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38° Congreso Argentino de Producción Animal

Grazing Ecology Research Group

Estrategias de utilización para optimizar la producción primaria y secundaria de sistemas pastoriles

Strategies to optimize primary and secondary production on pastoral systems

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The context...

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- Innovations in pasture management?

Provenza et al. (2013) criticised the traditional inability of researchers to create innovative practices.

Van den Pol-van Dasselaar (2012) concluded that no major developments in grazing systems management were recently occurring in Europe.

Nowadays, there is increasing emphasis on grazing management and the role of the grazing animal on ecosystem services, concurrently with a decreasing emphasis on grazing management generating animal production outputs.

- Are we asking the right questions?

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The outline...

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- Sward *vs* grazing management
- Building animal oriented management targets
- Case study (PISA) to illustrate how sward targets oriented by grazing behaviour can be applied at farm level

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Concepts, definitions and limits of the rationale...

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- **Goal**: to propose sward management based on animal ingestive behaviour… then:
- ***sward structure*** is the spatial arrangement of morphological tissues at the moment of the bite;
- ***Ingestive behavior*** is a set of actions to gather a bite;
- ***Assumption:*** the higher is the intake rate the higher is the probability to reach maximum daily intake and secondary productivity

Temporal and spatial scale of sward targets: a period of occupation in a rotational stocking

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Sward oriented guidelines...

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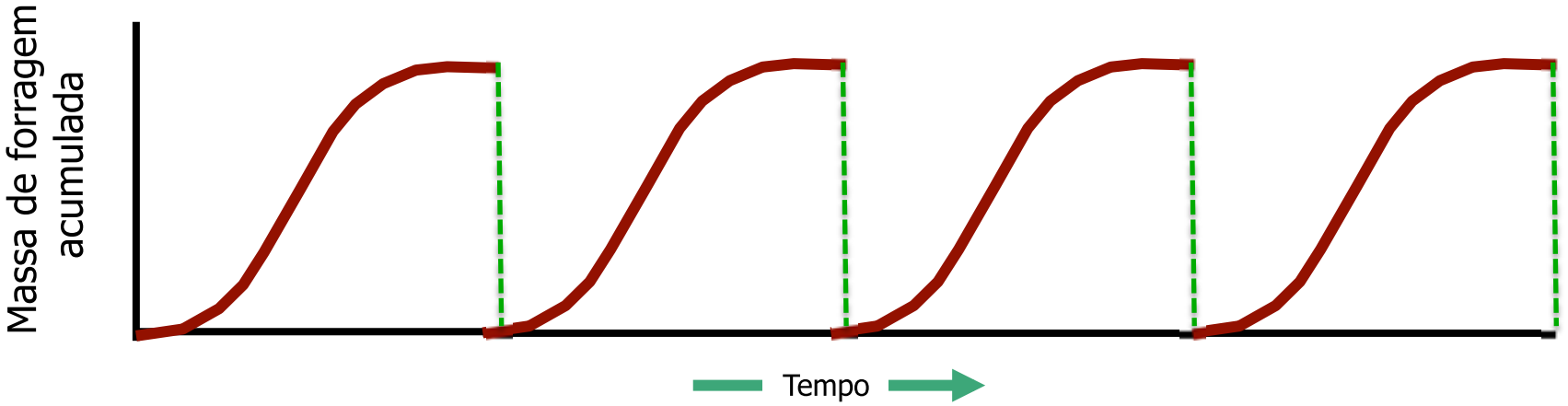
"[...] *recomendações de manejo do pastejo existentes foram feitas com base no argumento de que, para melhor aproveitar as características de crescimento das plantas forrageiras, o especialista em manejo de pastagens deveria manejar as plantas, em pastejo rotacionado [sic], objetivando obter uma série de rebrotações [sic] sucessivas que apresentassem o padrão de crescimento sigmóide. Nesse caso, os pastejos deveriam ser realizados sempre ao final da fase linear de crescimento como forma de obter a máxima taxa média de acúmulo de forragem* [...]"

Silva & Nascimento Júnior (2007)



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Classical rationale on pastoral systems

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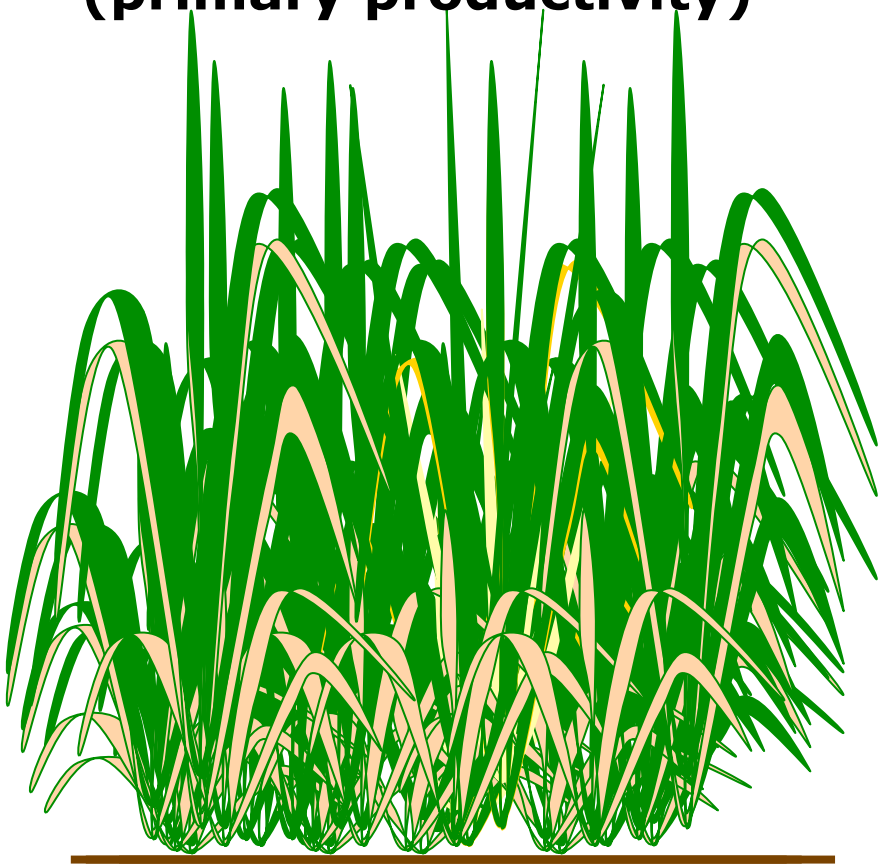
Plant growth (primary productivity) → **Plant harvest (secondary productivity)**



Courtesy, Sbrissia, A.

Courtesy, COAMO

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Sward oriented guidelines...

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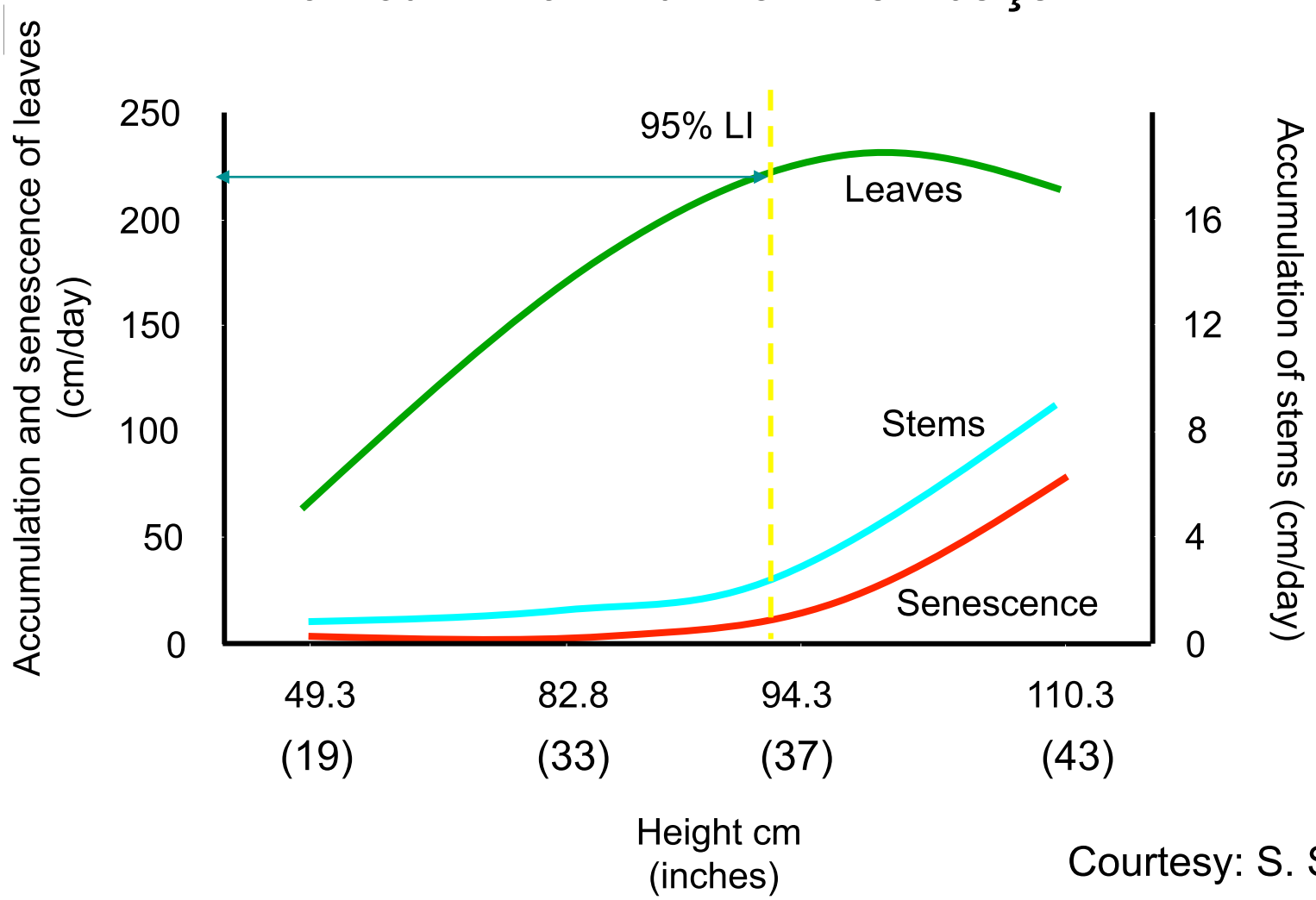
Panicum maximum cv Mombaça:



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Proposing animal oriented guidelines...

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- *Herbivores make decisions about where to forage and what combinations and sequences of foods to eat, integrating influences that span generations, with choices manifest daily within a lifetime (Provenza et al., 2015)*

- *Why do not take it into account?*

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Perspective

Synthesis: foraging decisions link plants, herbivores and human beings

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Abstract. Herbivores make decisions about where to forage and what combinations and sequences of foods to eat, integrating influences that span generations, with choices manifest daily within a lifetime. These influences begin *in utero* and early in life; they emerge daily from interactions among internal needs and contexts unique to biophysical and social environments; and they link the cells of plants with the palates of herbivores and humans. This synthesis summarises papers in the special issue of *Animal Production Science* that explore emerging understanding of these dynamics, and suggests implications for future research that can help people manage livestock for the benefit of landscapes and people by addressing (1) how primary and secondary compounds in plants interact physiologically with cells and organs in animals to influence food selection, (2) temporal and spatial patterns of foraging behaviours that emerge from these interactions in the form of meal dynamics across landscapes, (3) ways humans can manage foraging behaviours and the dynamics of meals for ecological, economic and social benefits, and (4) models of foraging behaviour that integrate the aforementioned influences.

Additional keywords: behaviour, habitat selection, managing grazing, meal patterns, models of foraging, nutrition, secondary compounds.

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Introduction

Herbivores face several challenges in foraging (Provenza and Balph 1990). Depending on location and context, they select their food from grasses, forbs, shrubs and trees, each being unique in the environment where the plant is growing, as well as a herbivore's age, physiological state, and past experiences with a plant part. Toxicity or nutritive value of particular plant parts also depends on the mix and sequence in which other plant parts are eaten in the meal. This affects dosages and interactions among primary compounds (energy, protein, minerals and vitamins) and secondary compounds (thousands of organic compounds that plants synthesise, broadly categorised as phenolics, terpenes and alkaloids). Given an opportunity, herbivores eat 50 or more foods in a day, although three to five items typically make up the bulk of a meal. In the process, they ingest thousands of phytochemicals that interact with one another and with cells in complex ways that we are just beginning to understand. What they choose changes within the meal, from meal to meal, day to day, and season to season.

Herbivores make decisions about where to forage, what combinations of foods to eat, and in which sequences to eat them. Their choices integrate influences that span generations; they begin *in utero* and become manifest within the lifetime of each individual from interactions that arise daily among needs and contexts unique to biophysical and social environments. The papers in this special issue describe emerging understanding of the following four topics: (1) physiological factors that influence meal dynamics, (2) temporal and spatial patterns of meal dynamics, (3) ways humans can manage foraging behaviours and the dynamics of meals for ecological, economic and social benefits that ultimately link plants, herbivores and human beings, and (4) models of foraging behaviours that assimilate various aspects of the aforementioned influences. We summarise key points from each topic and identify promising areas for future research (Fig. 1). Understanding behavioural mechanisms that influence meal dynamics and distribution patterns can help humans manage foraging behaviours better for ecological, economic and social benefits.

Physiological factors influencing meal dynamics

Animals experience and respond to different physiological states through affective and cognitive processes (Provenza 1995). Affective processes integrate the taste of food with post-ingestive feedback from cells and organ systems as they interact with primary and secondary plant compounds (Provenza and Villalba 2006). This non-cognitive integration changes liking

Animal oriented guidelines...

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Tropical Grasslands – Forrajes Tropicales (2013) Volume 1, 137−155

Harry Stobbs Memorial Lecture: Can grazing behavior support innovations in grassland management?

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Keywords: Grazing management, pasture structure, grazing systems, forage intake, bite mass.

Abstract

Grazing is a fundamental process affecting grassland ecosystem dynamics and functioning. Its behavioral components comprise how animals search for feed, and gather and process plant tissues in different spatio-temporal scales of the grazing process. Nowadays, there is an increasing emphasis on grazing management and the role of the grazing animal on ecosystem services, concomitantly with a decreasing emphasis on grazing management generating animal production outputs. Grazing behavior incorporates both approaches, which are not necessarily dichotomist. It would provide the basis to support innovation in grazing systems. However, it is unclear how the significant knowledge, developed in this research area since the disciplines of Agronomy and Ecology began to interact, have supported creativity in grazing science. It seems there is a current gap in this context, which was a major concern of researcher leaders like Harry Stobbs. This paper pays tribute to him, reviewing recent grazing behavior research and prioritizing those studies originating in the favorable tropics and subtropics. New evidence on how pasture structure limits forage intake in homogeneous and heterogeneous pastures is presented. Pasture management strategies designed to maximize bite mass and forage intake per unit grazing time are assumed to promote both animal production and landscape value. To conclude, a Brazilian case study (PISA) is briefly described to illustrate how grazing behavior research can reach farmers and change their lives by using simple management strategies ("take the best and leave the rest" rule) supported by reductionist approaches applied in holistic frameworks.

Resumen

El pastoreo es un proceso fundamental que afecta la dinámica y el funcionamiento de los ecosistemas de pasturas. Sus componentes comprenden la forma cómo los animales buscan el alimento y lo ingieren y cómo procesan los tejidos de las plantas en diferentes escalas espacio-temporales dentro del proceso de pastoreo. Actualmente existe un énfasis creciente en el manejo del pastoreo y en el papel de los animales en pastoreo respecto a los servicios de ecosistemas, conjuntamente con el descenso del énfasis en el manejo de pastoreo con fines de producción animal. El comportamiento de pastoreo incorpora ambos enfoques, los cuales no necesariamente son dicotómicos; puede proporcionar la base para innovaciones en los sistemas de pastoreo. No obstante no es claro cómo los avances significativos del conocimiento en esta área de investigación, desde que las disciplinas de agronomía y ecología comenzaron a interactuar, han contribuido a la creatividad en la ciencia del pastoreo. Aparentemente existe un vacío en este contexto, y esto fue una de las preocupaciones principales de investigadores líder como Harry Stobbs. En el presente documento se rinde homenaje a este científico y se revisan las investigaciones recientes en comportamiento de pastoreo, priorizando estudios procedentes de zonas favorables del trópico y subtrópico. Se presenta una nueva evidencia de la forma cómo la estructura de una pastura limita el consumo del forraje tanto en pasturas homogéneas como heterogéneas. Se asume que las estrategias de manejo del pastoreo, diseñadas a maximizar el bocado y su ingestión por unidad de tiempo de pastoreo, son dirigidas a promover tanto la producción animal como el valor paisajístico. Para concluir, se presenta un estudio de caso en Brasil (PISA) que ilustra y describe brevemente cómo la investigación en el comportamiento de pastoreo puede llegar a los productores para contribuir a su bienestar solo con la adopción de estrategias sencillas de manejo (la regla del "tome lo mejor y deje el resto"), con el apoyo de enfoques reduccionistas que se aplican en marcos holísticos.

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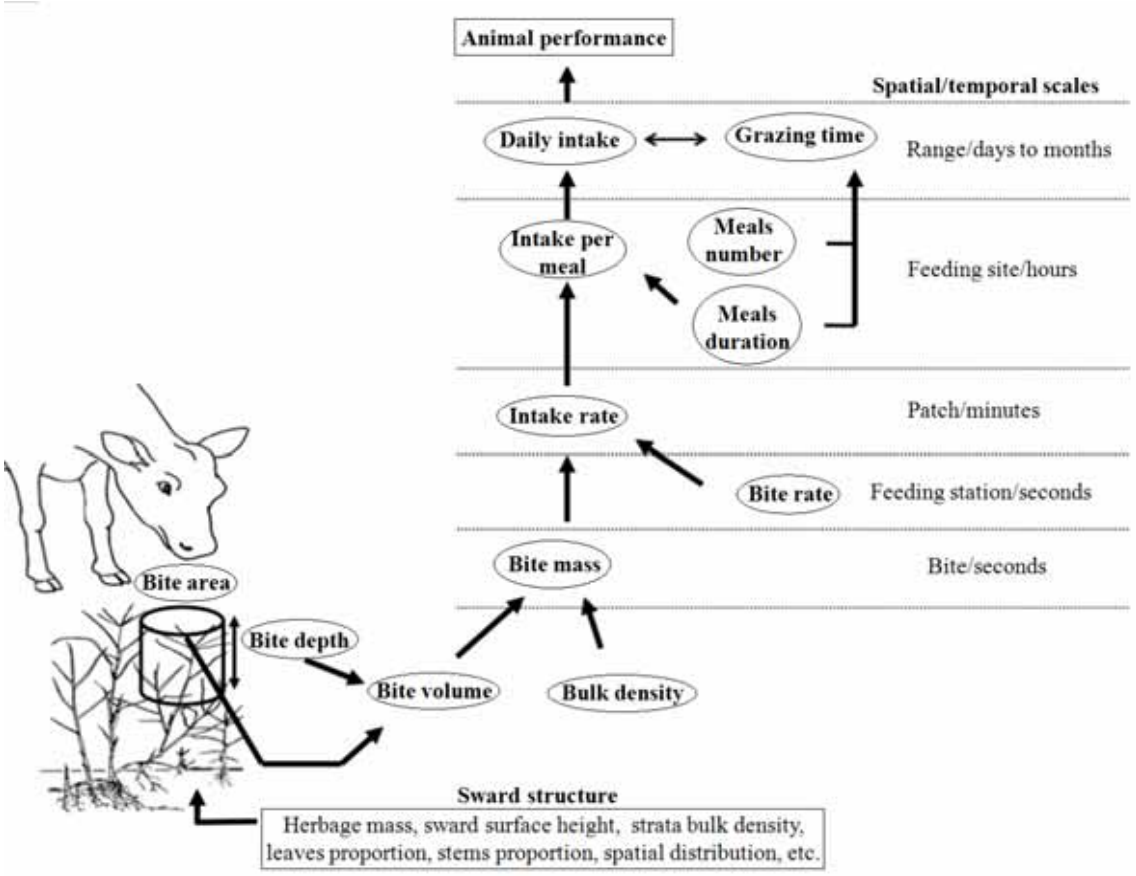
Email: paulocfc@ufrgs.br



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Animal oriented guidelines: evaluation process

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from reductionism… *…to production systems*

(-) *Spatio-temporal scales* (+)

Phase 1
Scale: bite
Output: sward targets
Main parameter: Intake rate

Phase 2
Scale: tiller
Output: sward dynamics
Main parameter: Efficiency of harvesting

Phase 3
Scale: paddock
Output: sward production
Main parameter: Efficiency of utilization

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Understanding the grazing process and defining structures to grazing...

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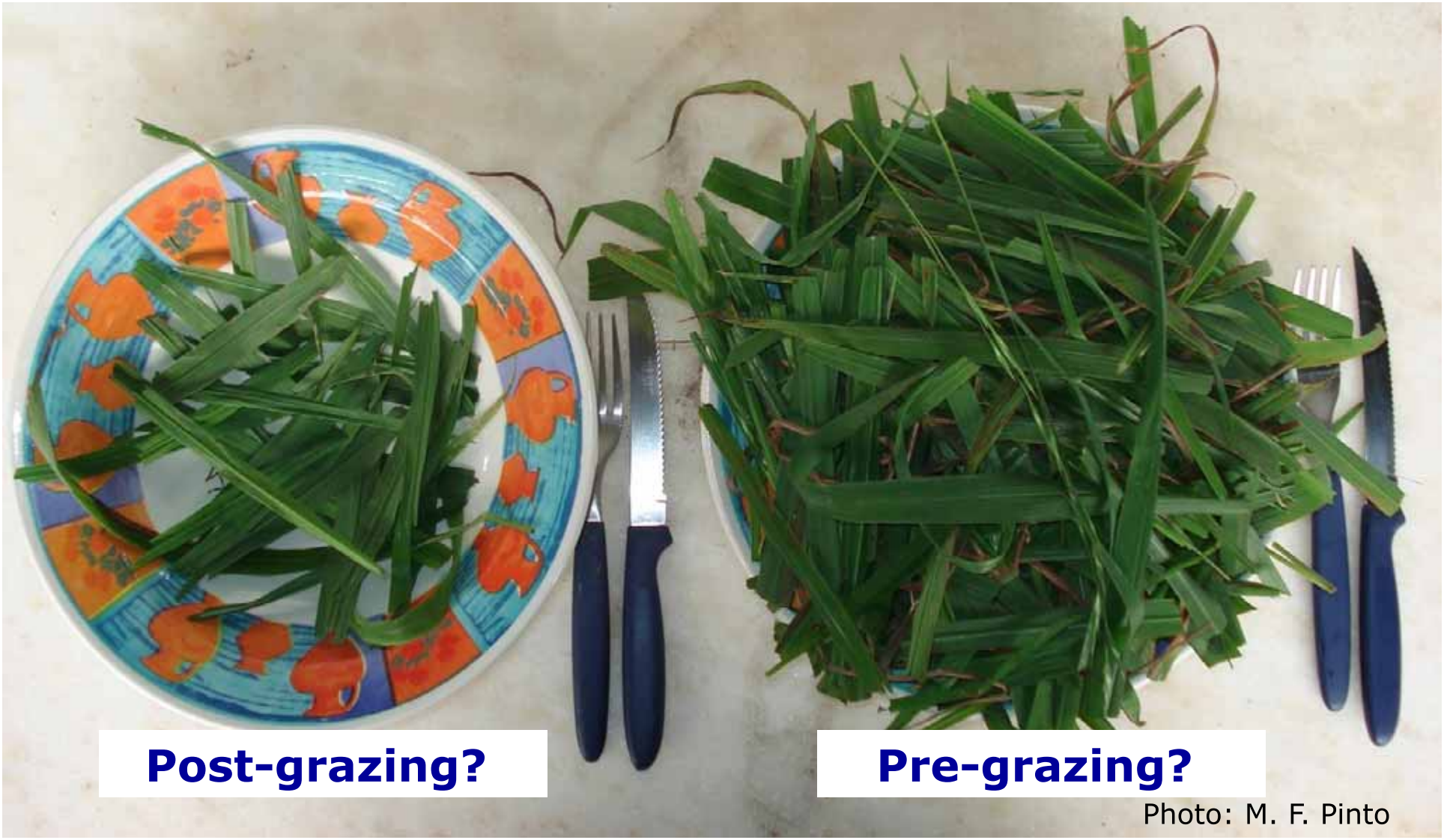

Photo: M. F. Pinto

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Determining pre-grazing targets...

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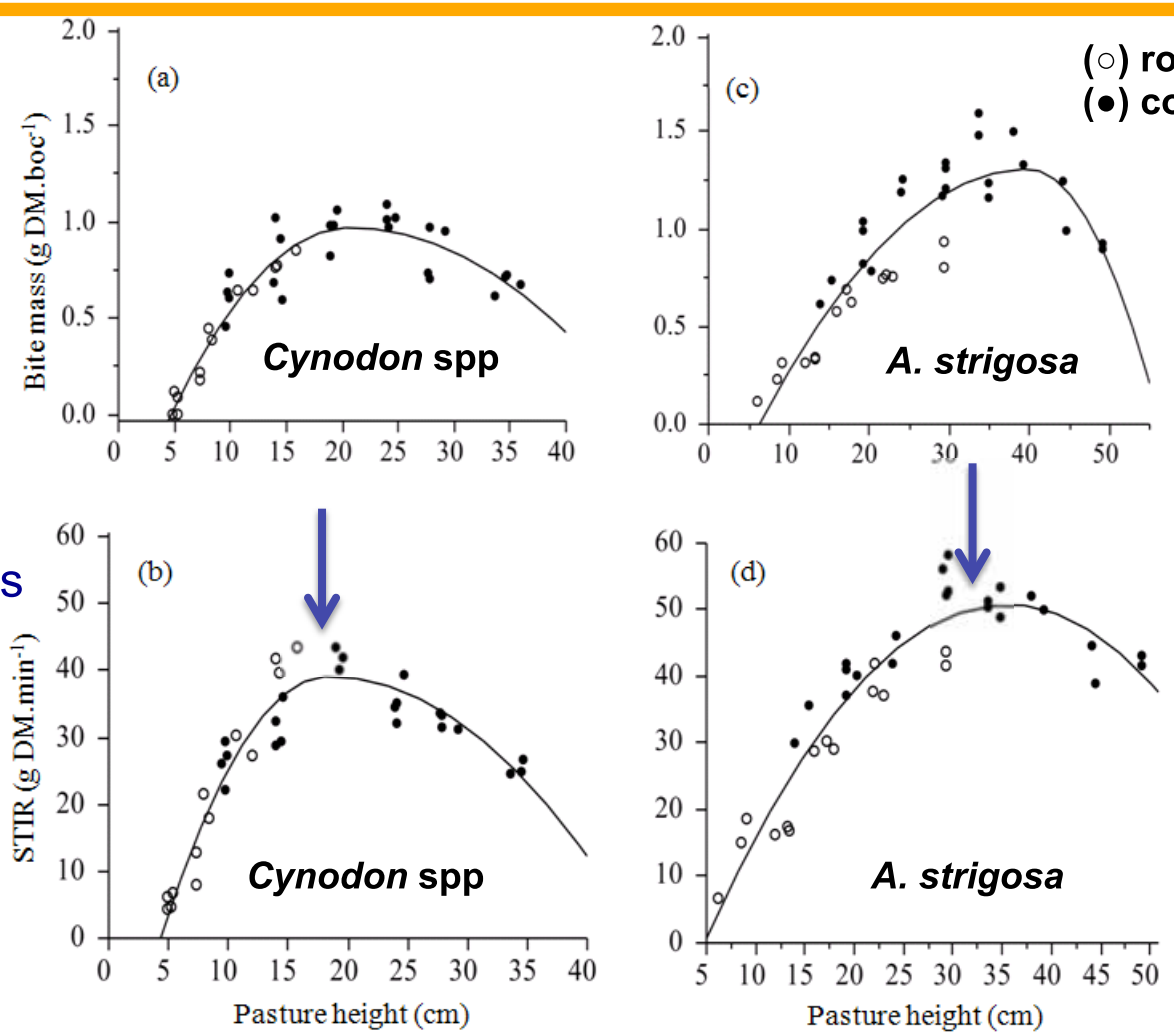
(○) rotational stocking
(●) continuous stocking

Pre-grazing targets



Mezzalira et al., 2015. Adaptations of Type IV functional response for estimating short-term intake rate by grazing herbivores. Journal of Functional Ecology (in prep).

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When to move out ?

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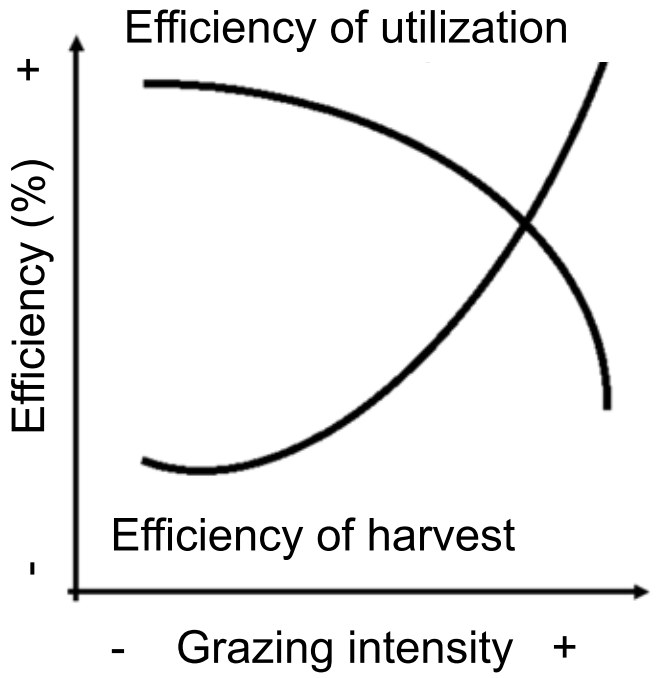
- Pre-grazing structure: broader theoretical framework than post-grazing structure



Courtesy: M. Wade

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When to move out ?

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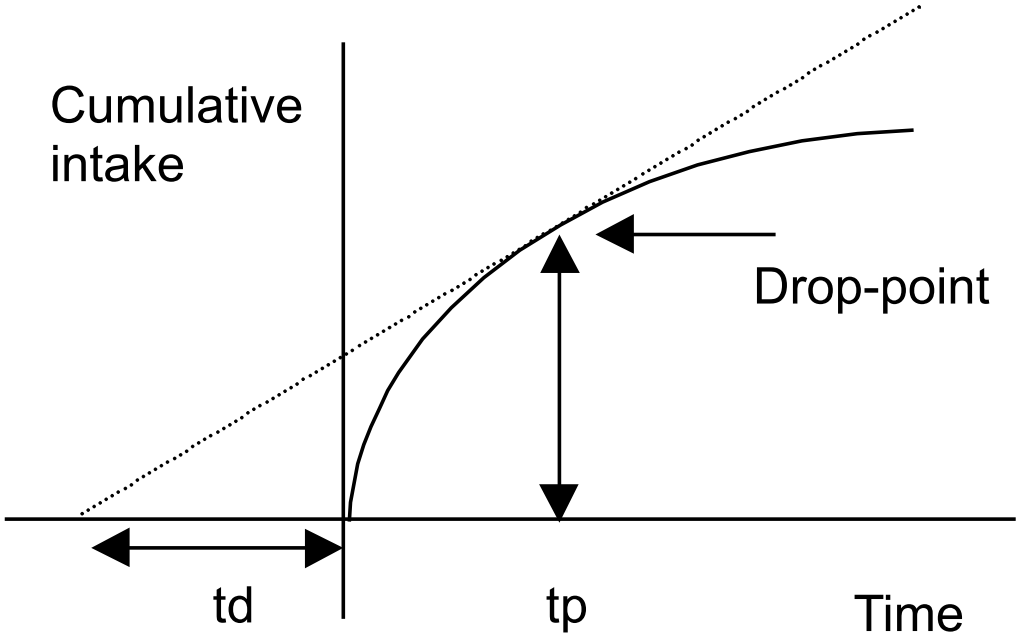

Marginal Value Theorem (Charnov, 1976)

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Grazing behaviour determining post-grazing pasture structure

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Courtesy: J. Mezzalira

Changes in sward structure during grazing

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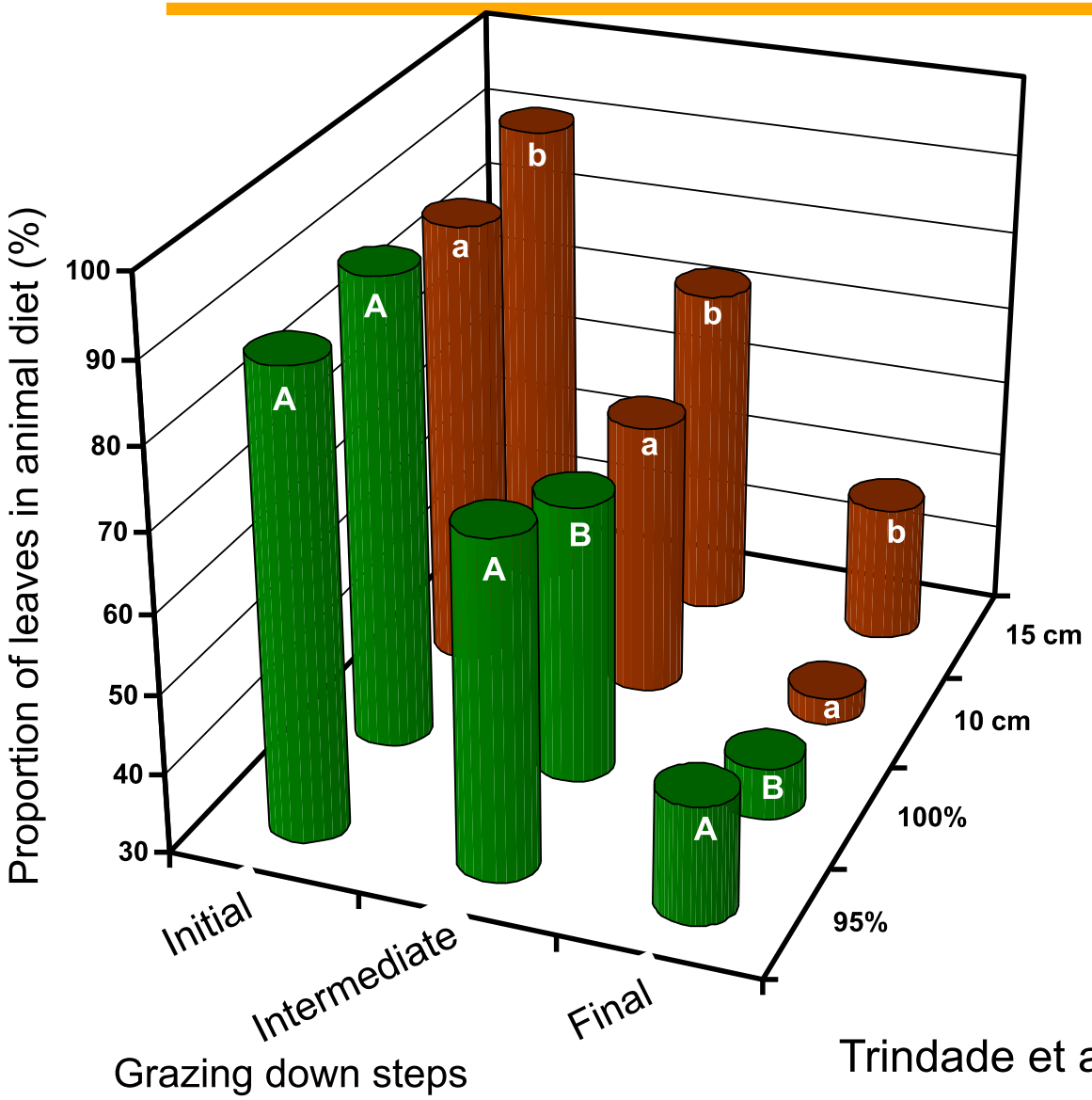

Trindade et al., 2007

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Changes in ingestive behavior during grazing

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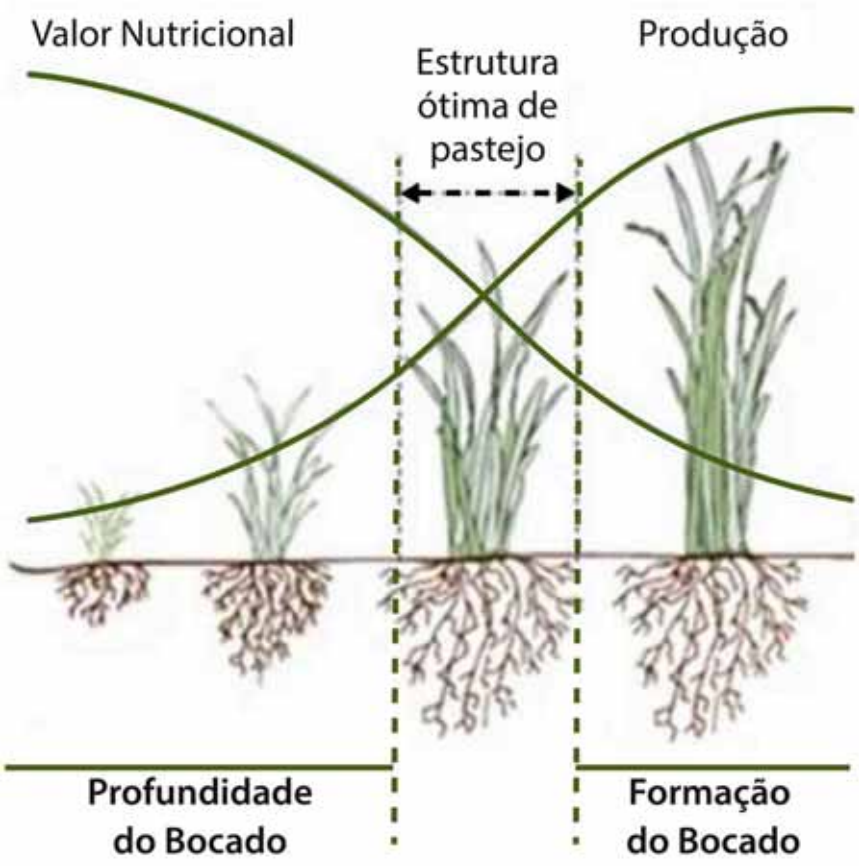
The bite dilemma

Pasture structural thresholds



Schram, D. (2015)

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Changes in ingestive behavior during grazing

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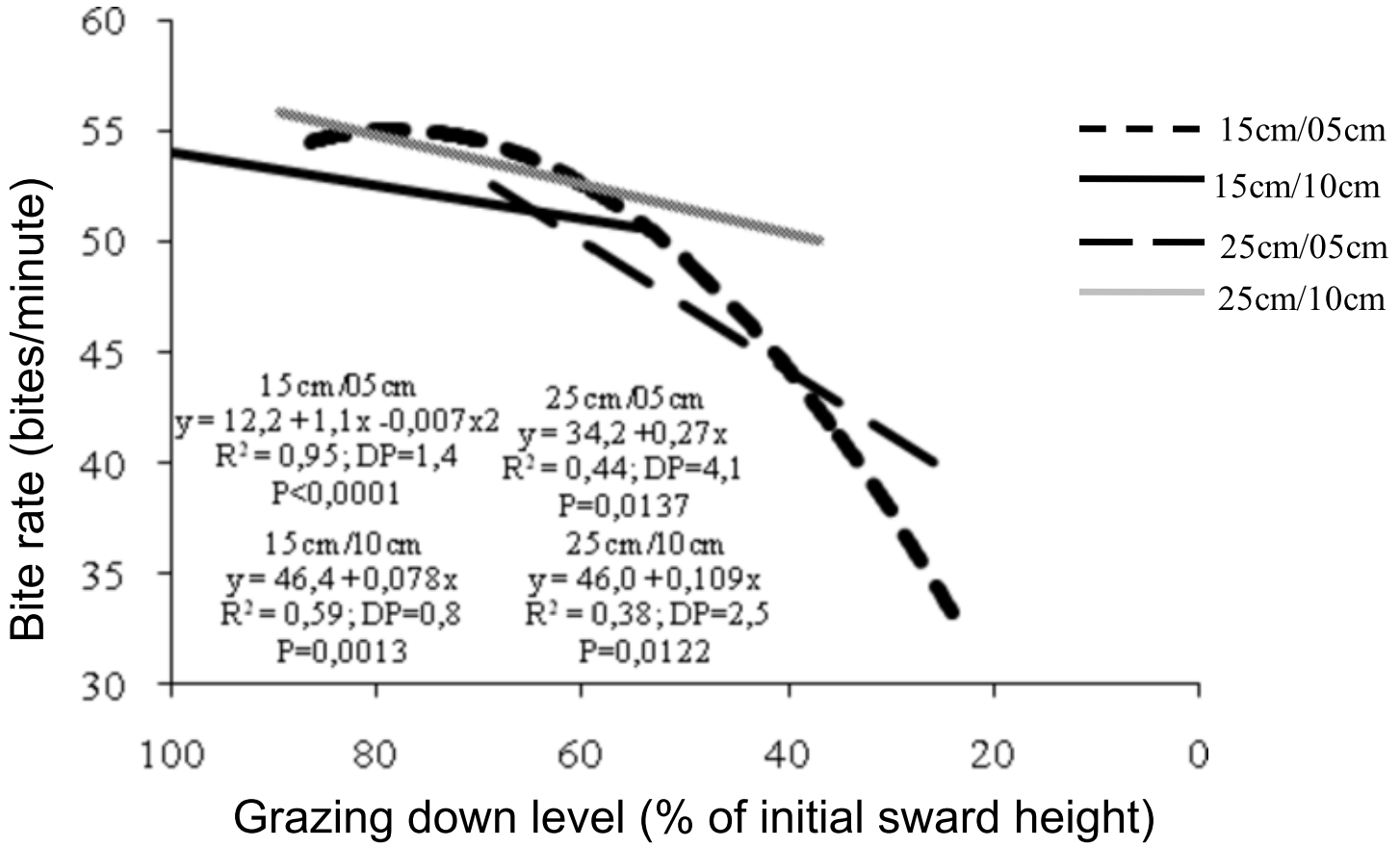

Amaral et al., 2012. Sward structure management for a maximum short-term intake rate in annual ryegrass. Grass and Forage Science, 68: 271-277

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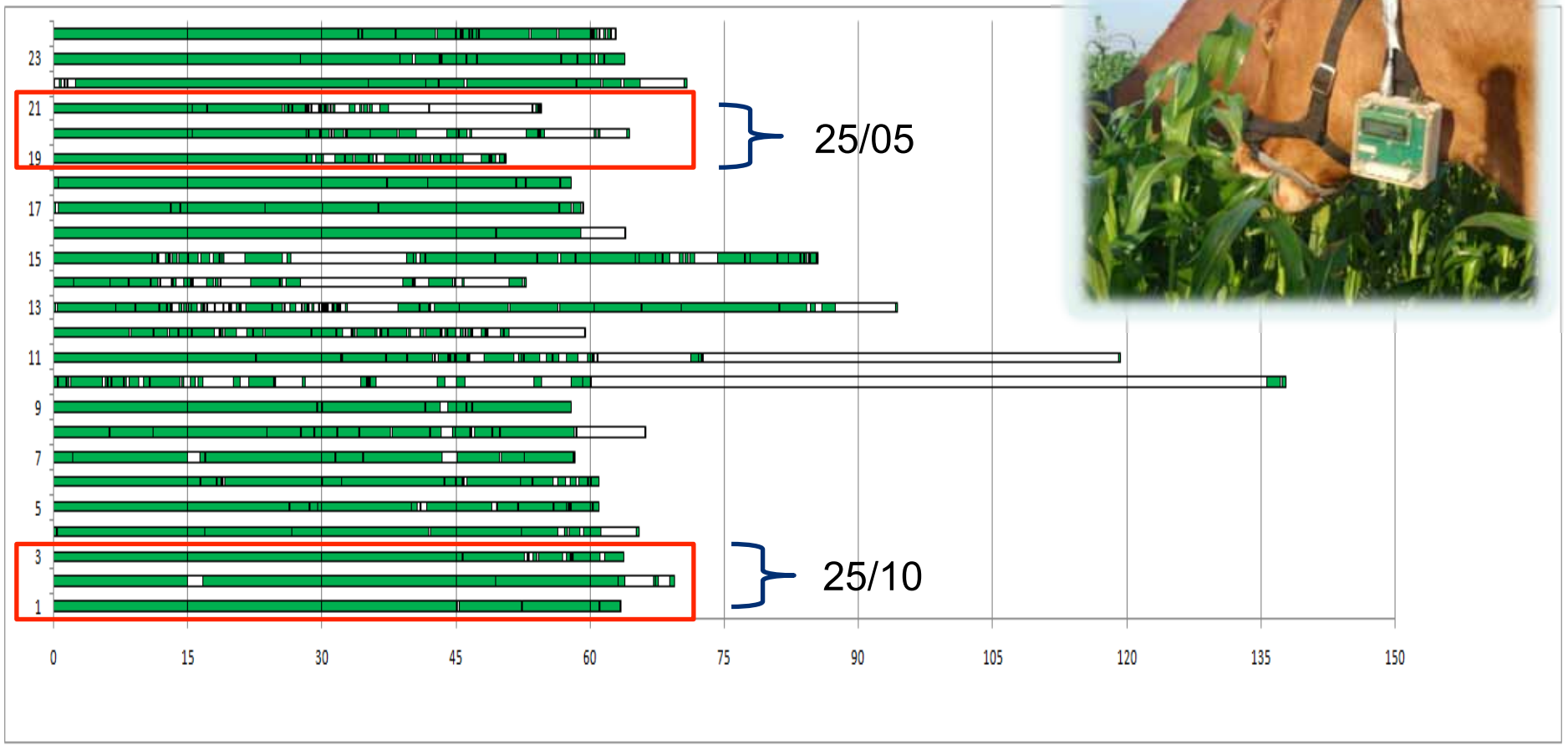

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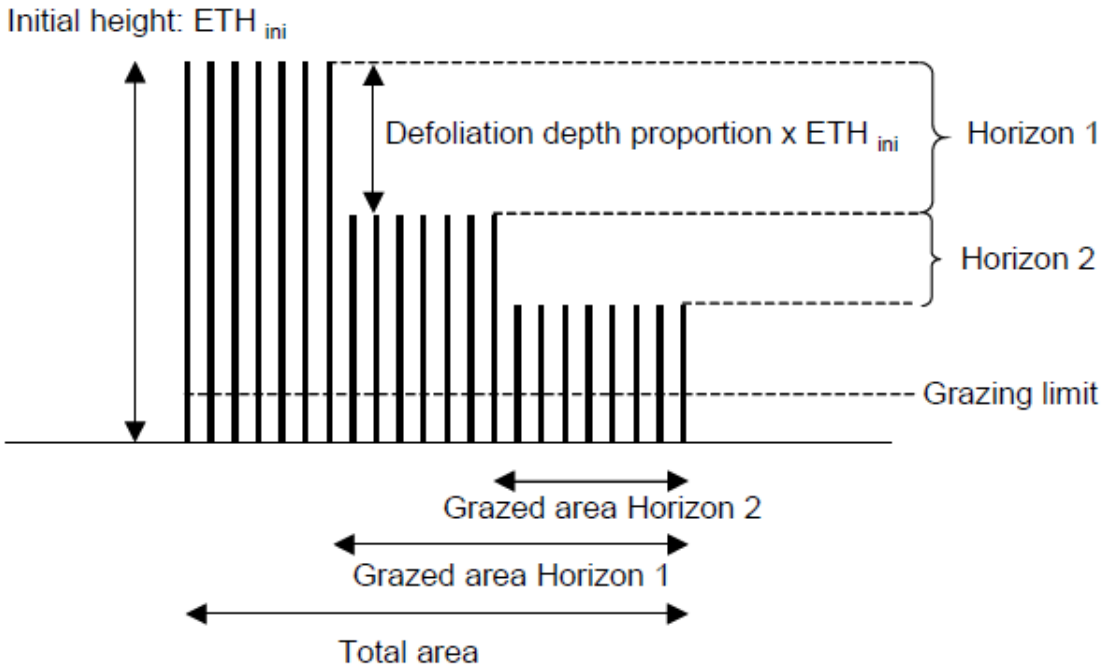
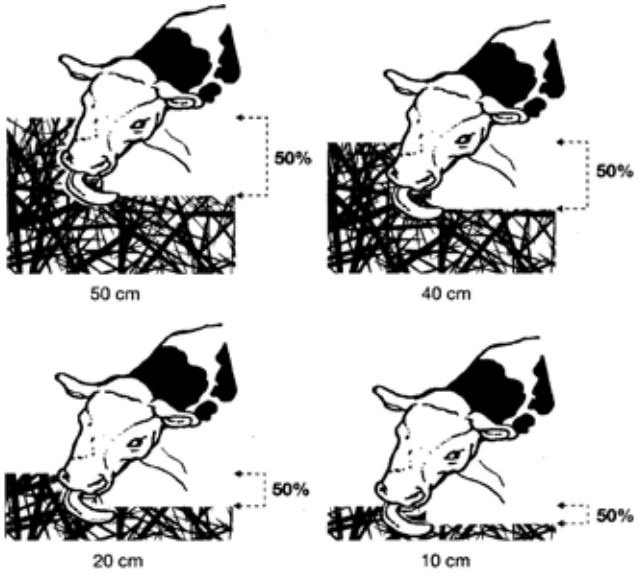


Grazing by horizons (Baumont et al., 2004)



Grazing by horizons (Cangiano et al., 1999)

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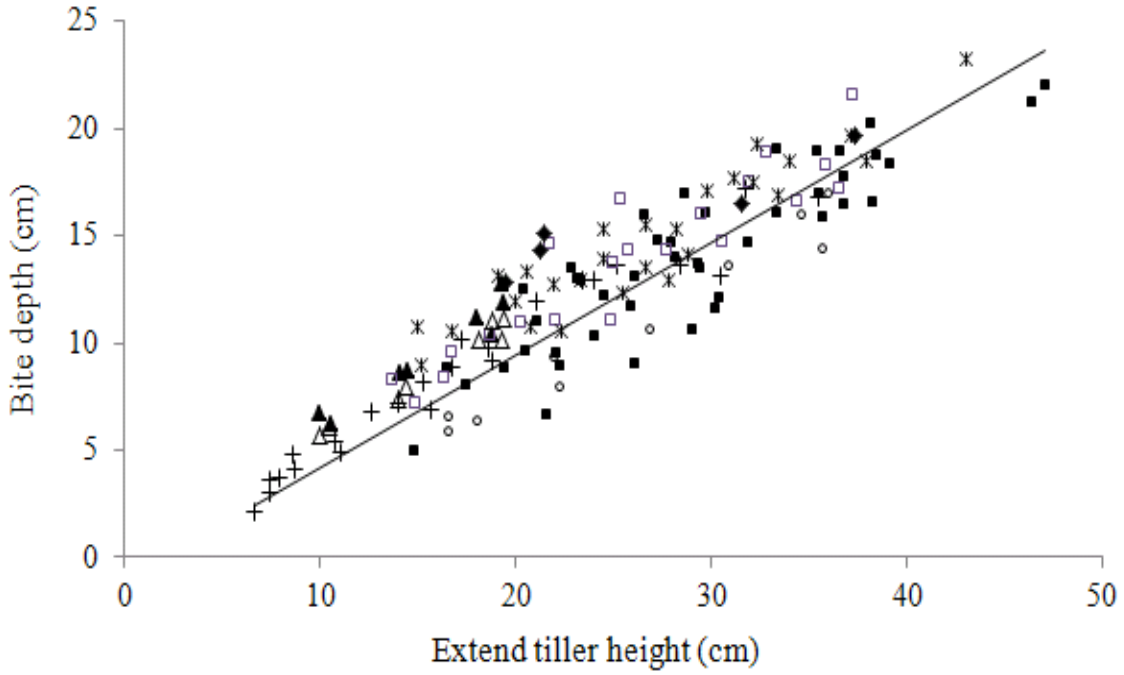

Relationship between bite depth and extended tiller height in Tropical and Temperate pastures (Carvalho, 2013)

(∆) sheep and (▲) beef heifers in natural grassland (Gonçalves *et al.* 2009a); (♦) beef heifers in *A. strigosa* (Mezzalira *et al.* 2013b); (■) beef heifers in *B. brizantha* (Da Trindade 2007); (+) sheep in *F. arundinacea* and *D. glomerata* (Carvalho *et al.* 1998); (○) horses in five cv. of *Cynodon* sp. (Dittrich *et al.* 2005); (*) ponies in *Cynodon* sp. and *P. paniculatum* (Dittrich *et al.* 2007); (□) dairy cows in *A. strigosa* (Lesama *et al.* 1999); (y = 1.1 + 0.52x; R2 = 0.8391; SE = 1.9; *P<0.0001;* n = 203).

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Sward structure and behaviour changing simultaneously

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Changes in sward structure and behavior during grazing

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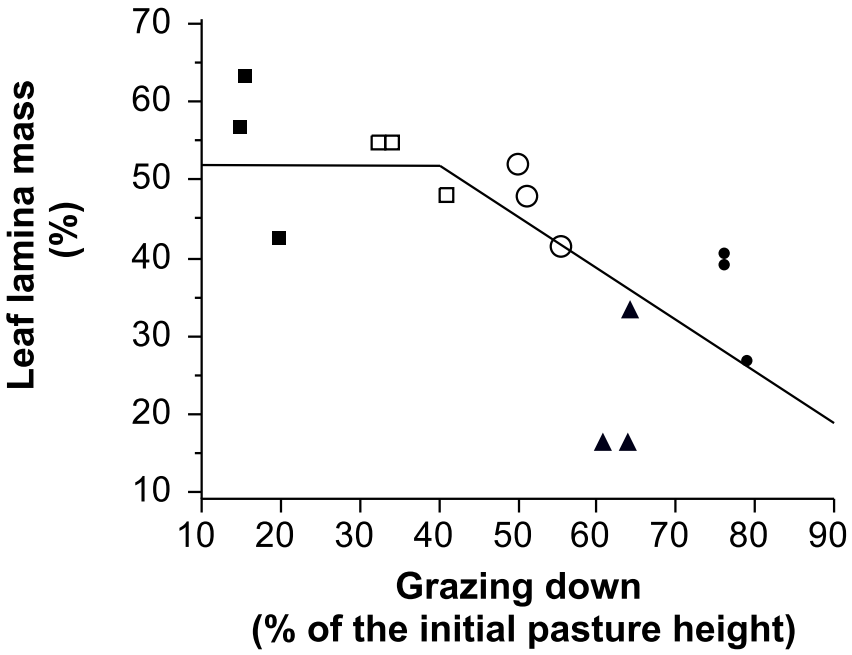

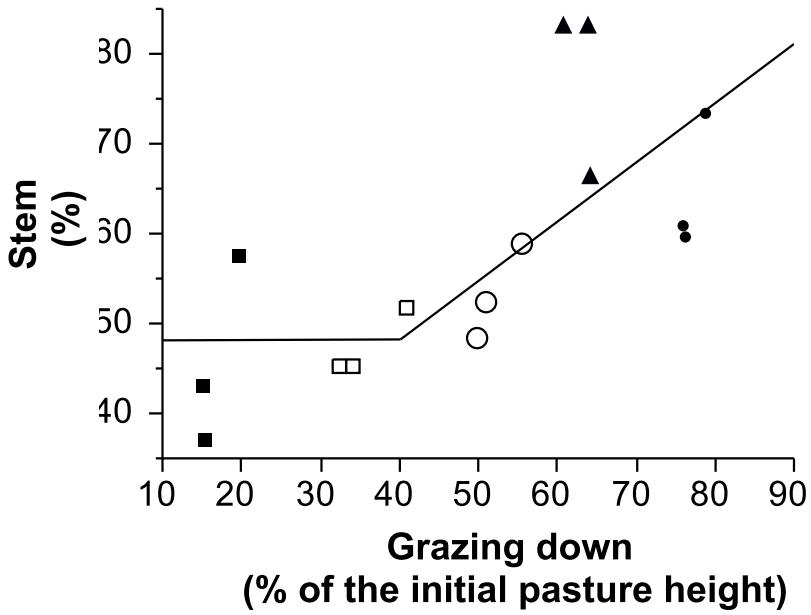

Fonseca et al., 2013. Effect of sward surface height and level of herbage depletion on bite features of cattle grazing Sorghum bicolor swards. Journal of Animal Science, 91:4357-4365

Changes in sward structure and behavior during grazing

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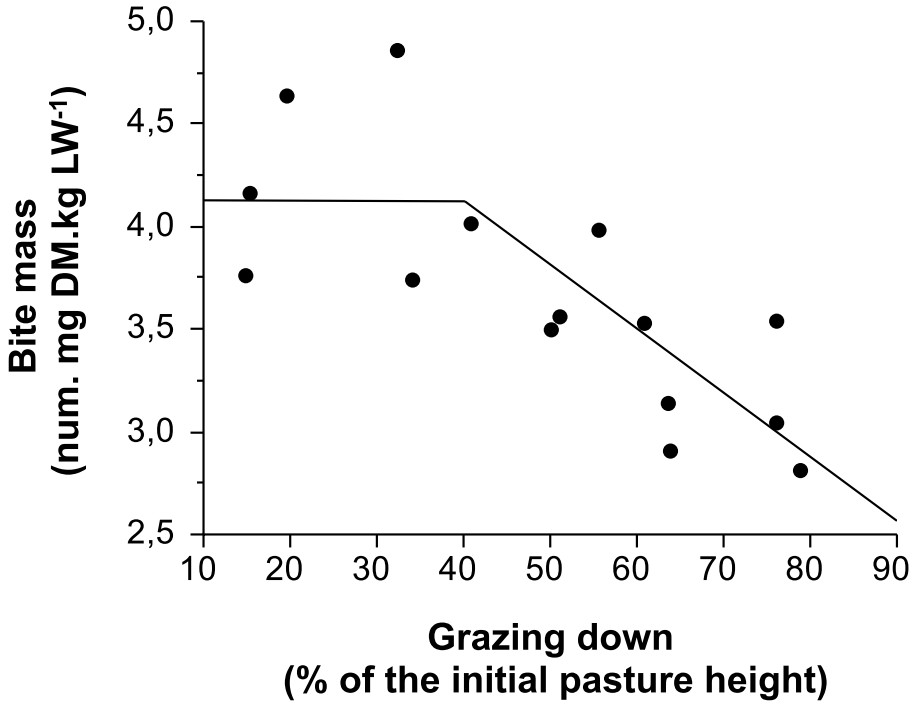

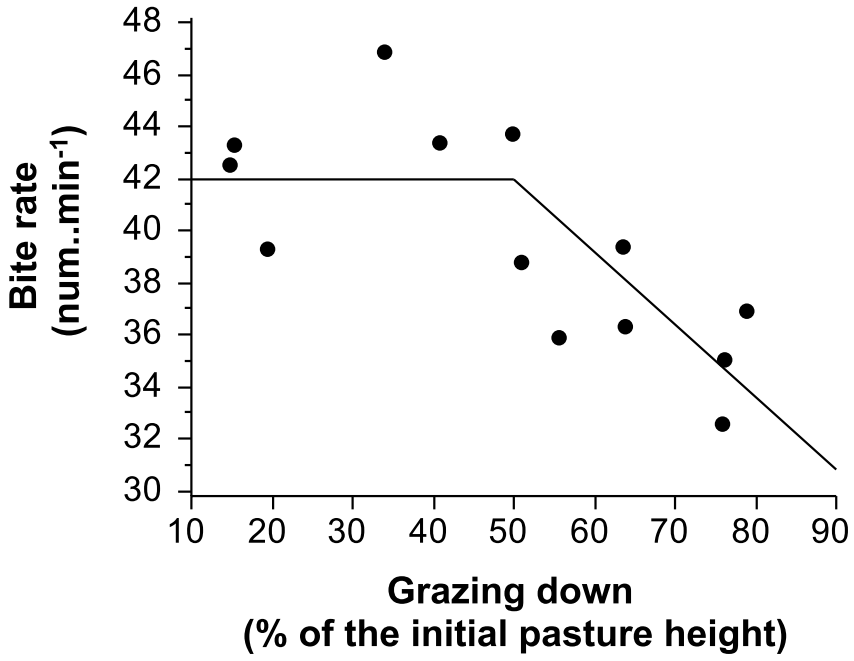

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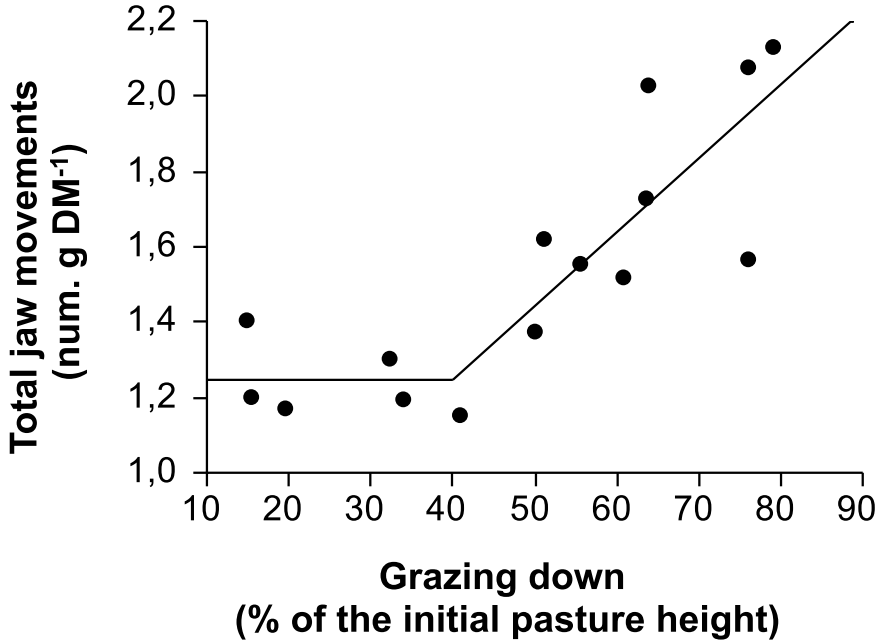

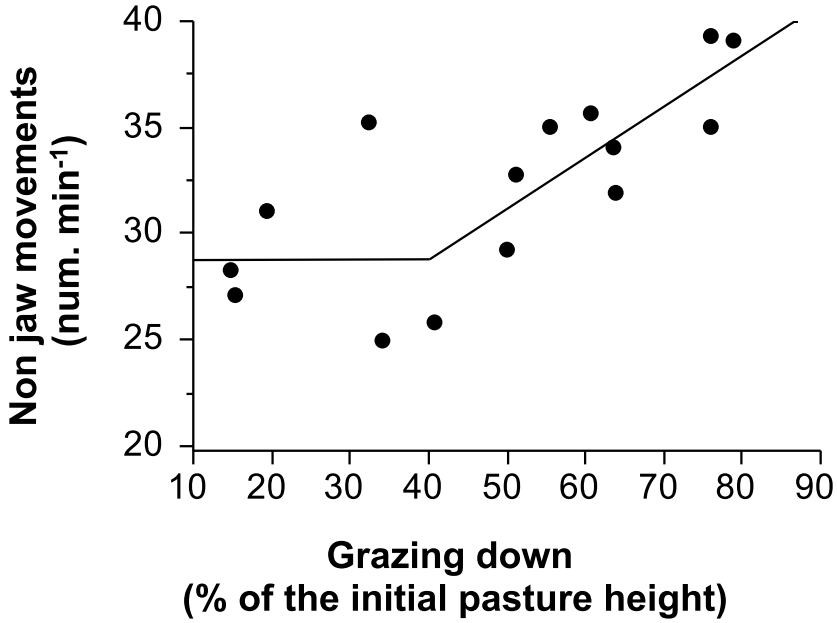

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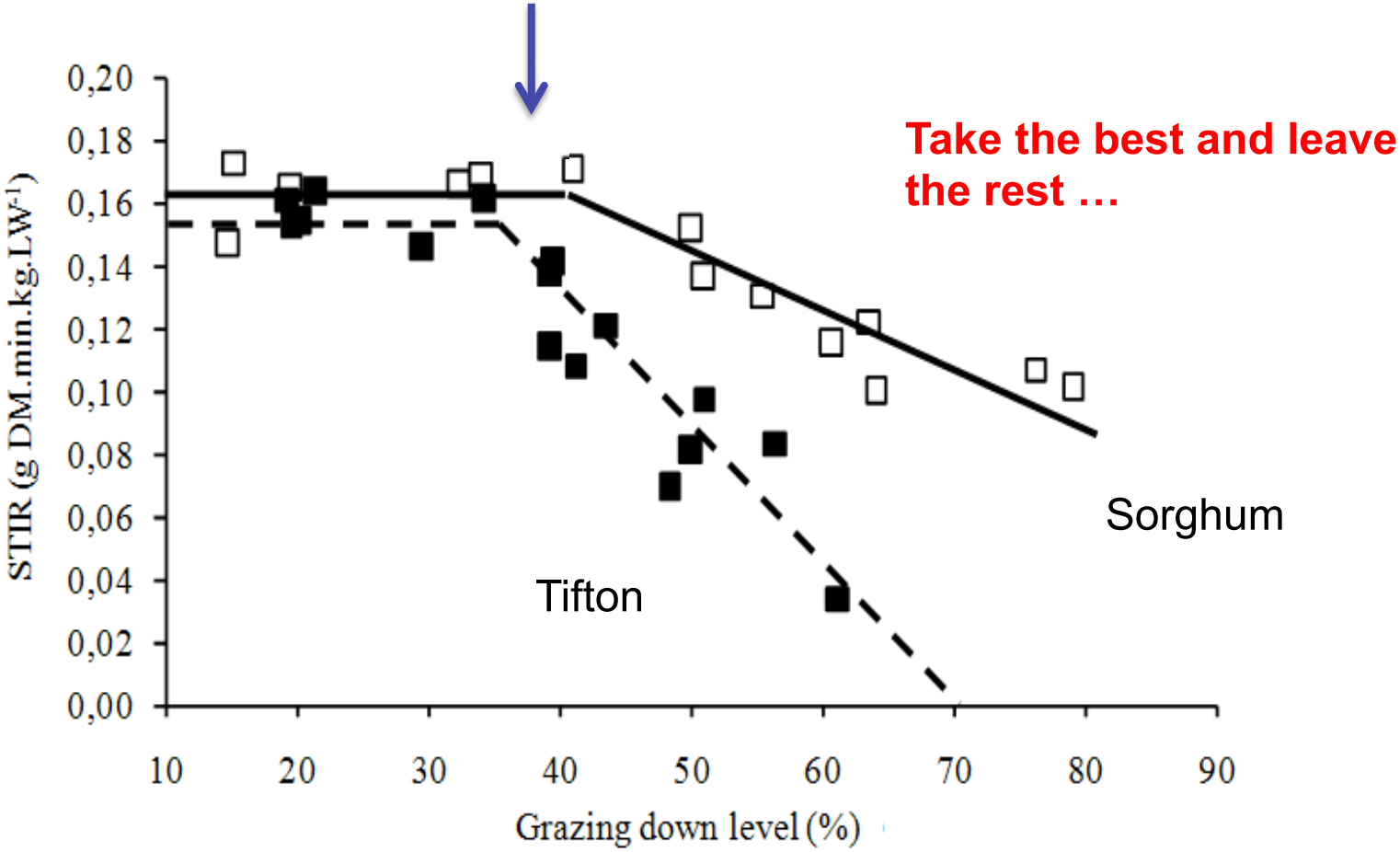

Carvalho, P. C. F. 2013. Harry Stobbs Memorial Lecture: Can grazing behaviour support innovations in grassland management?. Tropical Grasslands – Forrajes Tropicales, v. 1, p. 137-155, 2013.

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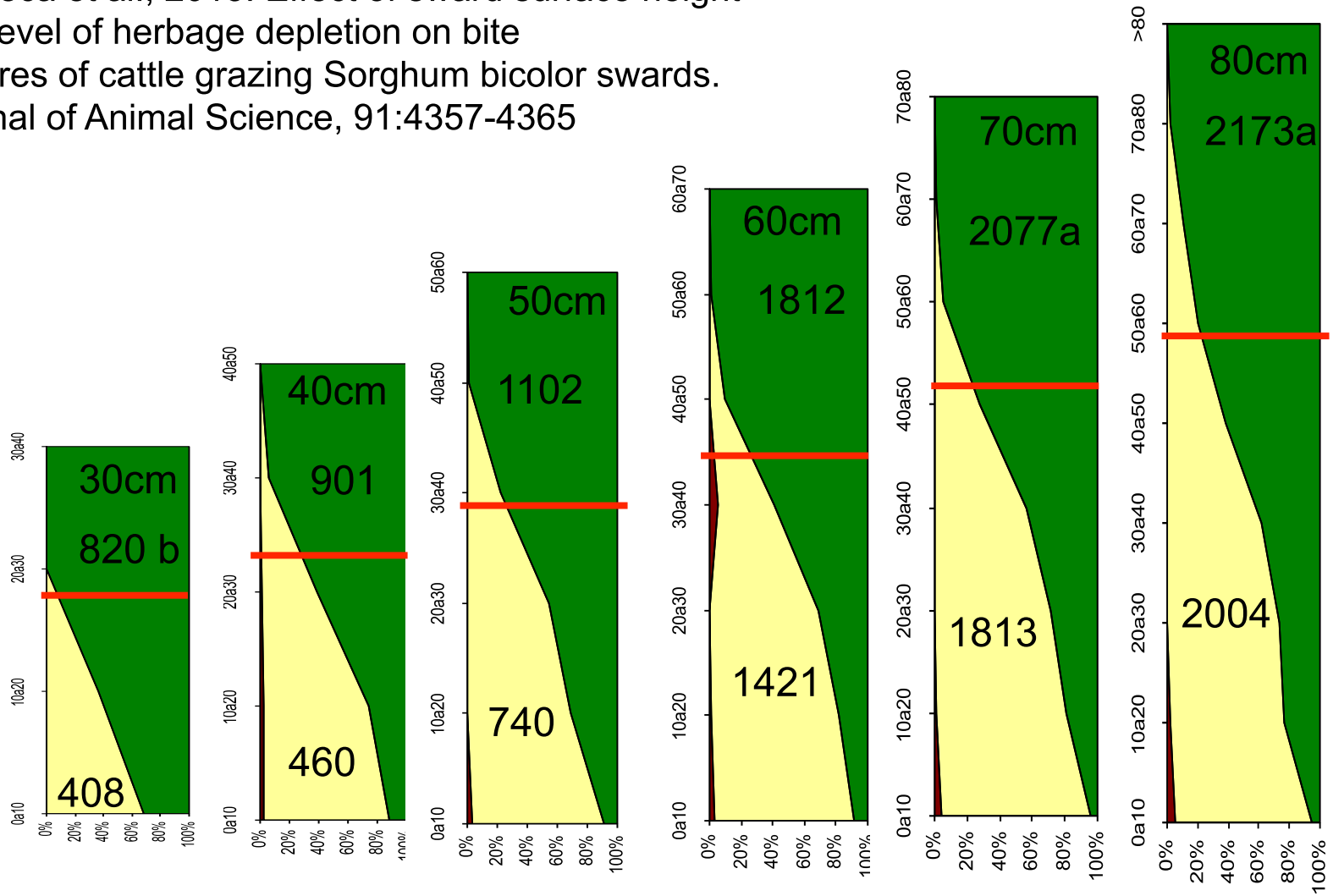

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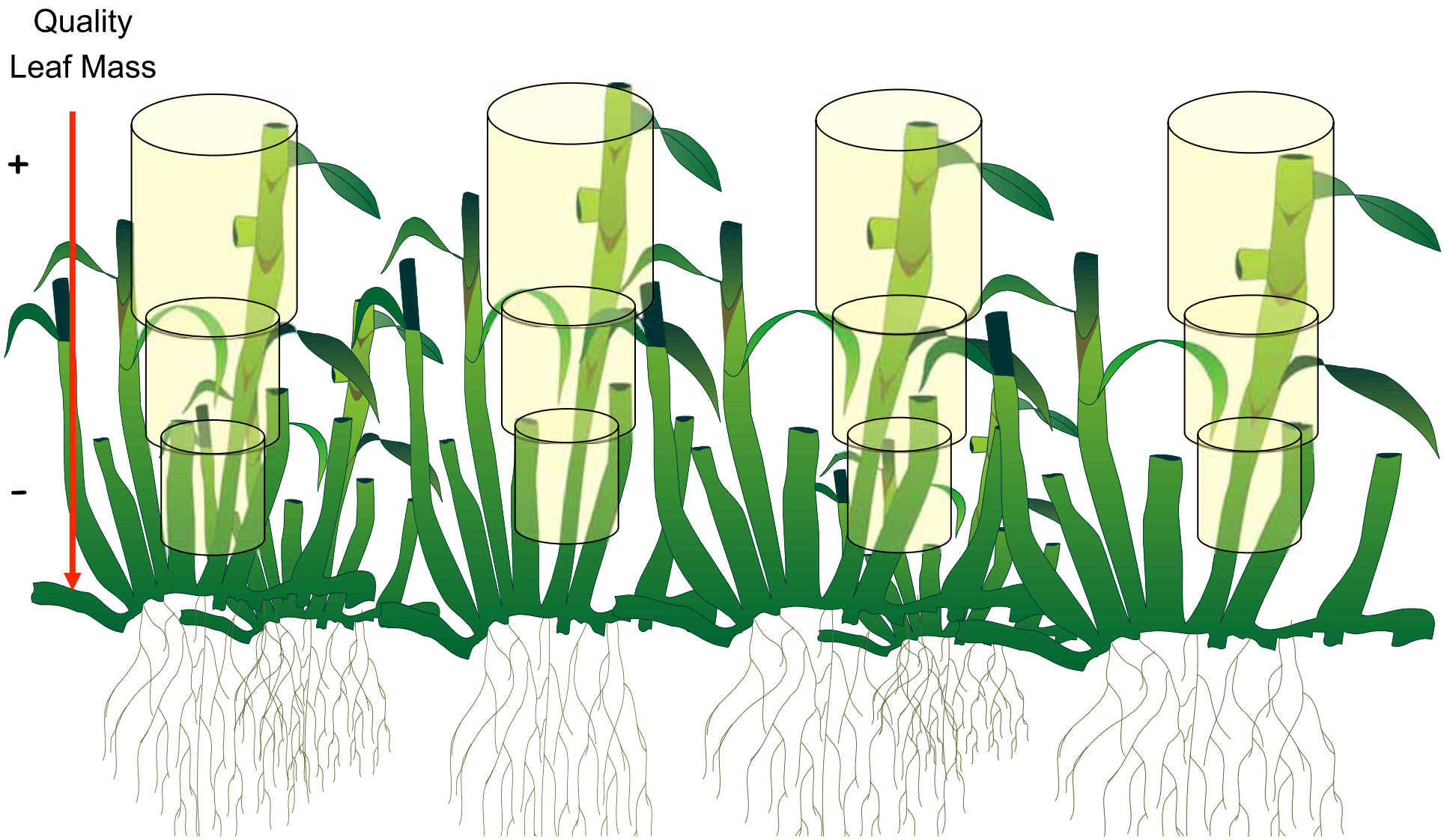

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Changes in sward structure and behavior during grazing

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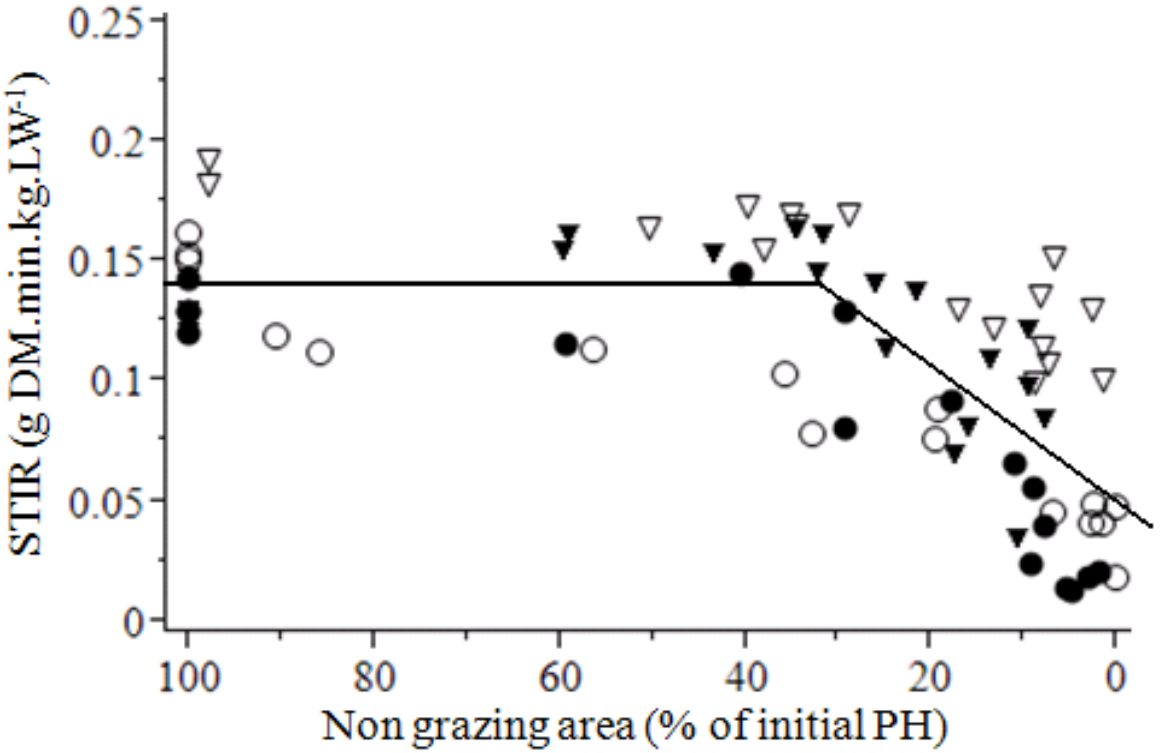

Changes in short-term herbage intake rate with reduction in the proportion of non-grazing area (Carvalho, 2013)

(●) dairy heifers in *Cynodon* sp. sward under continuous stocking; ○ () beef heifers in *A. strigosa* sward under continuous stocking; ▼( ) dairy heifers in *Cynodon* sp. sward under rotational stocking; and ( ) beef heifers in *S. bicolor* swards under rotational stocking (Fonseca et al., in prep).

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From bite to paddock scale

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Rotational stocking

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"Rotatinuous" stocking

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"Rotatinuous" stocking

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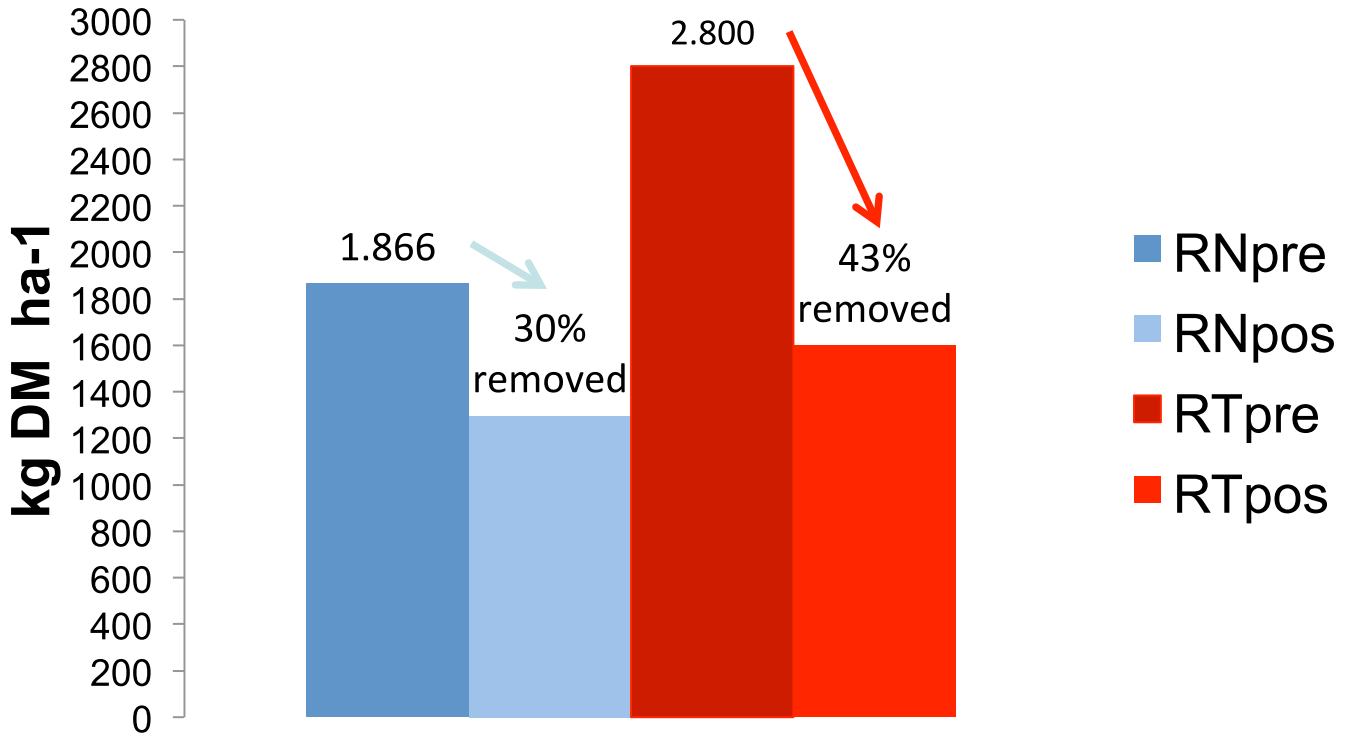
Forage mass



Schons, R. M.T. 2015. Critérios para manejo de pastagens podem ser fundamentados no comportamento ingestivo dos animais? Um exemplo com pastoreio rotativo conduzido sob metas de maximização do acúmulo ou da ingestão do pasto. Dissertação de Mestrado, UFRGS.

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"Rotatinuous" stocking

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Parameters	RN	RT	P	MSE
Grazing cycles (n°)	11	4	0.001	1.23
Resting period (n° days)	13	35	0.001	1.36
Pre-grazing leaf mass (kg DM ha^{-1})	854	1345	0.004	70.6
Post-grazing leaf mass (kg DM ha^{-1})	481	405	0.036	43.3
Pre-grazing LI (%)	91	95	0.001	0.23
Post-grazing LI (%)	77	63	0.001	2.13
Herbage accum. (kg DM ha^{-1} dia^{-1})	56	32	0.189	5.1
Herbage production (kg DM ha^{-1})	9023	6819	0.043	576.9

Schons, R. M.T. 2015. Critérios para manejo de pastagens podem ser fundamentados no comportamento ingestivo dos animais? Um exemplo com pastoreio rotativo conduzido sob metas de maximização do acúmulo ou da ingestão do pasto. Dissertação de Mestrado, UFRGS.

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"Rotatinuous" stocking

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Parameters	RN	RT	P	MSE
Forage harvested (kg/ha)	6267	4701	0.029	390.4
ADG (kg/day)	0.096	0.026	0.001	0.4
LWG/ha (kg)	392	174	0.004	0.86
Stocking rate (kg LW/ha)	1019	1478	0.001	90.8
Parasites (eggs/g feces)	480	3039	0.001	1004

Schons, R. M.T. 2015. Critérios para manejo de pastagens podem ser fundamentados no comportamento ingestivo dos animais? Um exemplo com pastoreio rotativo conduzido sob metas de maximização do acúmulo ou da ingestão do pasto. Dissertação de Mestrado, UFRGS.

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"Rotatinuous" stocking

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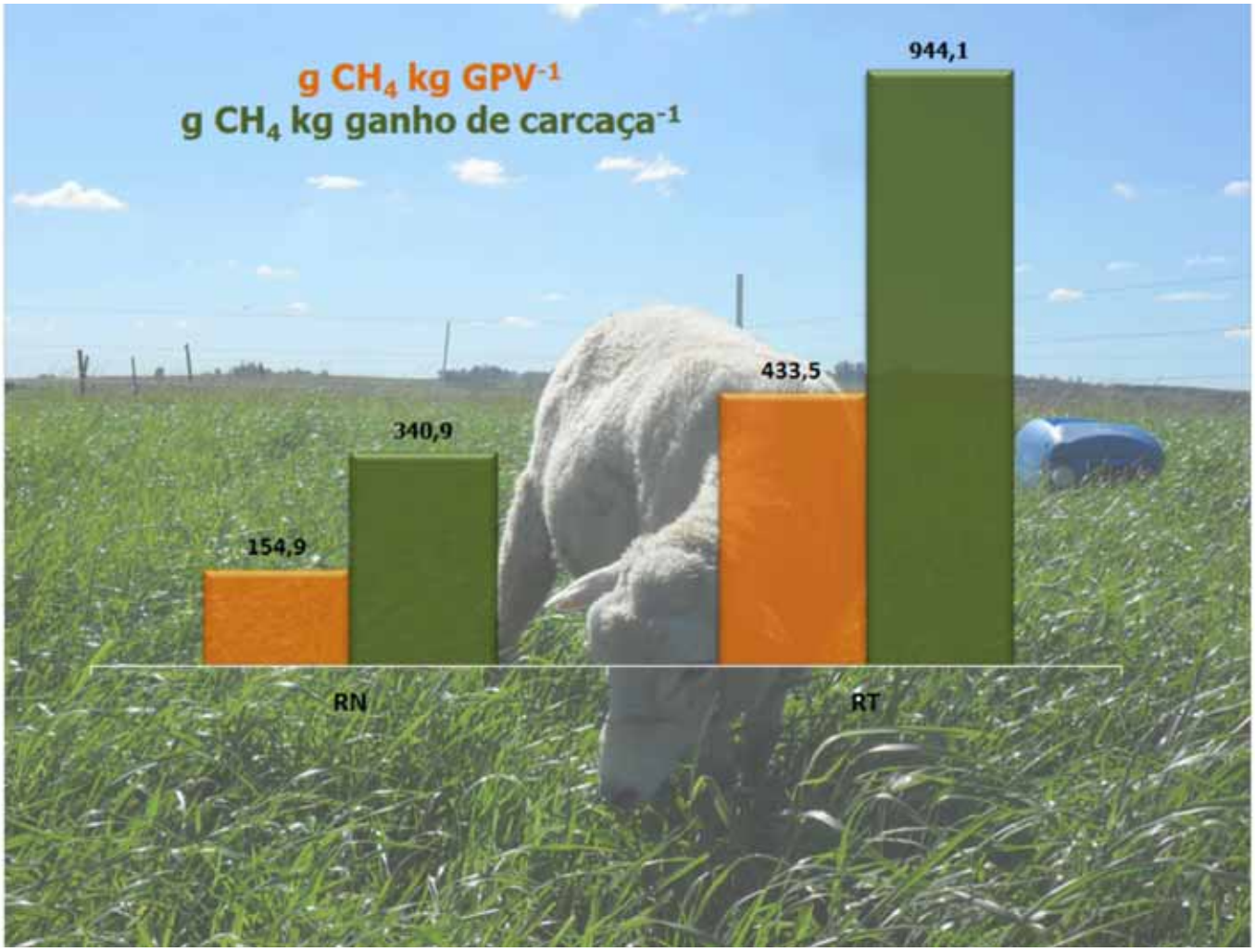

Savian, J. (Thesis – in prep.)

Conceptual model: integrating short-term and long-term variables

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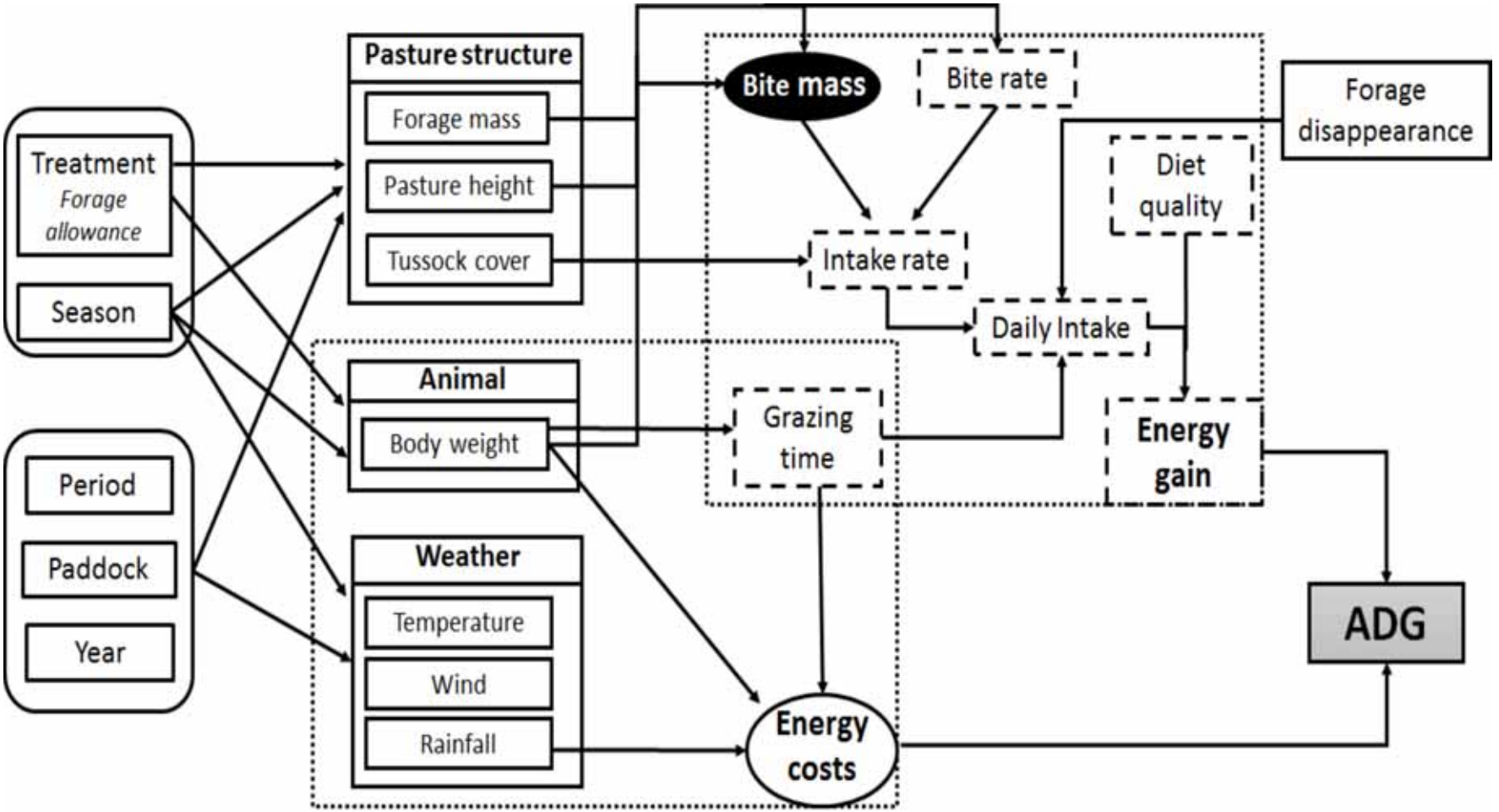

Carvalho, P.C.F. et al. 2015. Can animal performance be predicted from short-term grazing processes? Animal Production Science, 55: 319-327.

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Rotatinuous grazing: partial conclusions

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- Pre-grazing pasture targets depend on the type of forage but causal procesess are the same
- Post-grazing pasture targets do not depend on the type of forage (general rule) and causal processes are the same

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PISA

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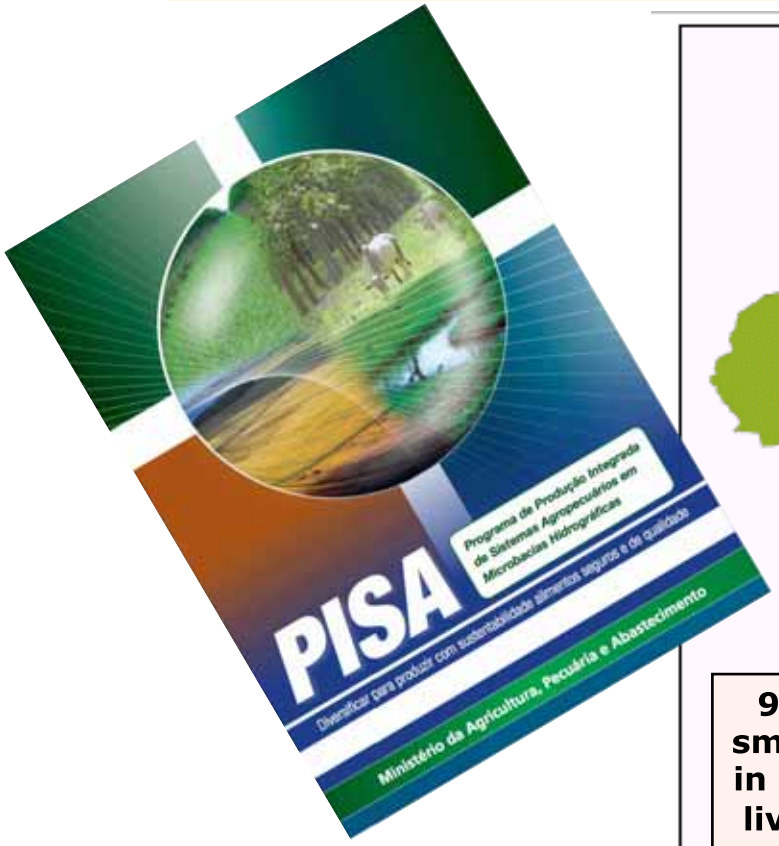
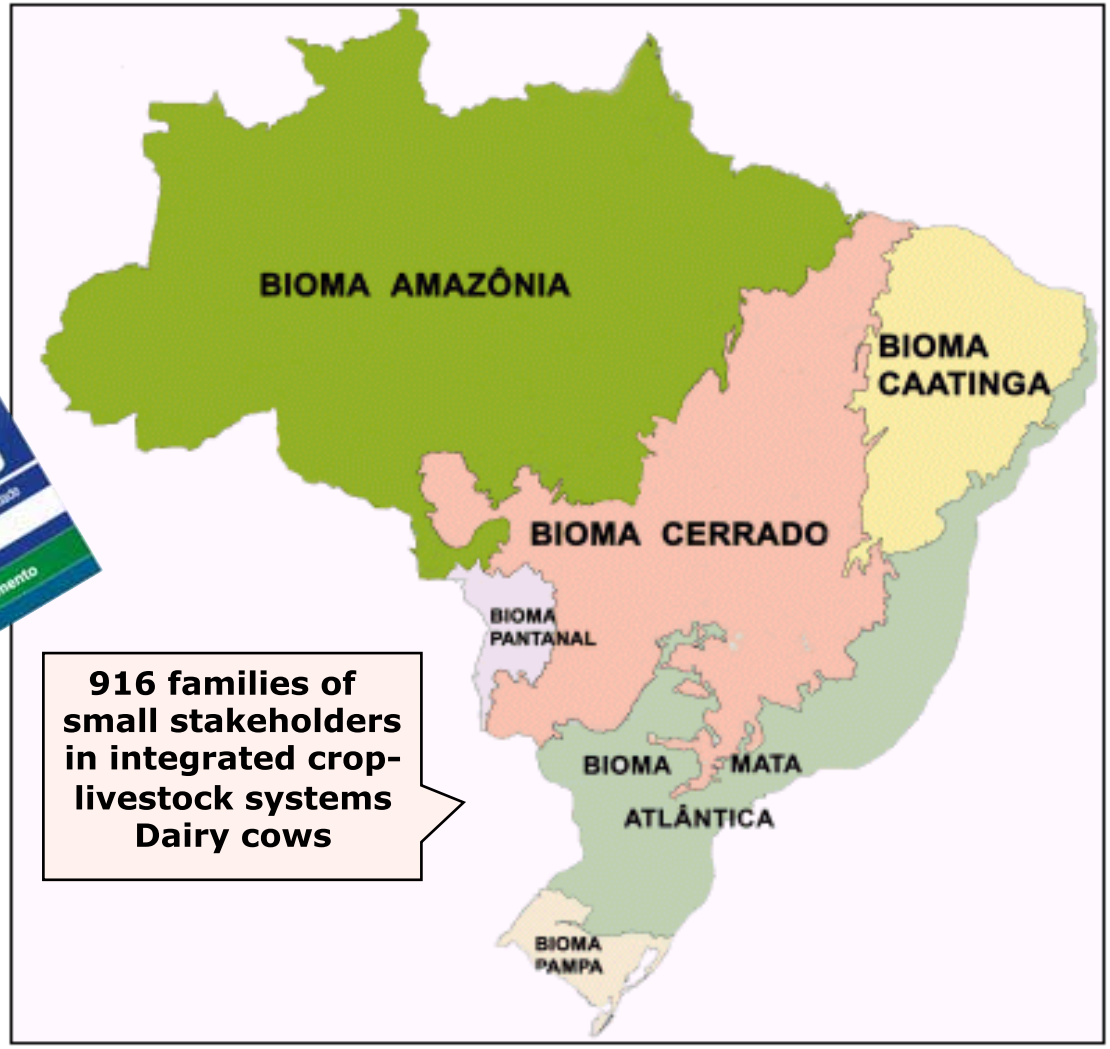
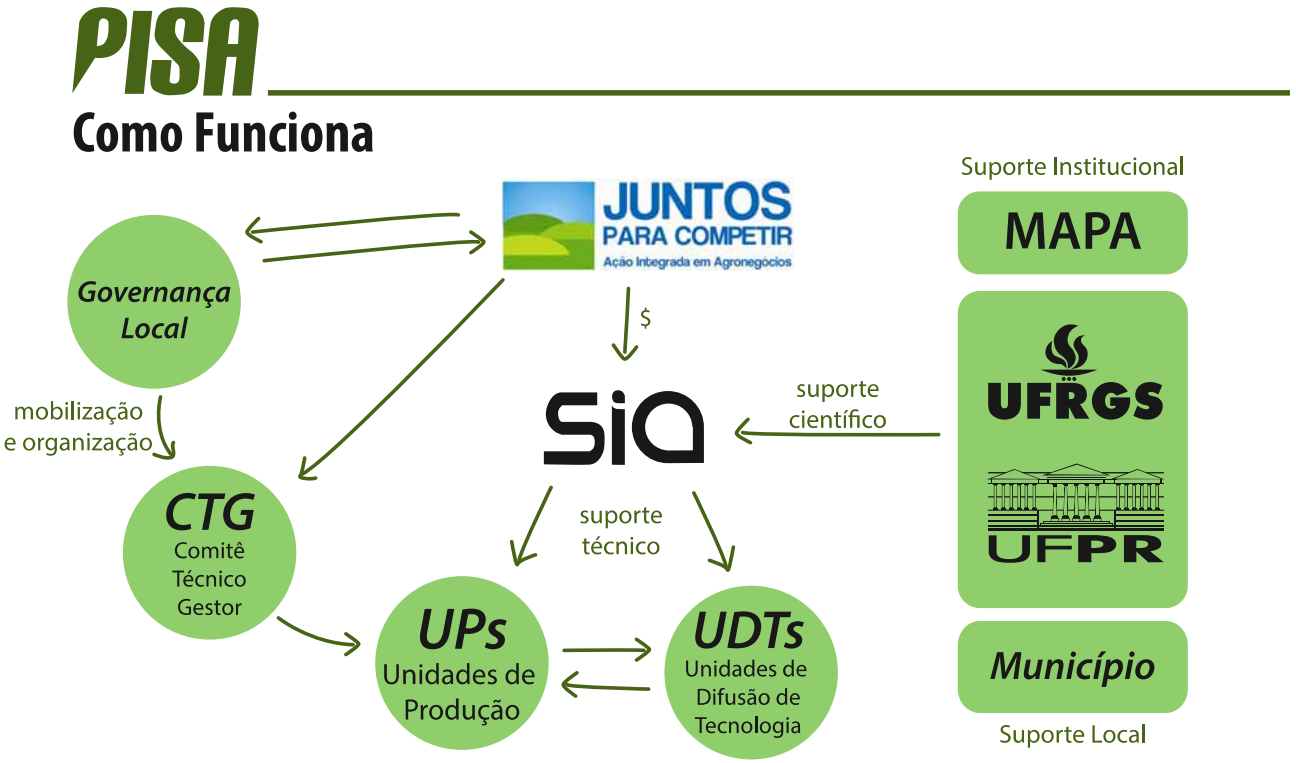
The PISA case study: from science to practice





Science into practice: changing small holders lives

PISA: structure



Schram, D. (2015)

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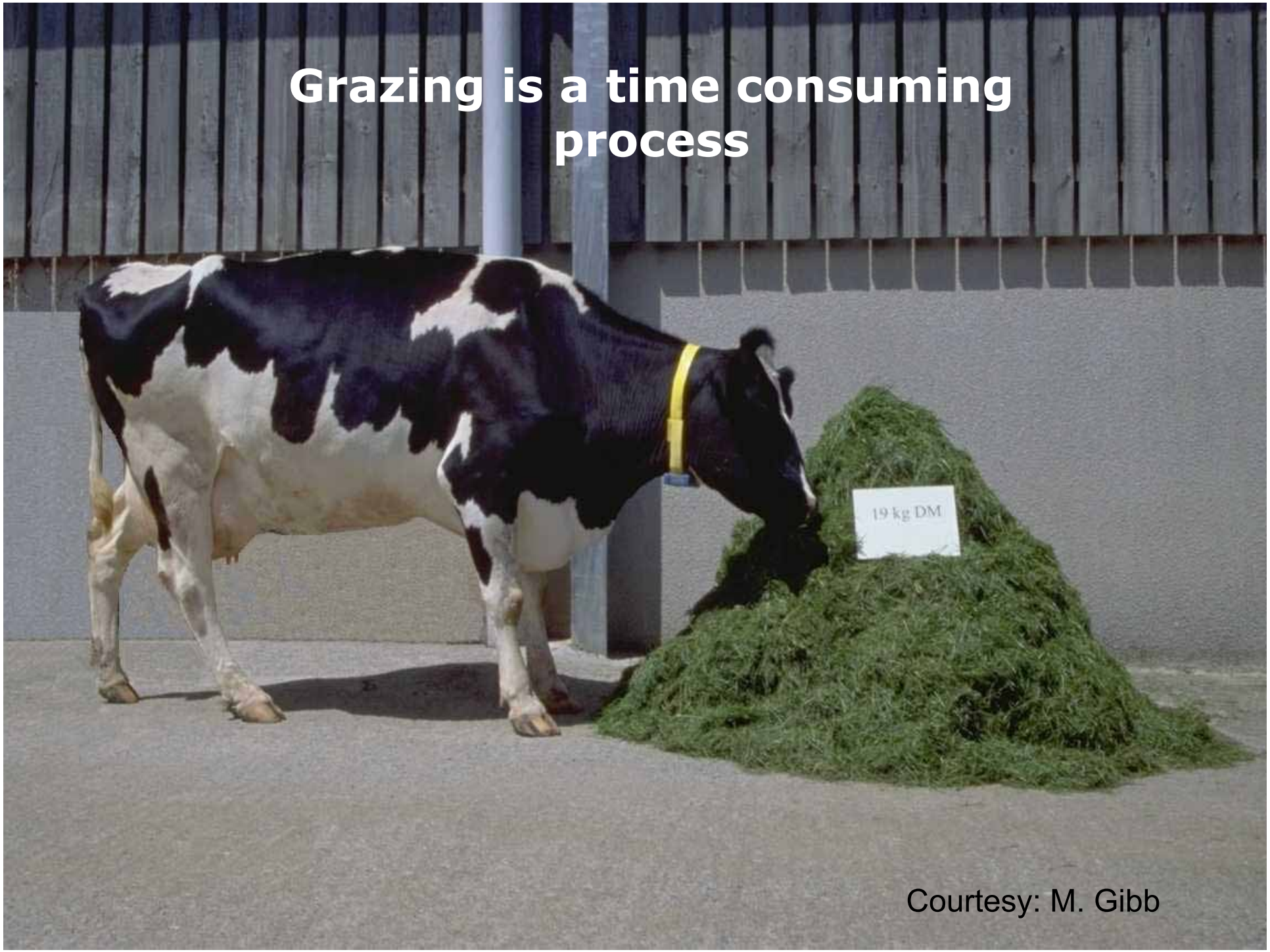
On average, farmers milk 14 lactating cows, for a total daily milk production of approximately 150 litres.

Ministério da Agricultura, Pecuária e Abastecimento

Grazing is a time consuming process



Courtesy: M. Gibb

The "Rotatinuous" stocking method

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Grupo de Pesquisa em Ecologia do Pastejo

ESPECIAL Pastagens

O boi é quem manda

Pastejo "rotatínuo" não abre mão da rotação de piquetes, mas respeita comportamento natural dos animais, que consomem apenas porção mais nobre do pasto.

MANISTELA FRANCO

A costume seus ouvidos – o termo rotatínuo veio para ficar, se inscrevendo definitivamente no dicionário da pecuária. Cunhado pelo professor Paulo César Faccio Carvalho, da Universidade Federal do Rio Grande do Sul (UFRGS), esse neologismo define um novo sistema de manejo de pastagens, que promete aumentar a produção tanto de carne quanto de leite no País. Mescla de rotativo com contínuo, a palavra dá uma pista clara do conceito técnico que o norteia. Os bovinos continuam sendo agrupados em lotes que mudam frequentemente de piquete (como no rotacionado), mas o principal critério para definição do tempo de permanência na área não é o capim e sim o comportamento dos animais, que podem selecionar o alimento, como no pastejo contínuo.

Essa é a grande "sacada" do novo sistema, ainda pouco conhecido pelos pecuaristas de corte, mas já bastante usado por produtores de leite do Rio Grande do Sul. "Após 14 anos de pesquisa, comprovamos que os ruminantes têm hábitos de pastejo muito próprios. Quando podem escolher, comem apenas a parte mais nutritiva das plantas (as folhas), rejeitando os materiais senescentes e os mais duros, como os colmos. O que fazemos, no rotatínuo, é respeitar esse comportamento, elevando a produtividade tanto de carne quanto de leite", explica Faccio. Segundo ele, o grande dilema atual do manejo de pastagens é escolher entre duas correntes: a máxima eficiência de colheita do capim e a máxima eficiência de utilização desse alimento pelo animal. A partir de determinado momento, elas passam a ser antagônicas. "Nós privilegiamos a segunda", salienta.

A altura de entrada do gado no pasto não tem segredo: corresponde a 95% de interceptação luminosa, conforme recomendam pesquisadores como Sila Carneiro da Silva, professor da Escola Superior de Agricultura Luiz de Queiroz (Esalq). Acima desse percentual de luz incidente, a planta começa a emitir mais colmos do que folhas, perdendo qualidade. "Chegamos à mesma conclusão, em 2004, por intermédio de outra linha de pesquisa. Observando o comportamento dos animais, descobrimos que, em pastagem com altura correspondente a 95% da interceptação luminosa, ocorriam as máximas taxas de ingestão", esclarece o pesquisador gaúcho. Mas qual deve ser a altura de saída? Neste ponto, o rotatínuo diverge dos demais sistemas de pastejo em uso e ganha singularidade.

Animais no módulo de tifton irrigado, que é usado praticamente o ano inteiro.

Tropical Grasslands – Forrajes Tropicales (2013) Volume 1, 137–155

Harry Stobbs Memorial Lecture: Can grazing behavior support innovations in grassland management?

PAULO CÉSAR DE FACCIO CARVALHO

Grazing Ecology Research Group, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil. www.ufrgs.br

Keywords: Grazing management, pasture structure, grazing systems, forage intake, bite mass.

Abstract

Grazing is a fundamental process affecting grassland ecosystem dynamics and functioning. Its behavioral components comprise how animals search for feed, and gather and process plant tissues in different spatio-temporal scales of the grazing process. Nowadays, there is an increasing emphasis on grazing management and the role of the grazing animal on ecosystem services, concomitantly with a decreasing emphasis on grazing management generating animal production outputs. Grazing behavior incorporates both approaches, which are not necessarily dichotomist. It would provide the basis to support innovation in grazing systems. However, it is unclear how the significant knowledge, developed in this research area since the disciplines of Agronomy and Ecology began to interact, have supported creativity in grazing science. It seems there is a current gap in this context, which was a major concern of researcher leaders like Harry Stobbs. This paper pays tribute to him, reviewing recent grazing behavior research and prioritizing those studies originating in the favorable tropics and subtropics. New evidence on how pasture structure limits forage intake in homogeneous and heterogeneous pastures is presented. Pasture management strategies designed to maximize bite mass and forage intake per unit grazing time are assumed to promote both animal production and landscape value. To conclude, a Brazilian case study (PISA) is briefly described to illustrate how grazing behavior research can reach farmers and change their lives by using simple management strategies ("take the best and leave the rest" rule) supported by reductionist approaches applied in holistic frameworks.

Resumen

El pastoreo es un proceso fundamental que afecta la dinámica y el funcionamiento de los ecosistemas de pasturas. Sus componentes comprenden la forma cómo los animales buscan el alimento y lo ingieren y cómo procesan los tejidos de las plantas en diferentes escalas espacio-temporales dentro del proceso de pastoreo. Actualmente existe un énfasis creciente en el manejo del pastoreo y en el papel de los animales en pastoreo respecto a los servicios de ecosistemas, conjuntamente con el descenso del énfasis en el manejo de pastoreo con fines de producción animal. El comportamiento de pastoreo incorpora ambos enfoques, los cuales no necesariamente son dicotómicos; puede proporcionar la base para innovaciones en los sistemas de pastoreo. No obstante no es claro cómo los avances significativos del conocimiento en esta área de investigación, desde que las disciplinas de agronomía y ecología comenzaron a interactuar, han contribuido a la creatividad en la ciencia del pastoreo. Aparentemente existe un vacío en este contexto, y esto fue una de las preocupaciones principales de investigadores líder como Harry Stobbs. En el presente documento se rinde homenaje a este científico y se revisan las investigaciones recientes en comportamiento de pastoreo, priorizando estudios procedentes de zonas favorables del trópico y subtrópico. Se presenta una nueva evidencia de la forma cómo la estructura de una pastura limita el consumo del forraje tanto en pasturas homogéneas como heterogéneas. Se asume que las estrategias de manejo del pastoreo, diseñadas a maximizar el bocado y su ingestión por unidad de tiempo de pastoreo, son dirigidas a promover tanto la producción animal como el valor paisajístico. Para concluir, se presenta un estudio de caso en Brasil (PISA) que ilustra y describe brevemente cómo la investigación en el comportamiento de pastoreo puede llegar a los productores para contribuir a su bienestar solo con la adopción de estrategias sencillas de manejo (la regla del "tome lo mejor y deje el resto"), con el apoyo de enfoques reduccionistas que se aplican en marcos holísticos.

Correspondence: Paulo C.F. Carvalho, Grazing Ecology Research Group, Federal University of Rio Grande do Sul, Av. Bento Gonçalves 7712, Bairro Agronomia, Porto Alegre CEP 91540-000, RS, Brazil.
Email: paulocfc@ufrgs.br

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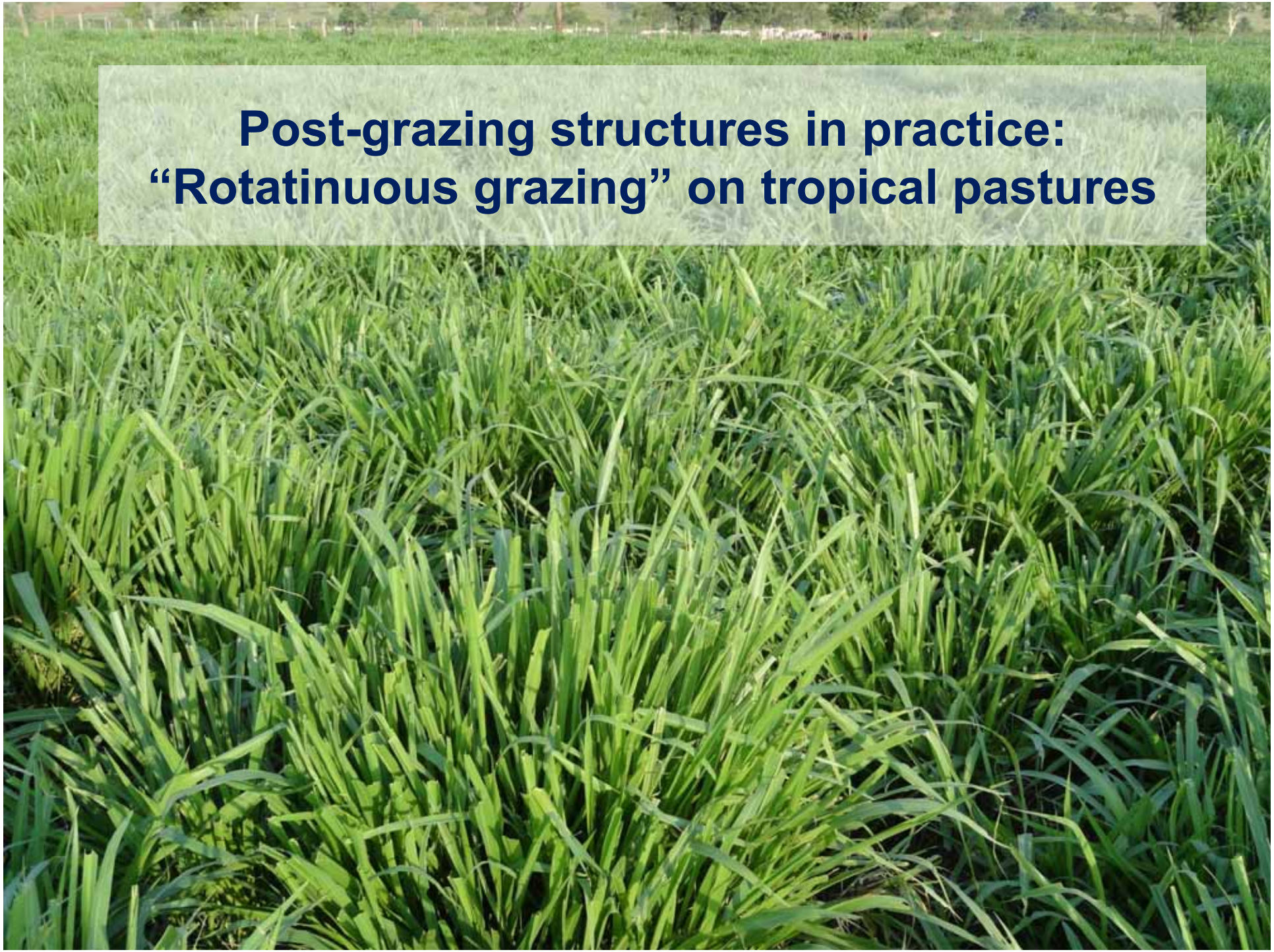
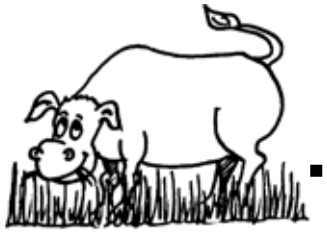
Post-grazing structures in practice: Rotatinuous grazing on temperate pastures


Post-grazing structures in practice:
“Rotatinuous grazing” on tropical pastures



Rotatinuous

(+)

Intake rate

(-)

Silage & concentrate

(-)

Costs & labour

Sward growth

(+)

C stocks

Milk/hd

(+)

(+)

Health & milk quality

Liability & $

(+)

Soil improvement

(+)

(+)

Planning short term

(+)

(+)

(+)

Planning long term

Family & sucession

(+)

(+)

Gross margin

Milk/ha

(+)

(+)

(+)

Long term changes:
Farm structure
Diversification
Self confidence

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The PISA case study: from science to practice

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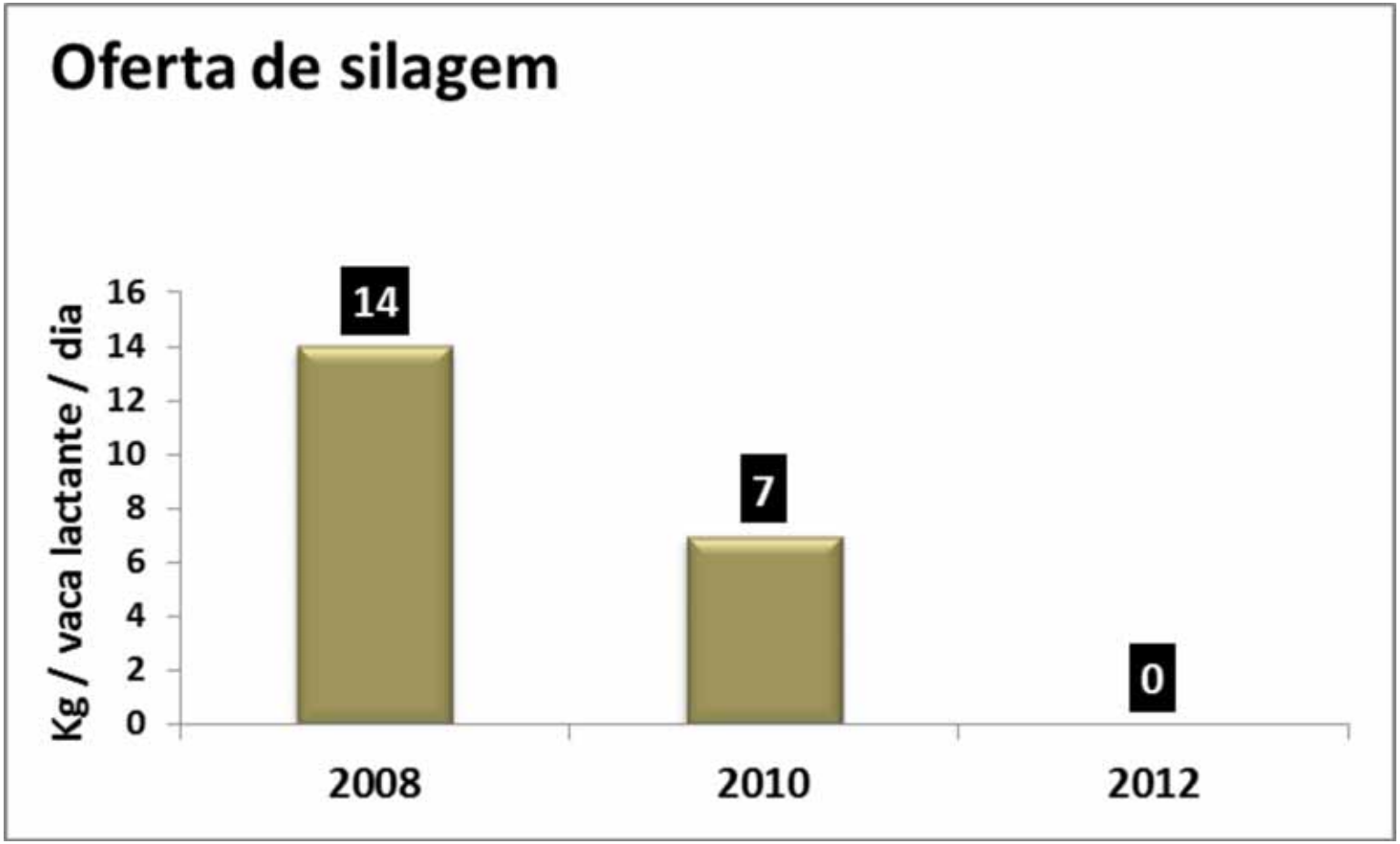

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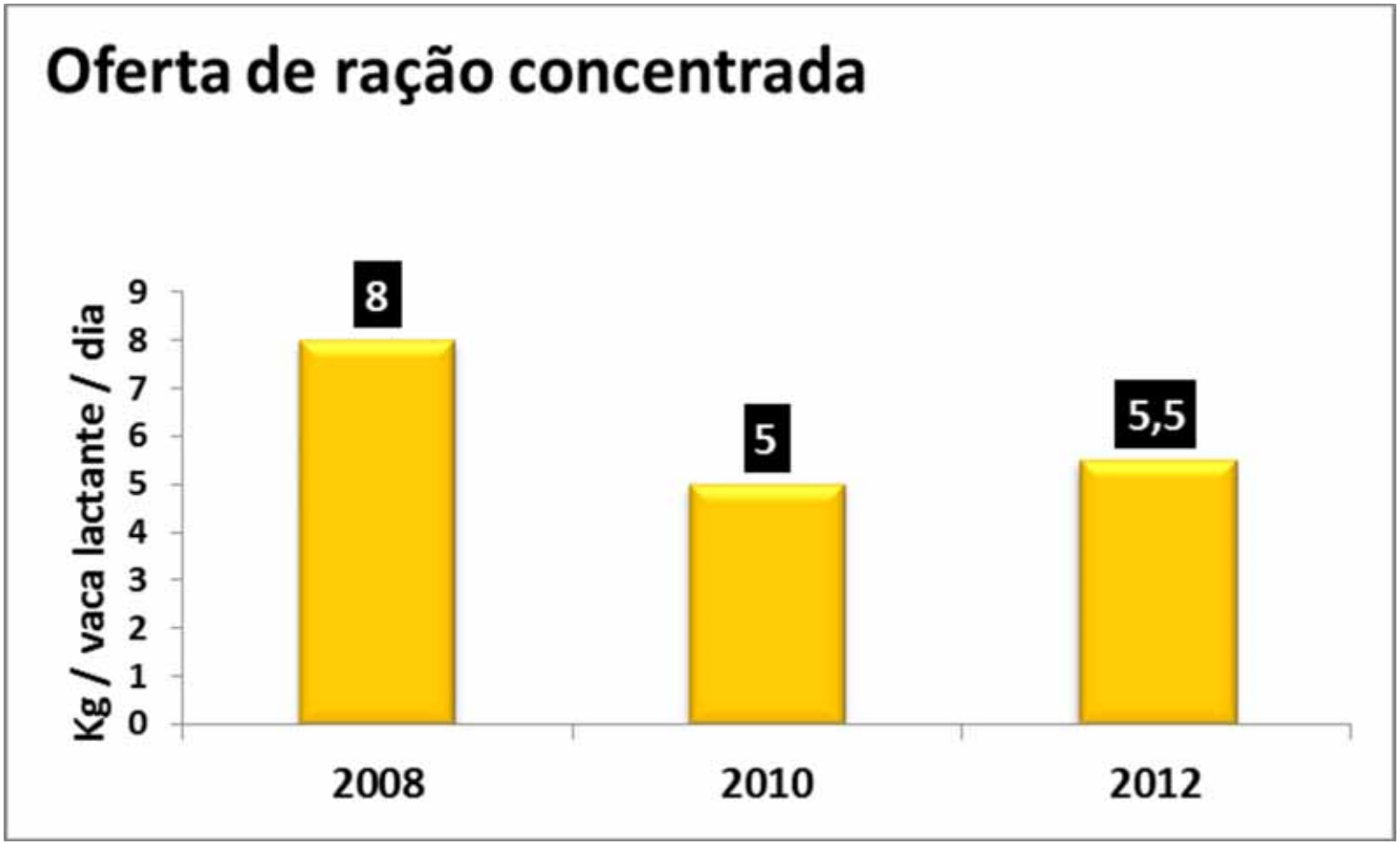

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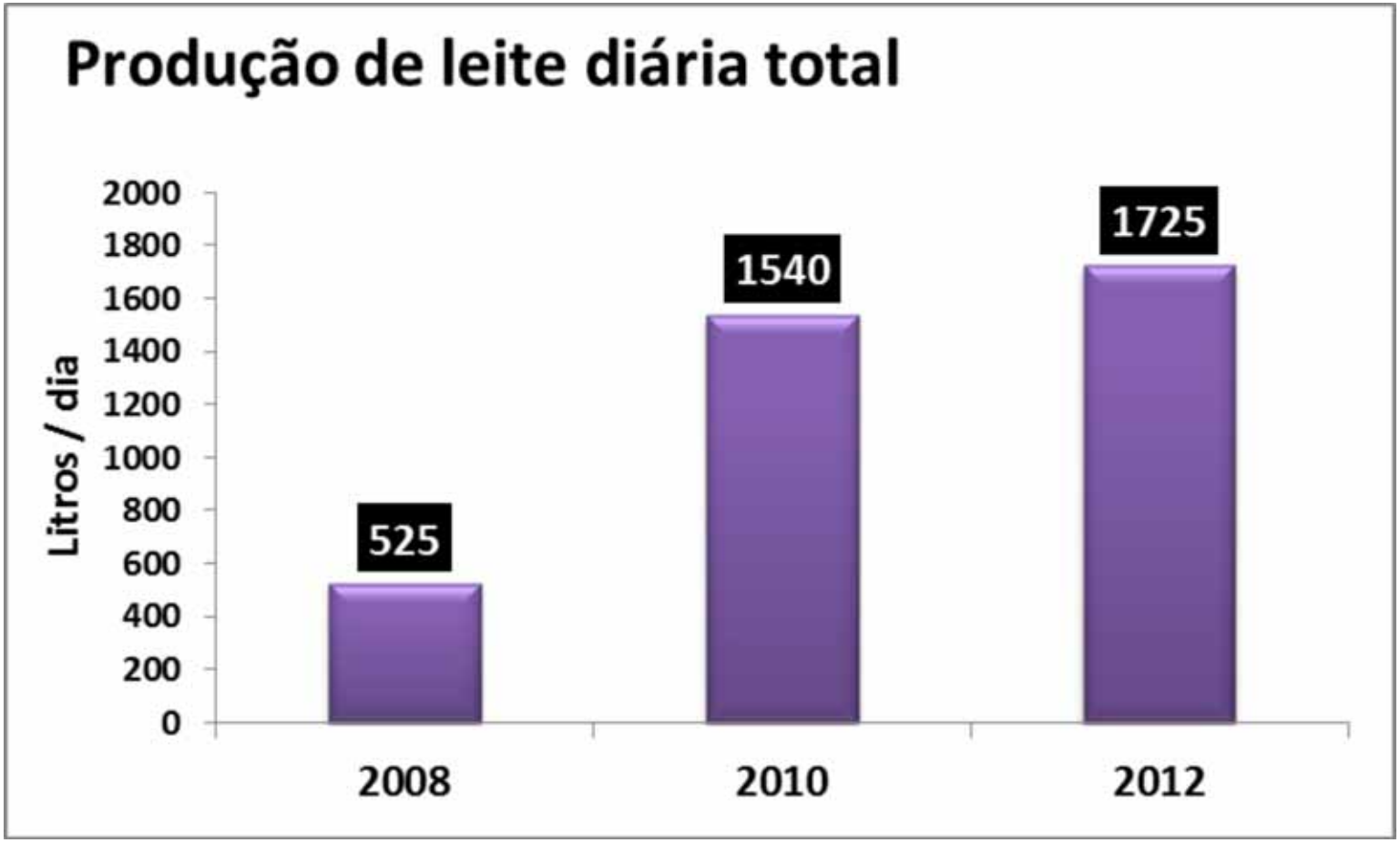

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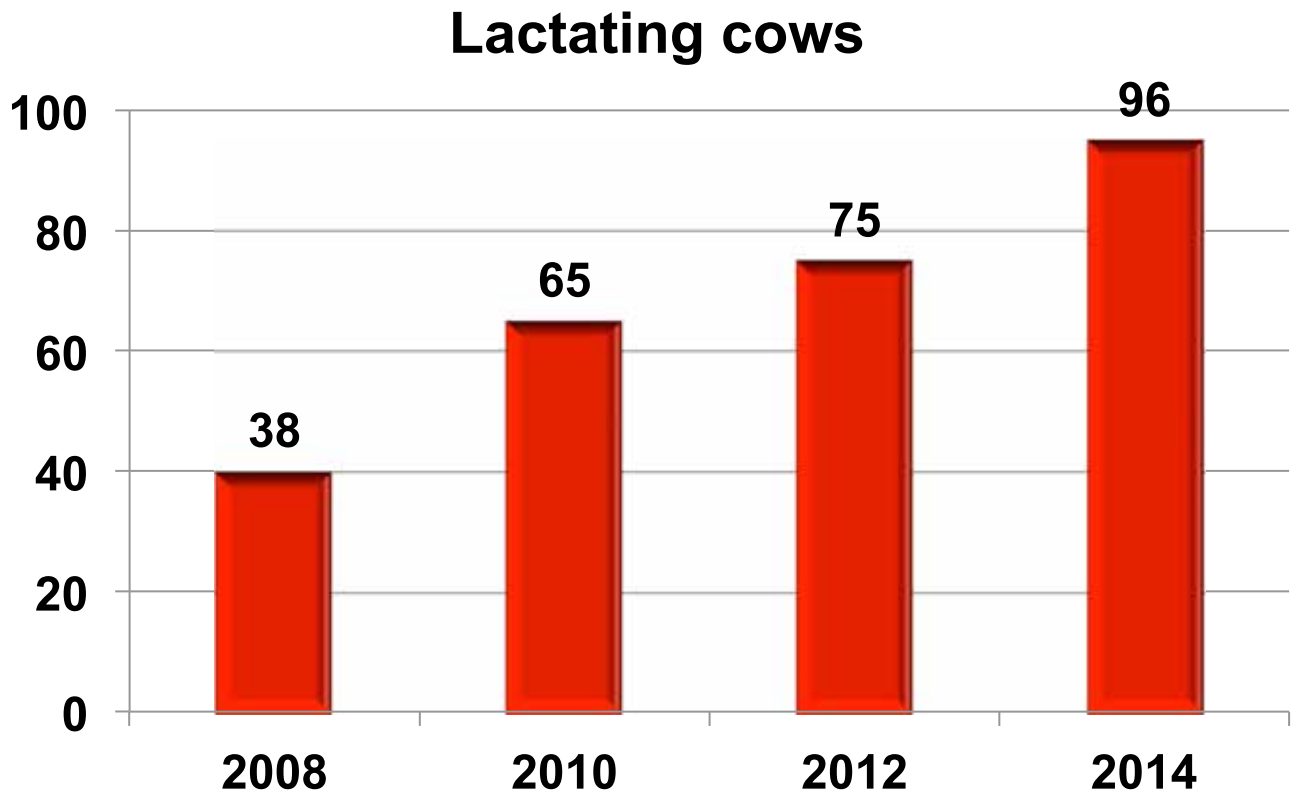

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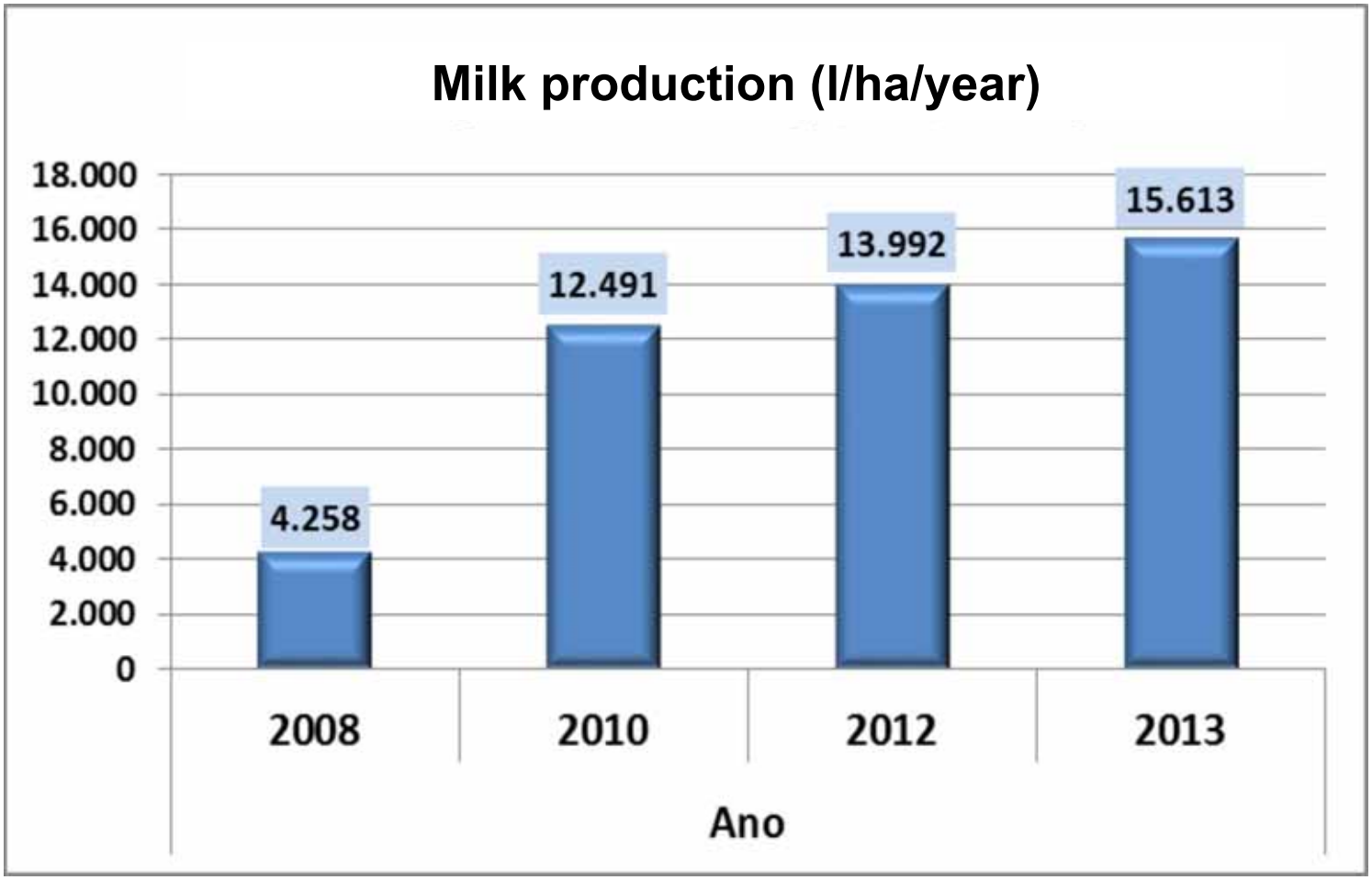

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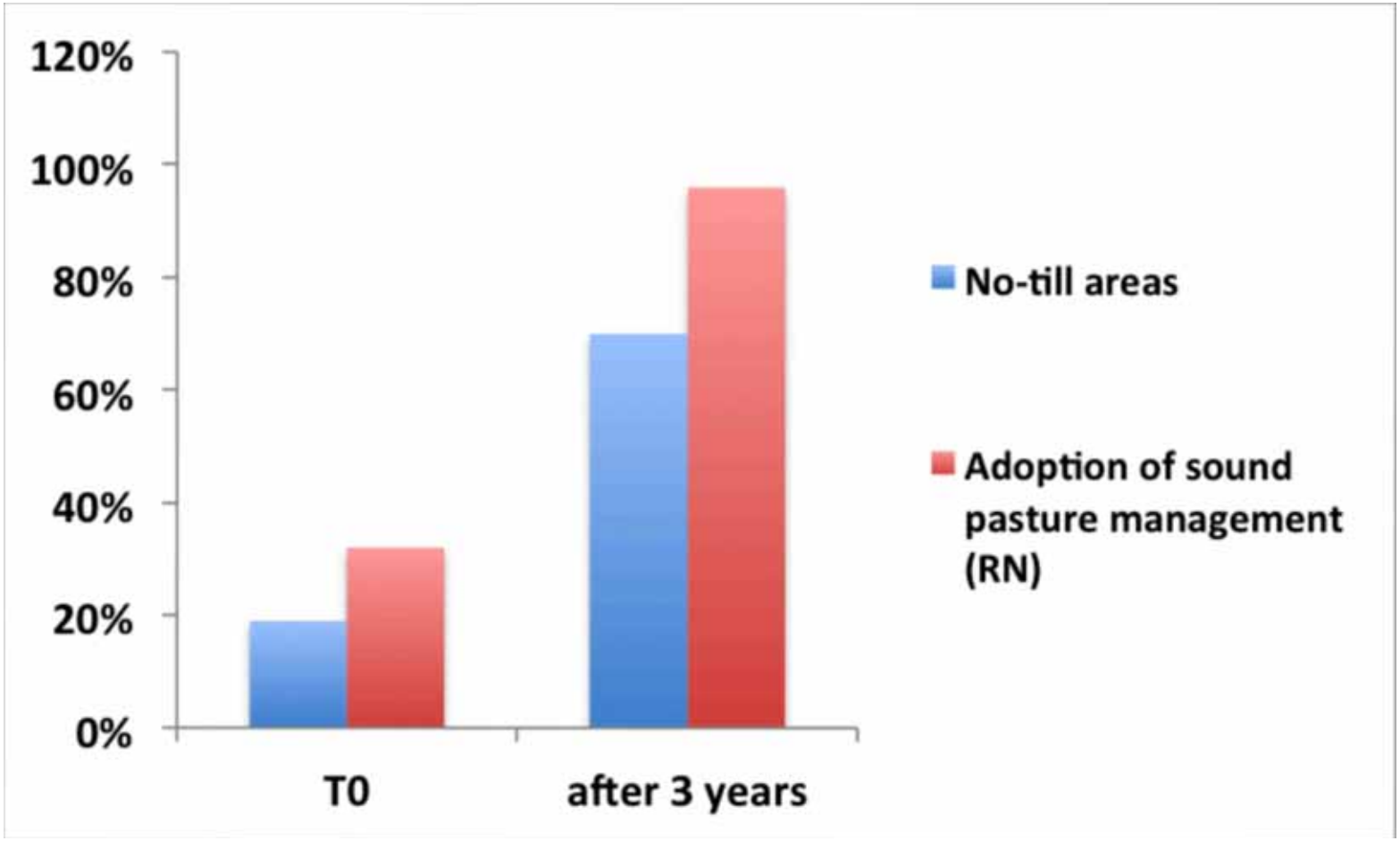
The PISA case study: from science to practice



Vieira, P.C. 2015. Impactos do programa PISA- Produção Integrada de Sistemas Agropecuários - em propriedades LEITEIRAS do Rio Grande do Sul . Dissertação de Mestrado, 47p.

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Stakeholder empowerment

Alexandre Becker
Sward stick– home made

Field day PISA Vale do Taquari
Travesseiro, RS, July 2012

Courtesy: SIA

PISA
PRODUÇÃO INTEGRADA DE SISTEMAS AGROPECUÁRIOS EM MICROBACIAS HIDROGRÁFICAS

PISA Cantuquiriguaçu
- 11 municípios
- 37 propriedades rurais

PISA Alto Uruguai
- 4 municípios
- 110 propriedades rurais

PISA Declivosas
- 4 municípios
- 4 propriedades rurais

PISA Centro
- 7 municípios
- 89 propriedades rurais

PISA Amocentro
- 10 municípios
- 20 propriedades rurais

PISA Missões II
- 4 municípios
- 120 propriedades rurais

PISA Fraiburgo
- 1 município
- 12 propriedades rurais

PISA Noroeste
- 5 municípios
- 95 propriedades rurais

PISA Ameosc
- 19 municípios
- 100 propriedades rurais

PISA Planalto
- 5 municípios
- 92 propriedades rurais

PISA Norte
- 6 municípios
- 100 propriedades rurais

PISA Vale do Taquari
- 4 municípios
- 57 propriedades rurais

PISA Sul
- 6 municípios
- 80 propriedades rurais

Need for innovation in grazing science

PISA

Grazing Ecology Research Group

Slide: R. Grecellé, 2011

Thanks to GPEP research group

Photos by C.E. Pinto

Lessons about biodiversity

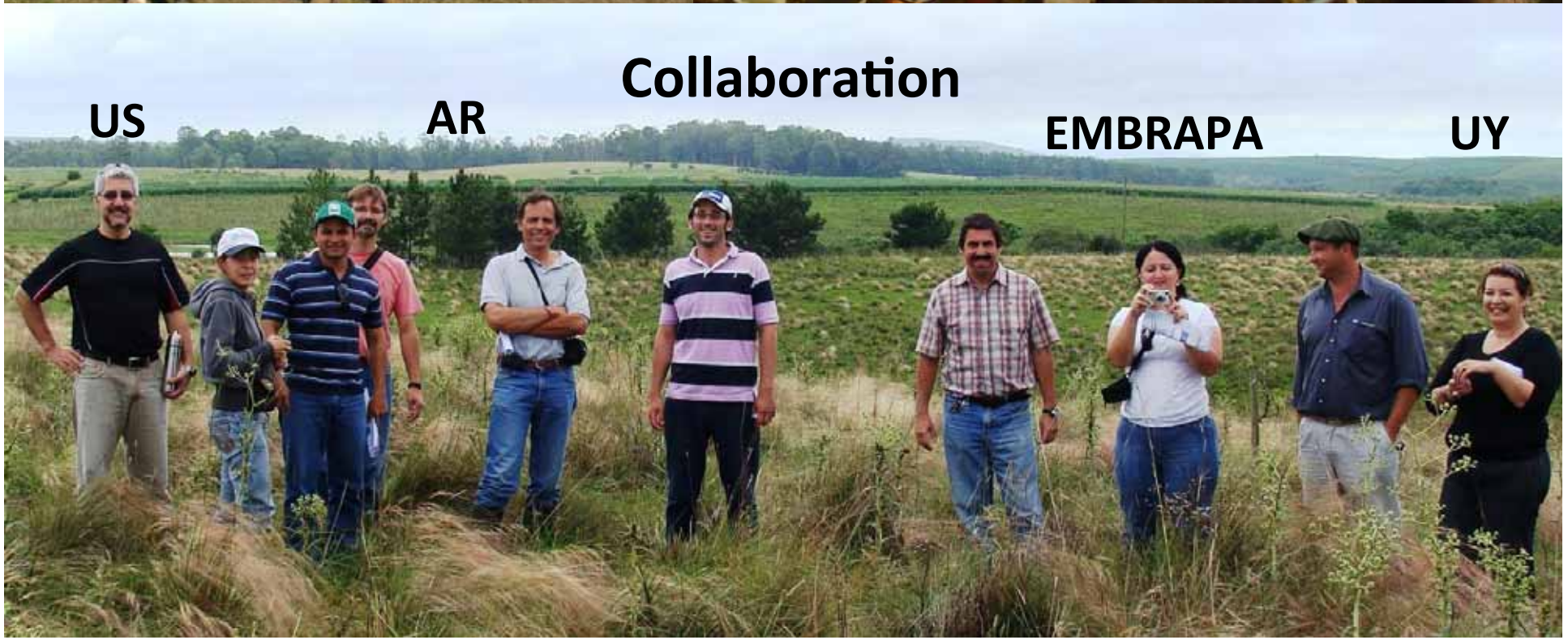
Long-term field sampling consequences…

..being enthusiastic…

Learning with the wise man…

Collaboration

US AR EMBRAPA UY



paulocfc@ufrgs.br

Building pastoral environments, a grazing management concept.....

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