



ALIANÇA
SIPA
SISTEMAS INTEGRADOS DE
PRODUÇÃO AGROPECUÁRIA

**Aliança para difundir a
Intensificação sustentável**

Organização sem fins lucrativos

**0 subestimado potencial do manejo de pastagens
para mitigar as emissões de GEE na pecuária a pasto**

Paulo C. F. Carvalho (UFRGS & Div. Neutralidade Climática–Aliança)





ALIANÇA SIPA

SISTEMAS INTEGRADOS DE
PRODUÇÃO AGROPECUÁRIA

Associação sem fins lucrativos

CNPJ 31.495.655/0001-01

Coordenação



GPSIPA · UFRGS

Grupo de Pesquisa em Sistema
Integrado de Produção
Agropecuária



NITA · UFPR

Núcleo de Inovação
Tecnológica em
Agropecuária



GPISI · UFR

Grupo de Pesquisa e Inovação em
Sistemas Puros e Integrados de
Produção Agropecuária



A Solução...

A via da Intensificação sustentável !

Intensificação das funcionalidades dos processos naturais que os ecossistemas agrícolas possam oferecer ...

Tilman et al. 2011. Global food demand and the sustainable intensification of agriculture. P. Natl. Acad. Sci USA 108: 20260–64.



AGROECOSYSTEM DIVERSITY

RECONCILING CONTEMPORARY AGRICULTURE
AND ENVIRONMENTAL QUALITY



Edited by
GILLES LEMAIRE
PAULO CÉSAR DE FACCIO CARVALHO
SCOTT KRONBERG
SYLVIE RECOUS





inct

institutos nacionais
de ciência e tecnologia

UM DOS MAIORES
PROGRAMAS DE
CIÊNCIAS E TECNOLOGIA DO
BRASIL

INCT

AGRICULTURA DE BAIXA EMISSÃO DE CARBONO



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Mudança de Uso da Terra



José Miguel Reichert (UFSM)
Pesquisador 1A – CNPq

**Adaptação às Mudanças
Climáticas**



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de ciência e tecnologia

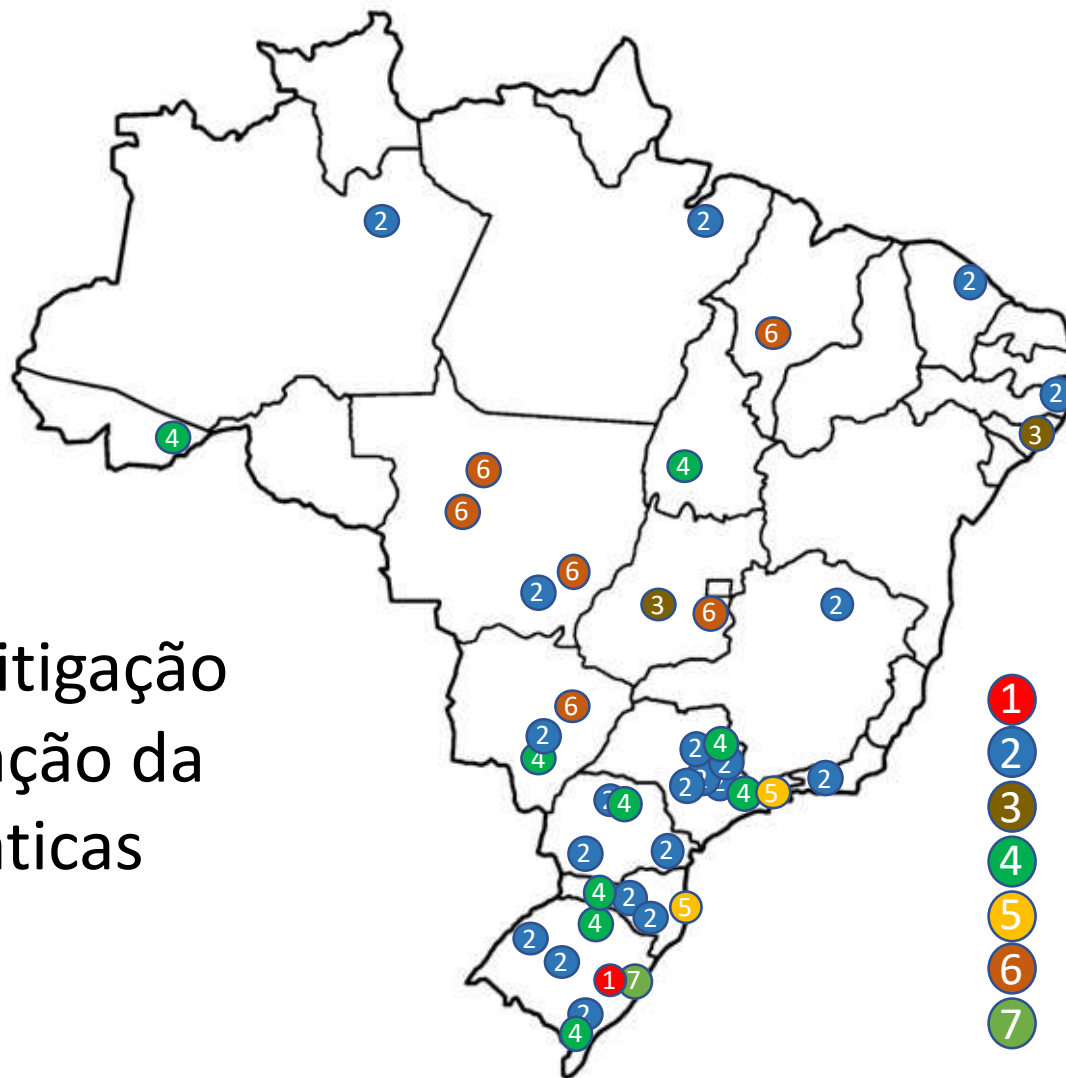
UM DOS MAIORES
PROGRAMAS DE
CIÊNCIAS E TECNOLOGIA DO
BRASIL

INCT

Agricultura de Baixa Emissão de Carbono

Rede Nacional de Pesquisa em Mitigação
das Emissões de GEE e de Adaptação da
Agricultura às Mudanças Climáticas

41 Instituições



- 1 Coordenadora
- 2 Un. Federais/Estaduais
- 3 IFES
- 4 Unidade da Embrapa
- 5 Instituto de Pesquisa
- 6 Empresa Privada
- 7 SEAPA- RS

Importância dos ecossistemas pastoris



Food and Agriculture
Organization of the
United Nations

More Fuel for the Food/Feed Debate

FAO Study indicates that
livestock primarily consume
foods not fit for human
consumption and meat
production requires less
cereals than generally reported



FAO, 2022



Forestland **31%**

Agricultural land
(non livestock) **17%**

**Agricultural land
(livestock) 20%**

Other **32%**

Pastures and
rangelands
9.6%

Non-convertible to
arable, can only be
used for livestock
keeping

Grasslands
5.2%

Could be converted
to arable land, while
causing decline in
ecosystem services

Cereals 1.7%

Arable land, equivalent
to 30% of global arable
land, with regional
differences

Fodder crops 0.6%

Oil seed cakes, by product 1.2%

Allocation of part of the
arable land used primarily
for oilseeds and grains

Crop residues 1%

Source: Mottet, A., de Haan, C., Falcucci, A., Tempio, G., Opio, C. and Gerber, P., 2017. Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. *Global Food Security*, 14, pp.1-8.

Importância dos ecossistemas pastoris



Context

~50 t C/ha (30 cm)

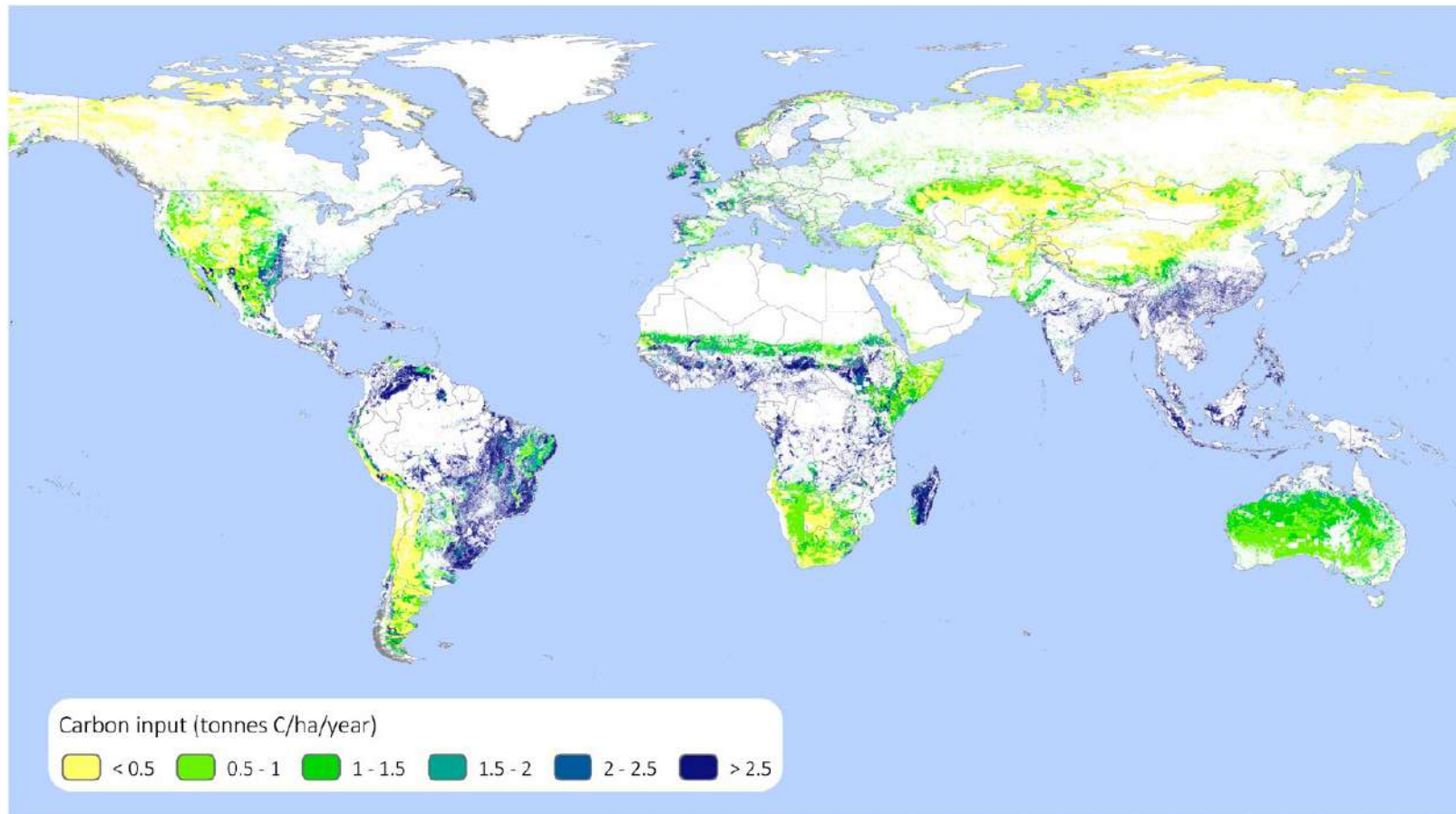
The adoption of the Paris Agreement in 2015 paved the way for countries to commit to the international response to climate change through the transition to a low-emission economy and the development of a climate-resilient future. In livestock systems, and indeed in the whole agricultural sector, there is a need to balance the benefits of animal-source foods and livestock keeping for nutrition, health and well-being, with the urgent need to reduce greenhouse gas (GHG) emissions to tackle the climate crisis, which also threatens food security.

Grasslands contain approximately 20 percent of the world's soil organic carbon (SOC) stocks, which implies that they play a significant role in the global carbon and water cycles (Puche *et al.*, 2019). Soils can act as both sources and sinks of carbon and many grasslands have suffered losses of SOC because of anthropogenic activities such as intensive livestock grazing, agricultural uses and other land-use activities. This trend, however, could be reversed by stimulating plant growth, capturing carbon in the soil, and protecting carbon in highly organic soils.

Importância dos ecossistemas pastoris

MAP 4

Global carbon input levels (tonnes C/ha/year) needed to maintain current SOC stocks under improved and unimproved grasslands



Source: United Nations Geospatial. 2020. *Map of the World*. United Nations. Cited 22 August 2022. www.un.org/geospatial/file/2285/download?token=puayKYRA modified with data from Coleman and Jenkinson, 1996.

Dondini et al. 2023. *Global assessment of soil carbon in grasslands – From current stock estimates to sequestration potential*. FAO Animal Production and Health Paper No. 187. Rome, FAO.

<https://doi.org/10.4060/cc3981en>

Mitos vs fatos (números) da pecuária



Diana Rodgers, RD @... · 3h ...

Plus, in most agricultural areas, livestock are the **ONLY** thing that can be produced for food, and again, provide **BETTER** nutrition than plants alone.

NOT ALL LAND IS SUITABLE FOR GROWING CROPS

REMOVING CATTLE DOESN'T MEAN THAT WE'LL FREE UP MORE LAND FOR CROP PRODUCTION. MORE THAN 60% OF AGRICULTURAL LAND GLOBALLY IS PASTURE AND RANGELAND THAT IS TOO ROCKY, STEEP, AND/OR ARID TO SUPPORT CULTIVATED AGRICULTURE – YET THIS LAND CAN SUPPORT CATTLE AND PROTEIN UPCYCLING.*



HWM.GLOBALFOODJUSTICE.ORG



Susan MacMillan @Su... · 1h ...
3 myths exploded:

1 Cattle populations are stagnant (NOT increasing) in Africa

2 Ruminants raised on rangelands make most use of rainwater—not blue water

3 86% of the feed eaten by ruminants is non-edible by humans

—@CGIAR @ILRI
@BioIntCIAT_eng at
#COP27 🌱

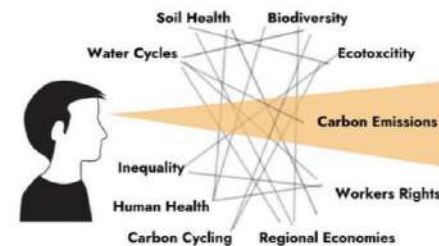
#LetsTalkLivestock



Diana Rodgers, RD @... · 3h ...

Or are policymakers afflicted by "Carbon Tunnel Vision" and not taking into account the multidimensional value livestock have to human health, rural livelihoods and ecosystem function?

Carbon Tunnel Vision



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Mas a pecuária é um problema...

“

I do think all rich countries should move to **100% synthetic beef**. Eventually, that green premium is modest enough that you can sort of change the [behaviour of] people or use regulation to totally shift the demand.

”

BILL GATES

American Businessman
Magnate



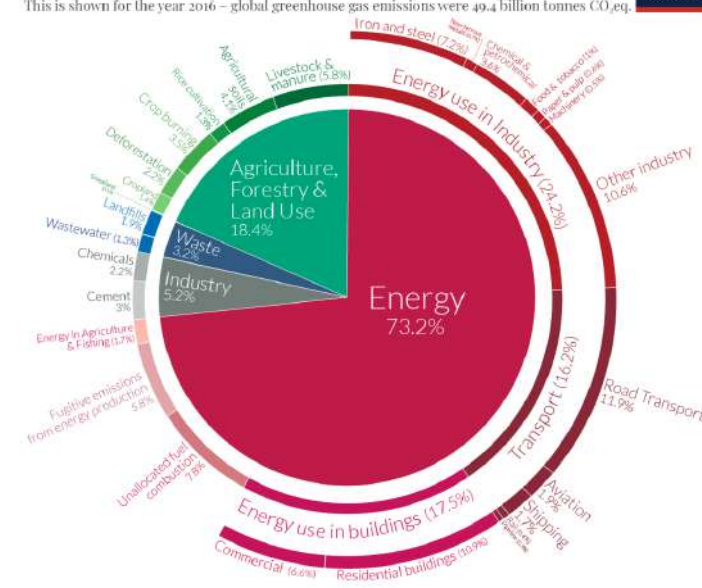
IMAGINE THE AMOUNT OF PROPAGANDA IT TOOK



TO MAKE PEOPLE BELIEVE COWS ARE THE PROBLEM

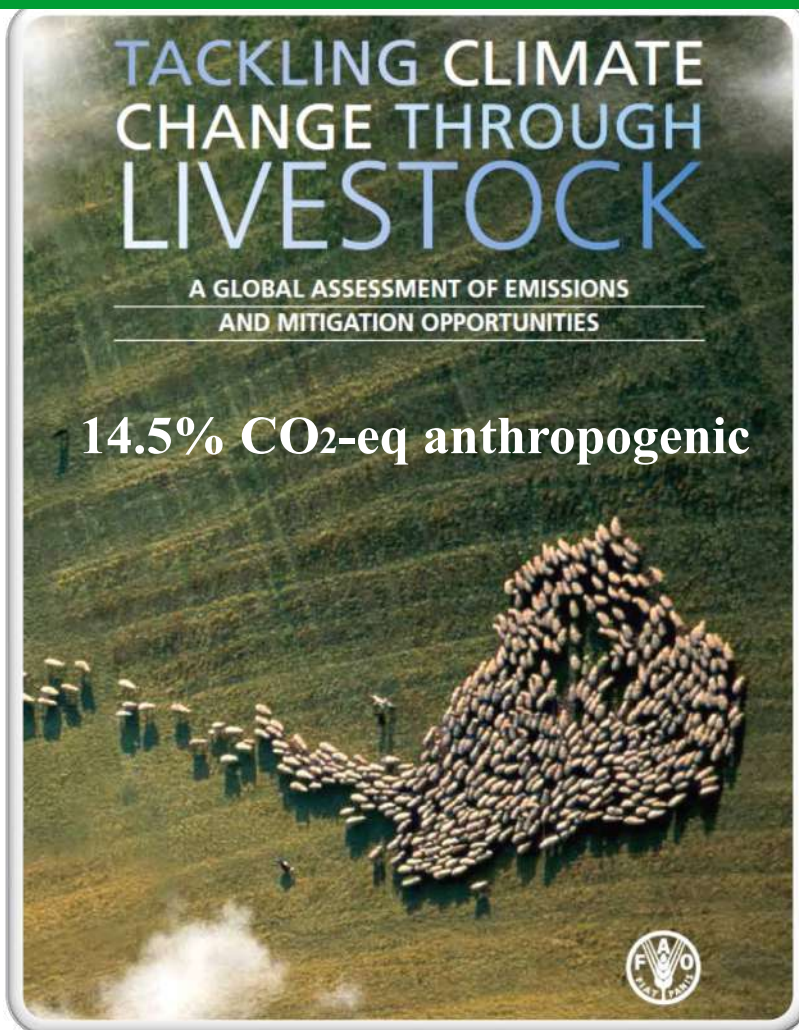
Global greenhouse gas emissions by sector
This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.

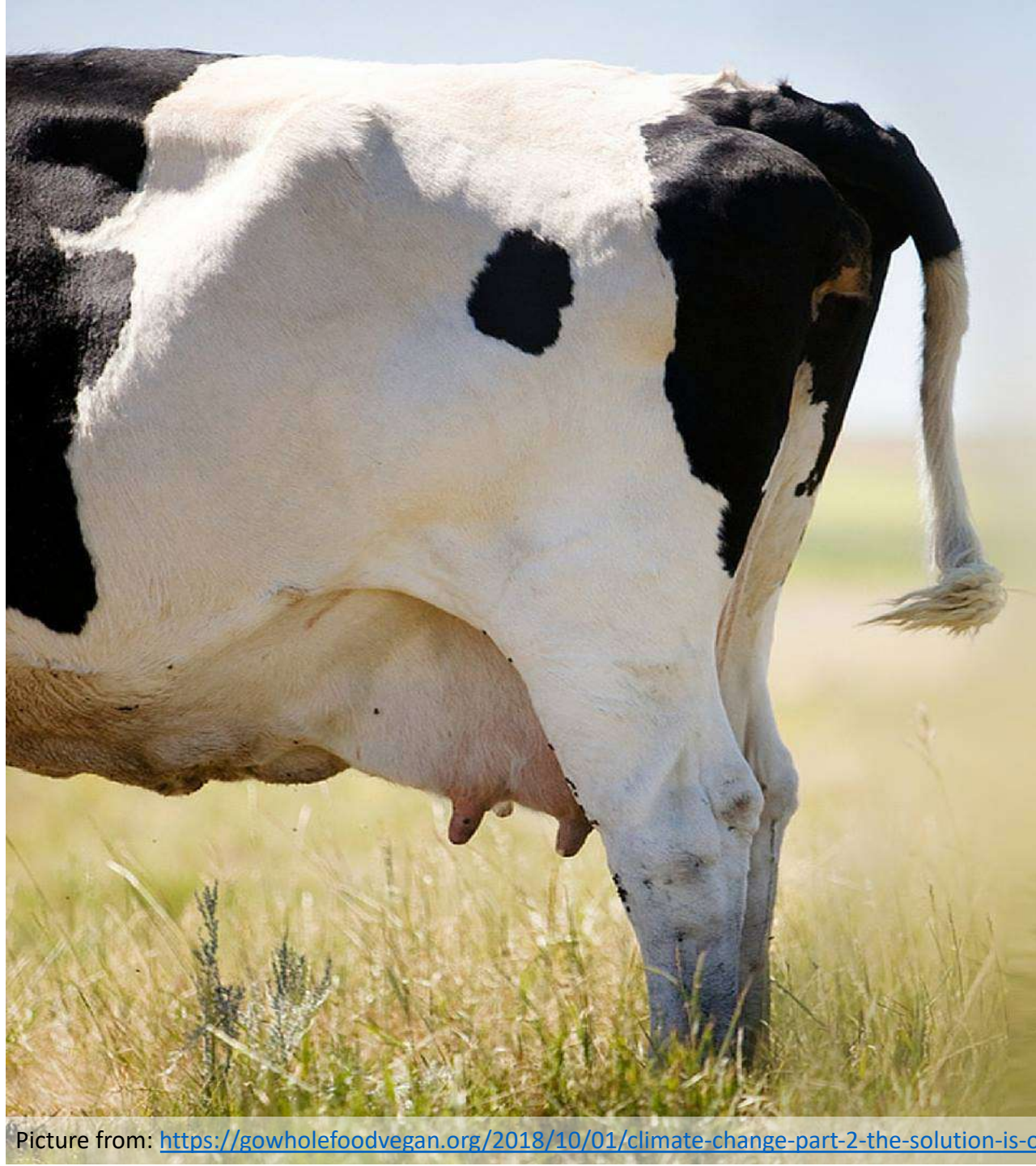
Our World
in Data



OurWorldinData.org – Research and data to make progress against the world's largest problems.
Source: Climate Watch, the World Resources Institute (2020).
Licensed under CC-BY by the author Hannah Ritchie (2020).

Mas a pecuária é um problema...



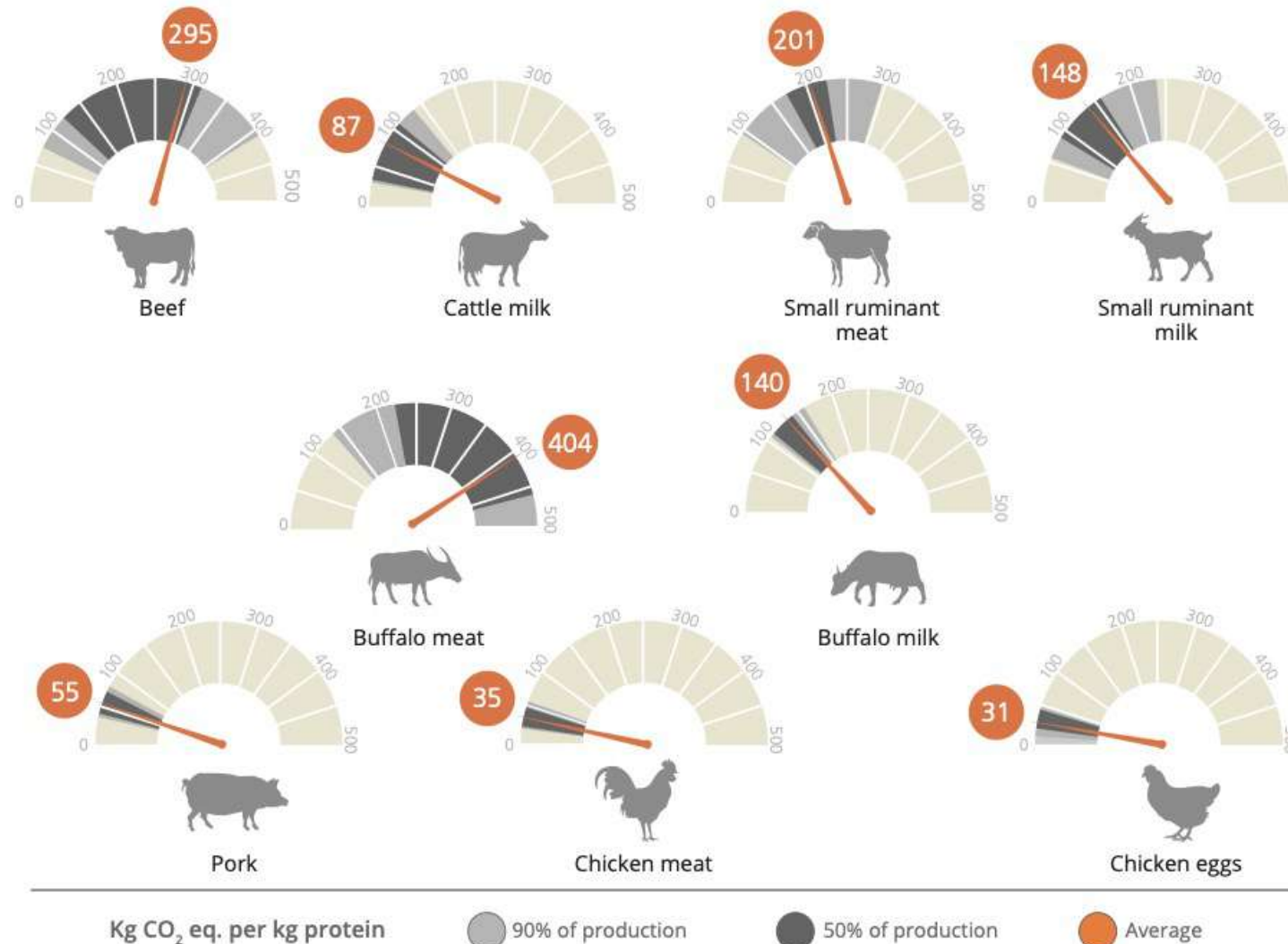


GASES
produced by

**ANIMAL
AGRICULTURE**

**CLIMATE
CHANGE**

Mas a pecuária é um problema (ou a solução?)



FAO. 2019.
*Five practical
actions
towards low-
carbon
livestock.*
Rome



Most of livestock's GHG mitigation potential is attributed to C sequestration

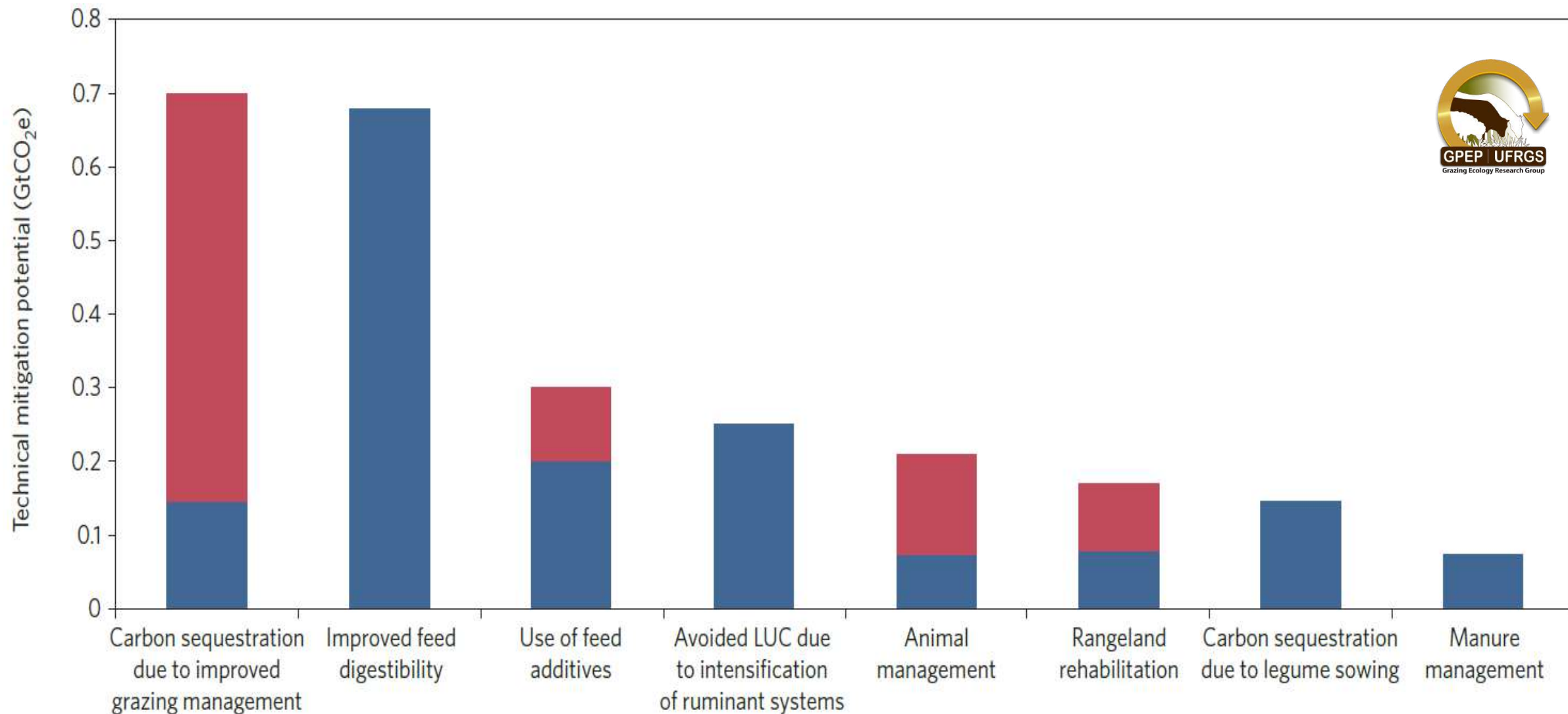


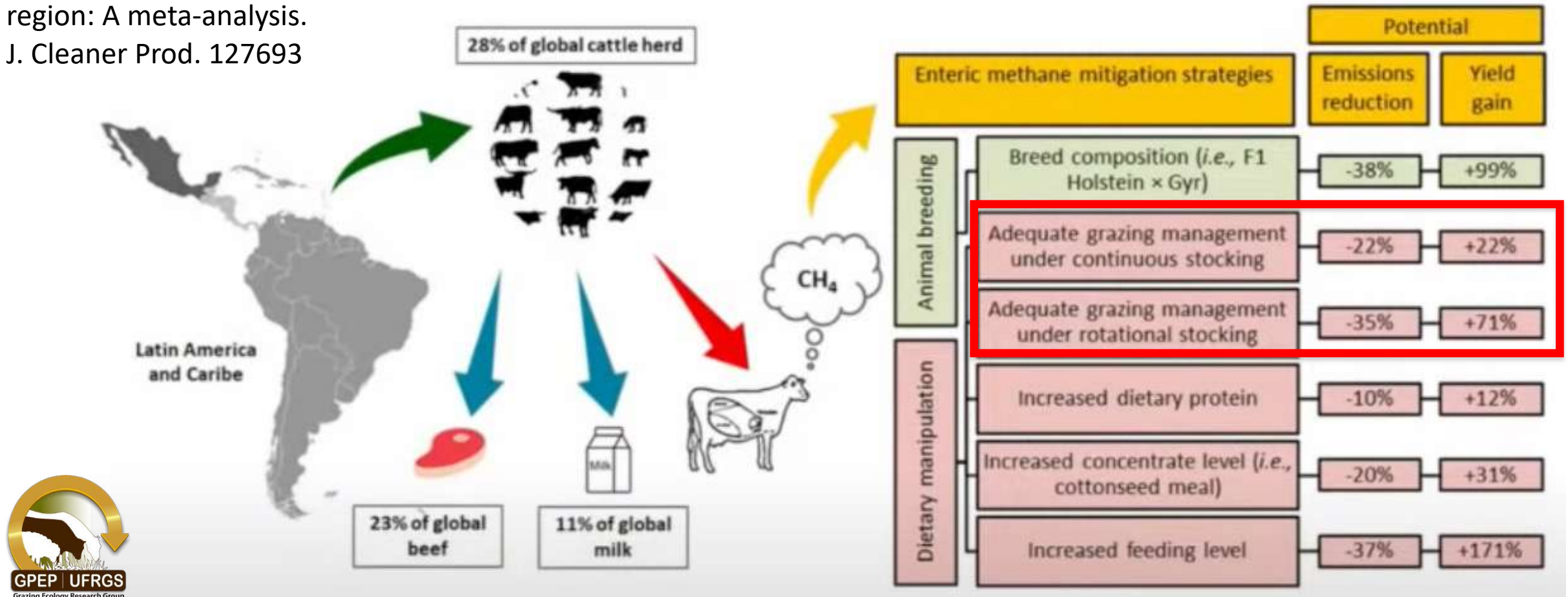
Figure 2. Technical mitigation potential of supply-side options for reducing emissions from livestock sector. Red represents the range for each practice, when available. From Herrero et al. (2016).

O potencial do manejo na mitigação dos GEE

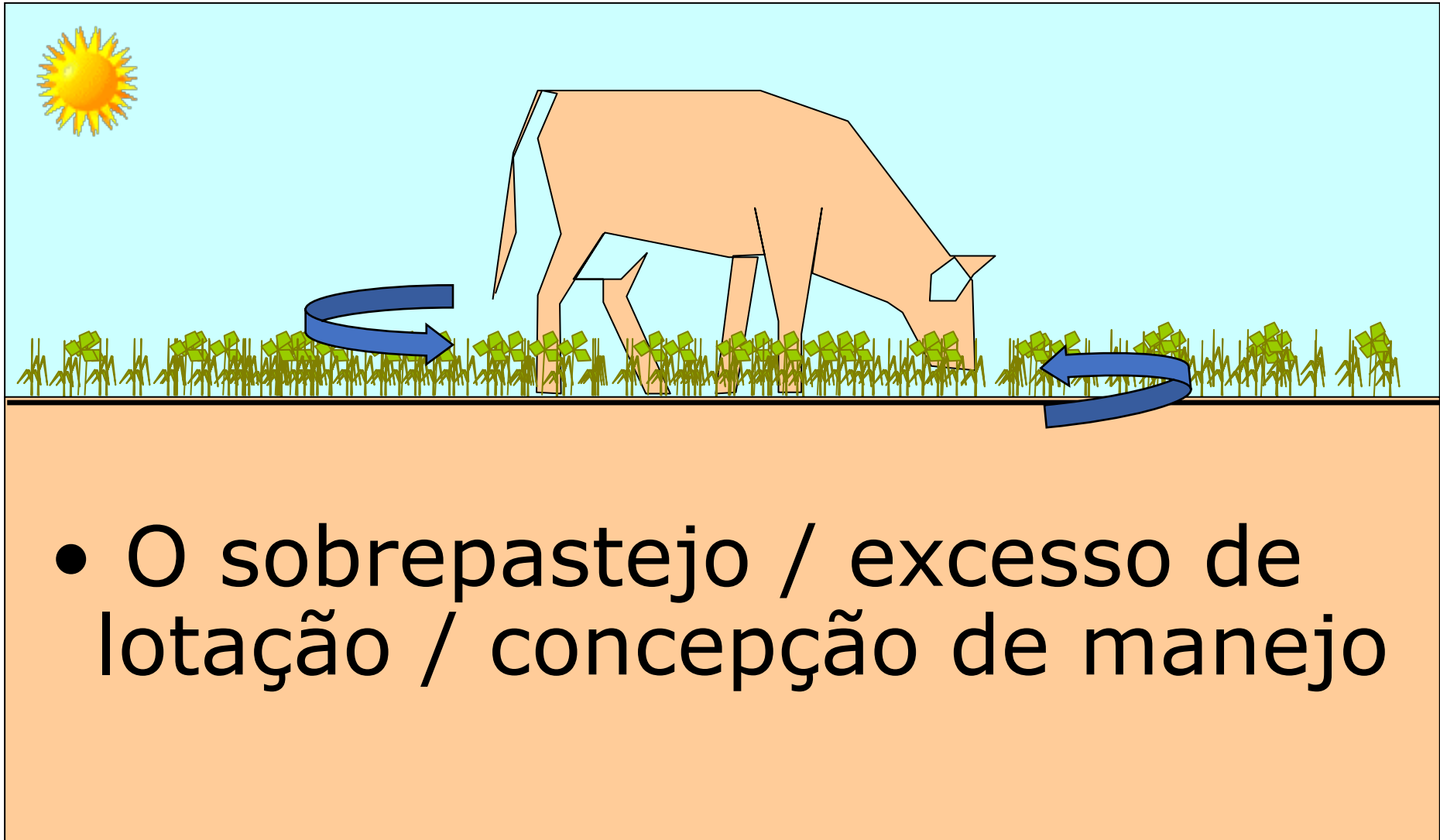
Congio et al. 2021. Enteric methane mitigation strategies for ruminant livestock systems in Latin America and Caribbean region: A meta-analysis.

J. Cleaner Prod. 127693

103 Estudos em 32 estratégias de mitigação, somente 6 resultaram em mitigação concomitante a desempenho



Qual o principal problema?



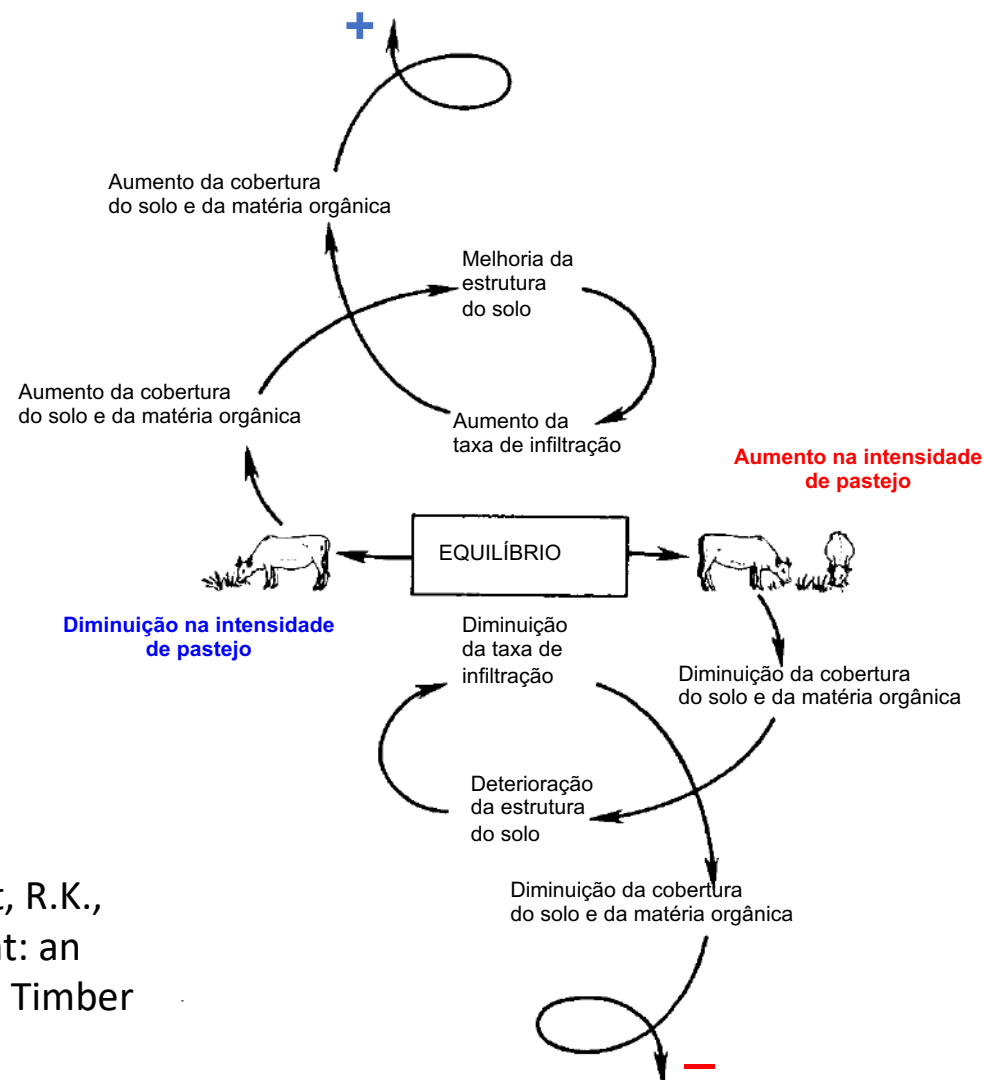
O potencial do manejo na mitigação dos GEE



[Esta Foto](#) de Autor Desconhecido está licenciado em [CC BY-NC-ND](#)

Será ?

Diferença entre o céu e o inferno: manejo!



Pasto C +

Pasto
renovado

Pasto degradado
(alta lotação +
zero fertilização)

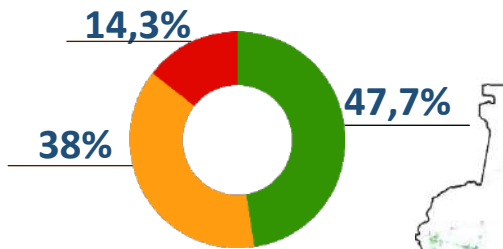
INSERE A LAVOURA NA PECUÁRIA
Benefícios para a pecuária...

Eficiência de colheita

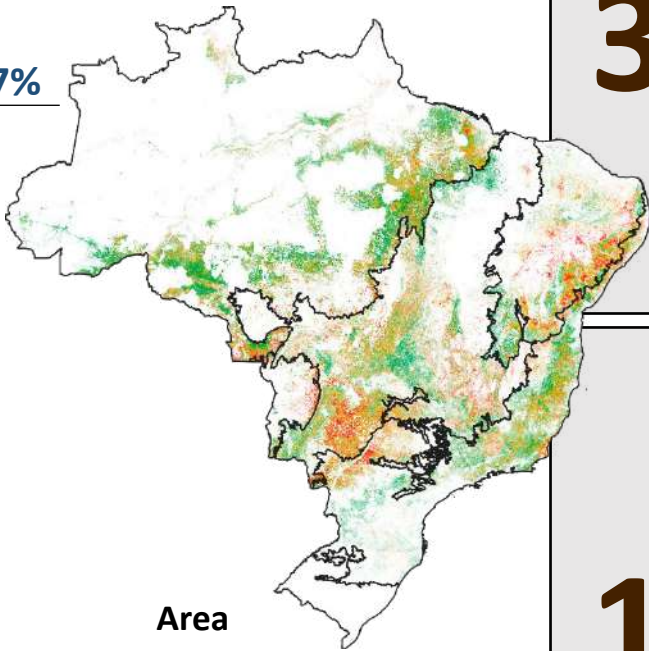


Foto: Mezzalira, J.

Pastos degradados são “oportunidades de mitigação”



Quality of pastures		Area
	Severely degraded	22,12 Mha
	Intermediate degradation	58,79 Mha
	No degradation	73,79 Mha



Total estimated reduction¹ potential

37.000.000

tCO₂e

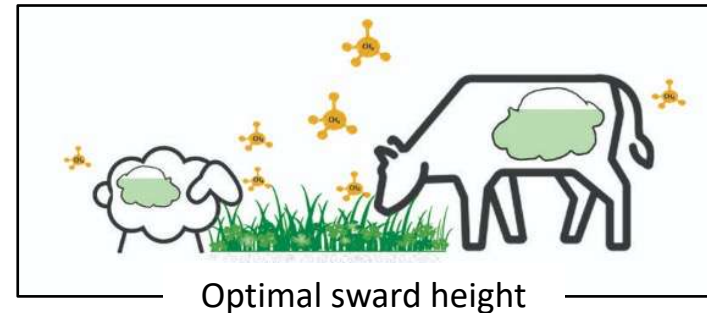
Total estimated removals² potential

14.700.000

tCO₂/year

¹ZUBIETA, Ángel Sánchez et al. Does grazing management provide opportunities to mitigate methane emissions by ruminants in pastoral ecosystems?. Science of the Total Environment, v. 754, p. 142029, 2021. **Reduction potential of 55%**

²MAIA, Stoeicio MF et al. Effect of grassland management on soil carbon sequestration in Rondônia and Mato Grosso states, Brazil. Geoderma, v. 149, n. 1-2, p. 84-91, 2009. **Removal potential of 0,66 ton CO₂e/ha/year**



O que podemos fazer pelo manejo?



O que significa “manejo de pastagens” ?

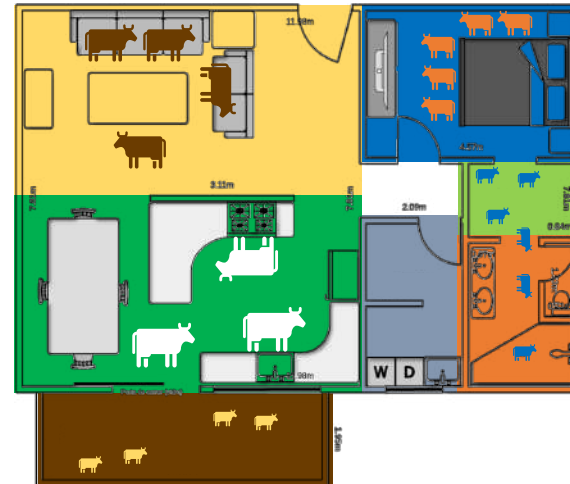
Analogia entre manejo de ecossistemas pastoris e a engenharia

Tijolo = bocado

Fundações e paredes =
estrutura do pasto

Planta baixa =
planejamento
espaço-temporal

Construção =
Farm design



Do bocado.....ao sistema de produção



Foco será no manejo do animal em pastejo (CH₄)



CONCEPÇÕES DE MANEJO DO PASTO

Intensidade de
desfolhação

+

C INTENSIVO

Alta intensidade
Baixa frequência



A COMUM

Alta intensidade
Alta frequência



B INEXISTENTE

Baixa intensidade
Baixa frequência



NONSENSE

+

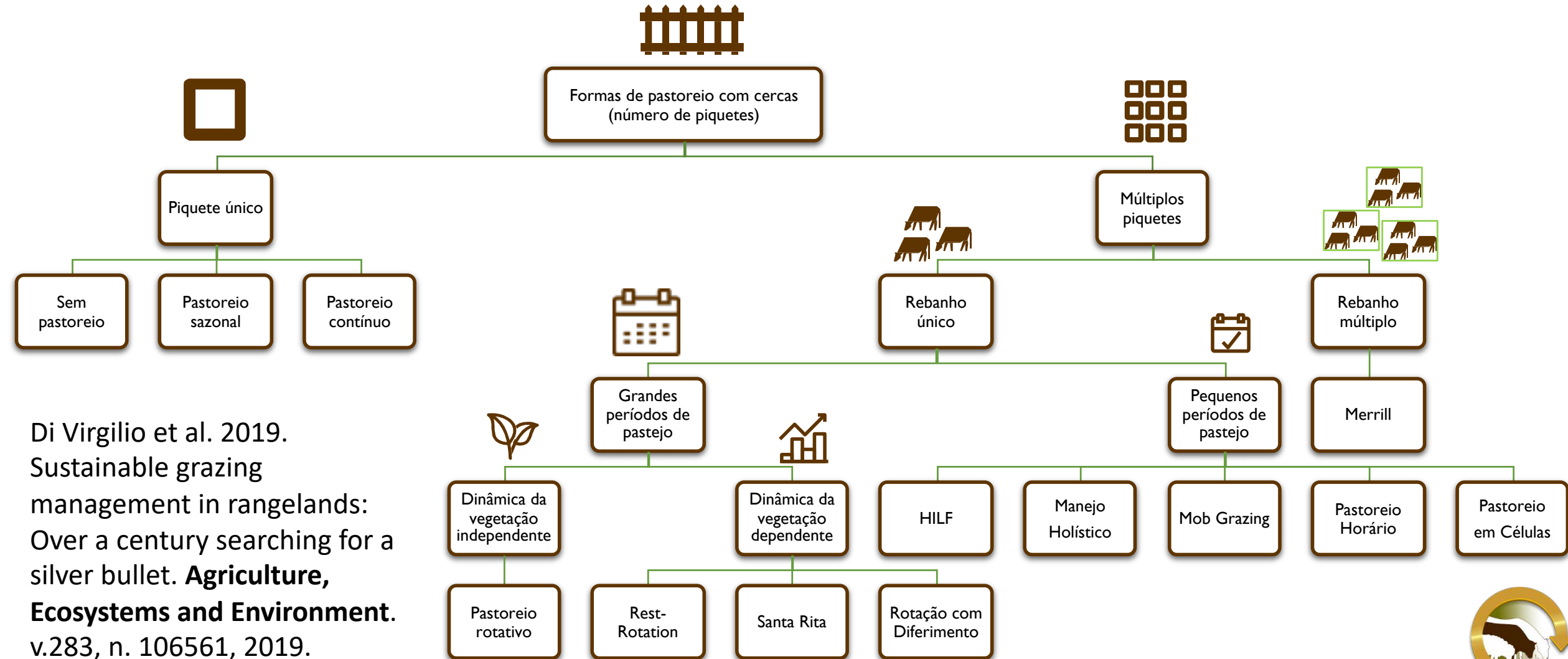
Frequência de
desfolhação

-

Ilustração: Paulo Carvalho e Fernanda Moojen



Métodos de Pastoreio



Di Virgilio et al. 2019.
Sustainable grazing
management in rangelands:
Over a century searching for a
silver bullet. **Agriculture,
Ecosystems and Environment.**
v.283, n. 106561, 2019.

Manejo Holístico, Regenerativo, Ultra-denso





Rotafino

BOVINOS

DE CORTE



Campo Nativo - 37 anos



Emissão de CH₄ e manejo de pastagens



CEZIMBRA et al. 2021. Potential of grazing management to improve beef cattle production and mitigate methane emissions in native grasslands of the Pampa biome. SCIENCE OF THE TOTAL ENVIRONMENT, v. 780, p. 146582..

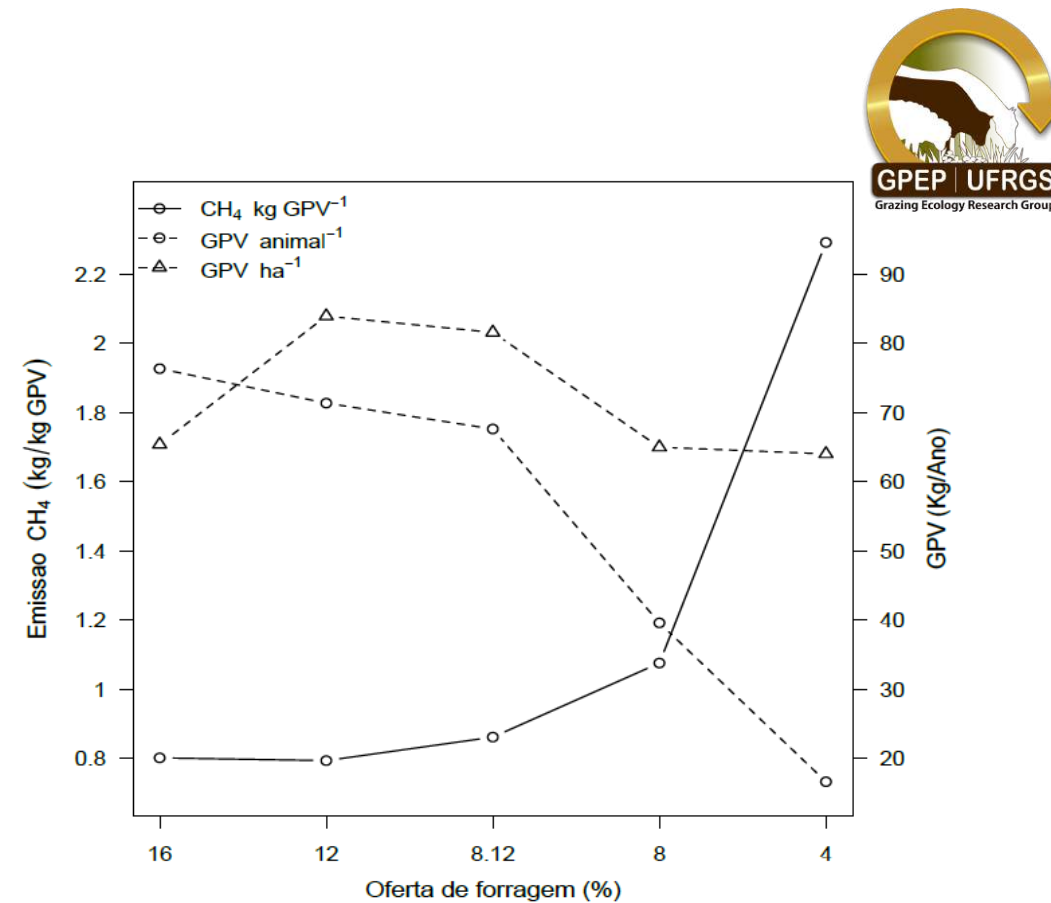


FIGURA 2: Emissão de metano anual em relação ao ganho de peso vivo (kg CH₄ por kg GPV), ganho de peso vivo anual por animal (kg animal⁻¹) e ganho de peso vivo anual por área (kg ha⁻¹) de acordo com as ofertas de forragem (OF) referentes ao ano de 2012.

Potencial de Aquecimento Global (Kg CO₂eq)



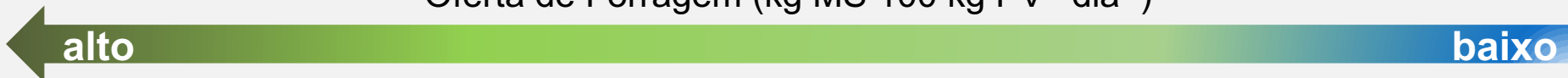
Potencial de Sequestro de Carbono Kg CO₂eq /ano (média 30 anos)



Estoque de carbono no solo

0 m	0 a 0,3 m	0 a 0,3 m	0 a 0,3 m	0 a 0,3 m
0,3 m	49,1 t ha ⁻¹ bom	49,8 t ha ⁻¹ bom	50,3 t ha ⁻¹ bom	45,7 t ha ⁻¹ bom
1 m	0,3 a 1 m	0,3 a 1 m	0,3 a 1 m	0,3 a 1 m
	72,2 t ha ⁻¹ médio	74,4 t ha ⁻¹ médio	85,4 t ha ⁻¹ bom	70,3 t ha ⁻¹ ruim
=	0 a 1 m	0 a 1 m	0 a 1 m	0 a 1 m
	121,3 t ha ⁻¹ médio	124,2 t ha ⁻¹ médio	135,7 t ha ⁻¹ bom	116,0 t ha ⁻¹ ruim

Oferta de Forragem (kg MS 100 kg PV⁻¹ dia⁻¹)



Carga (kg PV ha⁻¹) – Intensidade de pastejo



JANELA DE MANEJO



Touceiras
0% - 35%



Oferta
8% -12%



Estoques de 180 t C/ha (até 1 m)
Sequestro 0,6 a 2,5 t CO₂e/ha/ano



Massa
1400-2500 kg



Altura
9cm-12cm

Carvalho et al. 2019. Nativão, + de 30 anos de pesquisa em campo nativo. Boletim Técnico. 126p.

Emissão de CH₄ e manejo de pastagens

N. Caram et al.

Agricultural Systems 205 (2023) 103582

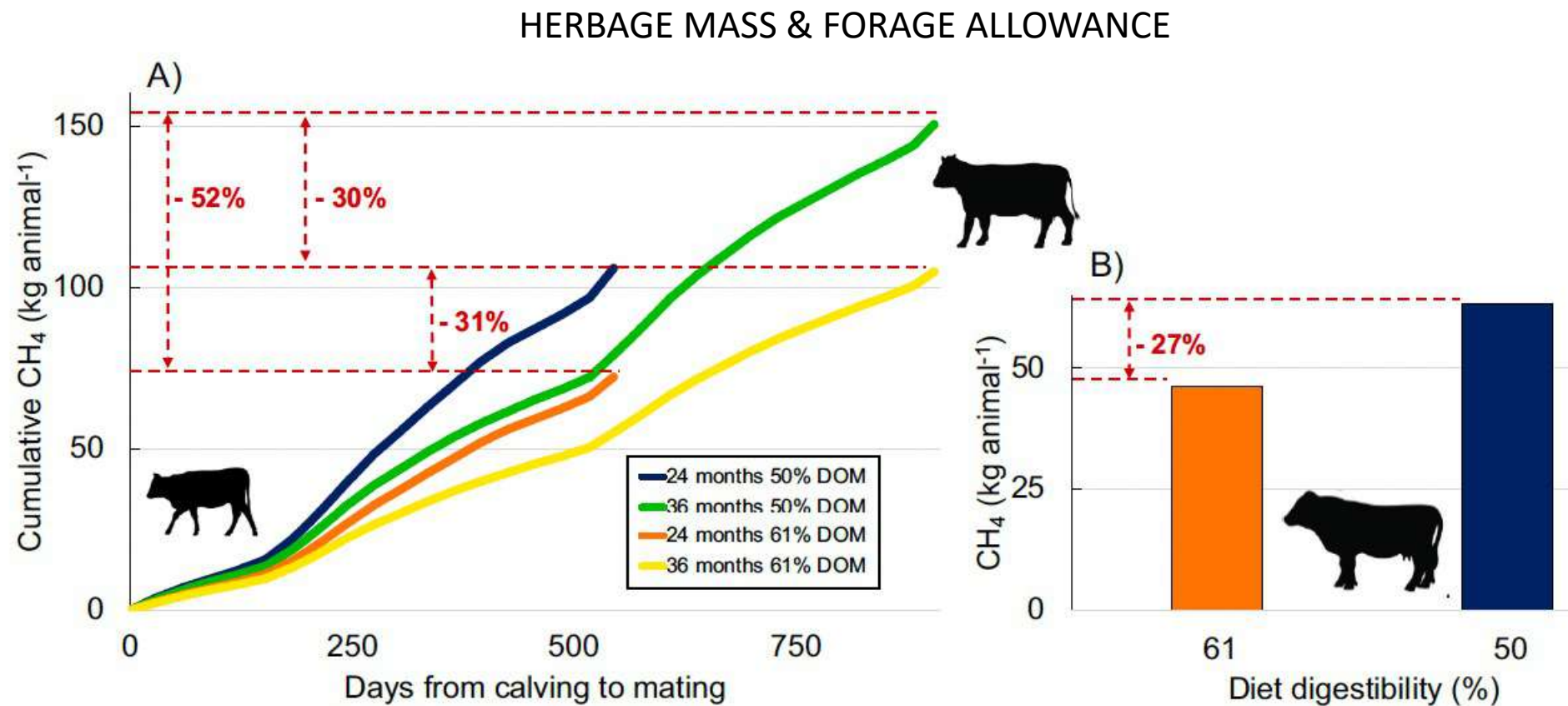


Fig. 5. Enteric CH₄ emissions of two theoretical scenarios to assess the energy use efficiency: a) cumulative enteric CH₄ emissions from calving to first pregnancy as a function of the energy intake and diet digestible organic matter (DOM); and b) annual CH₄ emissions of non-pregnant cows according to the annual energy intake associated with diet digestible organic matter (DOM).

SIPA – intensidades de pastejo e efeito na soja

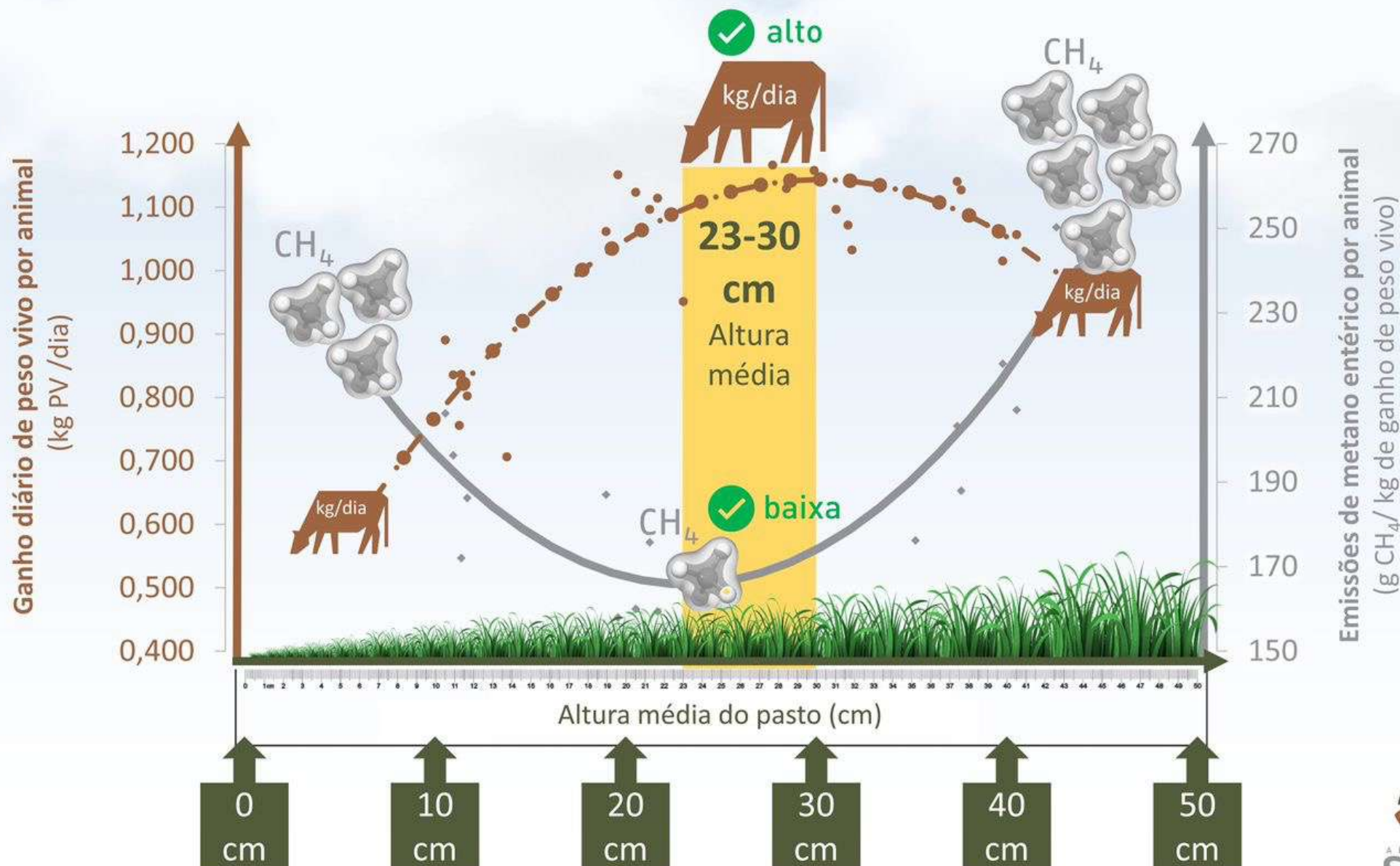
Inserindo a pecuária no contexto produtivo da soja

Local: São Miguel das Missões

22
anos de
experimento



Manejo de pastagens e GEE



Souza Filho, W.
2019. Mitigation of enteric methane emissions through pasture management in integrated crop-livestock systems: Trade-offs between animal performance and environmental impacts. J. Cleaner Production, 231:968-975.



Rotativo

O V I N O S



Efeito do método de pastoreio



SIPApp

MILHO/SOJA – INTEGRAÇÃO COM OVINOS

2003 - 2016 Local EEA – Eldorado do Sul/RS

O potencial do manejo na mitigação dos GEE

Dry matter intake (DMI) and methane emission by sheep grazing Italian ryegrass at different stocking methods (continuous and rotational) and grazing intensities (low and moderate).

Variables	Continuous		Rotational		Mean ± MSE	P _I	P _M	P _{I×M}
	Low	Moderate	Low	Moderate				
Experiment 1								
DM intake								
g animal ⁻¹ day ⁻¹	1369a	1322a	1244b	907b	1210 ± 71	0.110	0.035	0.210
CH ₄ emission								
g animal ⁻¹ day ⁻¹	24.5	22.7	23.7	20.7	22.7 ± 1.0	0.298	0.531	0.794
g kg DMI ⁻¹	19.5	19.3	19.5	19.5	19.5 ± 0.4	0.945	0.979	0.912
% GEI	5.9	5.5	5.9	6.0	5.8 ± 0.2	0.757	0.587	0.699
kg ha ⁻¹ day ⁻¹	0.66b	0.85a	0.67b	0.88a	0.74 ± 0.1	0.018	0.784	0.865
g kg ADG ⁻¹ day ⁻¹	183b	159b	240a	285a	220 ± 17	0.562	0.001	0.091
Experiment 2								
DM intake								
g animal ⁻¹ day ⁻¹	1477	1629	1563	1919	1674 ± 84	0.143	0.272	0.548
CH ₄ emission								
g animal ⁻¹ day ⁻¹	41.7	41.2	38.7	38.8	39.9 ± 1.3	0.952	0.443	0.913
g kg DMI ⁻¹	27.7a	26.7a	21.9b	19.3b	23.6 ± 1.1	0.398	0.013	0.682
% GEI	8.6a	8.2a	6.9b	6.1b	7.3 ± 0.3	0.351	0.017	0.826
kg ha ⁻¹ day ⁻¹	0.54b	0.80a	0.64b	1.0a	0.76 ± 0.1	0.007	0.114	0.590
g kg ADG ⁻¹ day ⁻¹	164b	178b	189a	215a	190 ± 6.6	0.092	0.016	0.619

DM=dry matter; DMI=dry matter intake; GEI=gross energy intake; ADG=average daily gain; MSE=mean standard error; P_I =probability for grazing intensity; P_M =probability for stocking method; $P_{I \times M}$ =probability of interaction between grazing intensity and stocking method. Means followed by lowercase letters on line differ by *F* test ($P < 0.05$).

Savian, J. V. et al. 2016. Grazing intensity and stocking methods on animal production and methane emission by grazing sheep. Agr. Ecos. Envir. 190: 112-119

Pastoreio Rotatínuo: um conceito disruptivo...

Como manejar o pasto?

“Faça a pergunta para o consumidor...”



Pastoreio Rotatínuo: um conceito disruptivo...



Rotatínuo (RN)

Vs



Rotativo (RT)



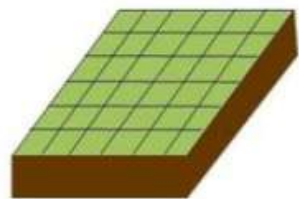
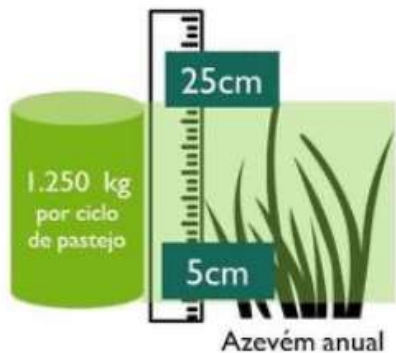
Pastoreio Rotatínuo: um conceito disruptivo...

Parâmetros	RN	RT
Ciclos de pastejo (n°)	12	4
Período de descanso (n° dias)	12.5	35.3
Massa de forragem pré-past. (kg MS ha ⁻¹)	855	1309
Massa de forragem pós-past. (kg MS ha ⁻¹)	475	379
Pré-pastejo LI (%)	90.6	95.1
Acúmulo de forragem (kg DM ha ⁻¹ dia ⁻¹)	52.1	33.2
Produção de forragem (kg DM ha ⁻¹)	8714	6822

Schons, R. T. et al. 2021. 'Rotatinuous' stocking: An innovation in grazing management to foster both herbage and animal production. *Livestock Science* 245 (2021) 104406

Pastoreio Rotatínuo: um conceito disruptivo...

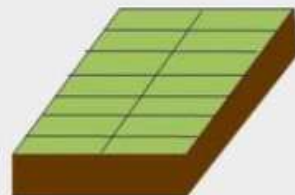
Em qual estratégia se colhe
mais pasto por hectare?



36 piquetes

1 pastejo a cada 35 dias

ROTATIVO



14 piquetes

1 pastejo a cada 13 dias

ROTATÍNUO

ROTATIVO

4 ciclos x 1.250 kg
=
5.000 kg de
forragem colhida



ROTATÍNUO

12 ciclos x 500 kg
=
6.000 kg de
forragem colhida



*Valores em matéria seca arredondados
de Schons, R.T. et al 2021

Infográfico elaborado por
Leandro Ebert e Fernanda Moojen

Pastoreio Rotatínuo: um conceito disruptivo...

Parâmetros	RN	RT
Forragem colhida (kg ha ⁻¹)	5955	4971
Eficiência de colheita (%)	68	72
GMD (kg dia ⁻¹)	0.119	0.047
Ganho de PV por ha (kg)	401	279
Taxa de lotação (kg PV ha ⁻¹)	850	1235
Parasitas (ovos/g fezes)	704	2472



Schons, R. T. et al. 2021. *Rotatinuous stocking*: an innovation in grazing management to foster both herbage and animal production. *Livestock Science* 245: 104406.

Pastoreio Rotatínuo: um conceito disruptivo...

Parâmetros	RN	RT
Consumo diário (g MO cb ⁻¹)	801	653
Eficiência de utilização (consumo/kg carcaça)	18.7	34.0
Custo de alimentação (US\$ alimento/kg de carcaça)	0.51	1.42
g CH ₄ /kg carcaça	513	1357



Savian, J. V. et al. 2021. "Rotatinuous" stocking as a climate-smart grazing management strategy for sheep production. *Science of Total Environment*, 753: 141790.

CONCEPÇÕES DE MANEJO DO PASTO



Objetivo:

Máxima taxa de ingestão

Maximizar consumo por unidade de tempo

Composição química

+ Proteína bruta

+ Digestibilidade MO

- FDN e FDA

Azevém

Altura entrada
18 cm

Altura saída
11 cm

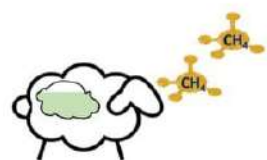
+ Consumo
de Matéria orgânica 2,52 %
Peso vivo

801 g/animal/dia

638 g MO digestível/animal/dia

291 kJ EM/kg peso vivo/dia

Emissões de
Metano (CH₄)



CH₄ g/ha/dia 645

CH₄ g/kg/GMD 217

CH₄ g/kg/MOD consumida 39,5

CH₄ (g/kg/MO Consumida) 31,4

CH₄ g/animal/dia 24,8

+Eficiente

- Impacto
ambiental

0 100 200 300 400 500 600 700

ROTATIVO
tradicional

Objetivo:

Máxima taxa de acúmulo de forragem

Maximizar acúmulo de forragem e eficiência de colheita

Composição química

- Proteína bruta

- Digestibilidade MO

+ FDN e FDA

Azevém

Altura entrada
27 cm

Altura saída
8 cm

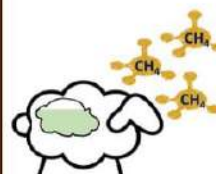
- Consumo
de Matéria orgânica 2,25 %
Peso vivo

653 g/animal/dia

507 g MO digestível/animal/dia

252 kJ EM/kg peso vivo/dia

Emissões de
Metano (CH₄)



CH₄ g/ha/dia 1.056

CH₄ g/kg/GMD 586

CH₄ g/kg/MOD consumida 45,7

CH₄ (g/kg/MO Consumida) 35,8

CH₄ g/animal/dia 22,2

0 100 200 300 400 500 600 700 800 900 1000



CONCEPÇÕES DE MANEJO DO PASTO

Intensidade de
desfolhação

+

C INTENSIVO

Alta intensidade
Baixa frequência



A COMUM

Alta intensidade
Alta frequência



B INEXISTENTE

Baixa intensidade
Baixa frequência



NONSENSE

+

Frequência de
desfolhação

Ilustração: Paulo Carvalho e Fernanda Moojen



CONCEPÇÕES DE MANEJO DO PASTO

Intensidade de
desfolhação

+

C INTENSIVO

Alta intensidade
Baixa frequência



A COMUM

Alta intensidade
Alta frequência



B INEXISTENTE

Baixa intensidade
Baixa frequência



D DISRUPTIVO

Baixa intensidade
Alta frequência



+

Frequência de
desfolhação

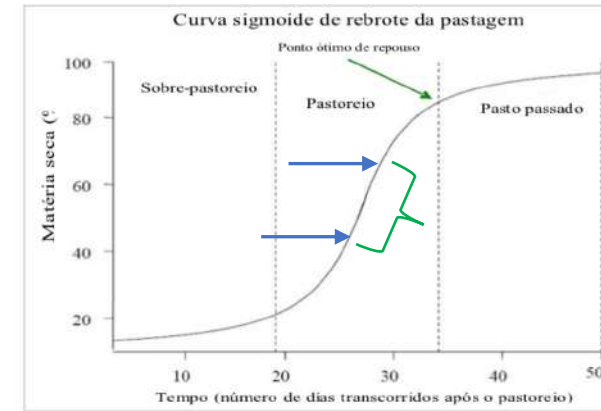


Figura 2: Curva sigmoide que expressa o rebrote do pasto, para as condições da Austrália.
Fonte: Adaptado de Sounness (2004).

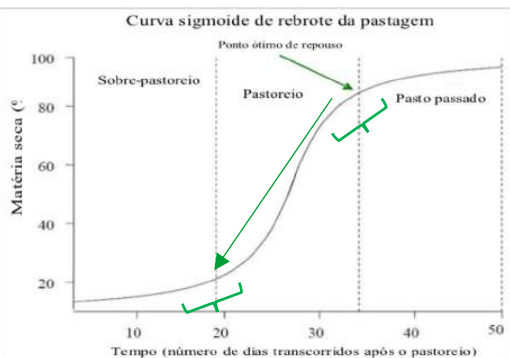


Figura 2: Curva sigmoide que expressa o rebrote do pasto, para as condições da Austrália.
Fonte: Adaptado de Sounness (2004).

Ilustração: Paulo Carvalho e Fernanda Moojen

Considerações & take-home messages



A agricultura não é a vilã da história...

Global decoupling of agricultural land and food production

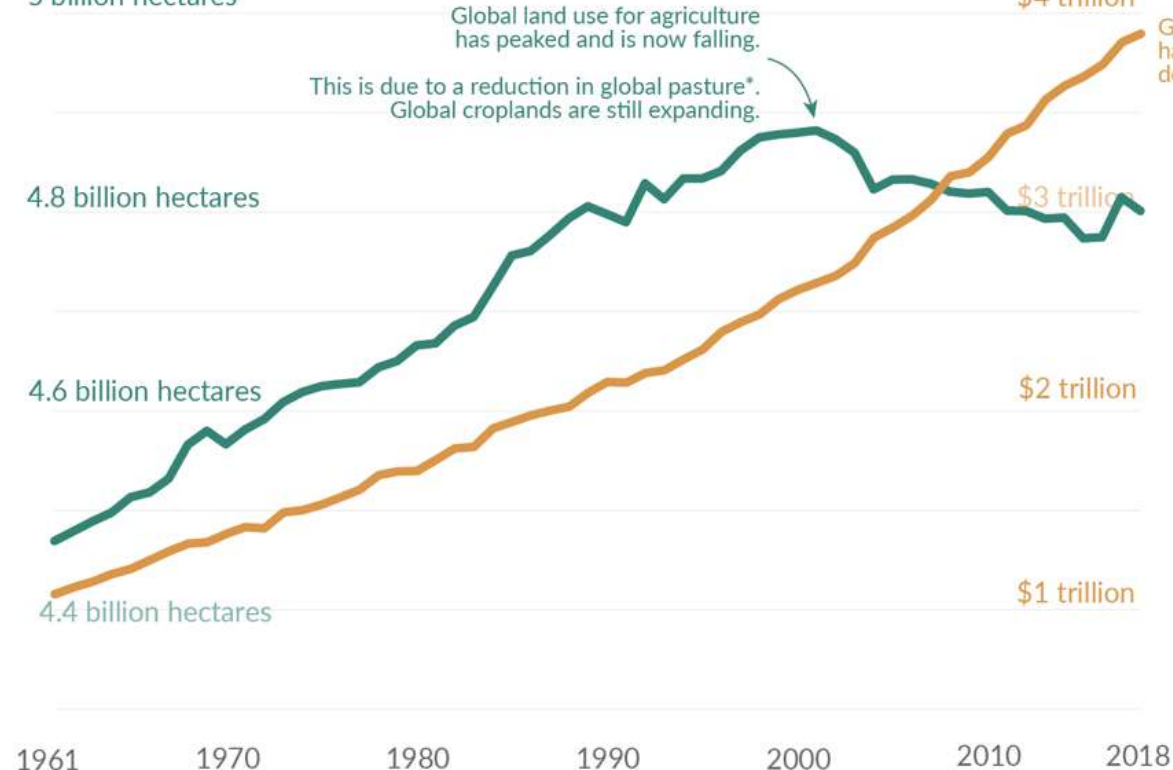
Our World
in Data

Agricultural land is the sum of cropland and pasture for grazing livestock.

Production is measured in constant 2015 international-dollars, which adjusts for inflation. Includes all crops and livestock.

Global agricultural land use

5 billion hectares



Global land use for agriculture has peaked and is now falling.
This is due to a reduction in global pasture*. Global croplands are still expanding.

Global agricultural production

\$4 trillion

Global agricultural production has continued to increase despite a reduction in land use

After millennia of agricultural expansion, the world has passed 'peak agricultural land'

The world produces more food than ever, but the amount of land we use is now falling. This means we can feed more people while restoring wild habitat.

*A peak in global pasture land does not mean that it has peaked everywhere. In tropical regions, it continues to increase, often at the expense of carbon-rich habitats.

Data source: Food and Agriculture Organization of the United Nations.

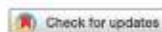
OurWorldinData.org - Research and data to make progress against the world's largest problems.

Licensed under CC-BY by the author Hannah Ritchie.



ALIANÇA
SIPA
SISTEMAS INTEGRADOS DE
PRODUÇÃO AGROPECUÁRIA

Mitos vs fatos (números) da pecuária



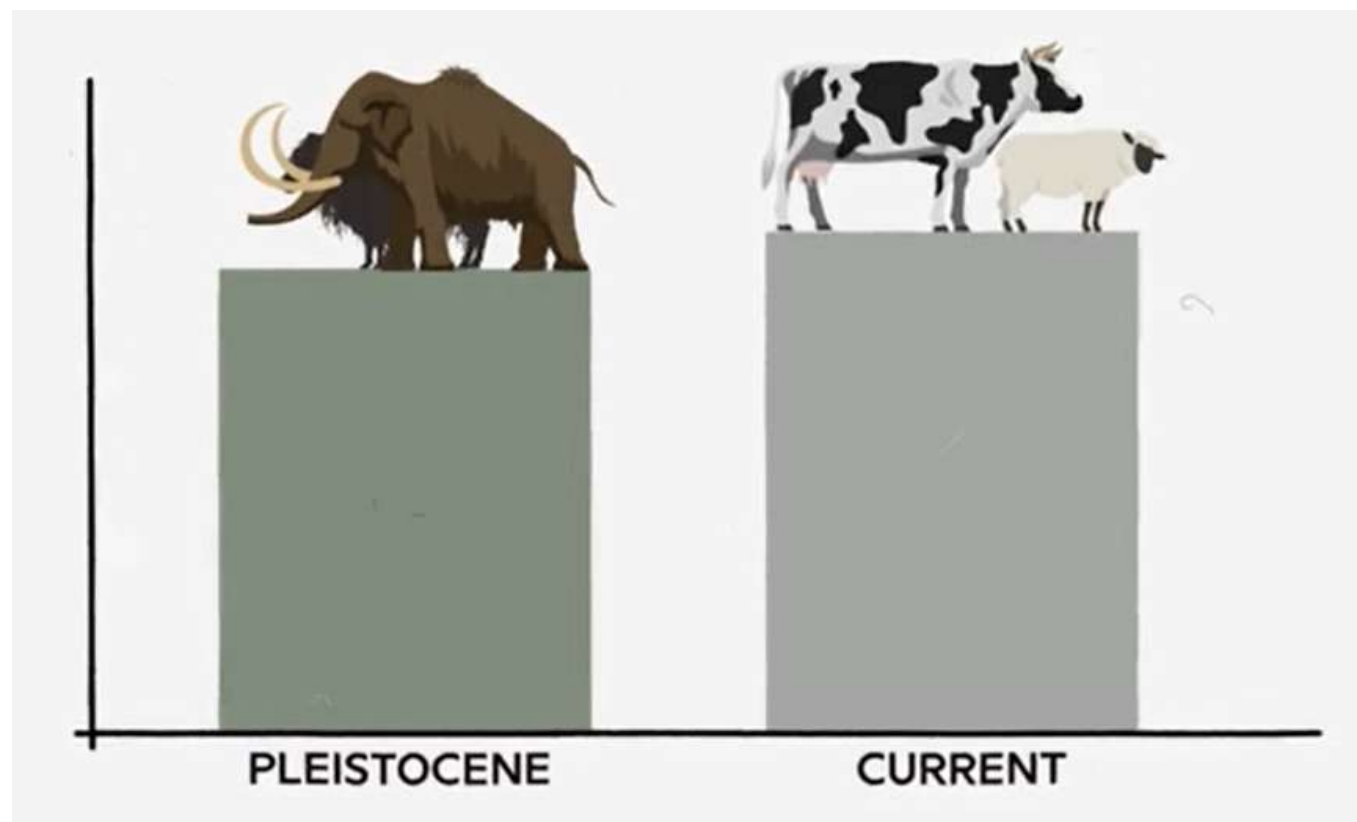
PERSPECTIVE OPEN

Underrated past herbivore densities could lead to misoriented sustainability policies

Pablo Manzano^{1,2,3,4}, Guillermo Pardo^{1,3}, Moustapha A. Itani^{1,2} and Agustin del Prado^{1,3,4}

Knowing the carrying capacity of the Earth's grazed ecosystems, and the relevance of herbivory, is important for many scientific disciplines, as well as for policy. Current herbivore levels are estimated to be four to five times larger than at the Pleistocene–Holocene transition or the start of the industrial revolution. While this estimate can lead the general public and the scientific community to predict severe, widespread environmental impacts by livestock in terms of deforestation, biodiversity loss, and climate change, it ignores the inherent uncertainty of such calculations. We revise the evidence published during the last decade regarding Late Pleistocene herbivore abundance, along with contemporary and some pre-industrial data on herbivore density in grazed ecosystems. Both Late Pleistocene and pre-industrial herbivore levels are likely to be consistently higher than what has generally been assumed, confirming increasing awareness on the importance of herbivory as a widespread ecological process. We therefore call for more refined research in this field to have the reliable baselines currently demanded by society and policy. These baselines should orient sound action toward policies on biodiversity conservation, ecosystem restoration, food systems, and climate change.

npj Biodiversity (2023)2:2 | <https://doi.org/10.1038/s44185-022-00005-z>

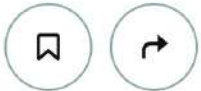


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Solução NÃO é deixar de comer carne...

Americans are quitting plant-based meat due to high prices, worse taste, and questionable health benefits

Jacob Zinkula Feb 15, 2023, 3:44 PM



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Demand for livestock products is expected to grow by as much as 50% by 2050



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Eating meat isn't a crime against the planet - if it's done right
Thomasina Miers

George Monbiot criticised 'chefs and foodies' like me for focusing on regenerative grazing. But alternative, lab-grown foods, could have terrible consequences

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CARNI Sostenibili

HEALTH & NUTRITION ENVIRONMENT & SUSTAINABILITY FOOD SAFETY & SECURITY ANIMAL WELFARE



Plant-based meat substitutes are the biggest failure in the food industry's history

Scritto da Andrea Bertaglio / 14 Oct 2022

Emissão de CH₄ e manejo de pastagens ESTRUTURA PARA CAPTURAR O BOCADO !

Science of the Total Environment 869 (2023) 161695

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv



Relevance of sward structure and forage nutrient contents in explaining methane emissions from grazing beef cattle and sheep

Lais Leal da Cunha^{a,*}, Carolina Bremm^b, Jean Victor Savian^c, Ángel Sanchez Zubieta^a,
Jusiane Rossetto^a, Paulo César de Faccio Carvalho^a

^a Grazing Ecology Research Group, Federal University of Rio Grande Do Sul, Porto Alegre, RS, Brazil

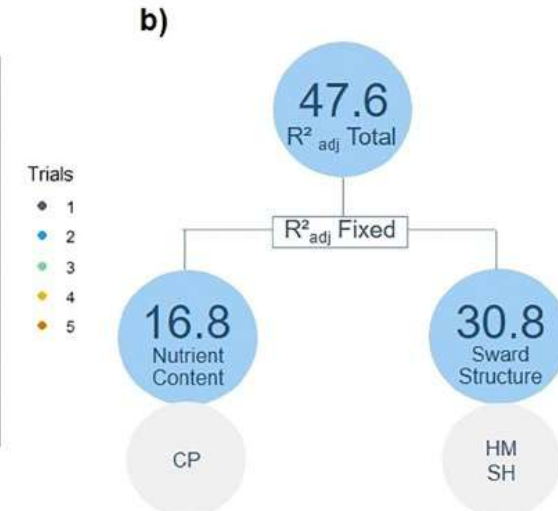
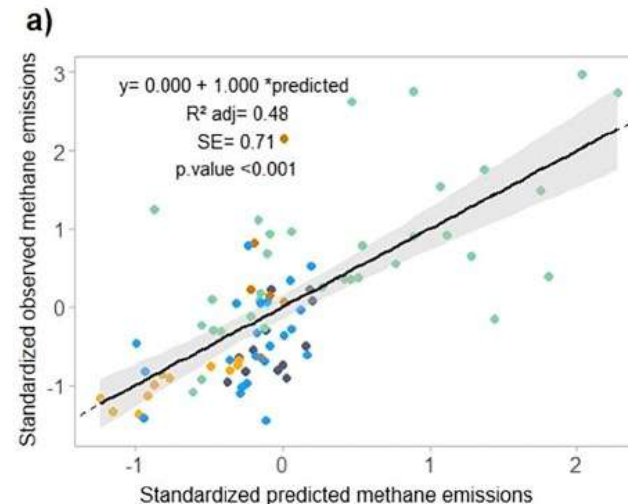
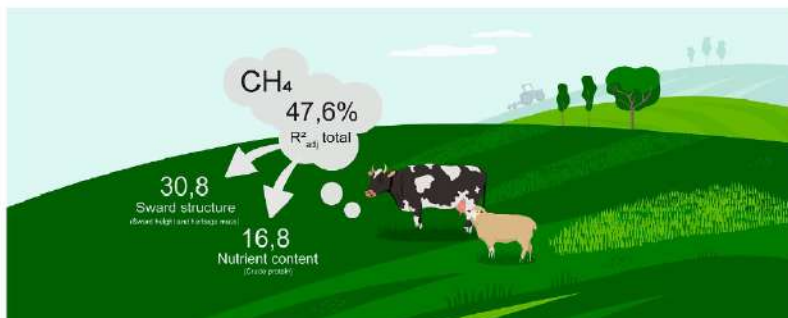
^b State Foundation of Agricultural Research, Rua Gonçalves Dias, 570, Bairro Menino Deus, Porto Alegre, RS, Brazil

^c Instituto Nacional de Investigación Agropecuaria (INIA), Programa Pasturas y Forrajes, Estación Experimental INIA Treinta y Tres, Ruta 8 km 281, Treinta y Tres, Uruguay

HIGHLIGHTS

- Forage nutrient contents have a low influence on CH₄ emissions by grazing ruminants.
- Sward structure is important for predicting methane emission models.
- In optimal sward structures, forage nutrient content is not a limiting factor.
- The isolated variables have low power to explain the CH₄ emissions.
- Offering an optimal sward structure to ruminants is a promising climate-smart strategy.

GRAPHICAL ABSTRACT



HM = herbage mass (quantity)
SH = sward height (structure)

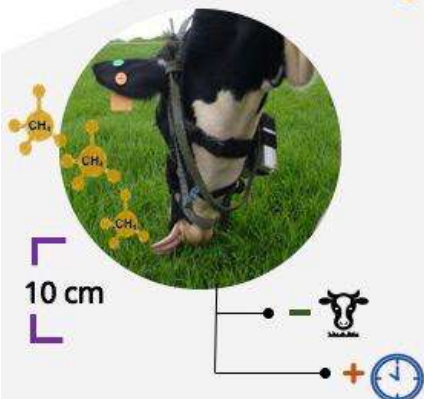
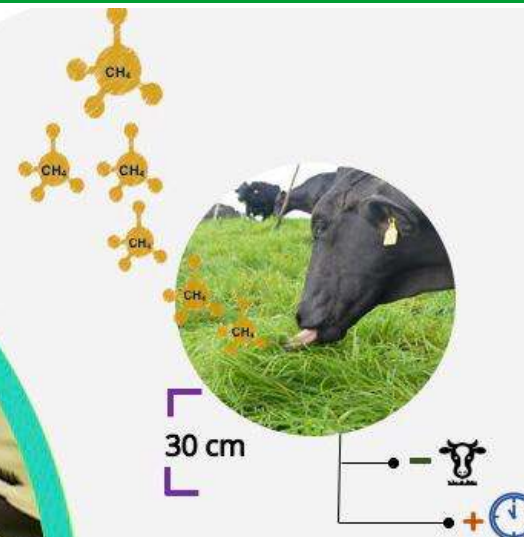
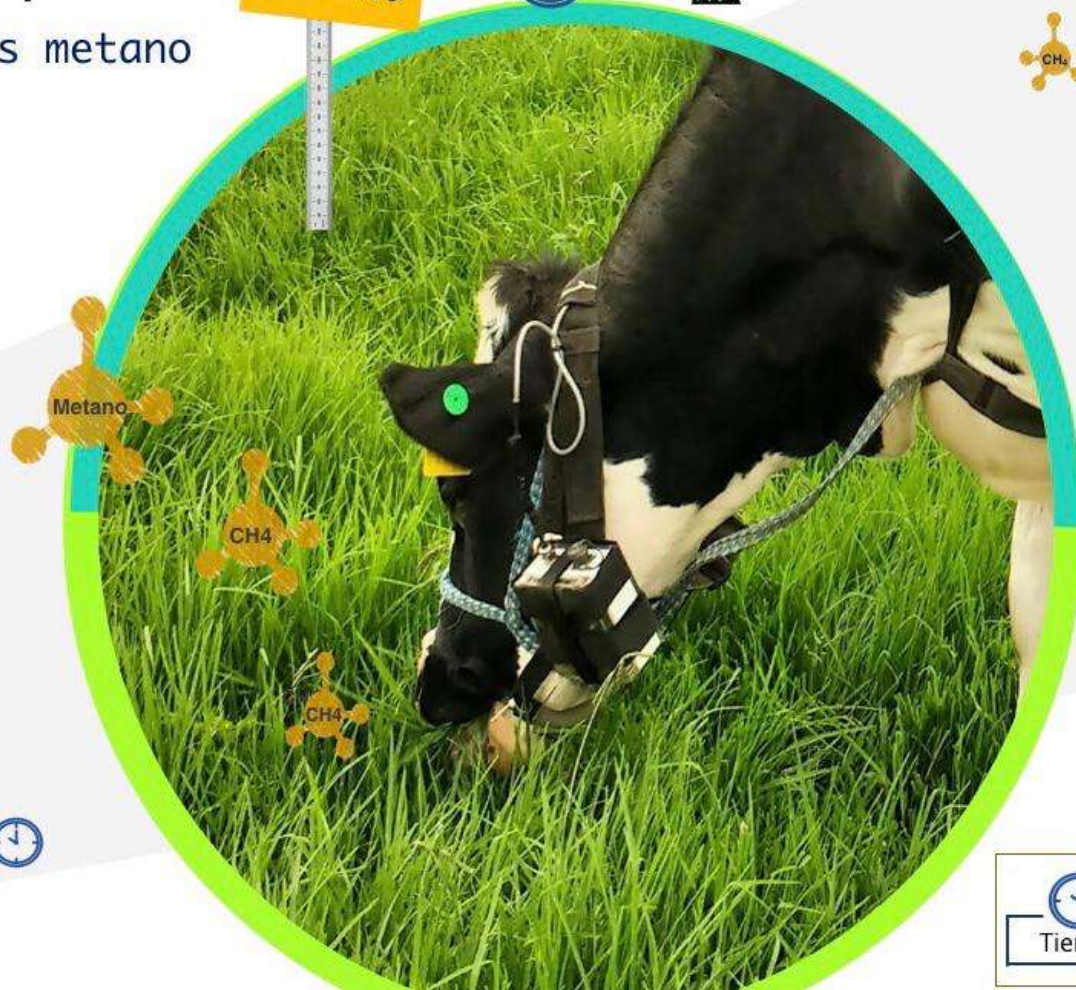
Inovações tecnológicas: Rotatínuo

Altura de pasto

20 cm



Menos metano



Inovações tecnológicas: Rotatínuo

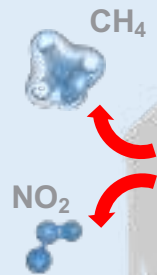
Rotativo

Rotatínuo



 **Maior intensidade de emissão**

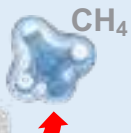
 **Menor eficiência de utilização**
(Un. produto / Un. Consumida de forragem)



 **Menor qualidade da dieta**

 **Maior intensidade de emissão**

 **Menor velocidade de ingestão**



Intensidade alta de pastejo

- Controle da estrutura do pasto visando eficiência de colheita

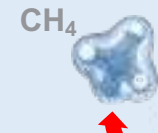
 **Maior emissão de CO_2**

 **Menor produção de raízes**

 **Maior eficiência de utilização**
(Un. produto / Un. Consumida de forragem)

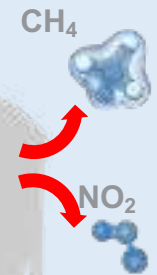
 **Menor intensidade de emissão**

 **Menor intensidade de emissão**



 **Maior velocidade de ingestão**

 **Maior qualidade da dieta**



Altura meta
Pré-pastejo

Intensidade moderada de pastejo

- Controle da estrutura do pasto visando minimizar o tempo em pastejo

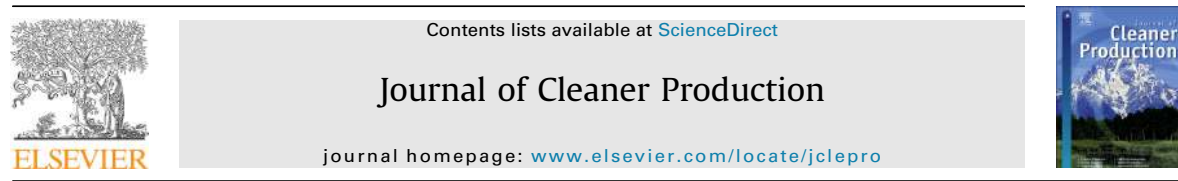
40%

Altura meta
Pós-pastejo

 **Maior produção de raízes**

 **Maior sequestro de CO_2**

Mitos vs fatos (números) da pecuária



Rotatinuous stocking: A grazing management innovation that has high potential to mitigate methane emissions by sheep

Jean Víctor Savian^{a,*}, Radael Marinho Tres Schons^a, Daniela Elisa Marchi^a, Thainá Silva de Freitas^a, Gentil Félix da Silva Neto^a, Jean Carlos Mezzalira^a, Alexandre Berndt^b, Cimélio Bayer^c, Paulo César de Faccio Carvalho^a

^a Grazing Ecology Research Group, Federal University of Rio Grande Do Sul, Porto Alegre, RS, Brazil
^b Brazilian Agricultural Research Corporation (EMBRAPA Pecuária Sudeste), São Carlos, SP, Brazil
^c Department of Soil Science, Federal University of Rio Grande Do Sul, Porto Alegre, RS, Brazil



- 72 %
emissão

g Ch₄/kg carcaça
RN 513 RT 1357



- 50 %
emissão



Mitigation of enteric methane emissions through pasture management in integrated crop-livestock systems: Trade-offs between animal performance and environmental impacts

William de Souza Filho^{a,*}, Pedro Arthur de Albuquerque Nunes^a, Raquel Santiago Barro^a, Taíse Robinson Kunrath^a, Gleice Menezes de Almeida^a, Teresa Cristina Moraes Genro^b, Cimélio Bayer^c, Paulo César de Faccio Carvalho^a

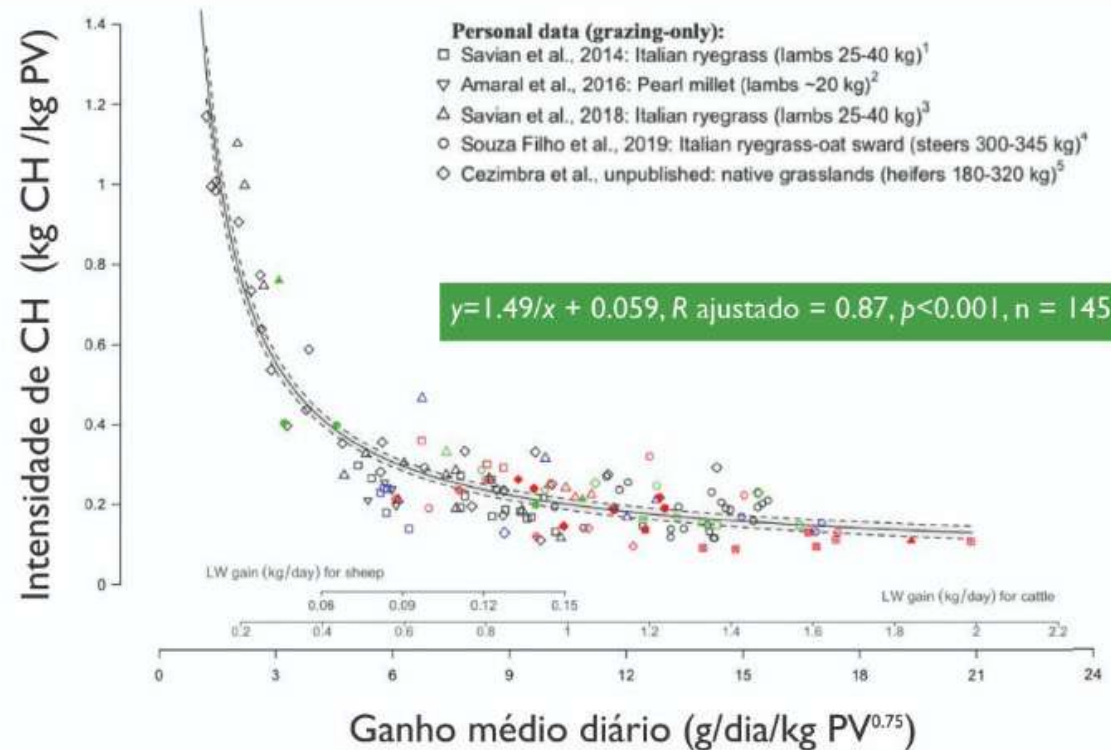
^a Department of Forage Plants and Agrometeorology, Faculty of Agronomy, Federal University of Rio Grande Do Sul (UFRGS), Bento Gonçalves Ave., 7712, Porto Alegre, RS, 91540-000, Brazil
^b Brazilian Agricultural Research Corporation (Embrapa CPPSUL), BR-153 Road, Bagé, Brazil
^c Department of Soil Science, Faculty of Agronomy, Federal University of Rio Grande Do Sul (UFRGS), Porto Alegre, Brazil



Mitos vs fatos (números) da pecuária

INÉDITO: Metas de desempenho animal associadas a mitigação de metano para a produção animal a pasto

Intensidade de pastejo moderadas a baixas



ZUBIETA et al. 2021.
Does grazing
management provide
opportunities to
mitigate methane
emissions by
ruminants in pastoral
ecosystems?
SCIENCE OF THE
TOTAL
ENVIRONMENT, v.
754, p. 142029.





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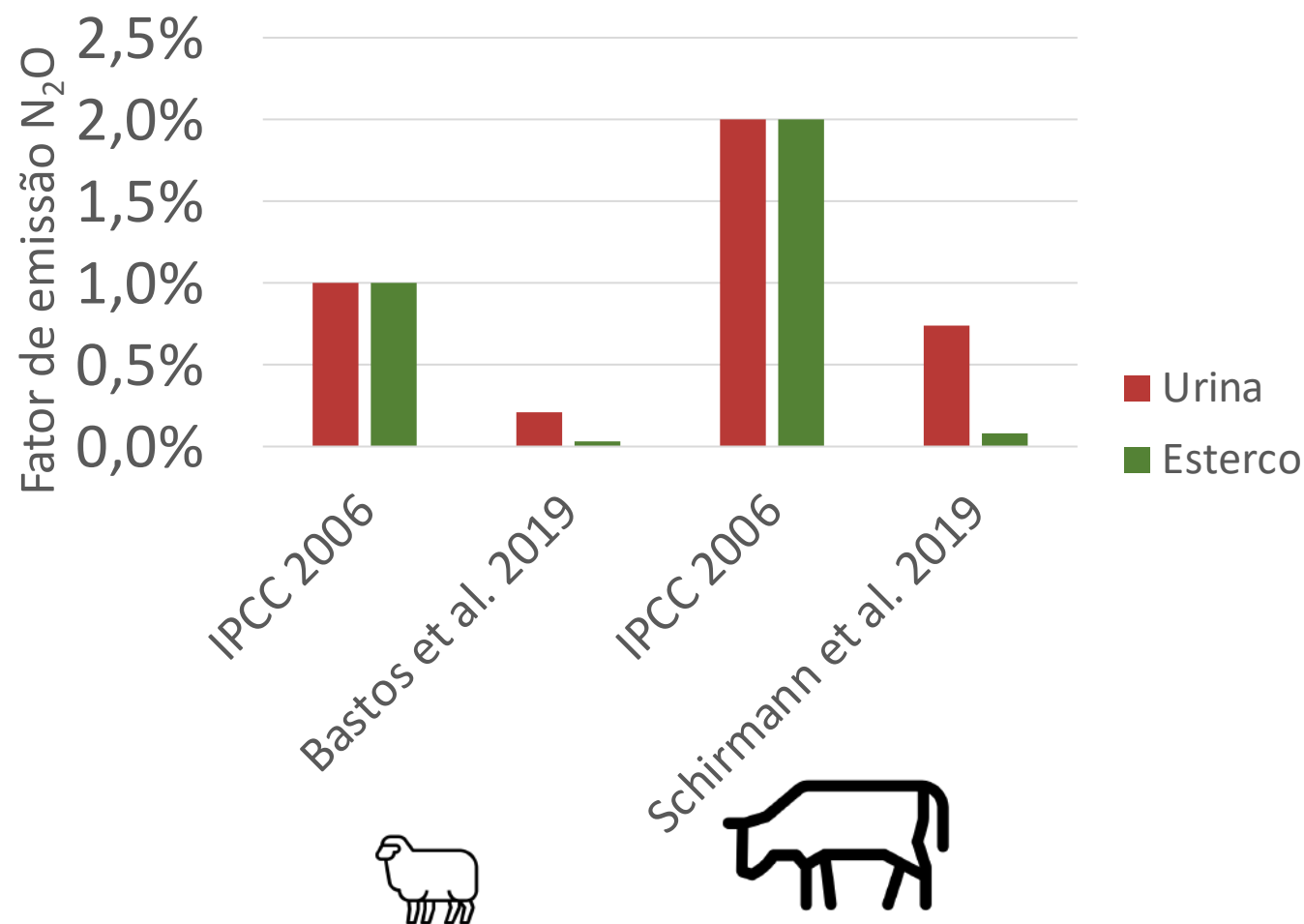
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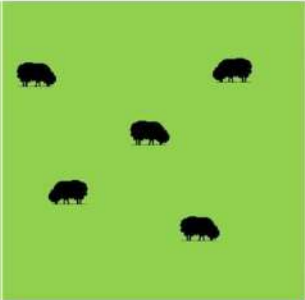
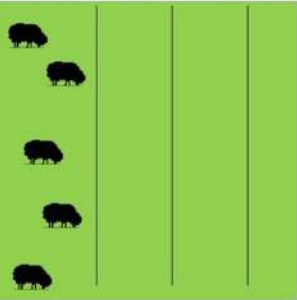
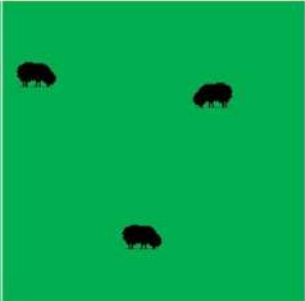
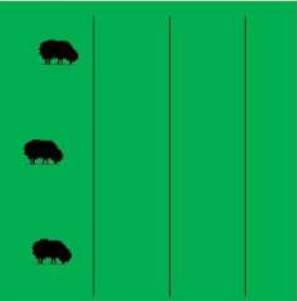
Aliança SIIPA e os fatores de emissão regionais

IPCC Tier 1 vs FATORES LOCAIS DE EMISSÃO



Inovações tecnológicas: Adubação de Sistema

EFEITO DA OFERTA DE FORRAGEM E MÉTODO DE PASTOREIO EM SISTEMAS PASTORIS

	Método de pastoreio CONTÍNUO	Método de pastoreio ROTATIVO
Oferta de forragem 10 kg de MS/100kg de peso vivo		
Oferta de forragem 20 kg de MS/100kg de peso vivo		

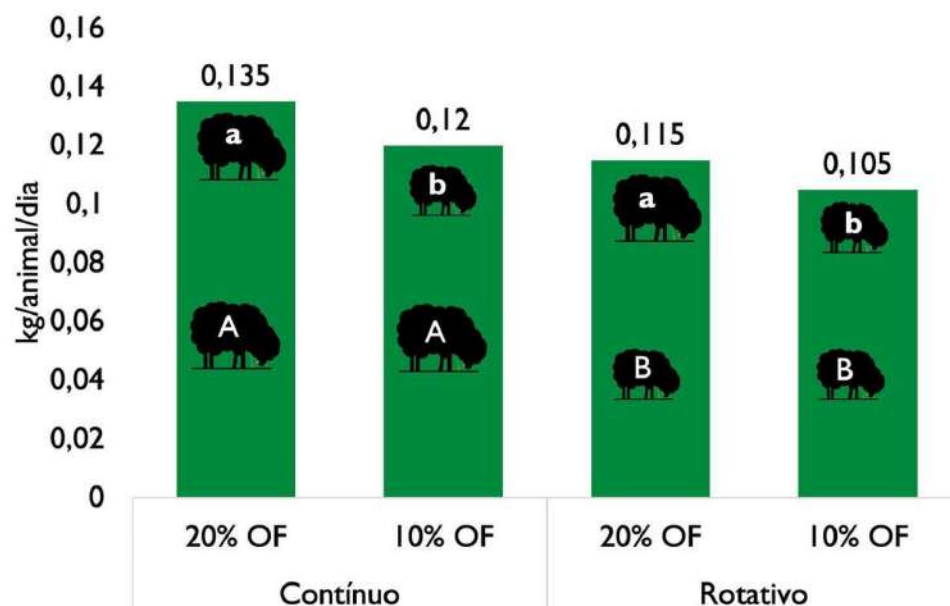
EXPERIMENTO DE LONGA-DURAÇÃO
9 ANOS DE DADOS ANALISADOS

Inovações tecnológicas: Adubação de Sistema

DESEMPENHO ANIMAL INDIVIDUAL

Método de pastoreio <0,001 diferença **SIGNIFICATIVA**

Oferta de forragem 0,002 diferença **SIGNIFICATIVA**



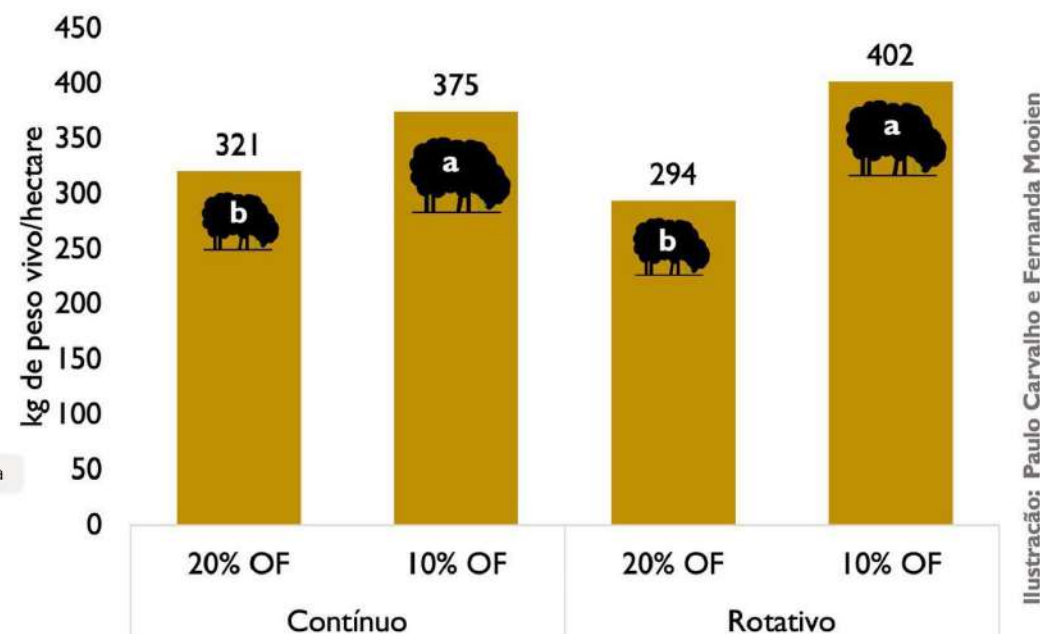
Tanto o **MÉTODO DE PASTOREIO** quanto a **OFERTA** influenciam no desempenho individual

Oferta 20% tem maior desempenho que oferta 10%
Pastoreio contínuo teve maior desempenho que pastoreio rotativo

DESEMPENHO ANIMAL POR HECTARE

Método de pastoreio 0,990 diferença **NÃO** significativa

Oferta de forragem <0,001 diferença **SIGNIFICATIVA**



NÃO importa o **MÉTODO DE PASTOREIO** mas sim a **OFERTA** no desempenho por hectare

Oferta 10% (10 kg matéria seca/100 kg de peso vivo) tem maior desempenho que oferta 20%

SIPA : mais produção com menos área



**SIPA lavoura & pecuária
+ 0,15 a 0,75 t C/ha/ano**

**SIPA lavoura , pecuária
& floresta
+ 0,55 a 2 t C/ha/ano**

Emissão de CH₄ e manejo de pastagens

L.L. da Cunha et al.

Science of the Total Environment 869 (2023) 161695

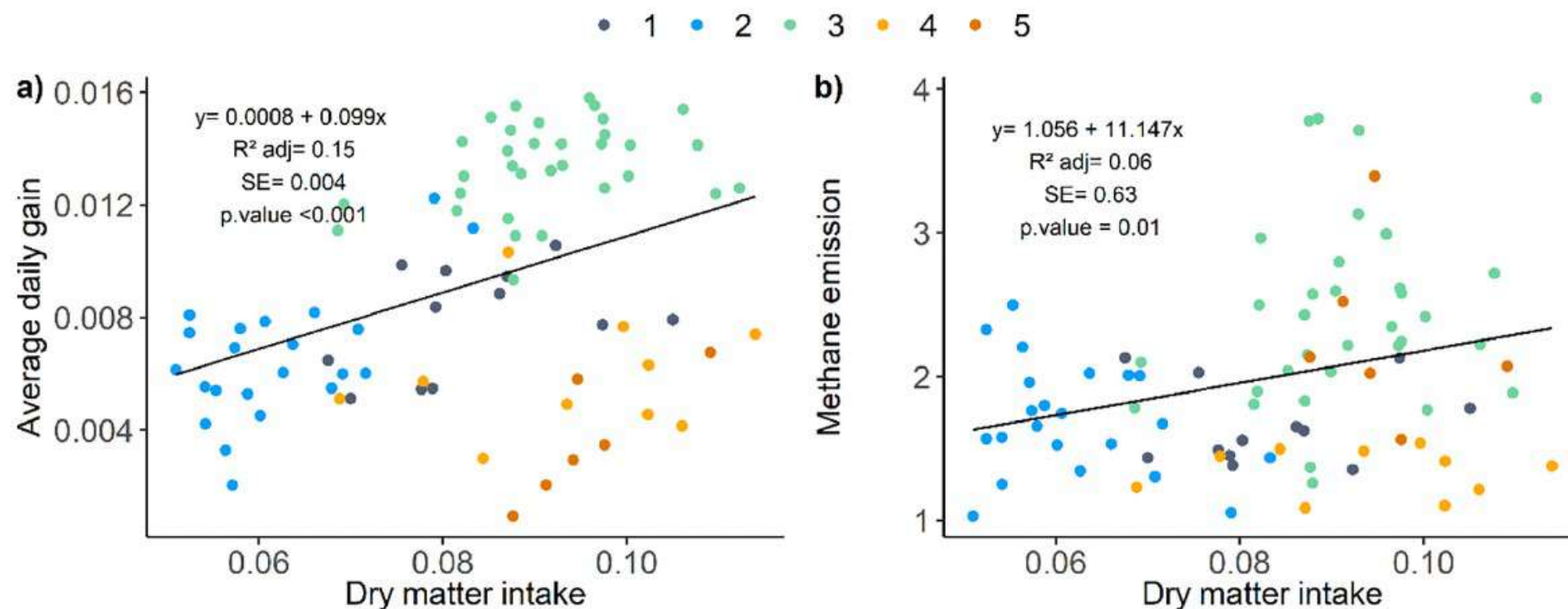


Fig. 6. Relationship between dry matter intake (kg/kg LW^{0.75}) and (a) average daily gain (kg day/kg LW^{0.75}) or (b) methane emissions (g/kg LW^{0.75}) of beef cattle and sheep grazing different grasslands. Trial 1 and 2, sheep grazing Italian ryegrass pastures; Trial 3, beef cattle grazing mixed Italian ryegrass and black oat pastures; Trial 4, sheep grazing pearl millet pastures; Trial 5, beef cattle grazing native grasslands.

CH₄ emissions from enteric fermentation in *grazing* experiments

Table 1. Intake and enteric CH₄ emissions by ruminants under grazing-only conditions and different grazing management practices

Study target	Animal category	Pasture ¹¹	CH ₄ production and intensity						Difference between control and best alternative, %			Reference	Country
			Intake, kg DM intake	Intake, % of LW	g/d	g/kg DM intake	% GE	g kg LW gain	Calculated kg year	g CH ₄ per feed input	g CH ₄ per animal output		
Sheep													
Pasture type and locations	Sheep	Multi-grasses	1.4 to 1.7	2.4 to 4.1	19.3 to 35.2	12.9 to 21.1	3.9 to 6.3	-	7.04 to 12.8	38.9	-	Ulyatt et al. (2005)	New Zealand
Grazing intensity and stocking method	Growing lambs	Annual ryegrass	0.91 to 1.4	-	20.7 to 24.5	19.3 to 19.5	5.5 to 6.0	159 to 285	7.5 to 8.9	1.0	44.2	Savian et al. (2014)	Brazil
	Lactating ewes		1.5 to 1.9	-	38.7 to 41.7	19.3 to 27.7	6.1 to 8.6	164 to 215	14.1 to 15.2	30.3	23.7		
Nitrogen fertilization	Growing lambs	Pearl millet	0.84 to 1.04	2.9 to 3.0	10.93 to 15.47	12.9 to 15.3	4.58 to 5.55	197.6 to 255.2	3.9 to 5.6	16.19	22.6	Amaral et al. (2016) ^{1,3}	Brazil
Sward heights in rotational stocking	Growing lambs	Annual ryegrass	0.74 to 0.92	2.5 to 2.9	22.2 to 24.8	27.1 to 30.1	7.6 to 8.3	217 to 586	8.1 to 9.1	12.39	63.0	Savian et al. (2018) ^{1,2}	Brazil

¹ Value of g CH₄/kg DM intake not reported in the publication and calculated from individual data of daily CH₄ production and OM content of the herbage.

² Value of CH₄ as % of GEI not reported, but available from authors.

³ Value of g CH₄/kg LW gain not reported and calculated from individual data of daily CH₄ production and LW gain.

