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SIPA
SISTEMAS INTEGRADOS DE PRODUÇÃO AGROPECUÁRIA

Aliança para difundir a Intensificação sustentável

Organização sem fins lucrativos

O 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)





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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

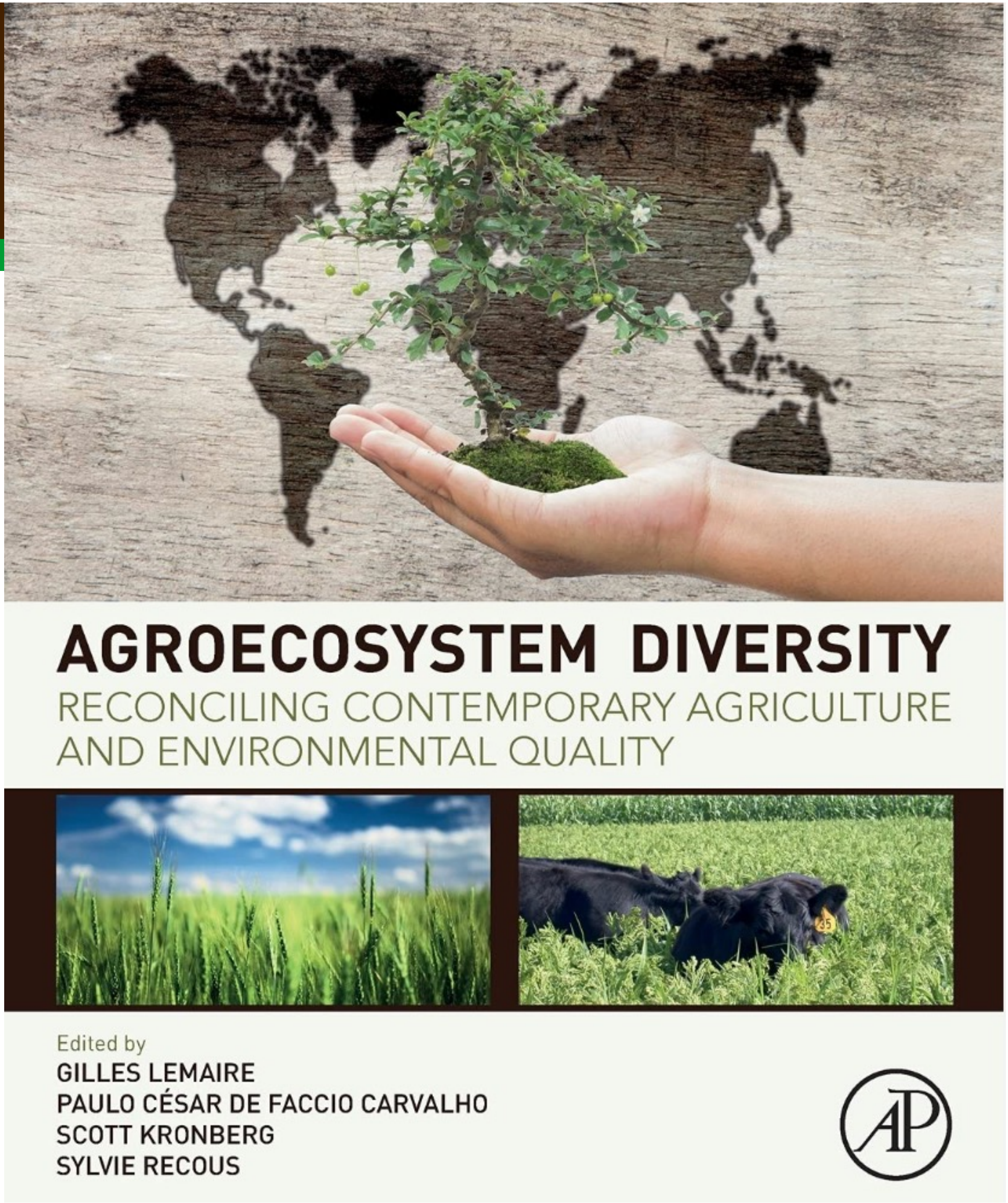
GPISI · UFR
Grupo de Pesquisa e Inovação em Sistemas Puros e Integrados de Produção Agropecuária

A Solução...

A via da Intensifição 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.



inct
institutos nacionais
de ciência e tecnologia

INCT

AGRICULTURA DE BAIXA EMISSÃO DE CARBONO

CNPq
Conselho Nacional de Desenvolvimento
Científico e Tecnológico

PROF. CIMÉLIO BAYER

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Universidade Federal do Rio Grande do Sul

Pesquisador PQ-1A CNPq

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Mudança de Uso da Terra

José Miguel Reichert (UFSM)
Pesquisador 1A – CNPq

Adaptação às Mudanças Climáticas

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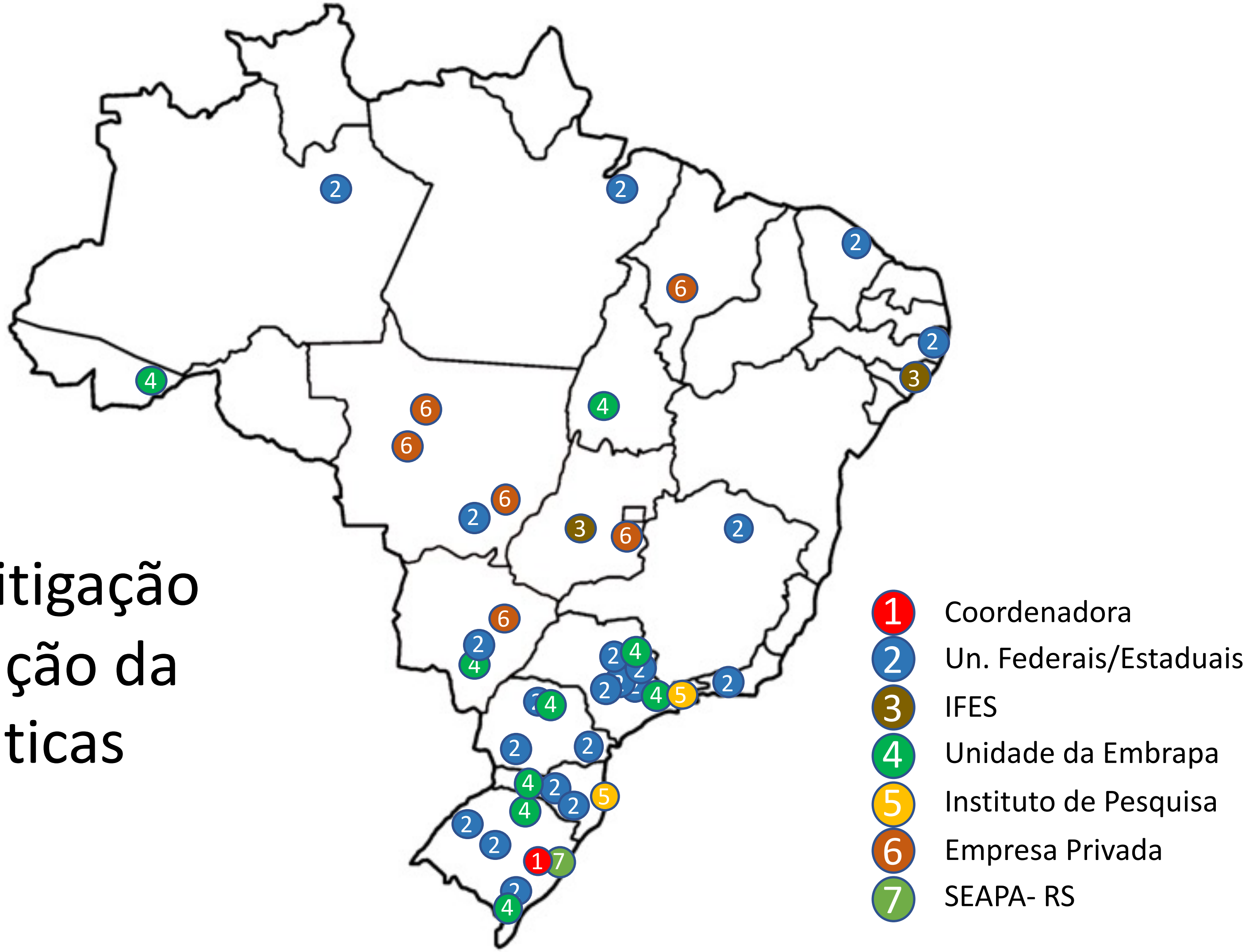
de ciência e tecnologia

INCT

Agricultura de Baixa Emissão de Carbono

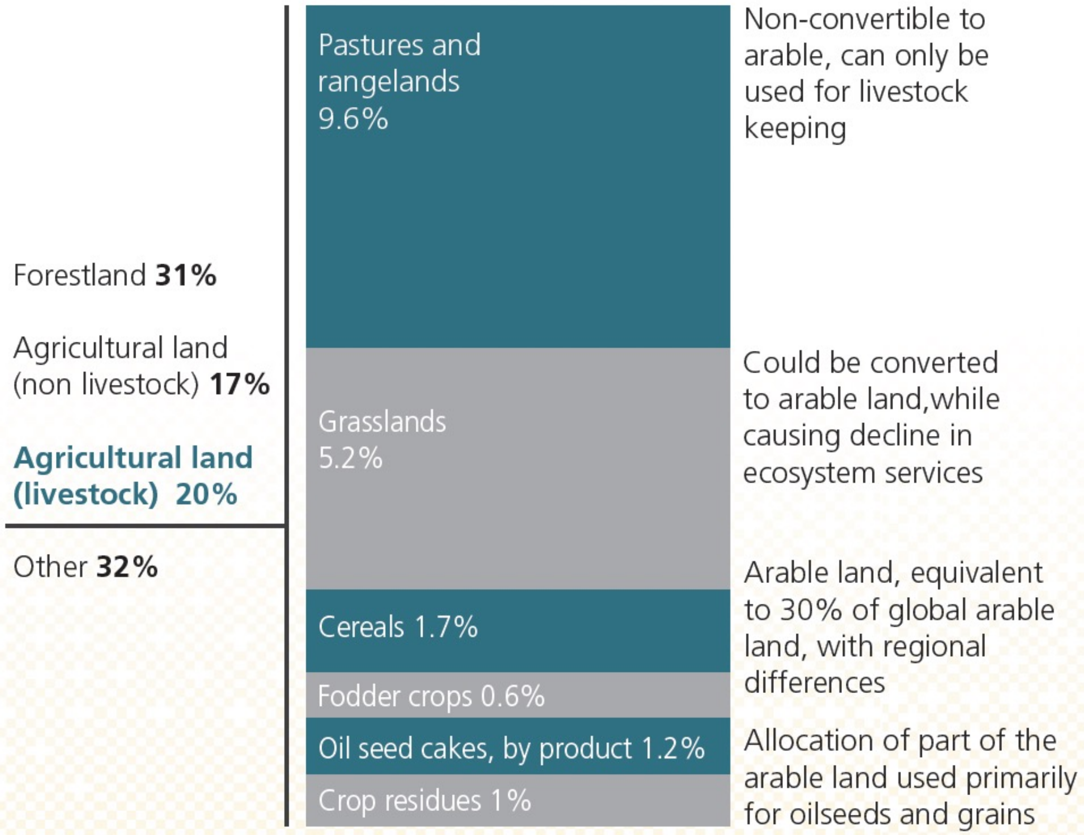
Rede Nacional de Pesquisa em Mitigação das Emissões de GEE e de Adaptação da Agricultura às Mudanças Climáticas

41 Instituições



Importância dos ecossistemas pastoris

FAO, 2022



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.

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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.

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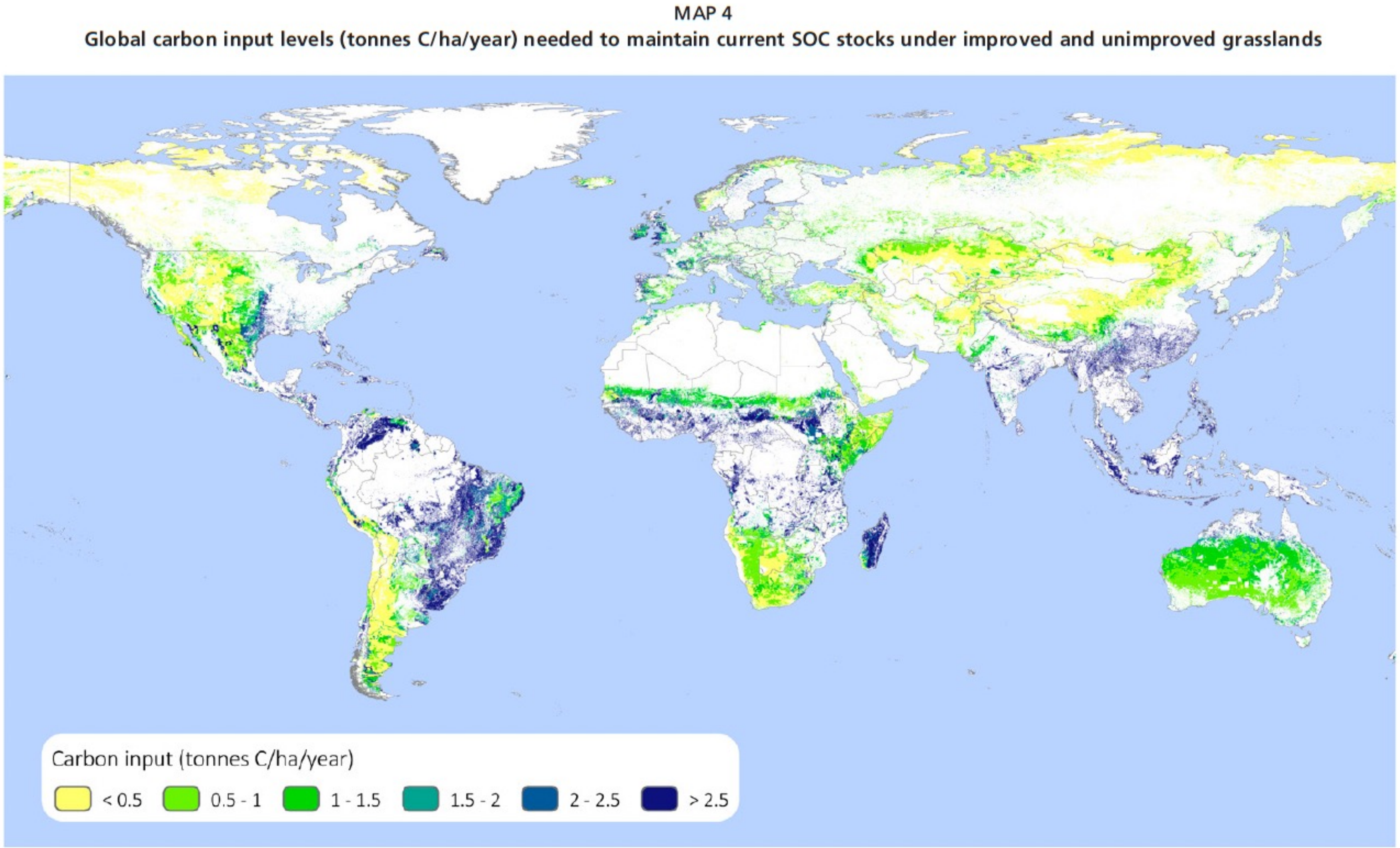
Importância dos ecossistemas pastoris



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*

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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.

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

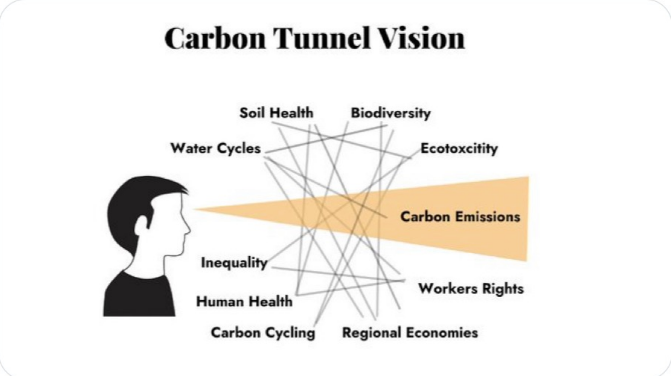
3 86% of the feed eaten by ruminants is non-edible by humans

—@CGIAR @ILRI @BiovIntCIAT_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?



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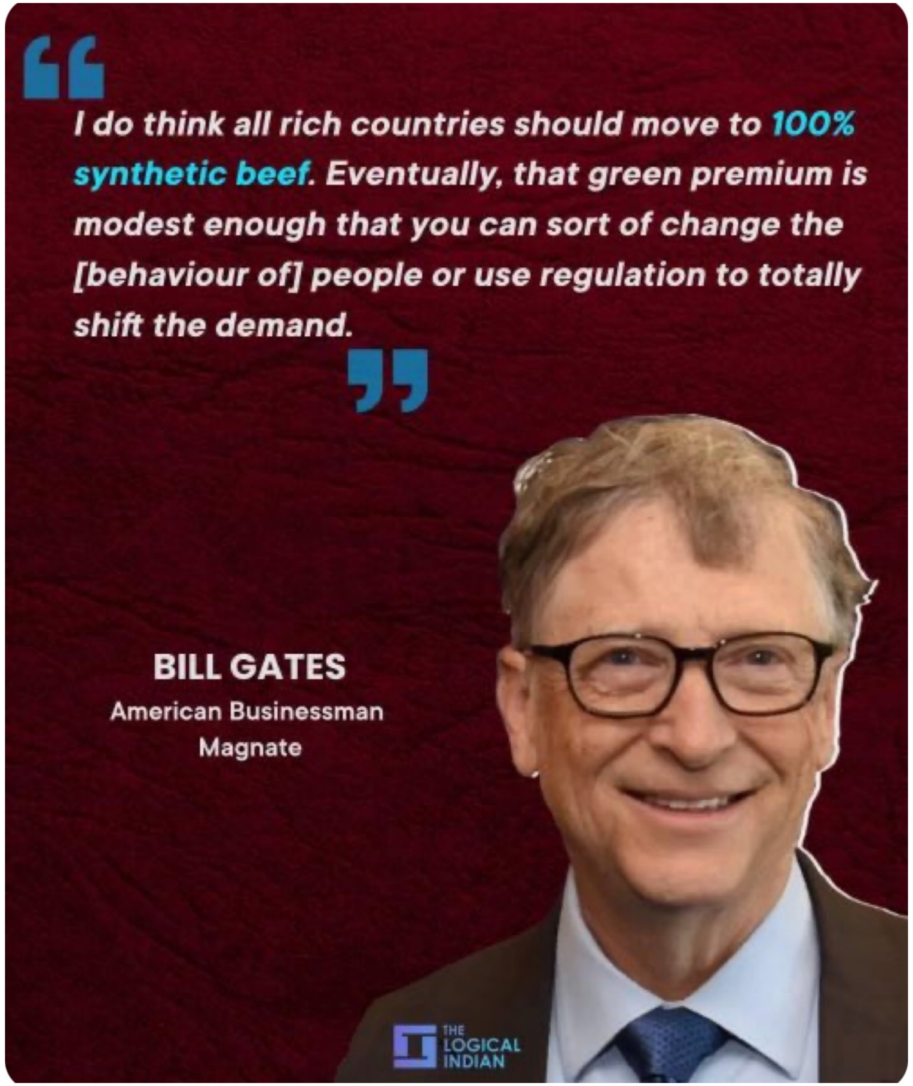
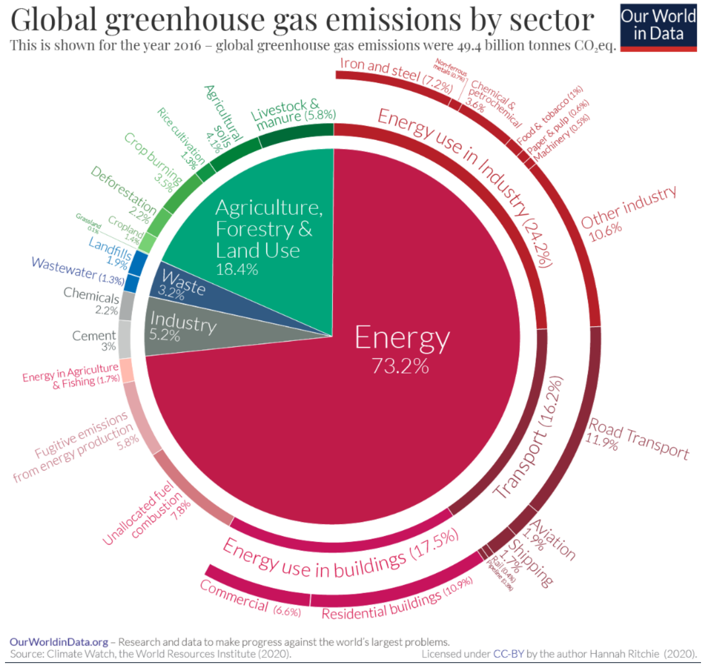
Mas a pecuária é um problema...





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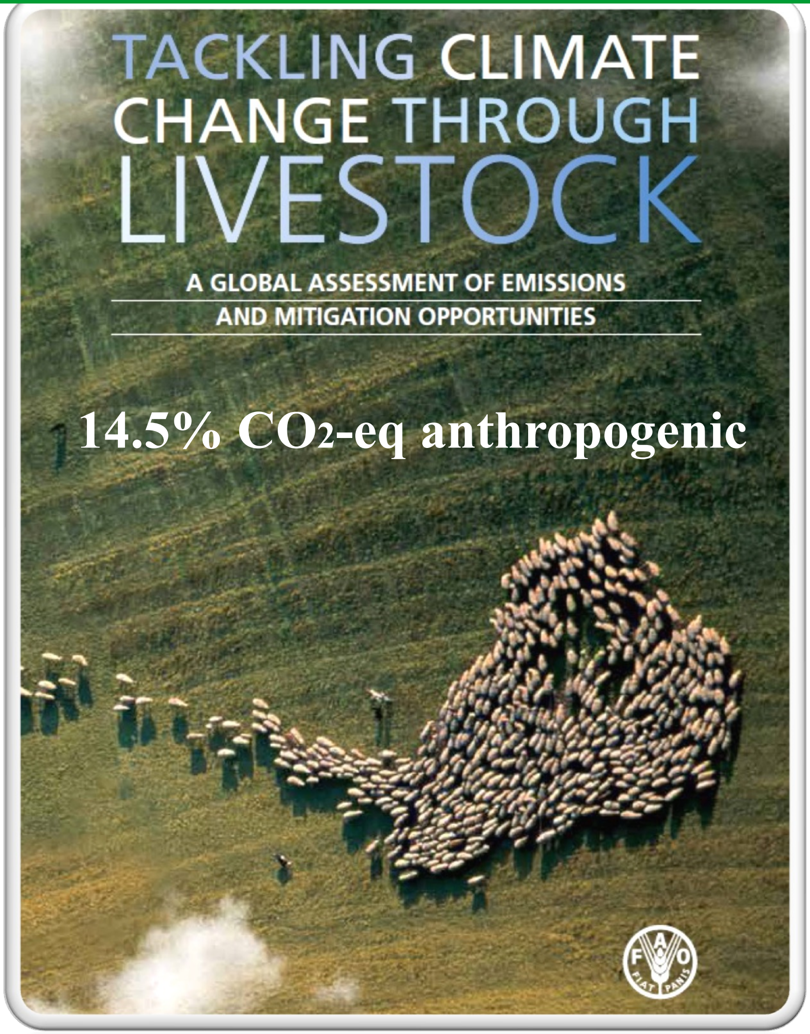
Mas a pecuária é um problema...



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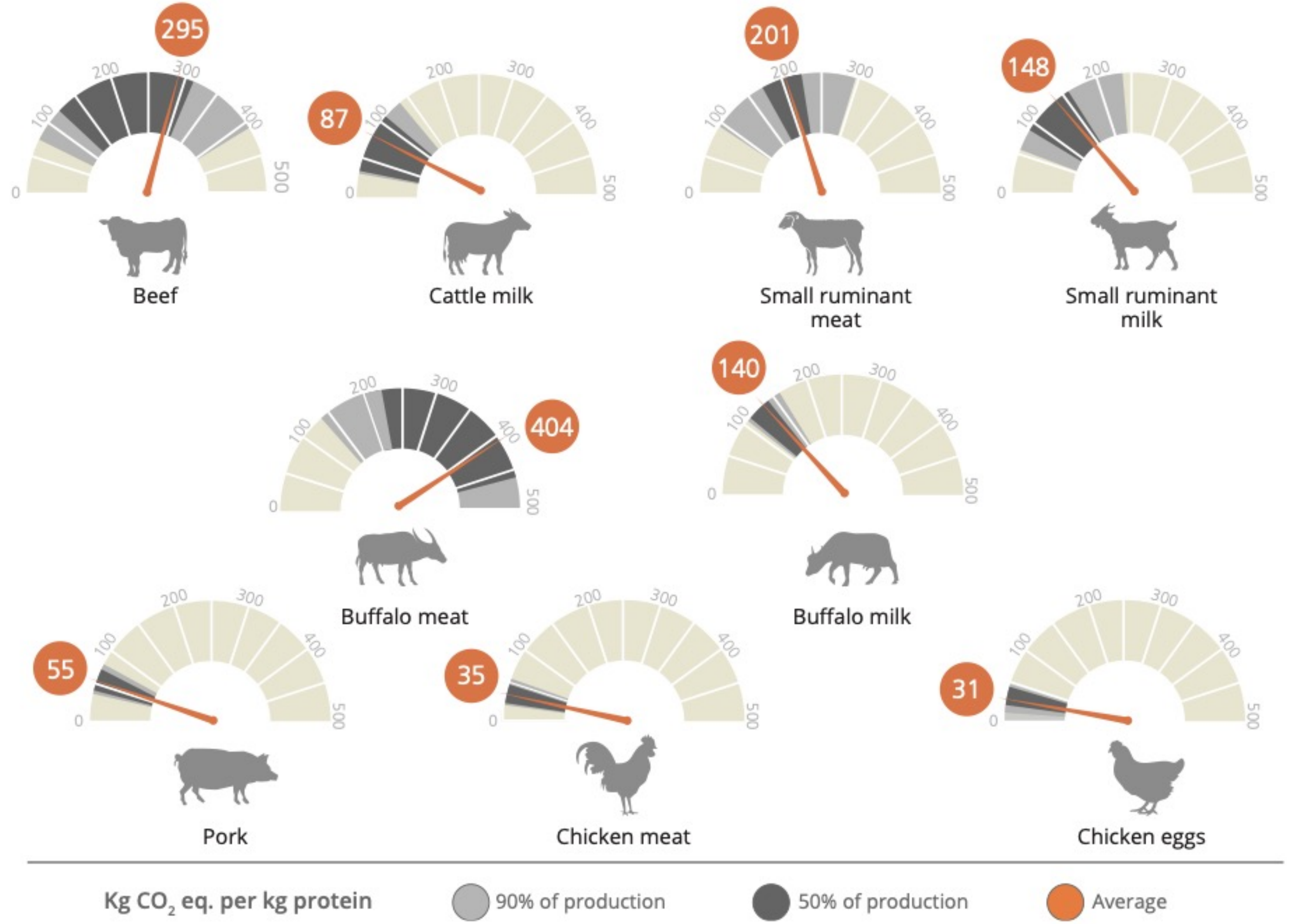
Picture from: https://gowholefoodvegan.org/2018/10/01/climate-change-part-2-the-solution-is-on-your-plate/

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



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

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

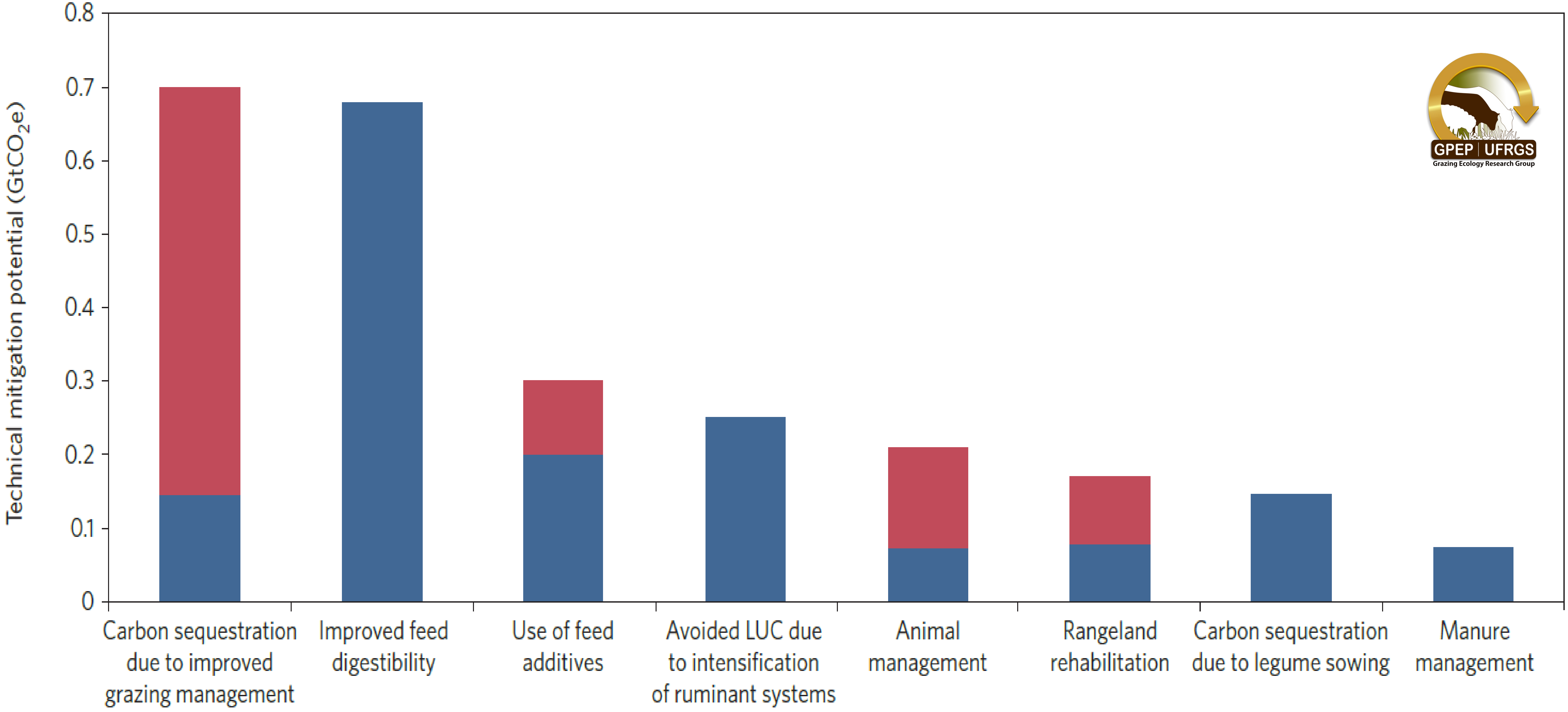
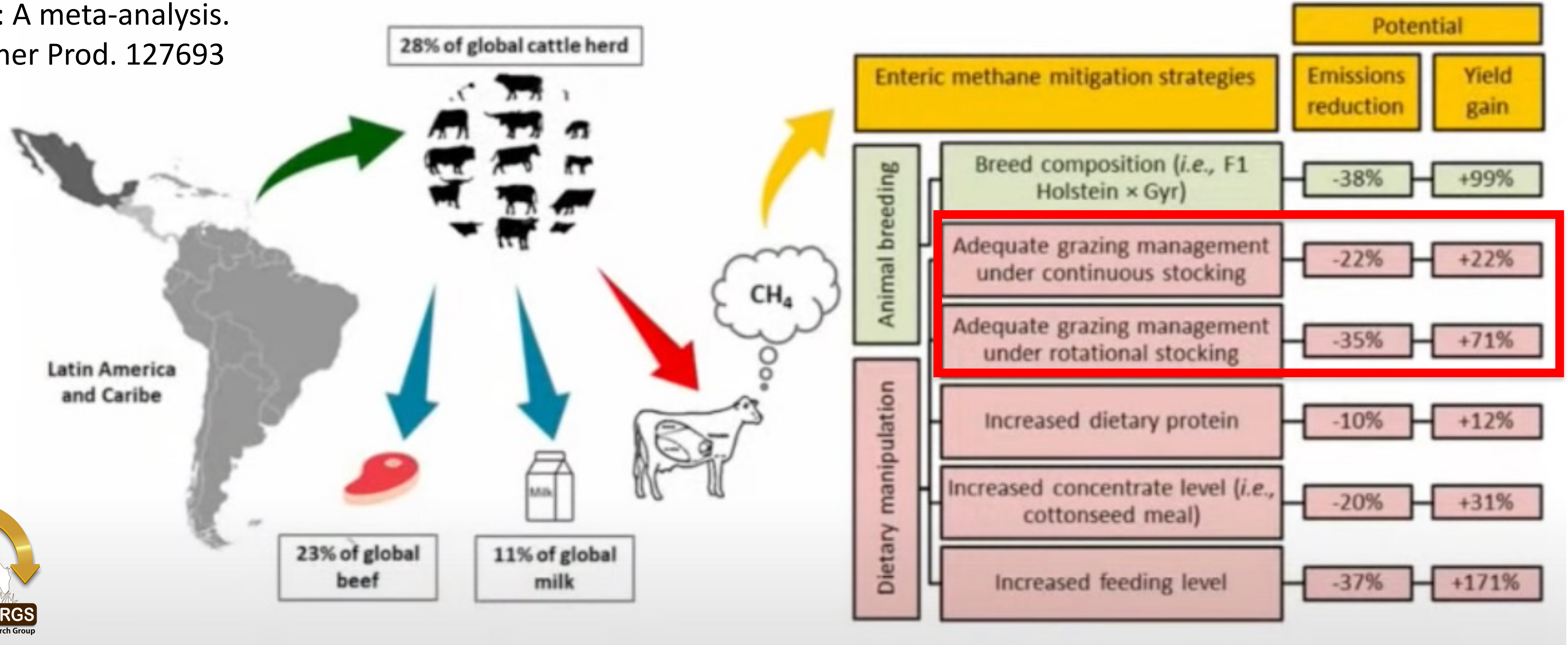


Figure 2. Technical mitigation potential of supply-side options for reducing emissions from livestock sector. Red represents the range for each practice, when available. From Herrero et al. (2016).

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



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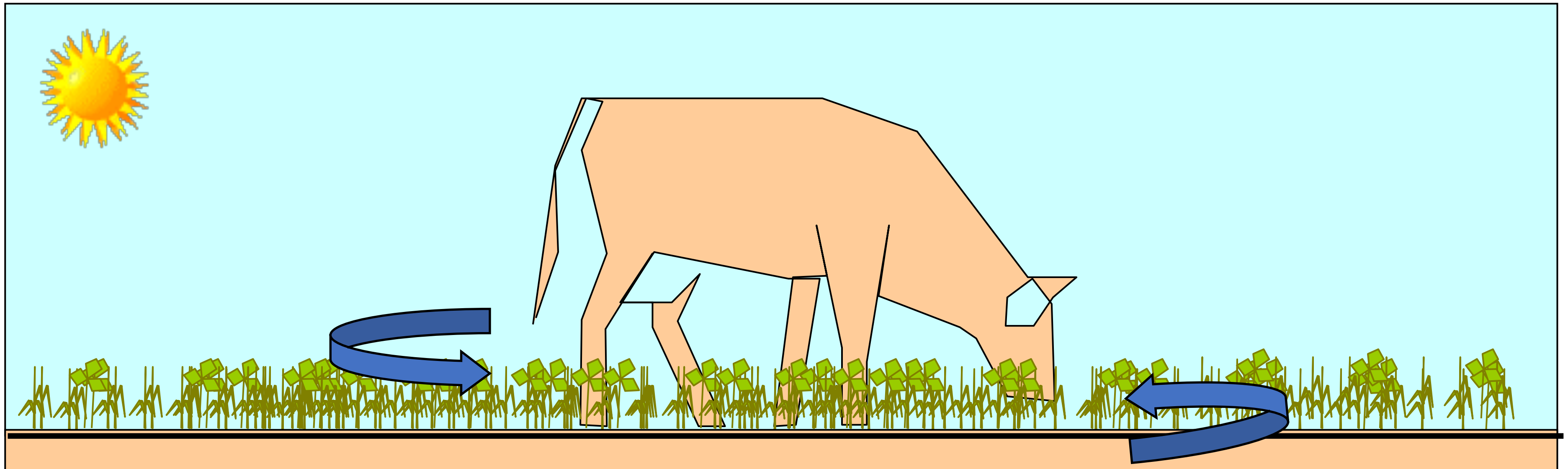
Qual o principal problema?



- O sobrepastejo / excesso de lotação / concepção de manejo

O potencial do manejo na mitigação dos GEE

Será ?

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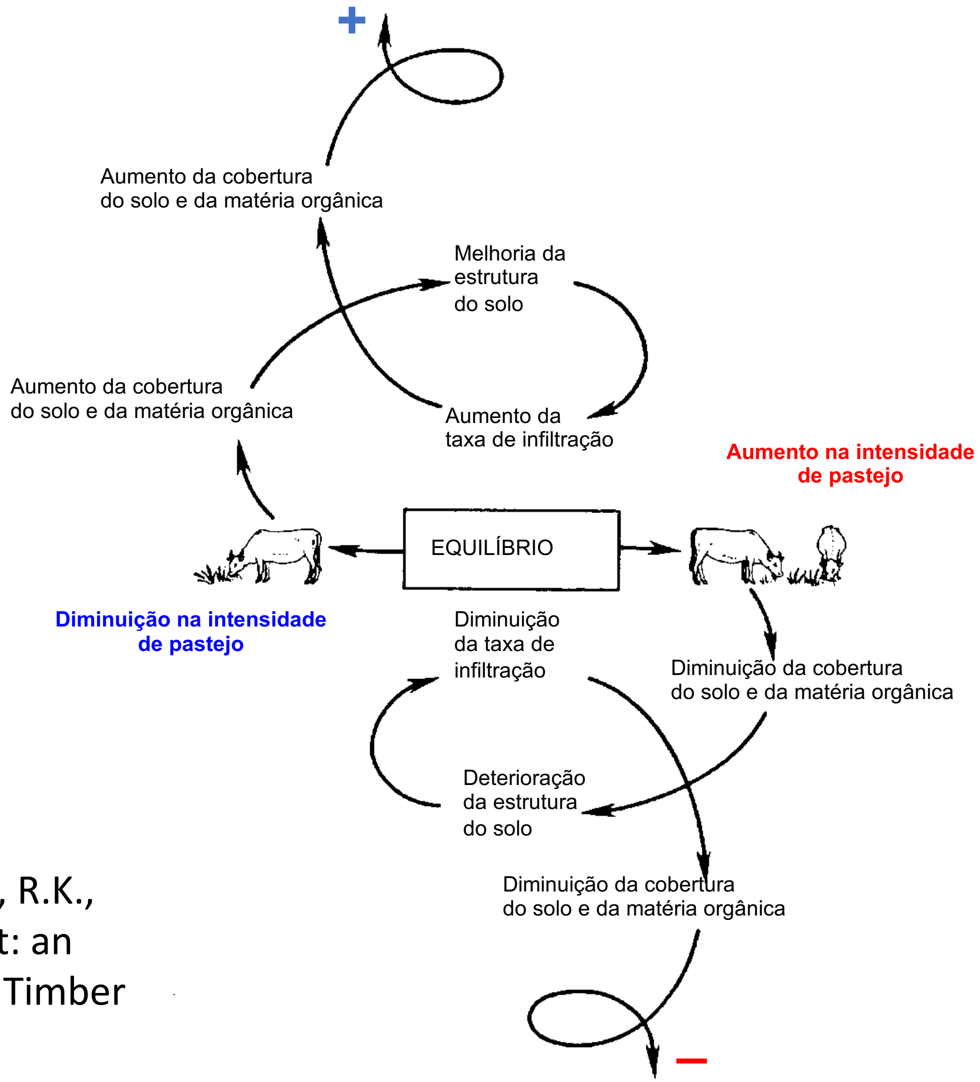
Diferença entre o céu e o inferno: manejo!



Thurow, 1991. . In: Heitschmidt, R.K., Stuth, J.W. Grazing management: an ecological perspective. Oregon: Timber Press

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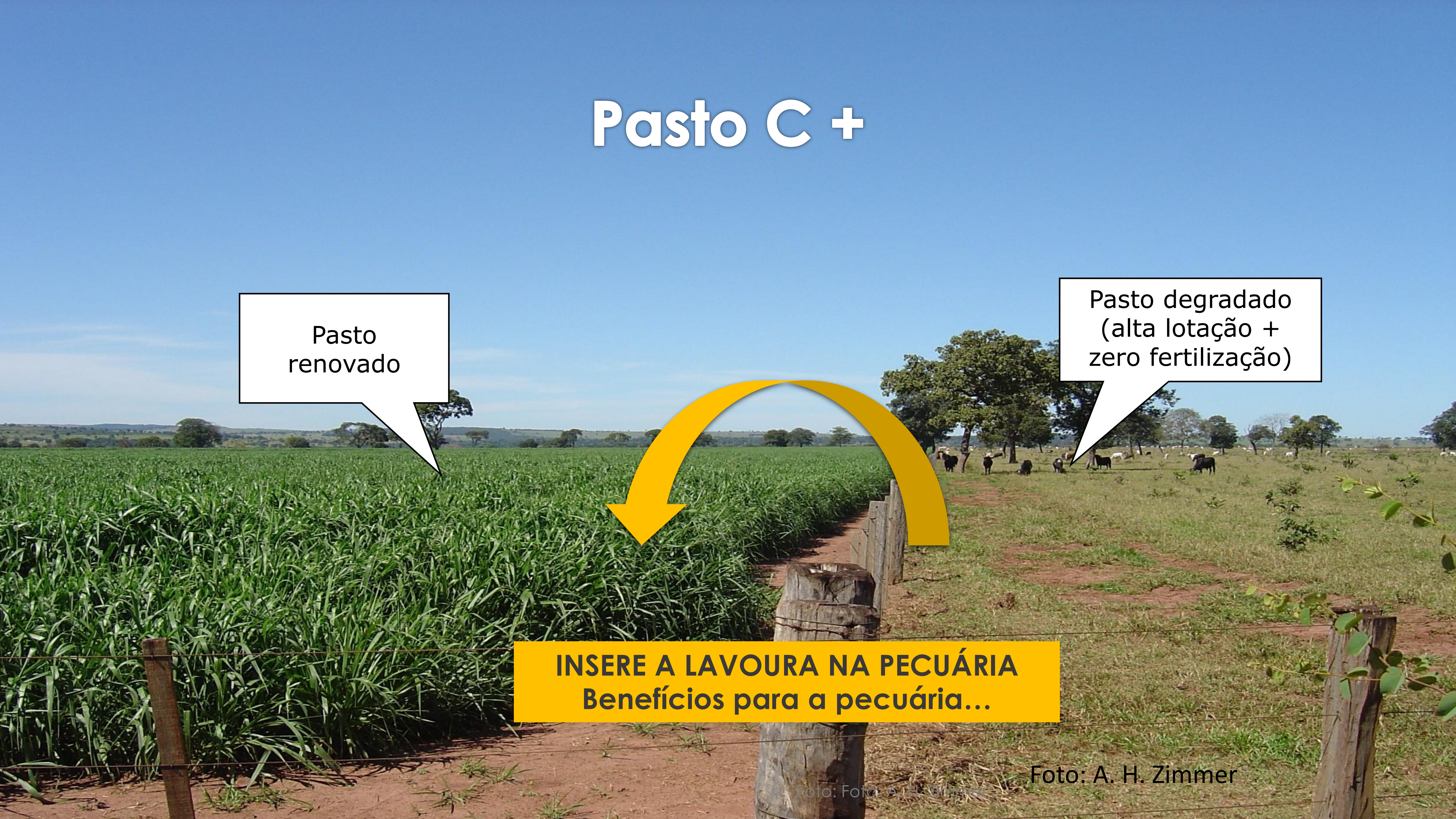
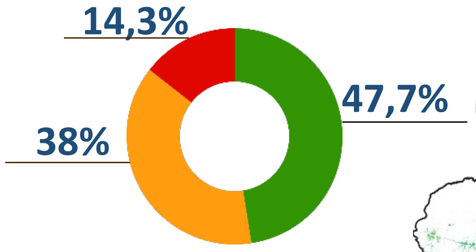
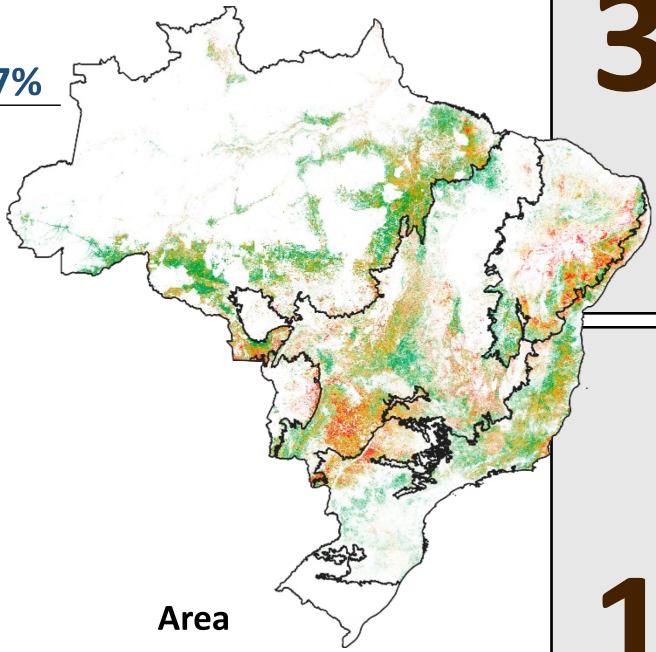
Pasto C +


Pasto renovado
Pasto degradado (alta lotação + zero fertilização)
INSERE A LAVOURA NA PECUÁRIA
Benefícios para a pecuária...
Foto: A. H. Zimmer


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 reduction[1] potential

37.000.000

tCO_2e

Total estimated removals[2] potential

14.700.000

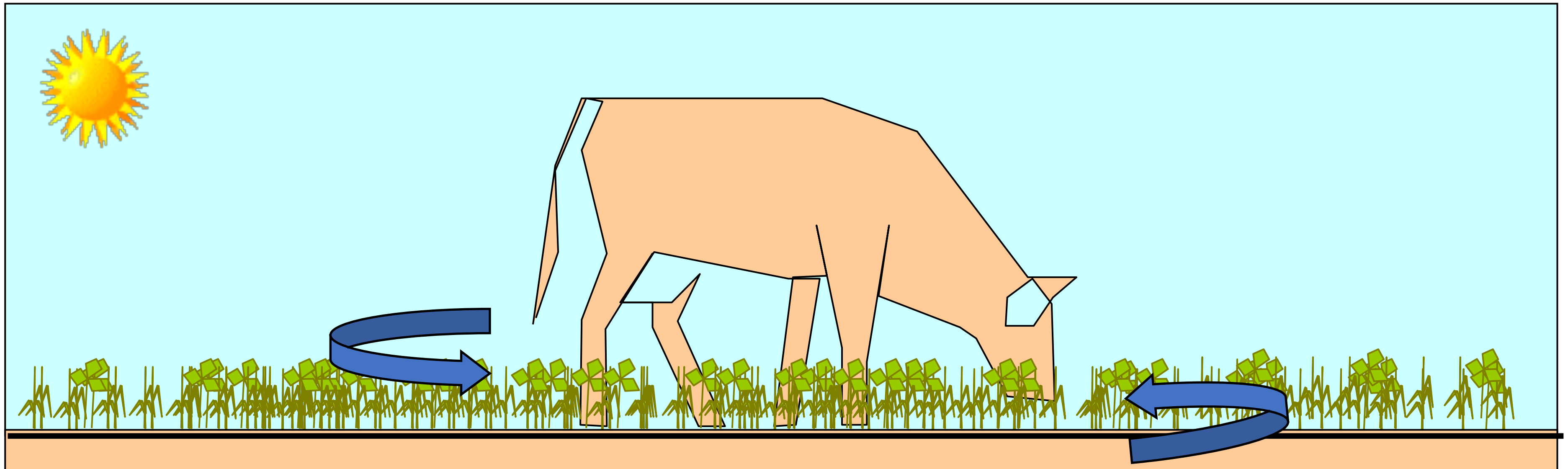
tCO2/year

[1]ZUBIETA, 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%

[2]MAIA, Stoecio 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 CO_2e/ha/year

Optimal sward height

O que podemos fazer pelo manejo?



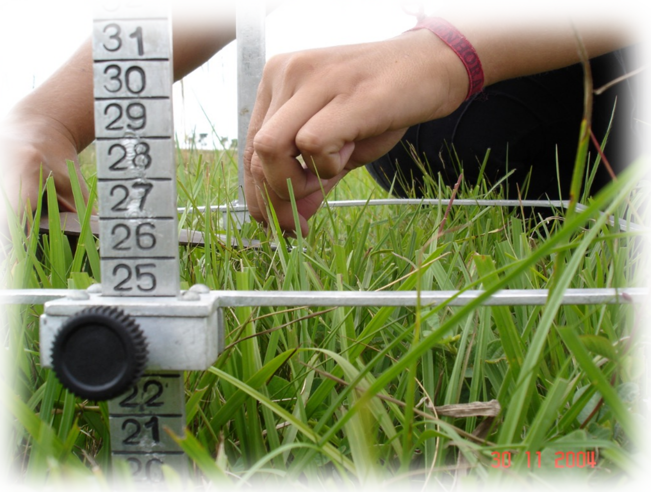
- Exemplos com bovinos, ovinos, pastos nativos, cultivados tropicais e temperados

O que significa “manejo de pastagens” ?

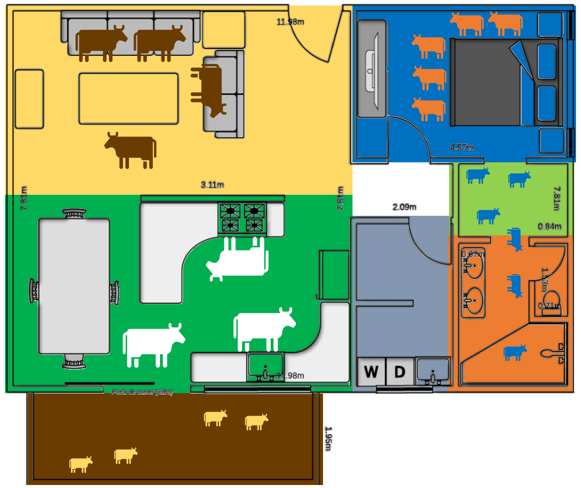
Analogia entre manejo de ecossistemas pastoris e a engenharia

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 (CH_4)

CONCEPÇÕES DE MANEJO DO PASTO

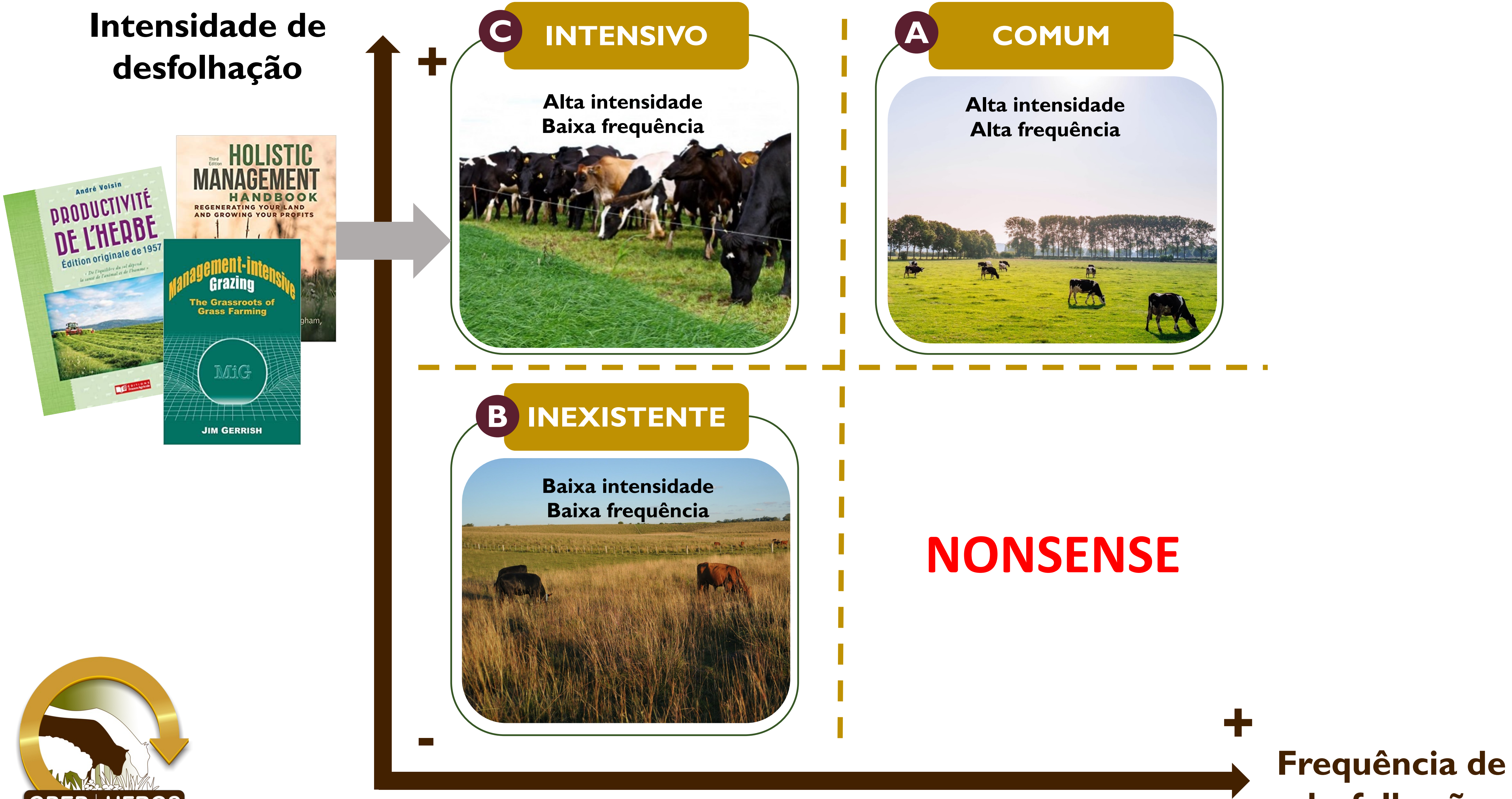


Ilustração: Paulo Carvalho e Fernanda Moojen

Métodos de Pastoreio

- Formas de pastoreio com cercas (número de piquetes)
  - Piquete único
    - Sem pastoreio
    - Pastoreio sazonal
    - Pastoreio contínuo
  - Múltiplos piquetes
    - Rebanho único
      - Grandes períodos de pastejo
        - Dinâmica da vegetação independente
          - Pastoreio rotativo
        - Dinâmica da vegetação dependente
          - Rest-Rotation
          - Santa Rita
          - Rotação com Diferimento
      - Pequenos períodos de pastejo
        - HILF
        - Manejo Holístico
        - Mob Grazing
        - Pastoreio Horário
        - Pastoreio em Células
    - Rebanho múltiplo
      - Merrill

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.

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Manejo Holístico, Regenerativo, Ultra-denso


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Rotativo
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..

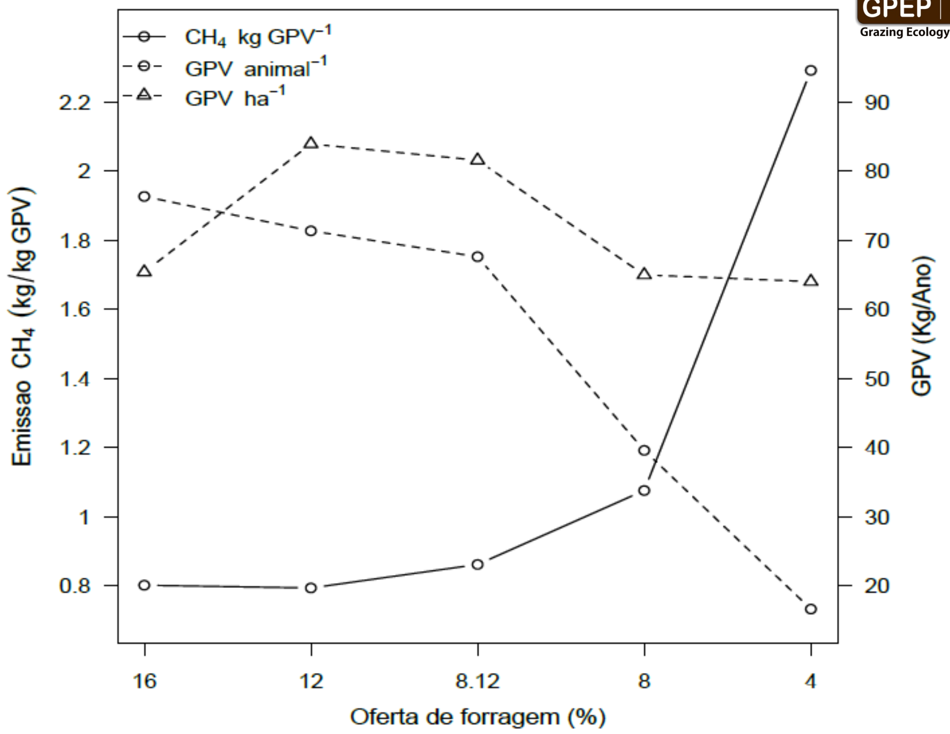
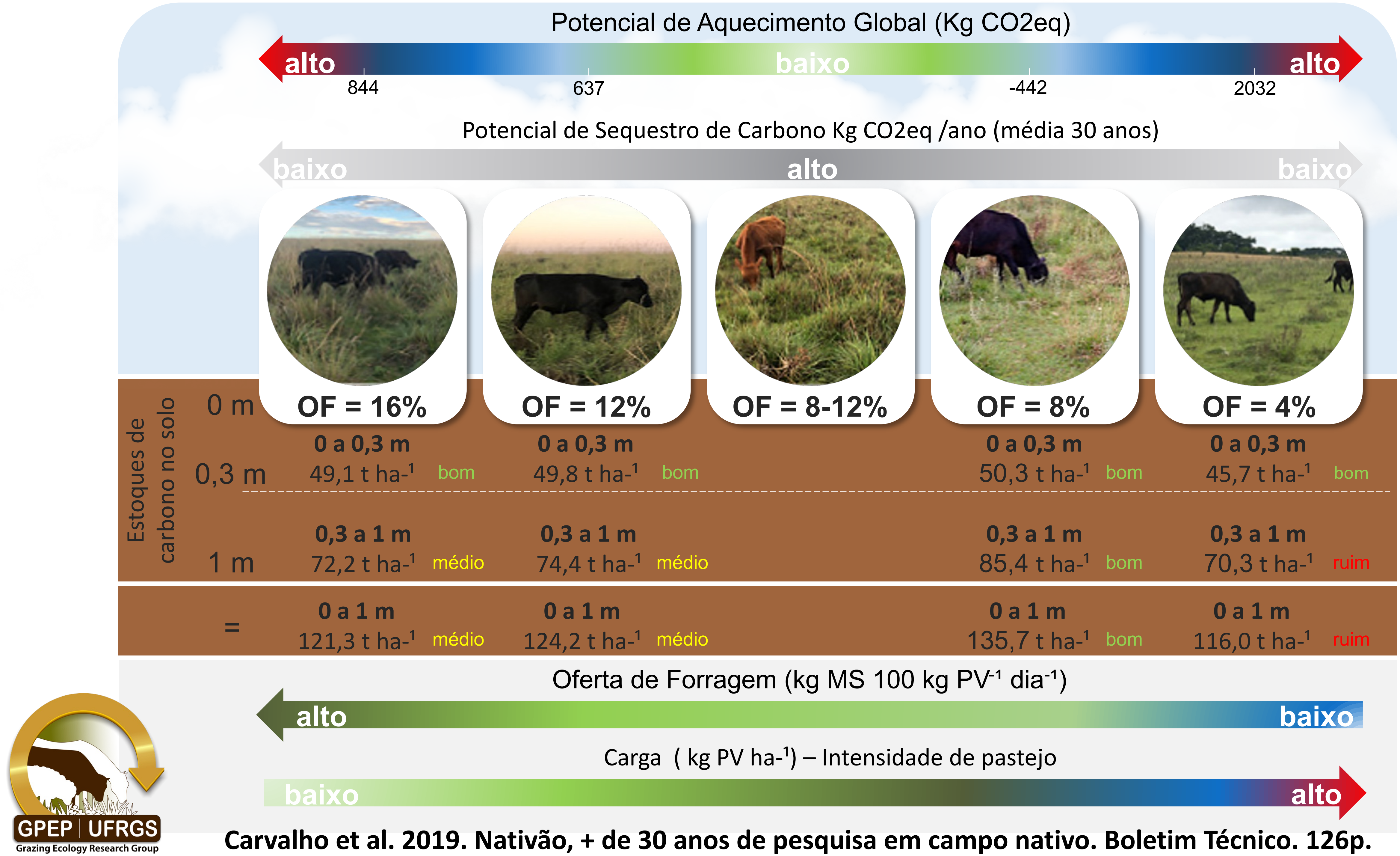


FIGURA 2: Emissão de metano anual em relação ao ganho de peso vivo (kg CH_4 por kg GPV), ganho de peso vivo anual por animal (kg $animal^{-1}$) e ganho de peso vivo anual por área (kg ha^{-1}) de acordo com as ofertas de forragem (OF) referentes ao ano de 2012.



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

JANELA DE MANEJO

Touceiras
0% - 35%

Massa
1400-2500 kg

Oferta
8% -12%

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

Agricultural Systems 205 (2023) 103582

HERBAGE MASS & FORAGE ALLOWANCE

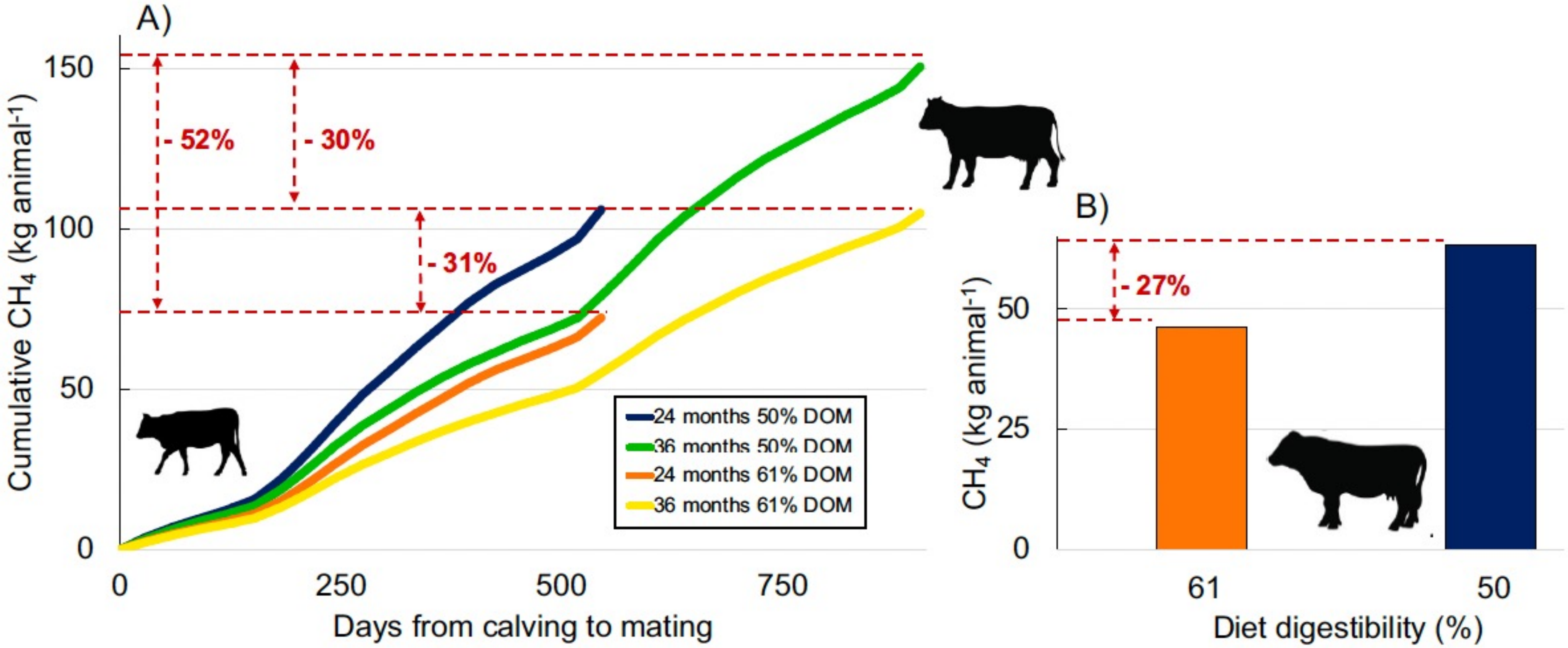


Fig. 5. Enteric CH_4 emissions of two theoretical scenarios to assess the energy use efficiency: a) cumulative enteric CH_4 emissions from calving to first pregnancy as a function of the energy intake and diet digestible organic matter (DOM); and b) annual CH_4 emissions of non-pregnant cows according to the annual energy intake associated with diet digestible organic matter (DOM).

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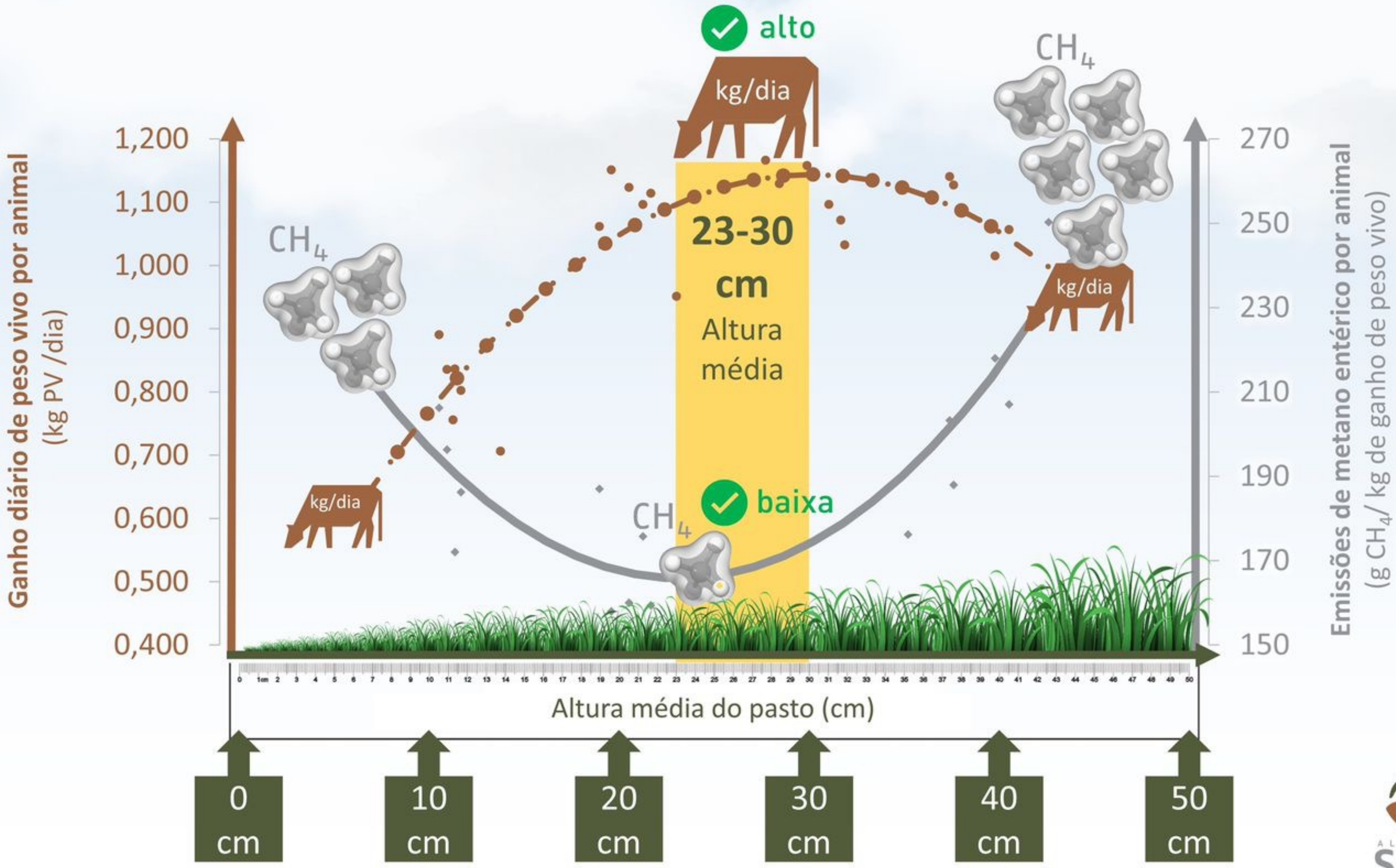
SIPA – intensidades de pastejo e efeito na soja

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.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Rotativo
OVINOS

Efeito do método de pastoreio

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	$P_{I\times M}$
	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	6.0b	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

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Pastoreio Rotatínuo: um conceito disruptivo...

Como manejar o pasto?

"Faça a pergunta para o consumidor..."

PASTOREIO
ROTATÍNUO
ALIANÇA SIPA

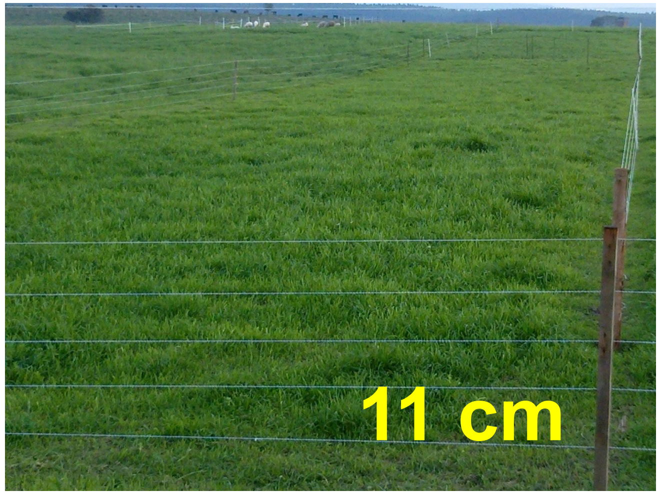
Pastoreio Rotatínuo: um conceito disruptivo...

PASTOREIO
ROTATÍNUO
ALIANÇA SIPA

Pré

Rotatínuo (RN) Vs Rotativo (RT)

Pós



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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*

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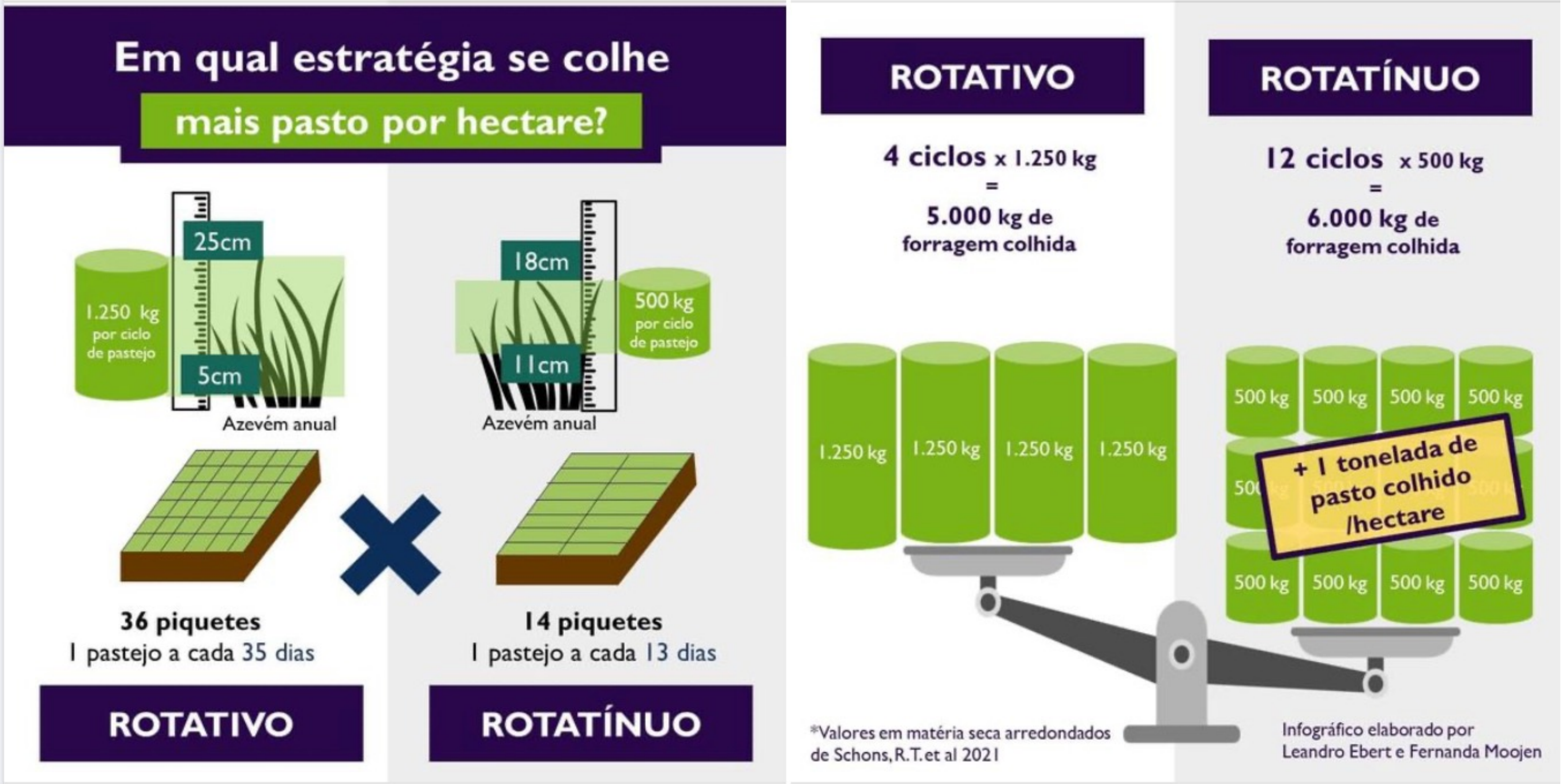
Pastoreio Rotatínuo: um conceito disruptivo...



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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.

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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 CH4/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.

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CONCEPÇÕES DE MANEJO DO PASTO

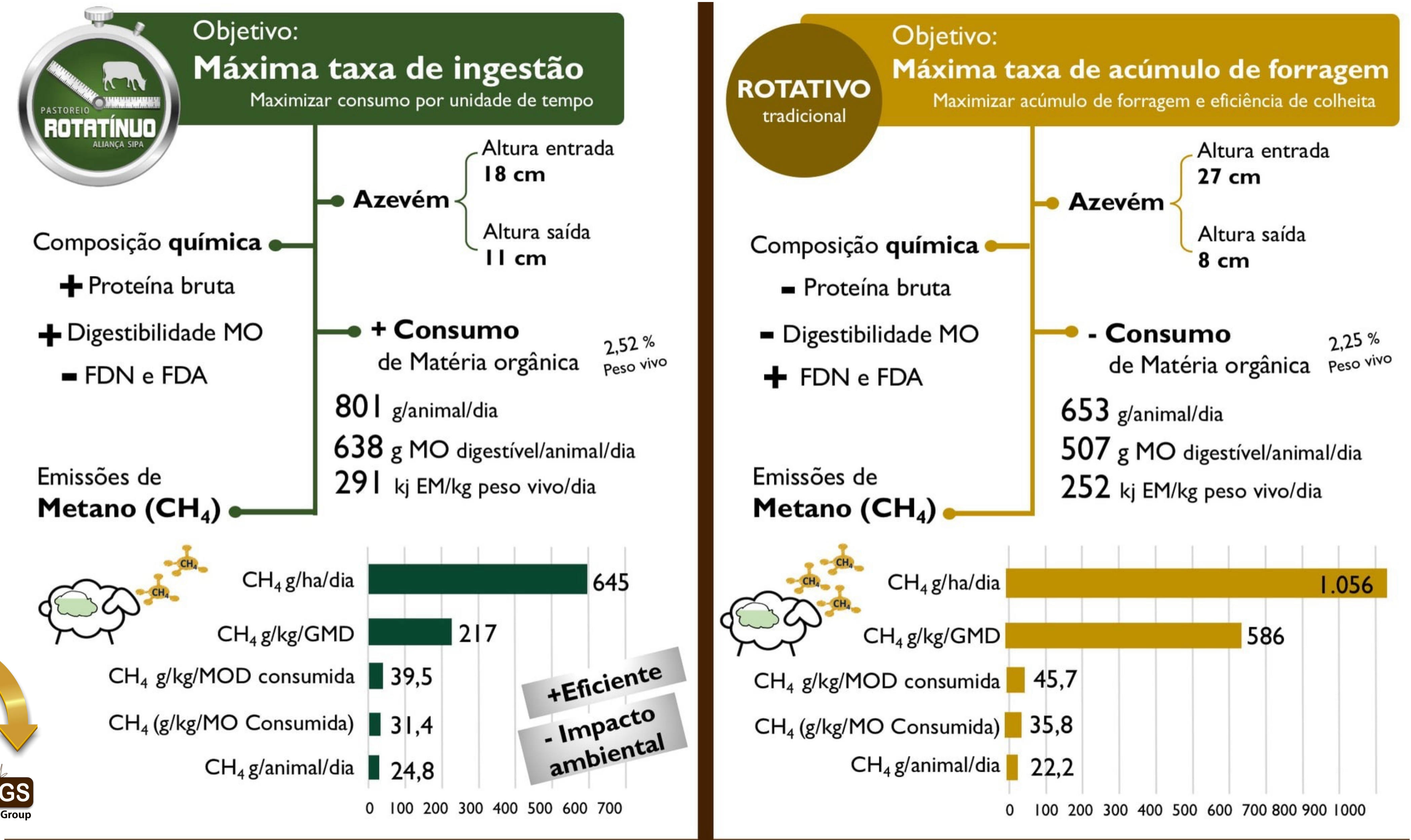

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Ilustração: Alejandra Marin e Fernanda Moojen

Savian et al. 2018 - Journal of Cleaner Production

CONCEPÇÕES DE MANEJO DO PASTO

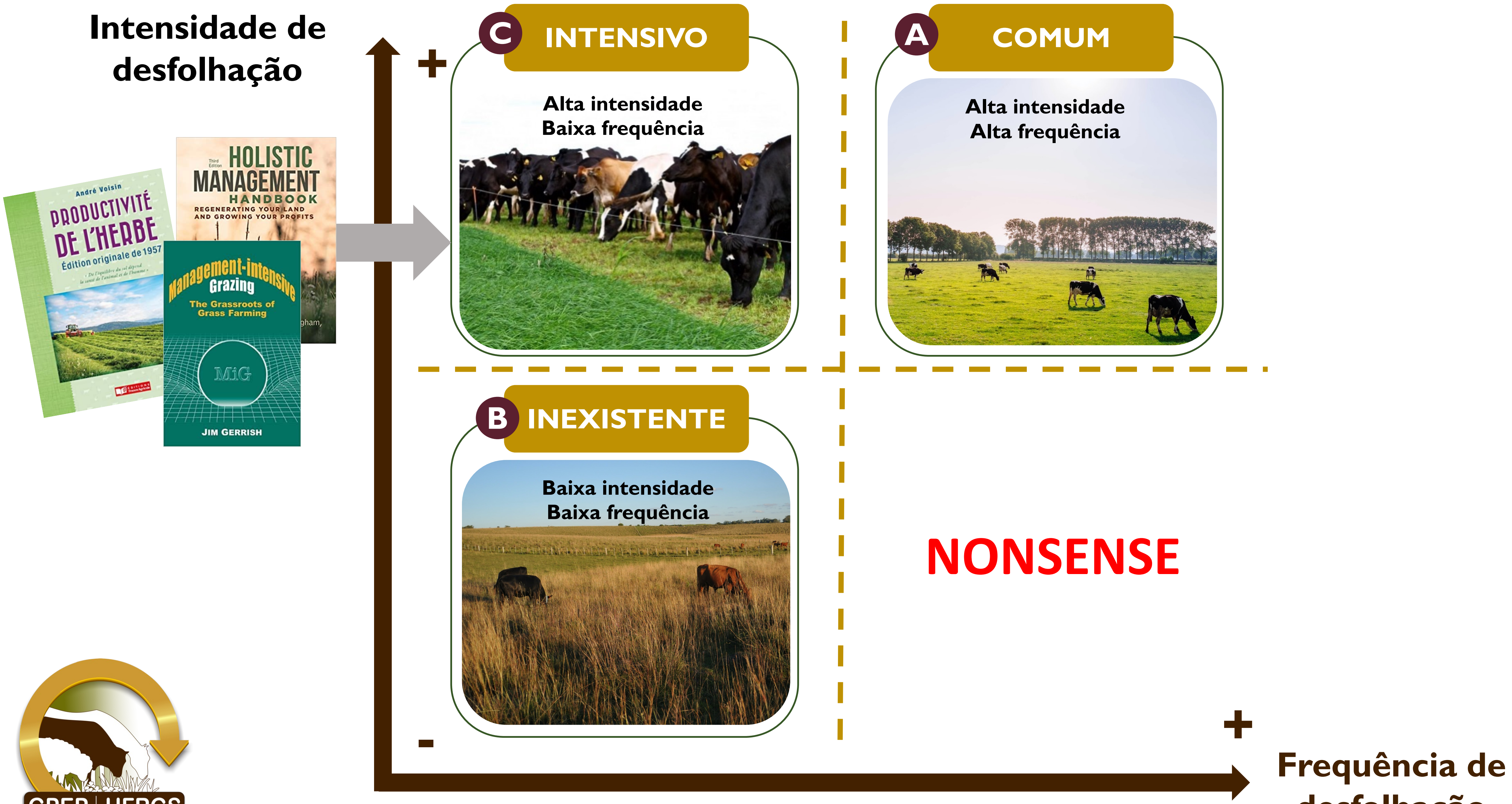

Ilustração: Paulo Carvalho e Fernanda Moojen

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CONCEPÇÕES DE MANEJO DO PASTO

Intensidade de desfolhação

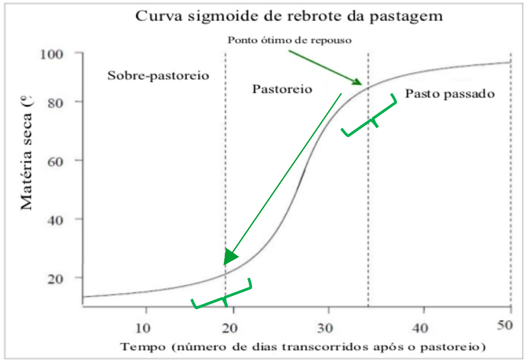


Figura 2: Curva sigmoide que expressa o rebrote do pasto, para as condições da Austrália.
Fonte: Adaptado de Sounness (2004).

+

C INTENSIVO

Alta intensidade
Baixa frequência

A COMUM

Alta intensidade
Alta frequência

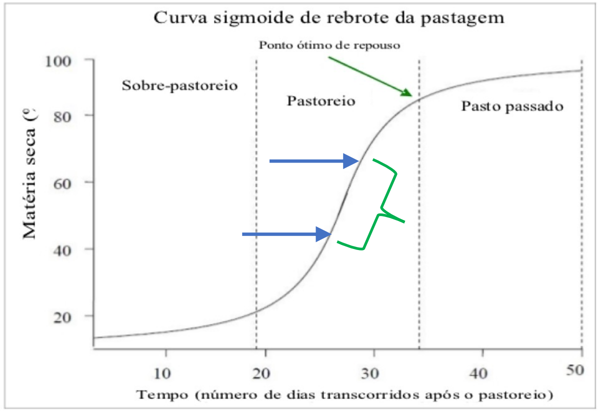


Figura 2: Curva sigmoide que expressa o rebrote do pasto, para as condições da Austrália.
Fonte: Adaptado de Sounness (2004).

B INEXISTENTE

Baixa intensidade
Baixa frequência

D DISRUPTIVO

Baixa intensidade
Alta frequência

PASTOREIO ROTATÍNUO
ALIANÇA SIPA

-

+

Frequência de desfolhação

Ilustração: Paulo Carvalho e Fernanda Moojen

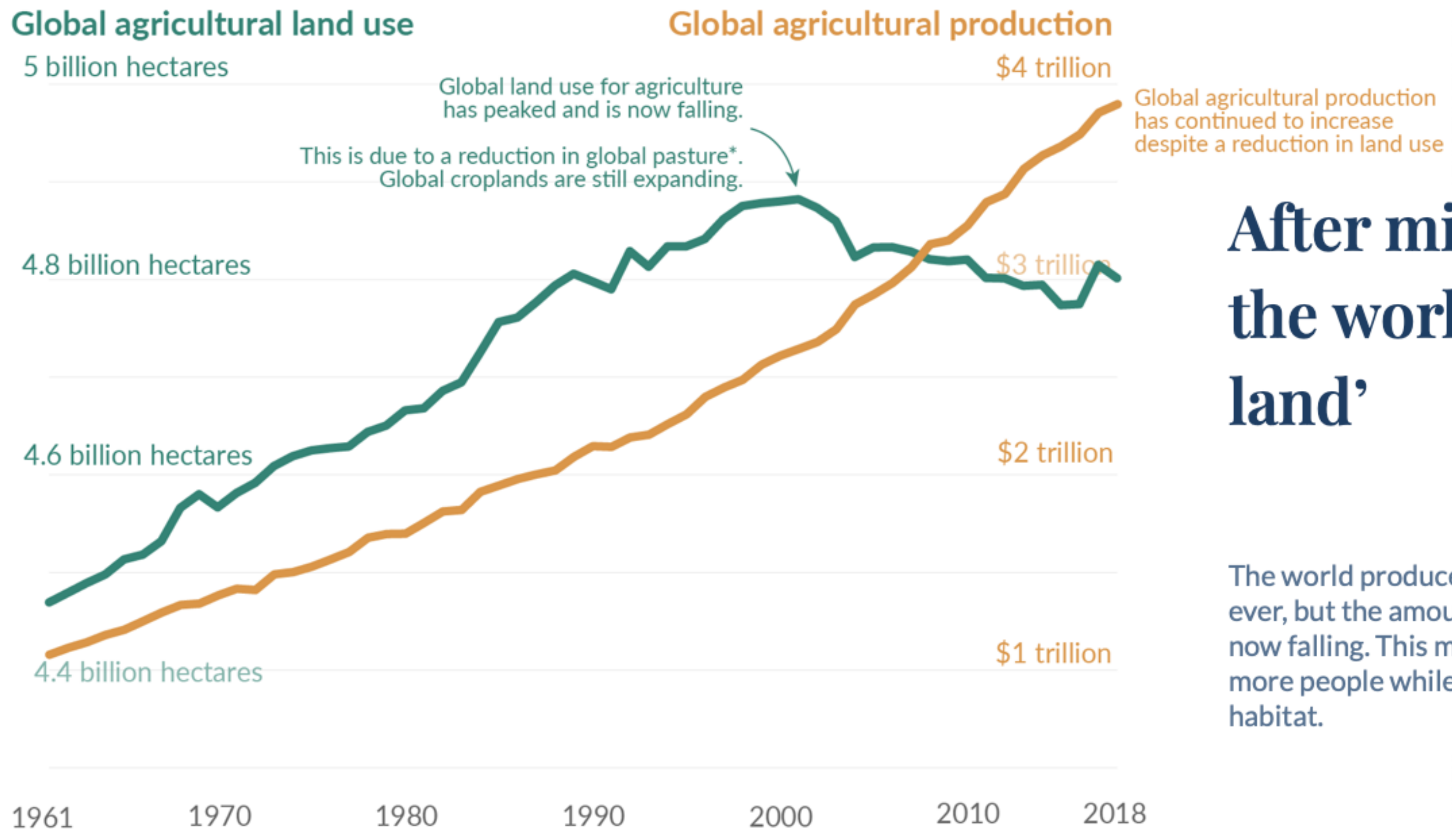
Considerações & take-home messages

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.



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.

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Mitos vs fatos (números) da pecuária

npj | biodiversity

www.nature.com/npjbiodivers

PERSPECTIVE OPEN

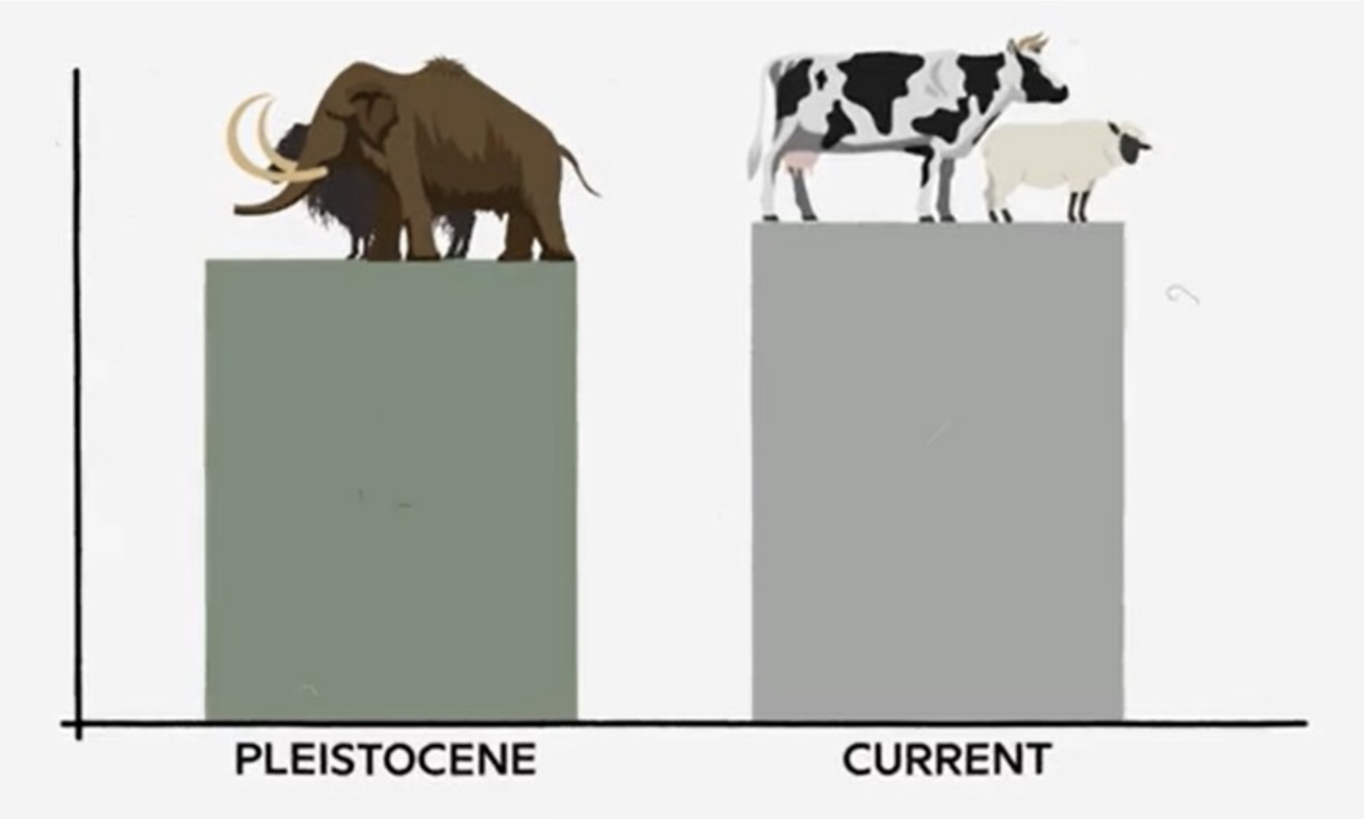
Check for updates

Underrated past herbivore densities could lead to misoriented sustainability policies

Pablo Manzano[1,2,3,4✉], Guillermo Pardo[3], Moustapha A. Itani[1,2] and Agustín del Prado[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

Read in app

FAO Livestock @FAOLivestock

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

Know more about our work on nutrition and animal source foods 👉 bit.ly/3wpMhJ6

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Opinion Farming

This article is more than **6 months old**

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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ECONOMICS & WASTE

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 !

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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

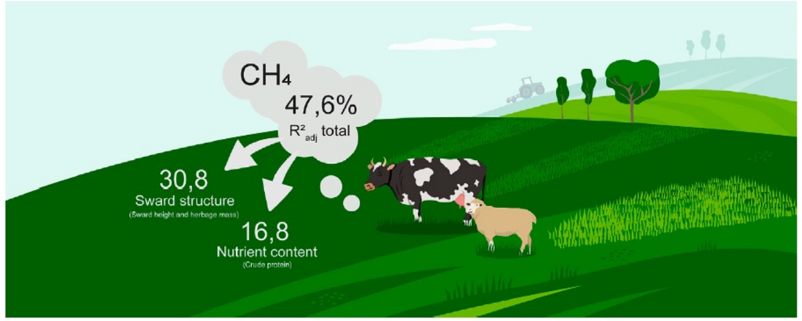
Lais Leal da Cunha [a,*], Carolina Bremm [b], Jean Victor Savian [c], Ángel Sanchez Zubieta [a], Jusiane Rossetto [a], Paulo César de Faccio Carvalho [a]

[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

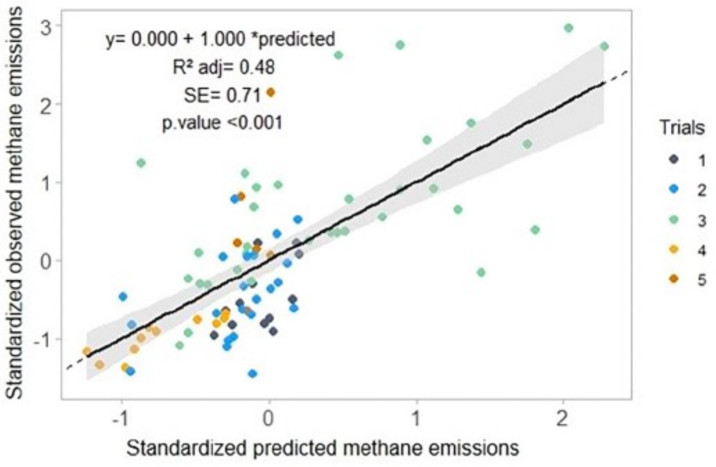
H I G H L I G H T S

- Forage nutrient contents have a low influence on CH_4 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 CH_4 emissions.
- Offering an optimal sward structure to ruminants is a promising climate-smart strategy.

G R A P H I C A L   A B S T R A C T



a)

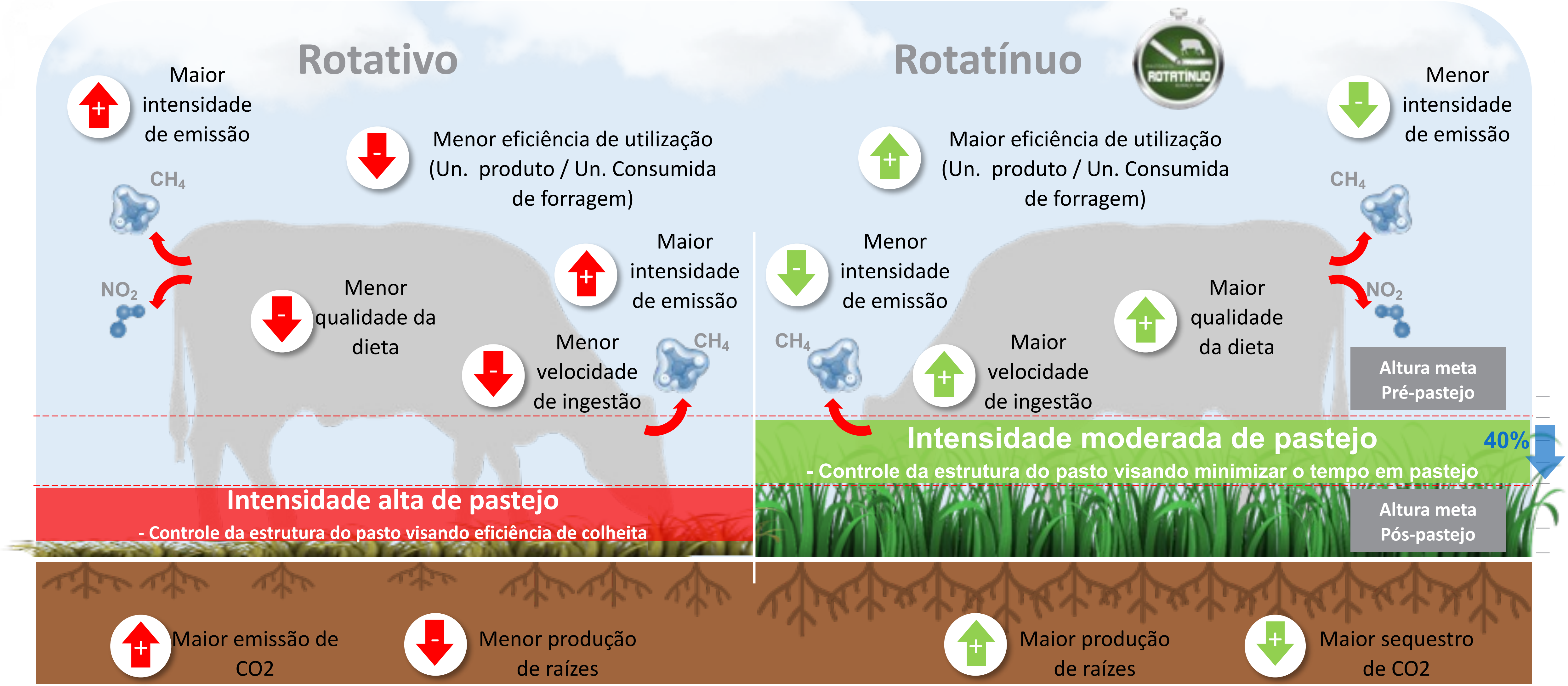


b)

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

Inovações tecnológicas: Rotatínuo

Inovações tecnológicas: Rotatínuo



Mitos vs fatos (números) da pecuária

Contents lists available at ScienceDirect

Journal of Cleaner Production

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

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

PASTOREIO Rotatínuo

SIA UFRGS

- 72 % emissão

g Ch4/kg carcaça

RN 513   RT 1357

- 50 % emissão

Journal of Cleaner Production 213 (2019) 968–975

Contents lists available at ScienceDirect

Journal of Cleaner Production

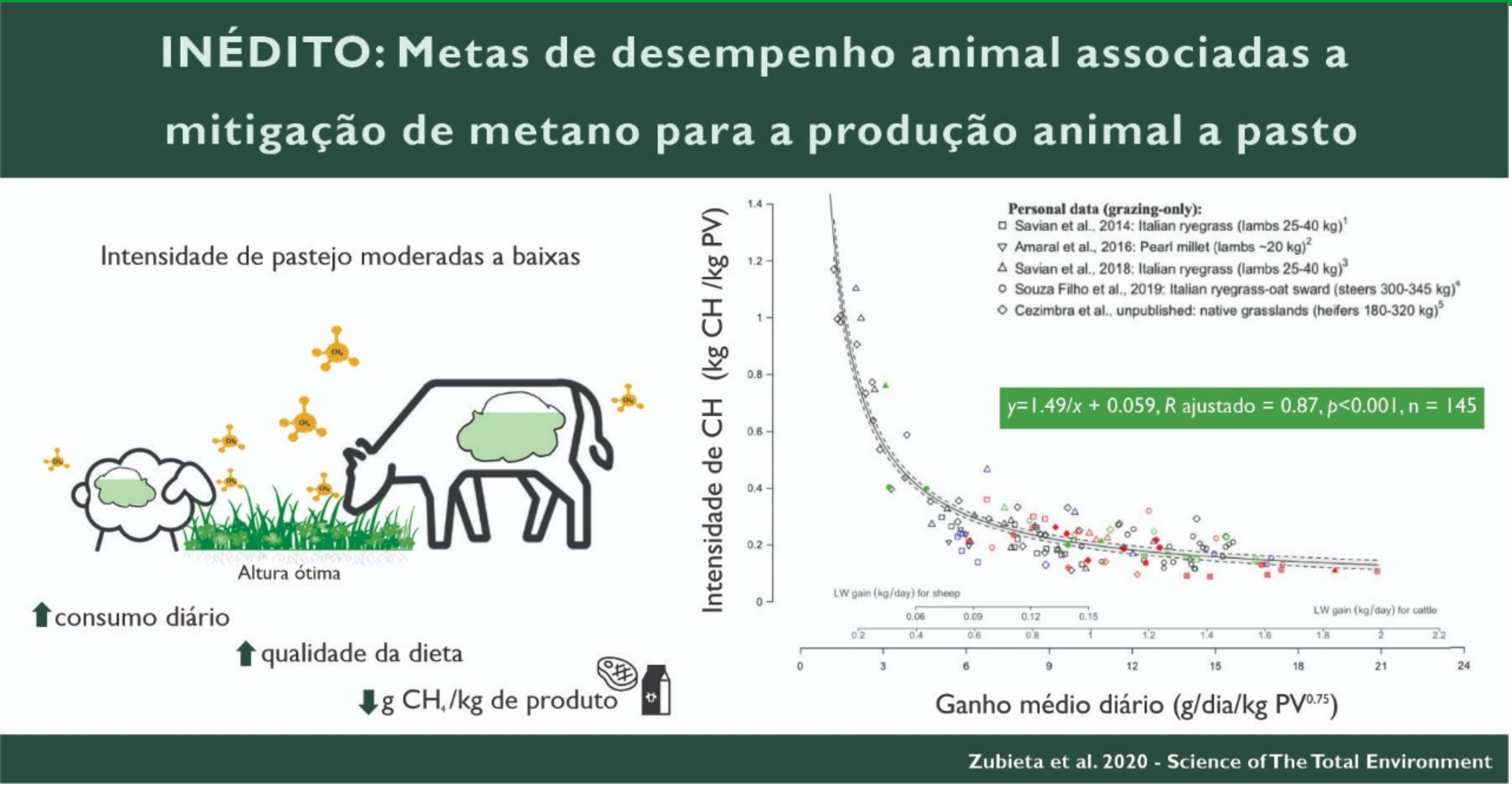
journal homepage: www.elsevier.com/locate/jclepro

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



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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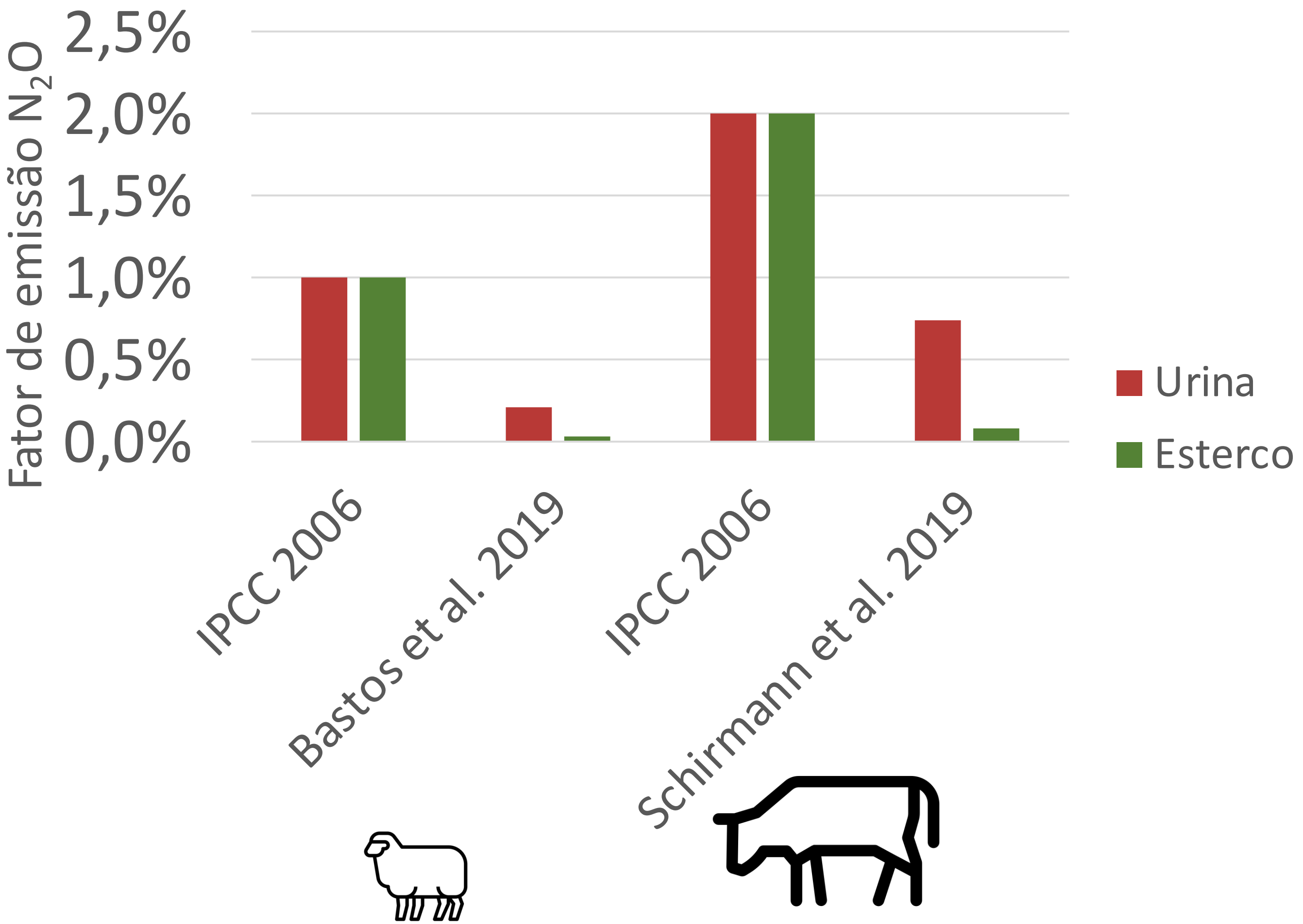


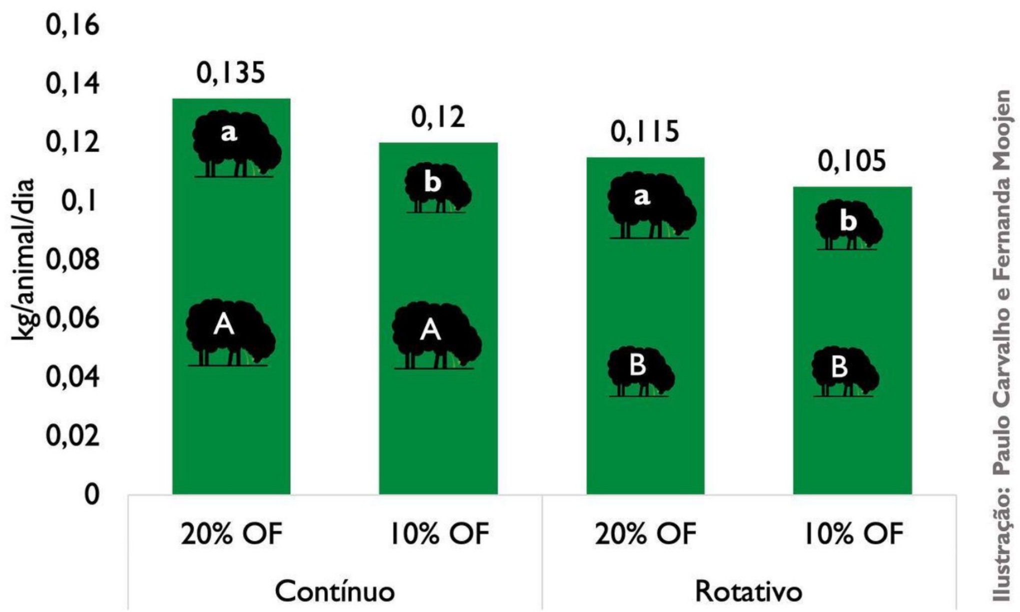
Inovações tecnológicas: Adubação de Sistema

Inovações tecnológicas: Adubação de Sistema

DESEMPENHO ANIMAL INDIVIDUAL

Método de pastoreio <0,001 diferença SIGNIFICATIVA

Oferta de forragem 0,002 diferença SIGNIFICATIVA



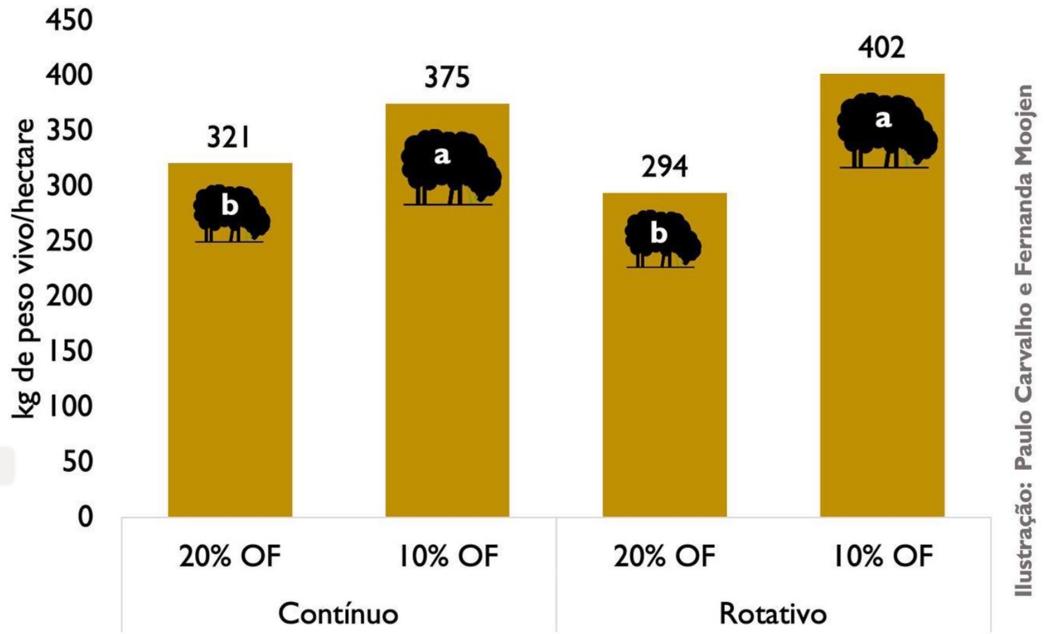
Tanto o MÉTODO DE PASTOREIO quanto a OFERTA influenciam no desempenho individual
Oferta 20% tem maior desempenho que oferta 10%
Pastoreio contínuo teve maior desempenho que pastoreio rotativo

Moojen et al. 2021- Grass and Forage Science

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%

Moojen et al. 2021- Grass and Forage Science

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

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Emissão de CH4 e manejo de pastagens

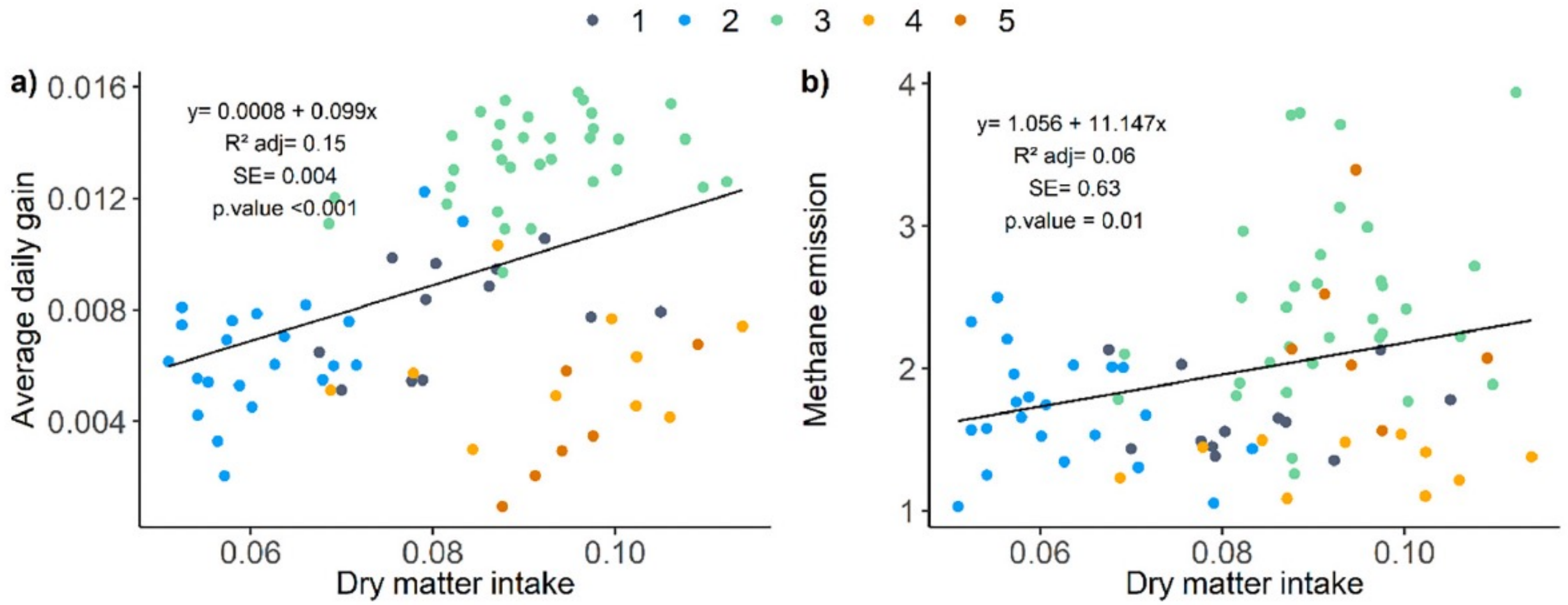

Fig. 6. Relationship between dry matter intake (kg/kg $LW^{0.75}$) and (a) average daily gain (kg day/kg $LW^{0.75}$) or (b) methane emissions (g/kg $LW^{0.75}$) of beef cattle and sheep grazing different grasslands. Trial 1 and 2, sheep grazing Italian ryegrass pastures; Trial 3, beef cattle grazing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

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CH_4 emissions from enteric fermentation in *grazing* experiments

Table 1. Intake and enteric CH_4 emissions by ruminants under grazing-only conditions and different grazing management practices

Study target	Animal category	Pasture[11]	Intake, kg DM intake	Intake, % of LW	CH_4 production and intensity					Difference between control and best alternative, %		Reference	Country
					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 Zeeland
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 CH_4/kg DM intake not reported in the publication and calculated from individual data of daily CH_4 production and OM content of the herbage.
[2] Value of CH_4 as % of GEI not reported, but available from authors.
[3] Value of g CH_4/kg LW gain not reported and calculated from individual data of daily CH_4 production and LW gain.