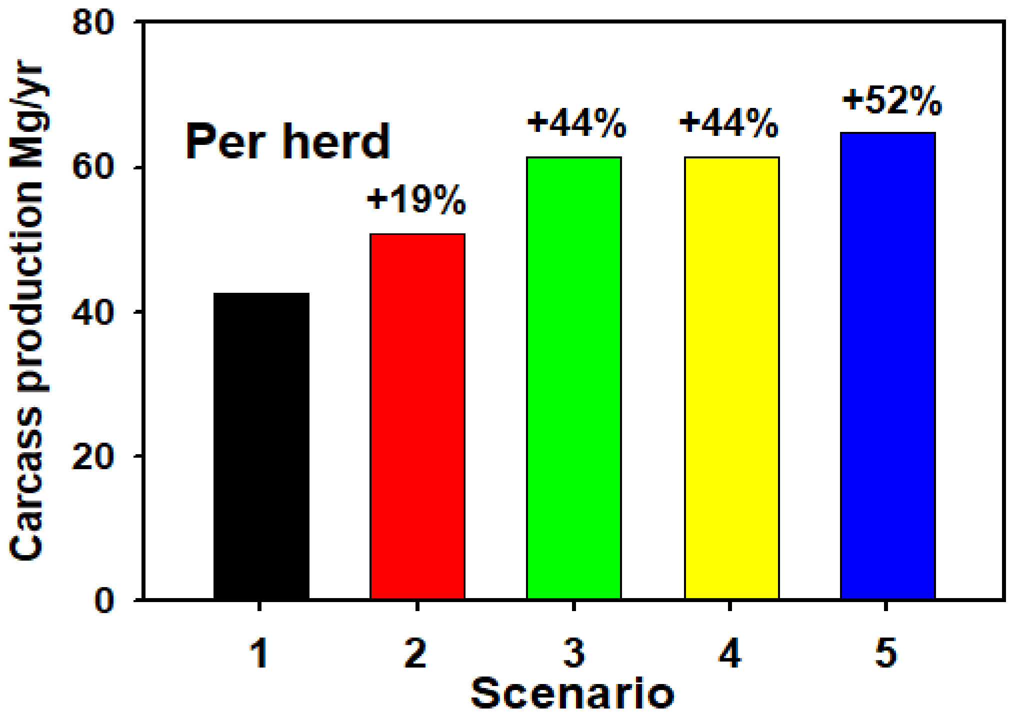
*01 Animal unit (AU) = 450 kg live weight

Cardoso et al. (2016, Agricultural Systems 143: 86–96)

Herd evolution



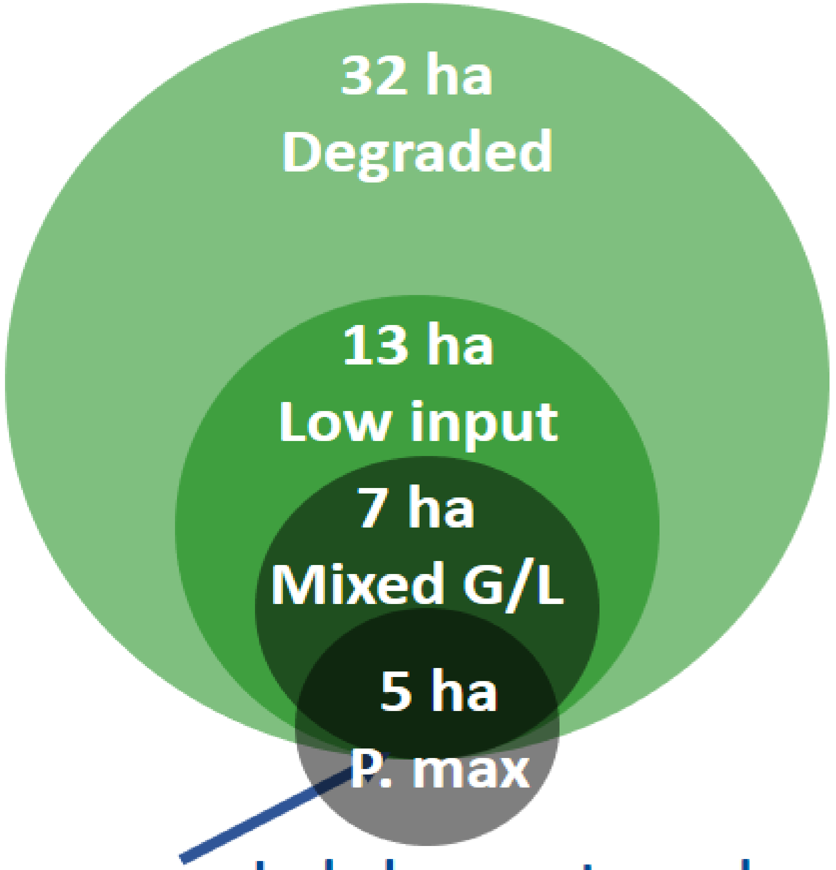
Animal carcass production in the five scenarios



Stocking rate
AU ha^{-1} (PV)

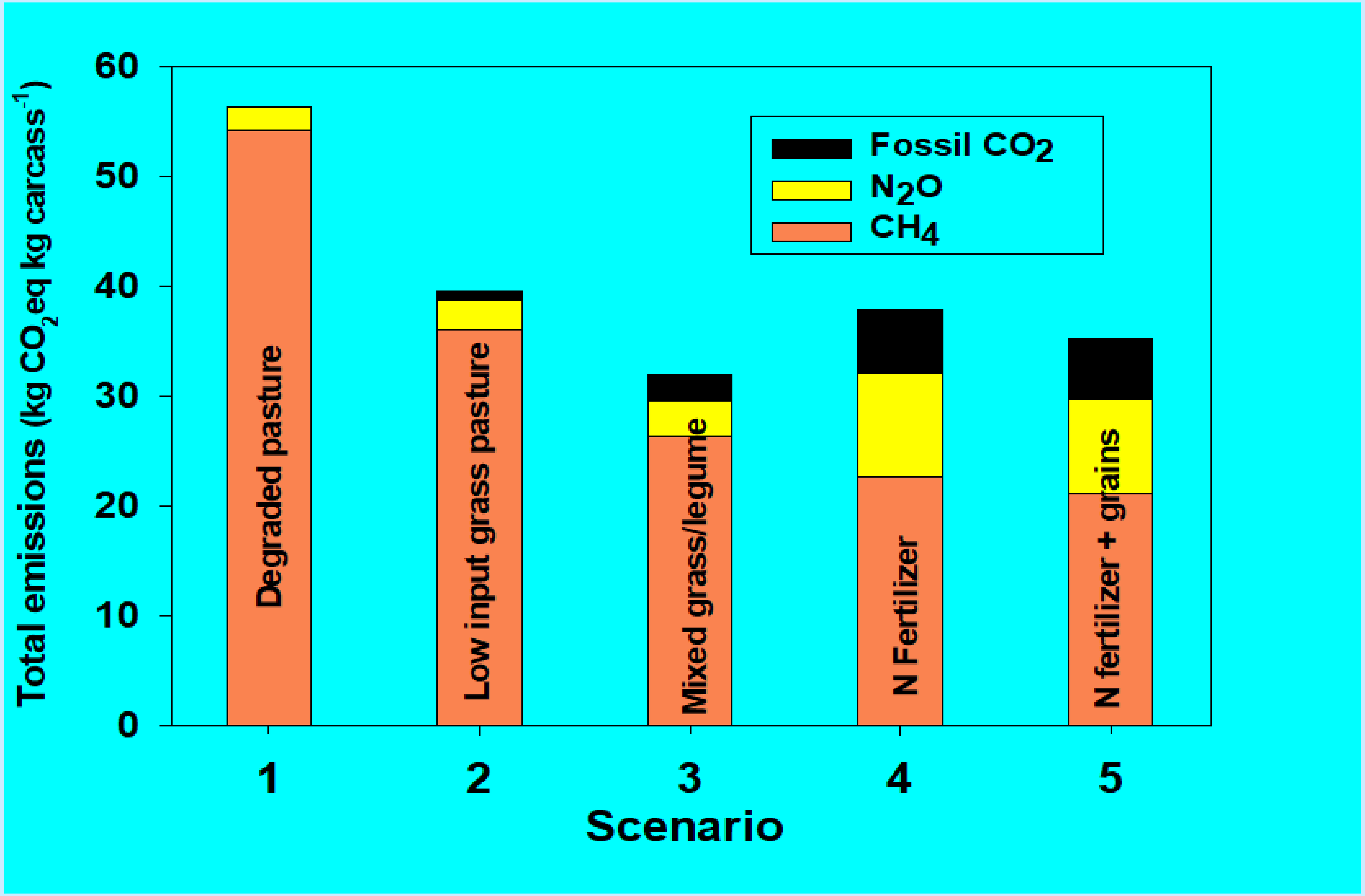
While the cattle fatten much more quickly in the more intensive systems, the cattle for termination only constitute a small proportion of the herd

Area necessary to produce 1,000 kg Carcass

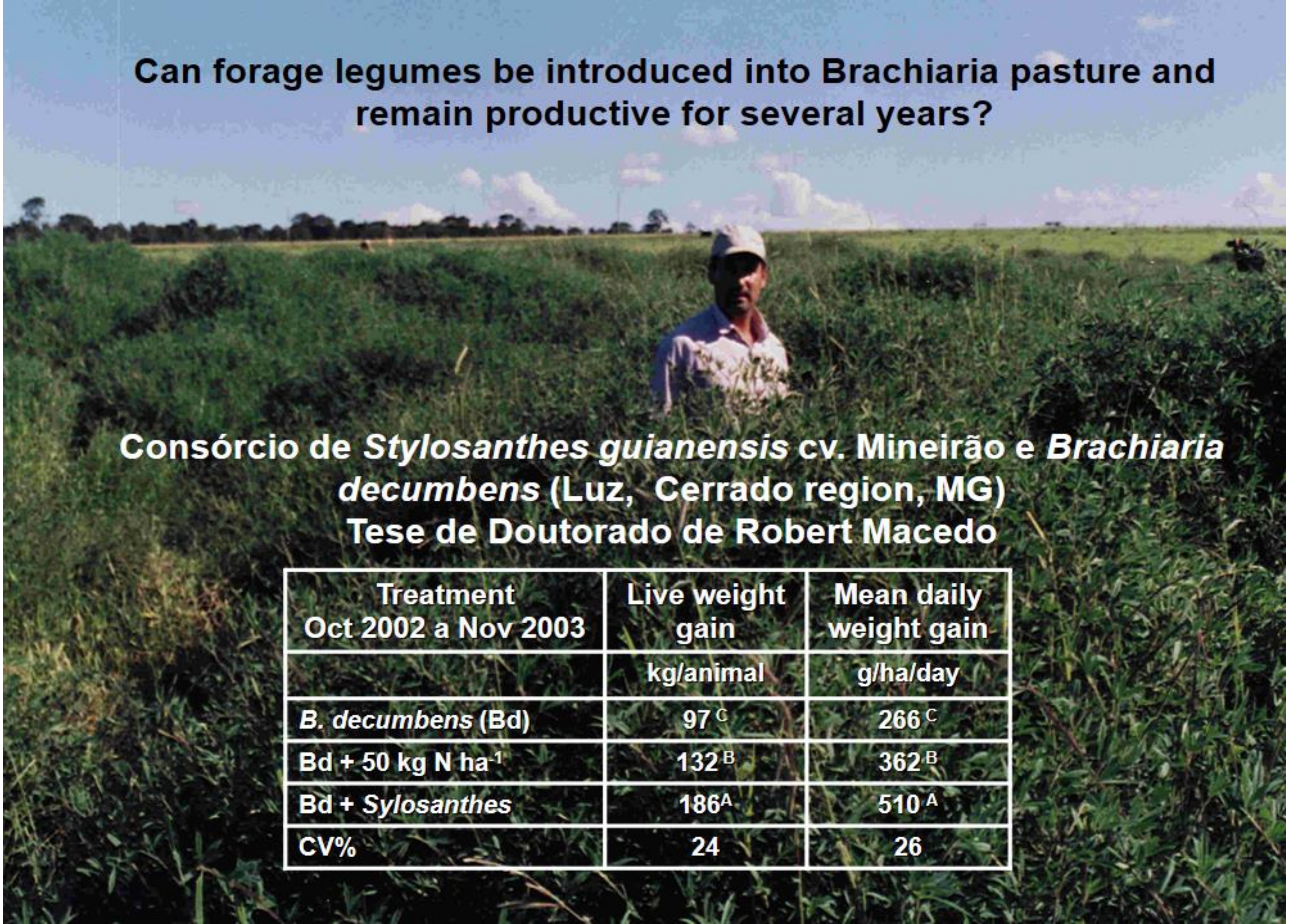


Includes area to produce grain for the final fattening stage.

Total GHG emissions from five scenarios of beef production in Brazil
(Emissions per kg of carcass)



As the N supply for the legume/grass pasture is from BNF with no fossil fuel input, it becomes the scenario with the lowest emissions per kg product

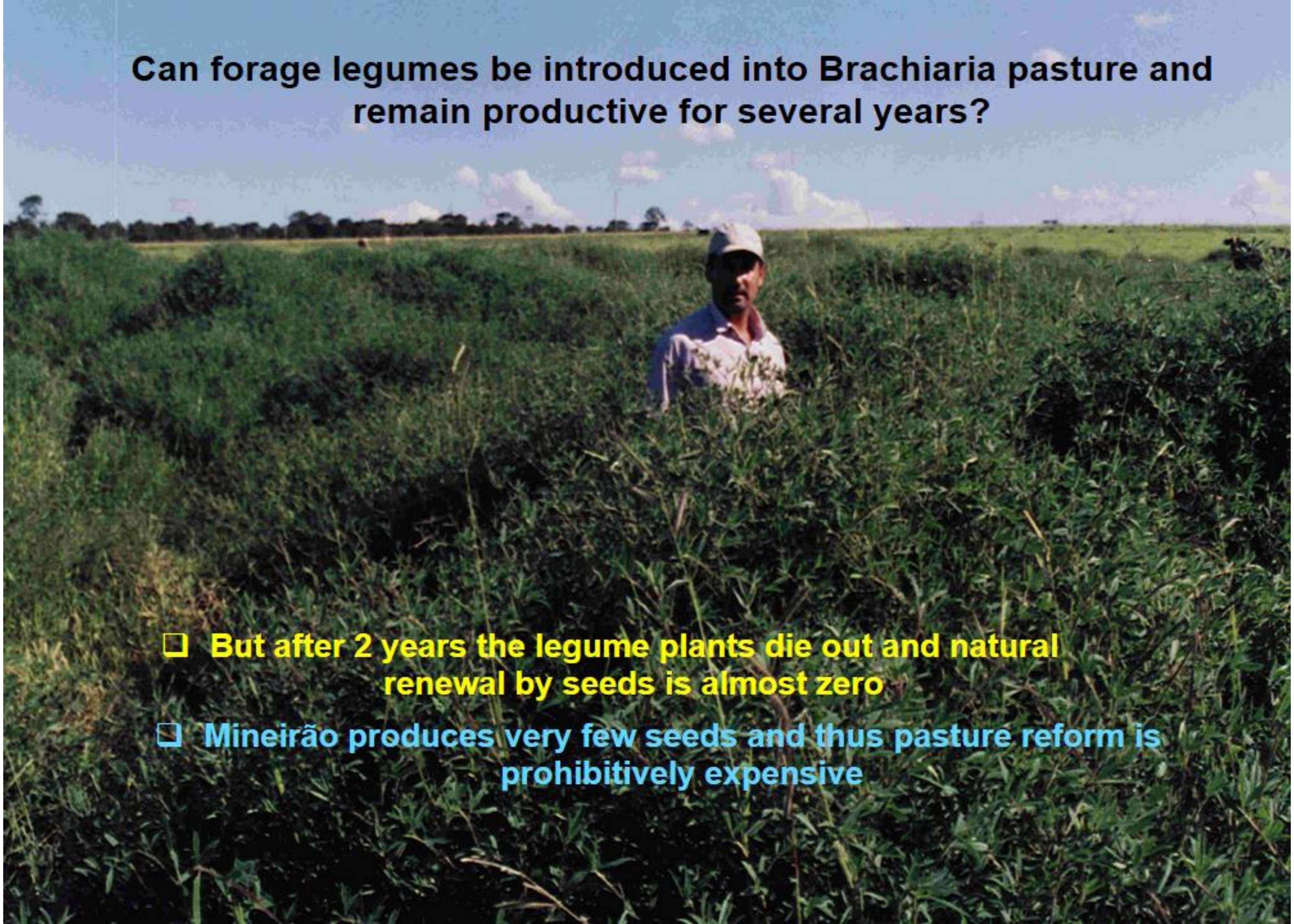


Can forage legumes be introduced into Brachiaria pasture and remain productive for several years?

Consórcio de *Stylosanthes guianensis* cv. Mineirão e *Brachiaria decumbens* (Luz, Cerrado region, MG)
Tese de Doutorado de Robert Macedo

Treatment Oct 2002 a Nov 2003	Live weight gain	Mean daily weight gain
	kg/animal	g/ha/day
B. decumbens (Bd)	97 C	266 C
Bd + 50 kg N ha^{-1}	132 B	362 B
Bd + *Sylosanthes*	186 A	510 A
CV%	24	26

Can forage legumes be introduced into Brachiaria pasture and remain productive for several years?



- But after 2 years the legume plants die out and natural renewal by seeds is almost zero
- Mineirão produces very few seeds and thus pasture reform is prohibitively expensive

Strategies to maintain the forage legume in the pasture are based principally on management

1. Soil management: the forage legumes in question require somewhat more phosphorus than Brachiaria
2. Rotational grazing and regulation of sward height is important for those legumes studies so far.

Effects of grazing management in brachiaria grass-forage peanut pastures on canopy structure and forage intake[1]

Fernanda K. Gomes,* Michael D. B. L. Oliveira,* Bruno G. C. Homem,* Robert M. Boddey,† Thiago F. Bernardes,* Mateus P. Gionbelli,* Marcio A. S. Lara,* and Daniel R. Casagrande*,[2]

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Journal of Animal Science 96: 3837–3849 (2018)

ABSTRACT: Maintenance of mixed grass–legume pastures for stand longevity and improved animal utilization is a challenge in warm-season climates. The goal of this study was to assess grazing management on stand persistence, forage intake, and

considered fixed, while block and year were considered random effects. In the summer, legume mass accounted for 19% of the canopy at 100LI, which was less than other treatments (a mean of 30%). The 100LI treatment had a greater grass stem mass

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Conclusions:

"The range from 90% to 95% of light interception is the recommendation to interrupt the rest period, since this strategy enhanced community stability, forage intake, and nutritional value of the diet."

"Under on-farm conditions, Brachiaria grass and forage peanut pastures should be managed at a range height of 24 to 30 cm"

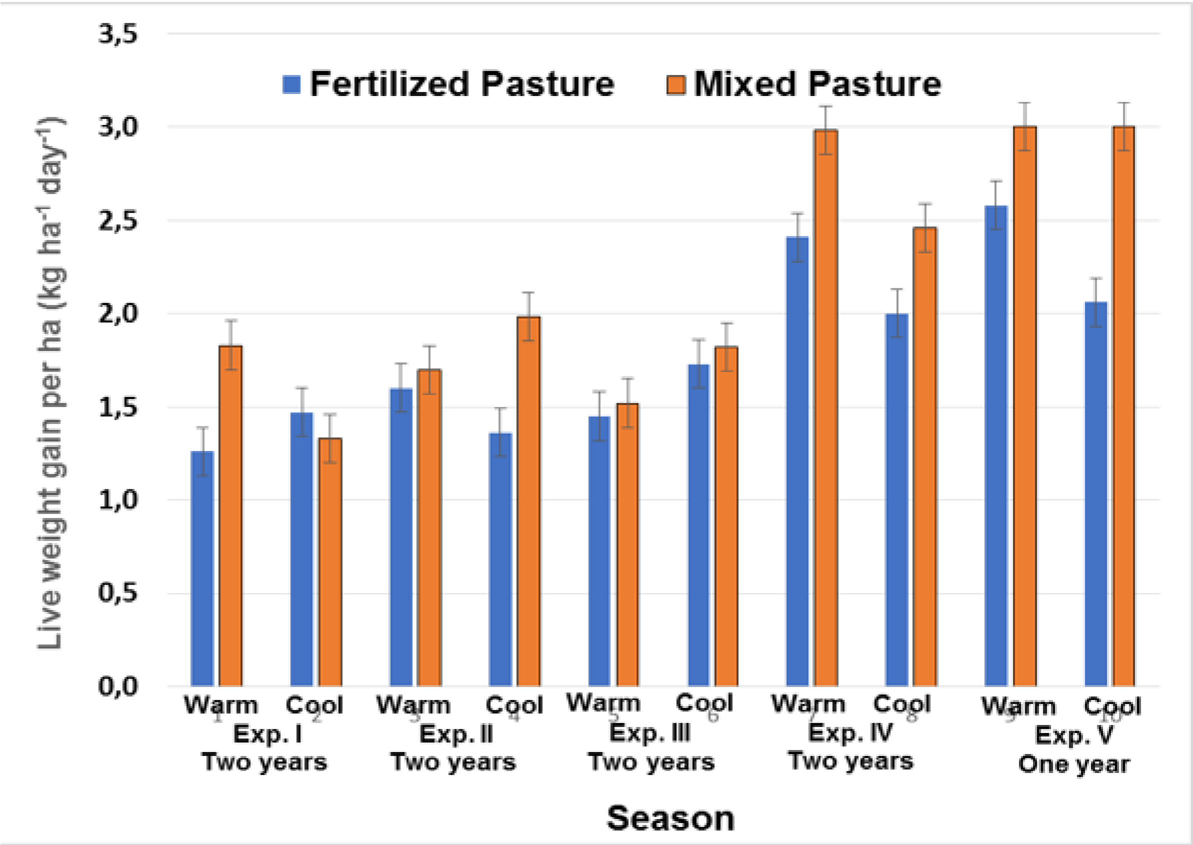
- ❖ The results of this short-term experiment of Gomes et al. (2018) suggested that with suitably managed grazing the proportion of the legume in the sward should remain high.

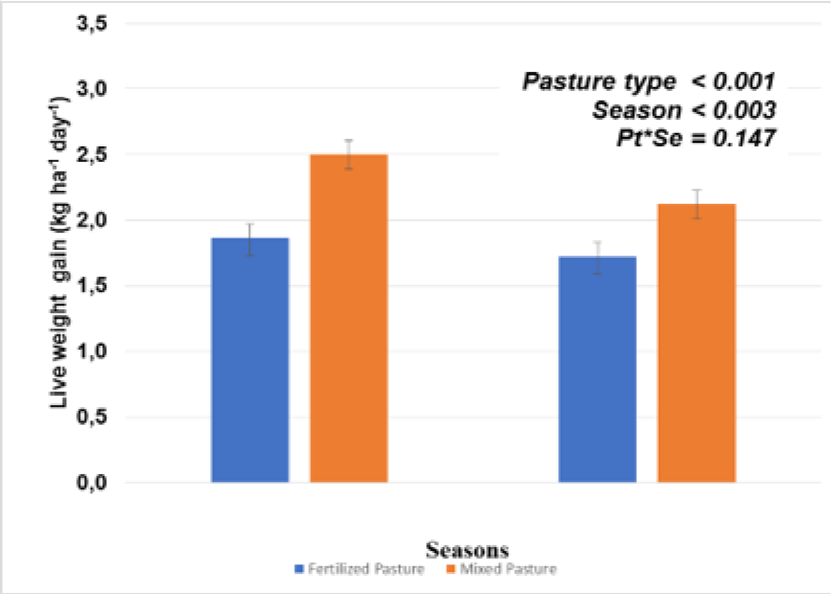
- ❖ **But what about long-term animal performance?**

- ❖ In 2004, José Marques Pereira and Claudia de Paula Rezende of the CEPLAC pastures division, set up an experiment to compare animal weight gain of heifers on pastures of *Brachiaria brizantha* (cv. Marandu) in monoculture with 2 x 60 kg N ha^{-1} $year^{-1}$ or in mixture with *Arachis pintoi* – planted with stolons

Live weight gain of Zebu heifers grazing Marandu grass supplied with 120 kg N ha^{-1} yr^{-1} or in a mixed Marandu/forage-peanut pasture.

Means taken for cool and warm seasons over a 9-year period.

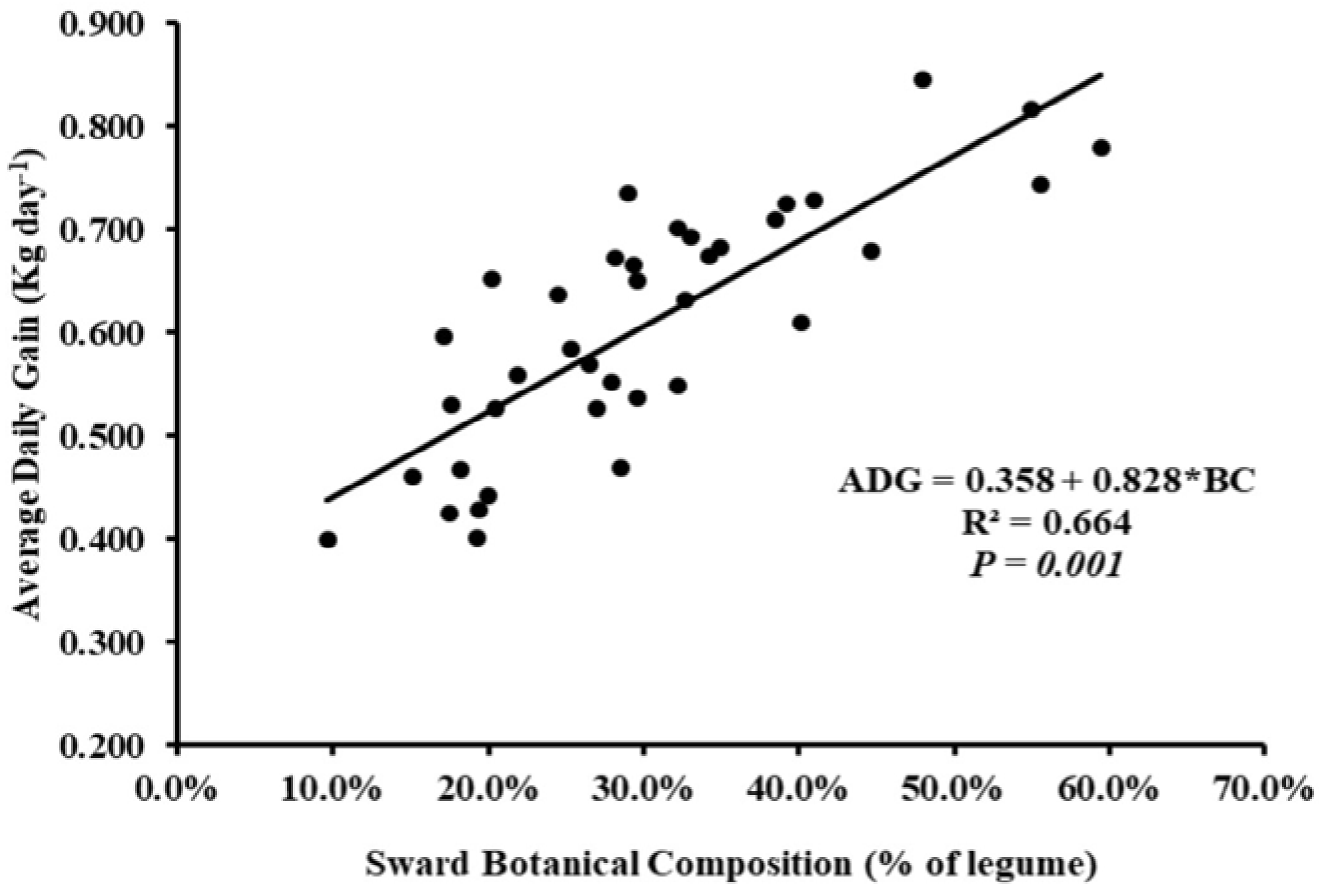




Management: Stocking rate was adjusted to maintain forage allowance at 4 % of body weight day^{-1} of forage mass.

Rotational grazing, 35 day cycle – 7 days grazing 28 days rest

Regression of daily live weight gain versus % legume in forage on offer
Mixed pasture Marandu grass/forage peanut



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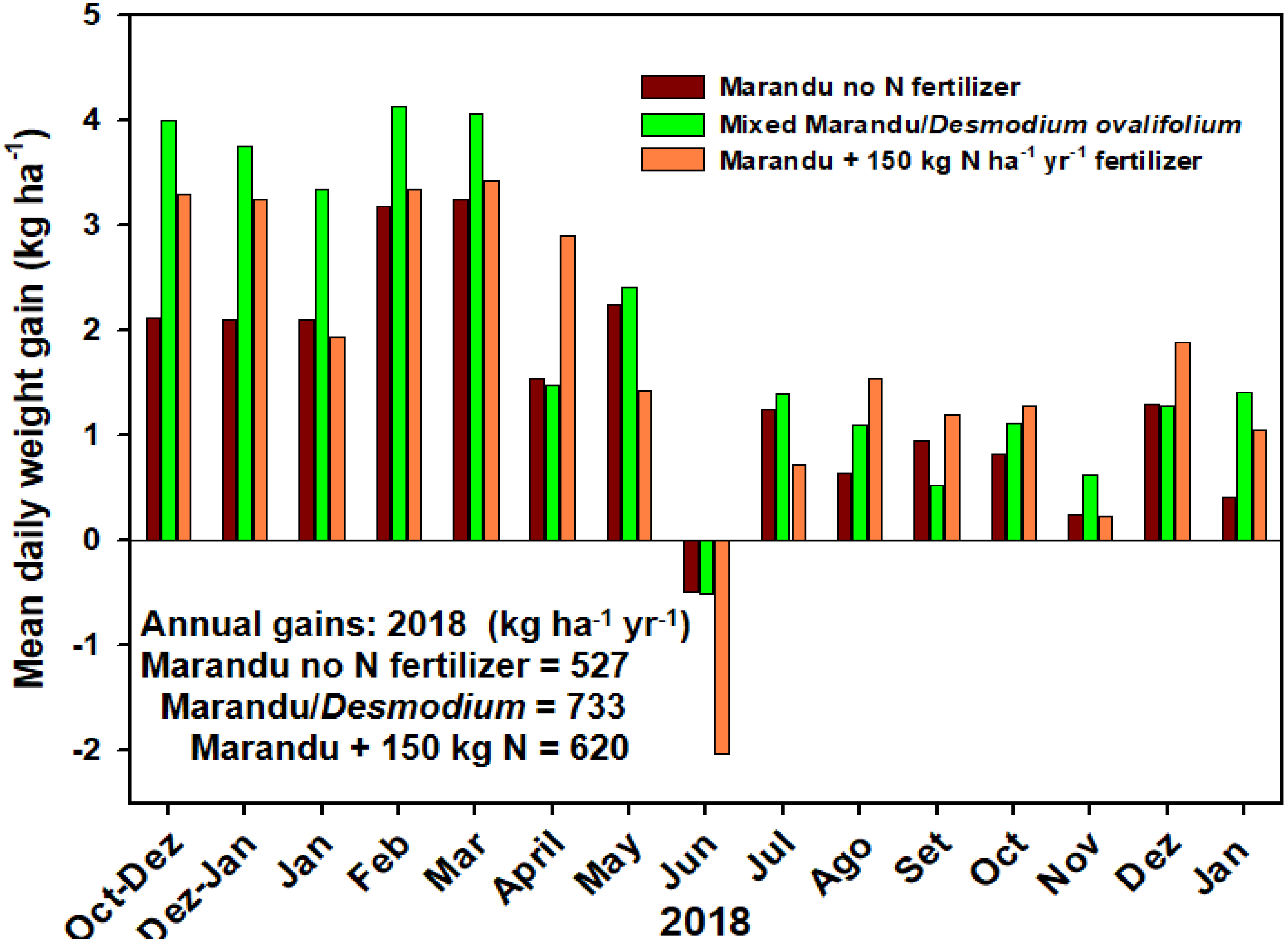
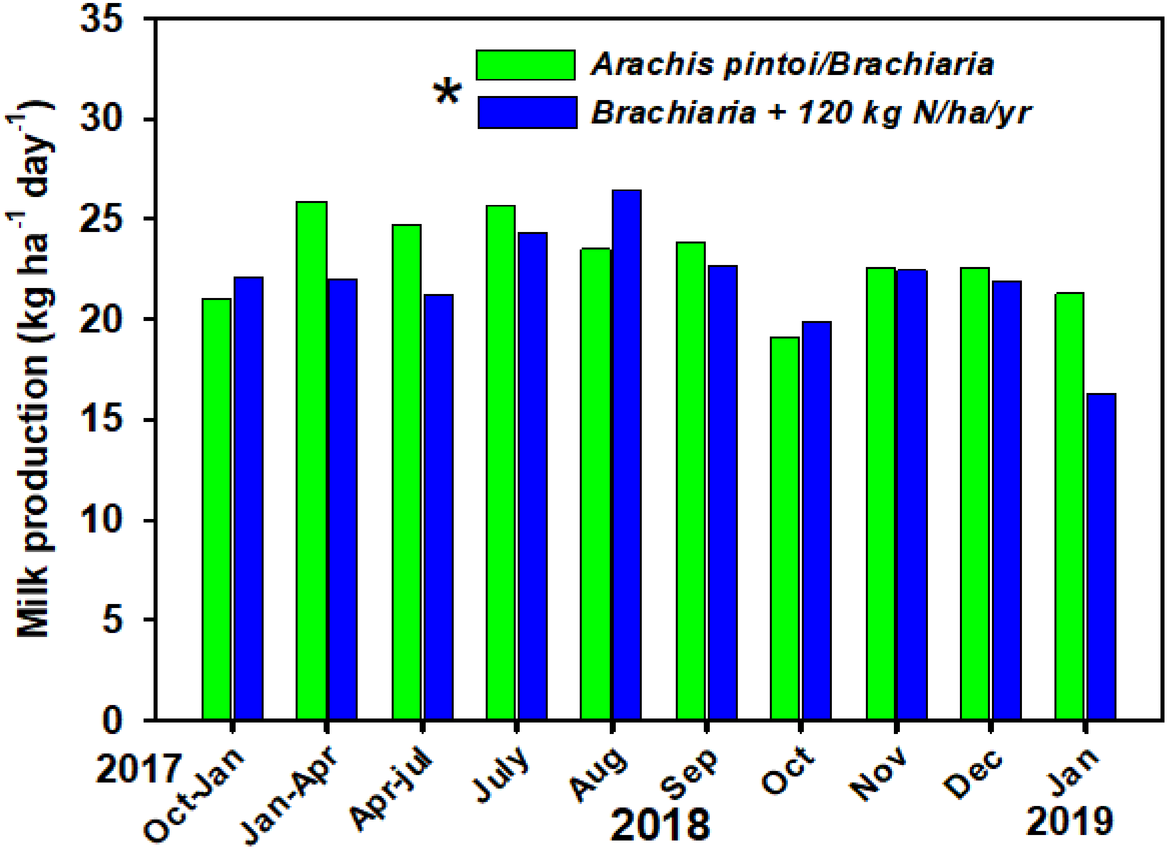
Live weight gain of Zebu heifers grazing Marandu grass supplied with 120 kg N ha^{-1} yr^{-1} or in a mixed Marandu/*Desmodium ovalifolum* pasture.



Management: Stocking rate was adjusted to maintain forage allowance at 4 % of body weight day^{-1} of forage mass.

Rotational grazing, 35 day cycle – 7 days grazing 28 days rest

Milk production Marandu grass supplied with 120 kg N ha^{-1} yr^{-1} or in a mixed Marandu/forage-peanut pasture.



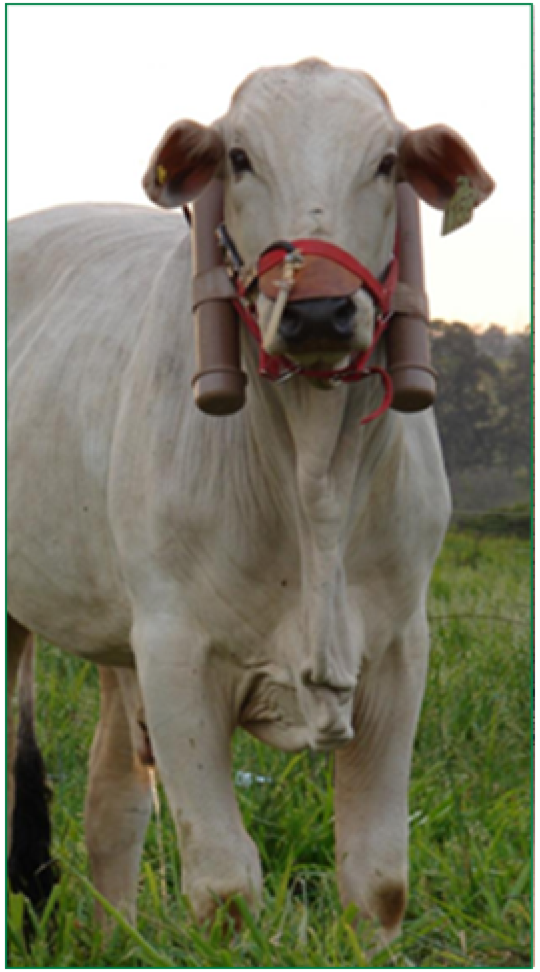
Management: Stocking rate was adjusted to maintain forage allowance at 4 % of body weight day^{-1} of forage mass.

Rotational grazing, 35 day cycle – 7 days grazing 28 days rest

* The differences between pasture treatments so far do not appear to be statistically significant at $p<0.05$, but the analysis is complicated by the fact that the animals are rotated through the different pasture treatments. Only the last 7 days of milk production are counted.

Enteric methane production from bovines

(responsible for ~22% of all Brazil´s anthropogenic GHG emissions)



Estimation of enteric methane production

- The cattle belch frequently, especially when eating or "chewing the cud", and release methane and SF_6.
- The animals are fitted with a "sniffer" and an evacuated reservoir (halter) to continuously sample the gas (typically for 24h).
- As the rate of release of SF_6 is known, from the ratio of CH_4 to SF_6 in samples (measured by gas chromatography), the daily rate of methane production can be calculated.

Why SF_6?: because you can measure it at levels of ppt (10^{-12}) with an electron capture detector (ECD)

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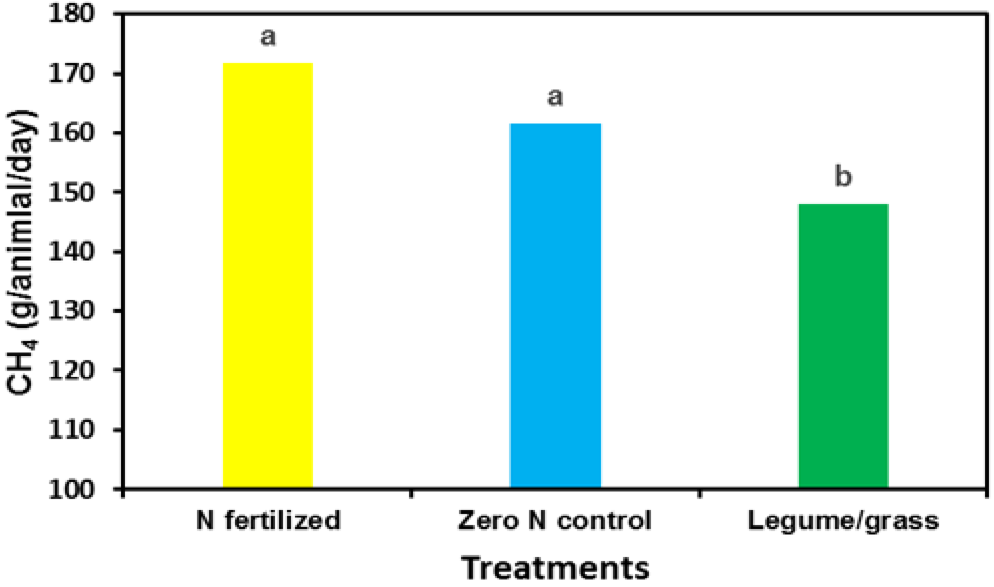
Impact on GHG emissions – per animal and per kg carcass
Forage peanut/Marandu grass v zero or 150 kg N fertilizer ha^{-1} yr^{-1}
(means of 8 evaluations over 24 months)



Methane emissions per animal were lowest for the mixed grass legume pasture, but as carcass yield was higher for the N fertilized pasture, there was no significant difference in methane emission per kg carcass

Data from PhD thesis of Bruno G. Homen and the team at Federal University of Lavras (MG).
Supervisor: Daniel R. Casagrande

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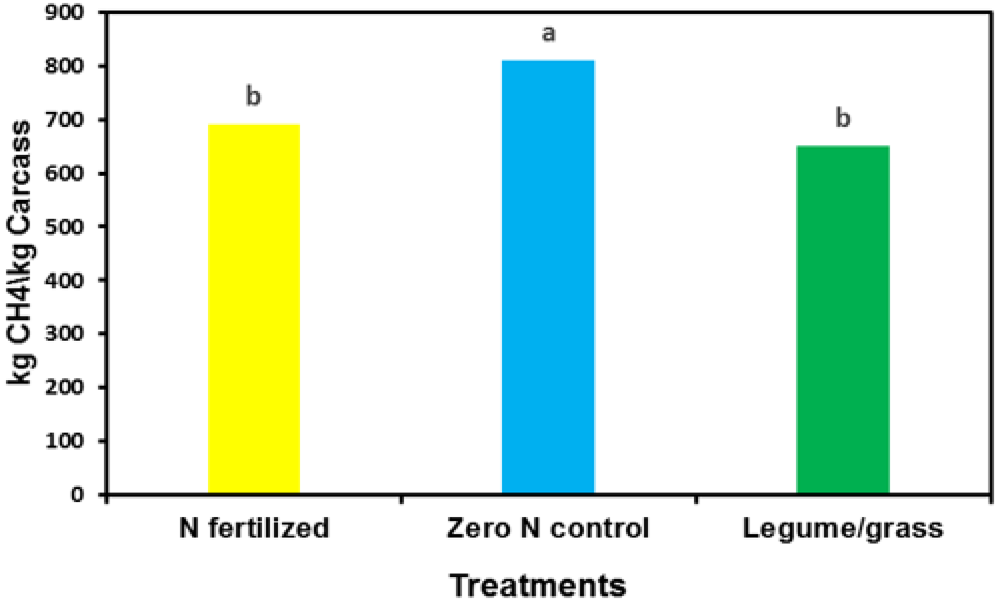


GHG emissions from dung and urine

CEPLAC station, Itabela

Each excreta was placed inside the area enclosed by the chamber

Static chambers were placed inside exclusion areas

Percentage of N in excreta emitted as N_2O

Two experiments at CEPLAC, Itabela, BA.

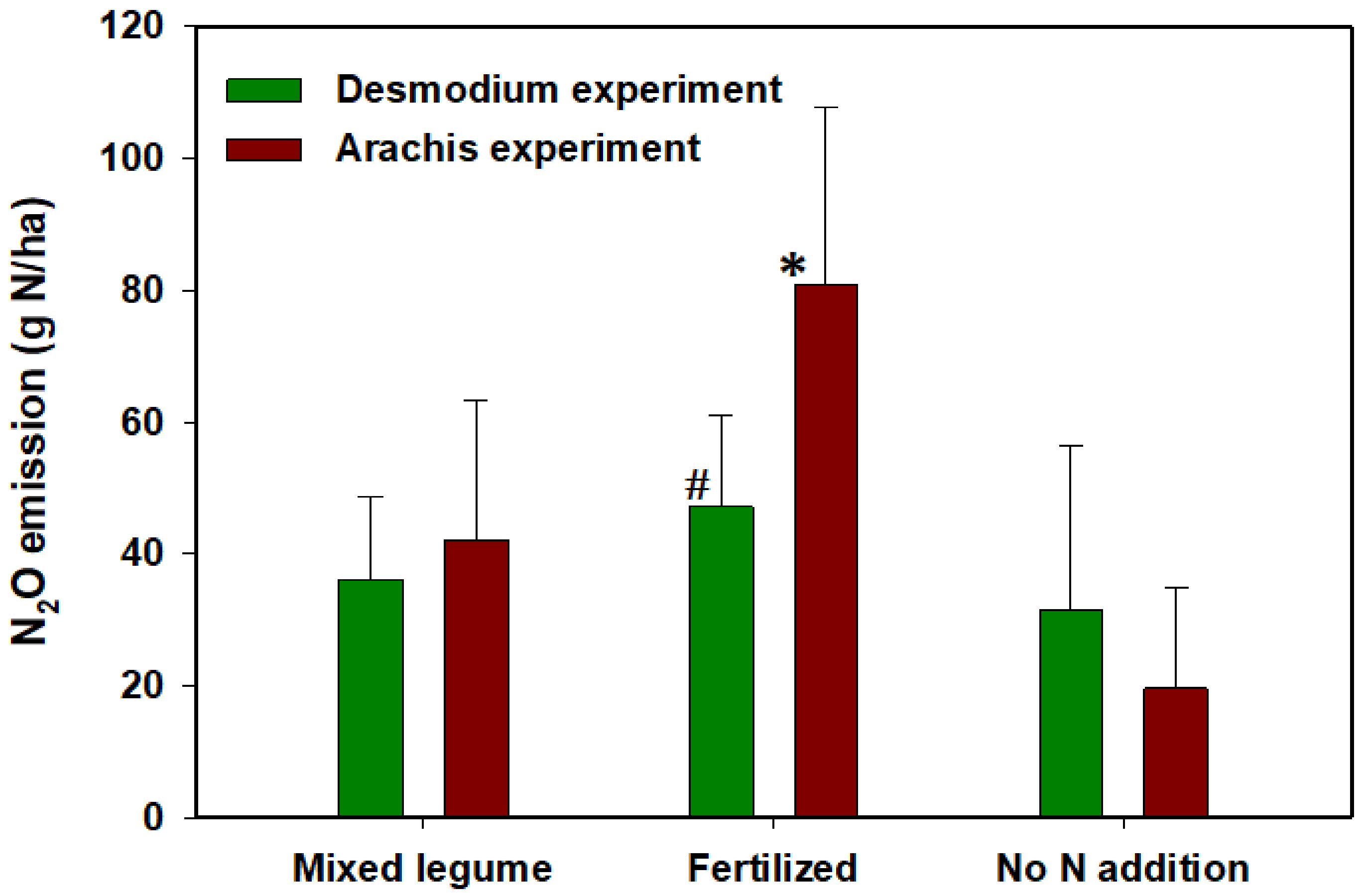
Pasture	*Exp. 01 - Desmodium mixed pasture				#Exp. 02 - Arachis
	g $N\text{-}N_2O$/100 g N-excreta				
	Summer	Autumn	Average		Aug-Nov
No N addition					
Urine	0.16	0.37	0.27		0.73
Dung	0.02	0.08	0.01		0.02
Fertilized pasture (150 kg N ha^{-1} yr^{-1})					
Urine	0.45	0.46	0.46		3.91
Dung	0.08	0.12	0.10		0.07
Mixed pasture with legume					
Urine	0.23	0.70	0.47		1.56
Dung	0.05	0.06	0.06		0.27

- % of N emitted as N_2O from urine was always much higher then from dung
- N_2O emissions from excreta were the same or higher for the N fertilized pasture compared to the mixed grass/legume

* PhD thesis of Camila do Santos

\# PhD thesis of Rafael Cassador Monteiro

Background soil N_2O emissions from two experiments where the *Brachiaria* pasture was managed without N fertilization, fertilized with N or mixed with *Desmodium ovalifolium* (exp 1)* or *Arachis pintoi* (exp 2)#.



* N fertilization
3 x 50 kg N ha^{-1} yr^{-1}

\# N fertilization
2 x 60 kg N ha^{-1} yr^{-1}

- While the results indicate that legume residues were responsible for some increase in N_2O emission, the overall annual emission from the mixed legume/grass pasture was lower than where N fertilizer had been added.

Can forage legumes be introduced into Brachiaria pasture and remain productive for several years?

- Both *Arachis pintoi* and *Desmodium ovalifolium* are stoloniferous and persist under suitable grazing management.
- The cultivars of *A. pintoi* released until now produce very few seeds and planting is very expensive or laborious.
- The variety Mandobi of A. pintoi now being released by Embrapa Acre (Carlos Andrade/Judson Ferreira) produces abundant seeds.
- Seeds of *D. ovalifolium* and *Macrotyloma axillare* (Java) can be fed to animals and the seeds germinate in the dung pats


Desmodium ovalifolium


Macrotyloma axillare

And for the Cerrado region?

- The prolonged dry season of the Cerrado region is unfavourable to the legumes studied in Bahia, Lavras, Jaboticabal (SP) and Rio de Janeiro (*A. pintoi*, and *M. axillare*) and the cultivars of *Stylosanthes* spp. tested so far, either do not provide much forage in the dry season, or have very poor seed production.
- This year Embrapa Beef Cattle and Cerrado Centres are releasing a new cultivar of *S. guianenis* – cv. Bela, which produces abundant seeds and provides forage in the dry season.
- Live weight gains for the first year were 607 g $head^{-1}$ day^{-1} compared to 437 g $head^{-1}$ day^{-1} for the grass alone pasture, with the greatest benefit in the dry season.

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Centro de Convenções da PUC-GO | Goiânia-GO
27 a 30 de agosto de 2018

55ª REUNIÃO ANUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA

ZOO tec
28º CONGRESSO BRASILEIRO DE ZOOTECNIA

CONSTRUINDO SABERES, FORMANDO PESSOAS E TRANSFORMANDO A PRODUÇÃO ANIMAL

PERFORMANCE OF BEEF CATTLE IN A CULTIVATED LEGUME-GRASS PASTURE IN THE BRAZILIAN CERRADO

Gustavo José BRAGA*[1], Allan Kardec Braga RAMOS[1], Marcelo Ayres CARVALHO[1], Giovana Alcantara MACIEL[1], Francisco Duarte FERNANDES[1]

Stylosanthes guianensis cv. Bela

- Bela continues to produce biomass into the dry season and at this time the cattle prefer the legume to the Brachiaria

- The one major problem with this new variety is that insufficient seeds germinate under normal conditions and after the second wet season the proportion of the legume in the sward declines.

- At present Bela is undergoing tests to determine if it would be possible to feed the seeds to the animal such that they would be scarified in rumen and germinate in the dung

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Conclusions

1. Best management practices to maintain the legume in tropical pastures generally include the regulation of grazing height – generally between 40 cm and 15 cm.
2. *Arachis pintoi* has great potential for the areas without prolonged dry seasons and the availability of seeds of the Mandobi cultivar should be of great value.
3. The problem of persistence of those legumes that do not reproduce vegetatively via stolons or rhizomes, may be solved by feeding the seeds to the cattle in the salt lick and the seedlings germinate in the dung patches
4. Methane emissions per kg product appear to be approximately the same for N fertilized and mixed legume/grass pastures and lower than unfertilized Brachiaria
5. Nitrous oxide emissions are lower in mixed legume/grass pastures than in N fertilized pastures.
6. There is no significant fossil CO_2 cost associated with the introduction of forage legumes.

But can we expect farmers/ranchers to adopt the best management practices?

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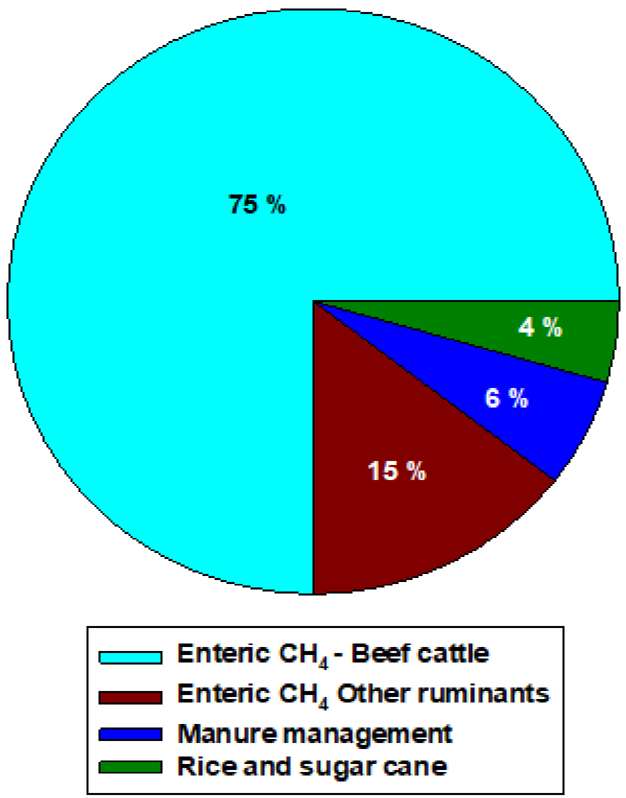
Emissions of Methane and Nitrous oxide in the Agricultural Sector Estimates for 2012

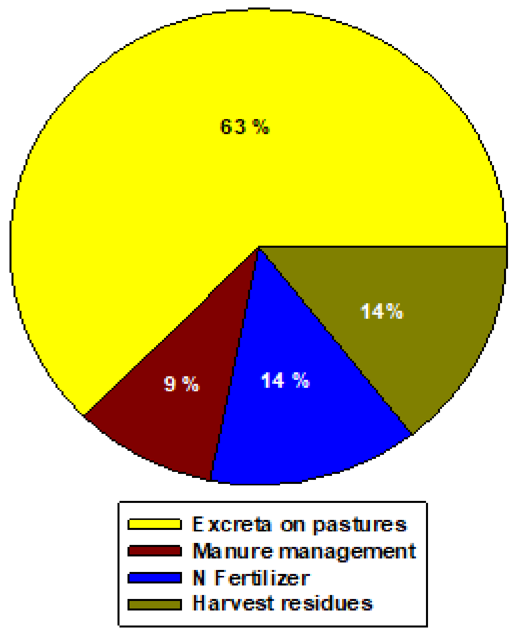
	Gg $year^{-1}$	GWP*	Tg CO_2eq	GWP#	Tg CO_2eq
Methane	13,270	21	278.7	28	371.6
Nitrous oxide	541	310	167.7	298	161.2
		Total	446.4		532.8

* Global warming potential IPCC (1996)
# IPCC (2013)

Methane emissions



Nitrous oxide emissions



Of the methane emissions, enteric methane from cattle and their excretions make up over 90 % of the total

For nitrous oxide emissions approximately 70 % are derived from cattle and other ruminants, the reminder being from crop production.

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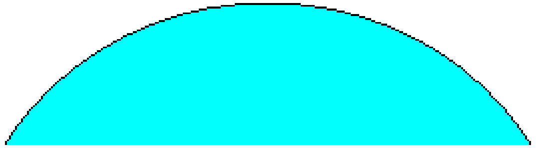

Nitrous oxide emissions

Of the methane emissions, enteric methane from cattle and their excretions

Conclusion: In the Agriculture sector, the GHG emissions from ruminants (principally beef cattle) are responsible for 89 % of all GHG emissions in the Agricultural sector. The total of emissions from the cattle/pastures becomes 30 % of ALL anthropogenic emissions in Brazil.

So for Brazil, the greatest opportunities for mitigation of GHG emissions in the Agricultural sector must be in the reduction of methane and nitrous oxide emissions from meat and dairy production

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