

Neutralization of enteric methane emissions by carbon sequestration under integrated crop-livestock and crop-livestock-forest systems in Cerrado region.

Roberto GUIMARÃES JÚNIOR¹, Robélio Leandro MARCHÃO¹, Karina PULROLNIK¹, Lourival VILELA¹, Giovana Alcantara MACIEL¹, Kleberson Worslley de SOUZA¹, Luiz Gustavo Ribeiro PEREIRA².

¹Embrapa Cerrados, Rodovia BR 020, km 18, CP 08223, 73310-970, Planaltina, DF, Brazil.

²Embrapa Gado de Leite, 36038-330, Juiz de Fora, MG, Brazil.

E-mail address of presenting author*: roberto.guimaraes-junior@embrapa.br

Introduction

Brazil holds the biggest commercial cattle herd and is one of the major beef exporters in the world. On the other hand, enteric methane from livestock is responsible for 20% of total greenhouse gases (GHG) emissions in the country (MCTI, 2014). The adoption of positive carbon balance technologies in agriculture is a key factor to Brazil succeed in public policy to reduce its carbon footprint. Thus, estimates on carbon sources and sinks are important to support the adoption of integrated production systems as a GHG mitigation strategy. The objective of this study was to estimate the impact of the adoption of integrated crop-livestock and crop-livestock-forest systems on the mitigation of enteric methane emissions from pasture based beef cattle in Cerrado region.

Material and Methods

Three beef cattle production systems were compared, in a year base, in terms of enteric methane emission and carbon sequestration: a) ICL – integrated crop-livestock system; b) ICLF - integrated crop-livestock-fo-

rest system with double lines of *Eucalyptus urograndis* trees and spacing between rows of 22m (417 trees.ha⁻¹) and c) LPP – low productive pasture. The stocking rates on *Brachiaria sp.* pastures were 3.0, 1.7 and 1 head per hectare, respectively. Beef cattle enteric methane emissions (ECH₄) were based on Mandarino *et al.* (2015) and data from Cerrado soil carbon sequestration for ICL and LPP came from a long-term experiment (24 years) according to Jantalia *et al.* (2006) and Sant’anna *et al.* (2015). Findings from Pulronik *et al.* (2015) supported the value of soil carbon sequestration in ICLF 24.5% lower than ICL. Regarding to the annual carbon trunk fixation rate, we estimated the accumulated mass of each tree being 0.0306 (density of 0.51 x volume of 0.06 m³) considering 46% of carbon content. All these studies were carried out in the central plateau of the Cerrado region at Embrapa Cerrados research Center, Brazil (15°36’41.51”S 47°42’08.92”O), on *Brachiaria sp.* pastures under Oxisols.

Results and Conclusions

The highest pasture carrying capacity and stocking rates resulted in the highest enteric methane emissions for ICL and ICLF when compared to LPP (Table 1.). Nevertheless, the soil carbon sequestration in ICL and the additional carbon sequestration by the trunk carbon fixation in ICLF systems can mitigate 100% of all ECH₄ emitted. Moreover, ICL and ICLF presented a positive annual carbon balance of 1.3 and 23.0 Mg CO₂eq.ha⁻¹, respectively. The opposite occurred with LPP, which presented a negative carbon balance of 0.4 Mg CO₂eq.ha⁻¹. The carbon surplus stock in integrated systems could neutralize the ECH₄ of more 1 head in ICL

and 20 heads in ICLF systems. These results support the statements that integrated systems in fact can contribute as a mitigating strategy of greenhouse gases. Besides that, it can be highlighted the necessity to recover pasture yields as an opportunity to reduce the environmental impact of livestock systems. It can be concluded that the adoption of integrated crop-livestock or crop-livestock-forest systems can mitigate the ECH₄ from pasture based beef cattle in Cerrado region.

Table 1. Enteric methane emissions, soil carbon sequestration, trunk carbon fixation and annual carbon balance under different beef cattle pasture based systems in Cerrado

System	ECH ₄ ¹ Mg CO ₂ eq.ha ⁻¹ .year ⁻¹	Soil Carbon Sequestration ² (100 cm depth) Mg CO ₂ eq.ha ⁻¹ .year ⁻¹	Trunk Carbon fixation ³ Mg CO ₂ eq.ha ⁻¹ .year ⁻¹	Annual Carbon balance Mg CO ₂ eq.ha ⁻¹
ICL	3.4	4.7	0	+ 1.3
ICLF	2.0	3.5	21.5	+ 23.0
LPP	1.1	0.7	0	- 0.4

¹CH₄ Global Warming Potential – GWP (100-year time horizon) relative to CO₂ = 25; ²Average soil carbon sequestration rate per year: ICL = 1.273 Mg ha⁻¹.year⁻¹; ICLF = 0.961 Mg ha⁻¹.year⁻¹; LPP = 0.182 Mg ha⁻¹.year⁻¹; ³ILPF Trunk carbon fixation = 5.869 Mg ha⁻¹.year⁻¹.

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