

## II SIGEE – Second International Symposium on Greenhouse Gases in Agriculture – Proceedings



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# Tradeoff between profitability and GHG emissions by beef cattle systems in Brazilian Amazon

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## Introduction

The debate on the relationship between human activities and the growth in the emissions of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) into the atmosphere has brought the need to study more deeply the relationship between productive activities and the emission of these greenhouse gases (GHG) (FAO, 2013). Thus, the definition of what changes should be implemented in the production process aiming to reduce GHG emissions level should also consider the economic and social sustainability of the activity (SILVA *et al*, 2016).

Beef cattle in Amazon, as in most of Brazil, is also predominantly developed in an extensive manner (ALVIM *et al*, 2015). The North Region had in 2014 a cattle herd of 45,826,142 beef heads, which represented 22% of the whole national herd, with emphasis to State of Pará with 19,911,217 - 43% of the regional cattle (IBGE, 2016). The study on the effects of this activity on the environment and the search for alternatives to mitigate the negative impacts will enable the development of more sustainable livestock. The increase in the adoption of more sustainable livestock systems, especially from an environmental point of view depends on the establishment of incentives to producers and, therefore, it is essential to identify models which present these virtuous characteristics, as well as economic performance, in order to define strategies for this combination.

The analysis of the tradeoff between profitability and GHG emissions in agricultural systems can be used to reconcile economic performance and environmental performance at a given productive context, given the scarcity of resources and the need of making decisions about their use. This way, various scenarios can be simulated, in which the comparison between the economic and environmental performance of productive activities provides information for the definition of actions that seek to achieve the sustainability that embraces economic and environmental indicators (STOORVOGEL *et al.*, 2004).

This work aims to show comparatively the performance of economic profitability indicators and GHG emissions in the development of beef cattle activity in the Amazon, having as reference two types of production systems and two level of technology adopted in the State of Pará, which are located in the middle region Southeast Pará and micro region Paragominas, within the context of studies conducted by PECUS Network - Greenhouse gases (GHG) dynamics in Brazilian livestock production systems.

## Material and Methods

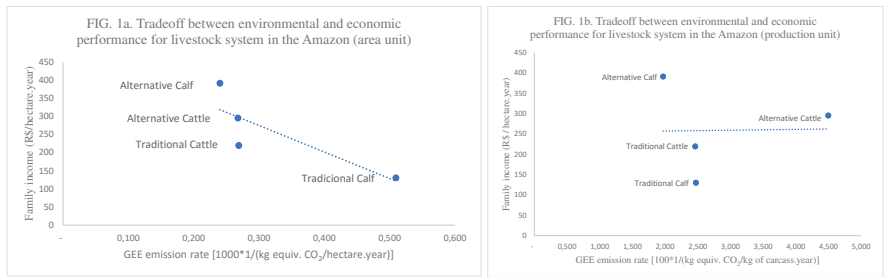
Four production systems in the micro region of Paragominas were evaluated, two systems considered modal and classified as traditional and two considered as alternative and with greater use of technology in the year 2014. Two models had as goal the production of calves (one traditional and other alternative) and the other two the production of live cattle, also with the two aspects. The economic evaluation was performed through the cost-benefit analysis and in accordance with the methodology shown in Guiducci *et al.* (2012), using as indicators, among others, the net income and the family income. It was considered the prices of inputs and products for the year 2014. For the calculation of GHG emissions it was used the Model Emissions PECUS v3.9.6 developed by the PECUS project team, with estimation of emission of GEE ( $\text{CH}_4 + \text{CO}_2 + \text{N}_2\text{O}$  converted for equivalent  $\text{CO}_2$ ) as environmental indicator.

For comparison between the economic and environmental performance of systems, jointly, it was used the tradeoff method, which portrays the idea of compensatory exchanges between performances.

## Results and Conclusions

The results presented here consider only the indicators “family income” as indicator of profitability and the “emission of GEE,” as proxies for economic and environmental performance, respectively.

Figure 1 shows the relationships between economic and environmental performance for each of the evaluated systems. In Figure 1a, it was considered emissions per unit of area (viewpoint of farmers), the Calf Alternative System, for example, with the highest economic performance (higher profitability per hectare) and, on the other hand, the lowest environmental performance (lower rate of emission, i.e. greater volume of emission). At the other end, we see the Traditional Calf and the Fat Cattle Traditional systems with higher environmental performance but with lower economic performance. Similarly, it is established that the alternative systems presented higher economic performance and lower environmental performance while the reverse occurs with traditional systems.



Legend: ..... Trend line  
FIGURE 1. Tradeoff between environmental and economic performance for livestock system.

However, Figure 1b, which considers emissions per unit of area (view-

point of consumers), shows the system production with the highest economic performance and highest productivity, having also higher environmental performance. The trend line has positive slightly slope. These systems are alternative systems for calves and cattle.

These results indicate that considering the evaluated models and their assumptions, there is an inverse relationship between economic performance and environmental performance in beef cattle in Brazilian Amazon defined by the negative slope of the trend line in the chart (Fig. 1a - viewpoint of farmers as decision makers). From that, it is inferred the need of establishing compensatory measures to encourage the adoption of more appropriate systems in environmental terms, assuming that the economic performance is determining factor for the decision-making of producers concerning adoption of the kind of system. As a suggestion for new researches, there is the need for quantification of the compensatory measures to be adopted, aiming at the balance of costs and social benefits resulting of such measures, represented by the valuation of the tradeoffs between economic and environmental performance

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Appendix

Table 1-A. Emissions of GEE and profitability for year related to livestock systems in the Amazon			
livestock system	kg Eqv. CO2. / ha.year	kg Eqv.CO2/ kg of carcass.year	Family Income (R\$ / ha.year)
Tradicional Calf	1.960,85	40,46	130,15
Alternative Calf	4.162,49	50,75	391,27
Traditional Cattle	3.716,25	40,63	219,47
Alternative Cattle	3.734,91	22,23	295,37