Validation of the RUMINANT model towards accurate estimations of enteric methane emissions under tropical conditions to support Colombian NDCs

Ruden-Restrepo, Alejandro[1,2]; Serna-Hurtado, Laura[1]; Gaviria-Uribe, Xiomara[1]; Sotelo, Mauricio[1]; Gutiérrez, Jhon Freddy[1]; Trujillo, Catalina[1]; Mazabel, Johanna[1]; Quintero, Stiven[1]; Villegas, Daniel[1]; Richards, Meryl[3]; Tapasco, Jeimar[1]; Chirinda, Ngonidzashe[1]; Arango, Jacobo[1]

[1]International Center for Tropical Agriculture – (CIAT), Tropical Forages Program. Km 17 Recta Cali–Palmira, Colombia. **CONTACT**: j.arango@cgiar.org
[2]Master Program in Agricultural Production Systems, Universidad de Caldas, Calle 65 # 26-10, Manizales, Caldas, Colombia.
[3]CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) Low Emissions Development. Droevendaalsesteeg 3a, 6708 PB Wageningen, Netherlands.

Introduction

The RUMINANT model simulates the digestive and metabolic processes of ruminant livestock, based on the characteristics of the animal breeds and the quality of the available feed (which must be entered by the model user). It models the nutritional needs, fermentation kinetics and estimates the potential consumption, the production of milk and meat, manure, excretion of nitrogen, and methane emissions from enteric fermentation (Herrero *et al.*, 2013).

Left: Brahman cattle included in the study and provision of food at will. Right: Polytunnel divided into four individual compartments. Pictures: CIAT

Objective

To validate the RUMINANT model through field and laboratory measurements to determine the precision and utility of the model as a Measurement, reporting and verification (MRV) tool for Colombia's bovine livestock Nationally Appropriate Mitigation Actions (NAMA), identify low emissions development strategies and improve GHG inventories.

Materials and methods

The study was conducted at CIAT headquarters (Palmira, Colombia) in a beef cattle fattening system, evaluating seven diets with a combination of different forage species which were offered to 25 Brahman steers (*Bos indicus*), with the same health treatment and approximate weight of 180 kg with free-choice availability of mineral salt.

Diet	Description
H	100% Angleton hay (*Dichanthium aristatum*)
Cy	100% Cayman (*Brachiaria* hybrid cv. Cayman CIAT BR 02/1752)
T	100% Toledo (*B. brizantha* cv. Toledo CIAT 26110)
CyLd	70% Cayman + 30% *Leucaena diversifolia*
CyLl	70% Cayman + 30% *Leucaena leucocephala*
TLdCa	70% Toledo + 15% *L. diversifolia* + 15% *Canavalia brasiliensis*
EK	70% Stargrass (*Cynodon plectostachyus*) + 30% Kudzu (*Pueraria phaseoloides*)

Table 1. Forage species and combinations used for the validation of the RUMINANT model

Enteric methane emissions produced by fattened steers on different diets were measured through the **polytunnel methodology** and all the diets were subjected to **laboratory analysis** to determine forage nutrition quality parameters (such as protein, fiber content, digestibility etc.) that serve as inputs to the RUMINANT model.

Results

The RUMINANT model was able to correctly predict the relative differences in enteric methane emissions produced by steers fed with different diets.

The determination coefficient (measurement of precision) was 0.7 and the mean difference between observed and simulated values was 1.4, which could be used as a correction factor.

Figure 1: Methane emissions from *in vivo* measurements and simulated values using RUMINANT (L CH_4 animal^{-1} day^{-1}) for each treatments' repetition.

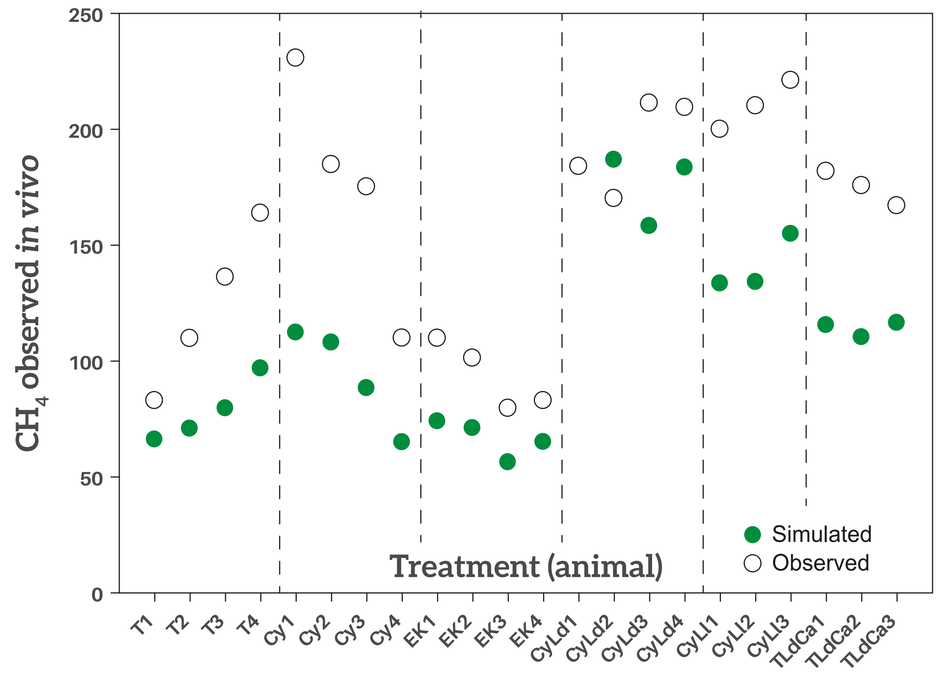

Figure 2: Relationship between methane emissions from *in vivo* measurements and simulated values using RUMINANT (L CH_4 animal^{-1} day^{-1}). Dotted red lines indicates confidence intervals of 95%.

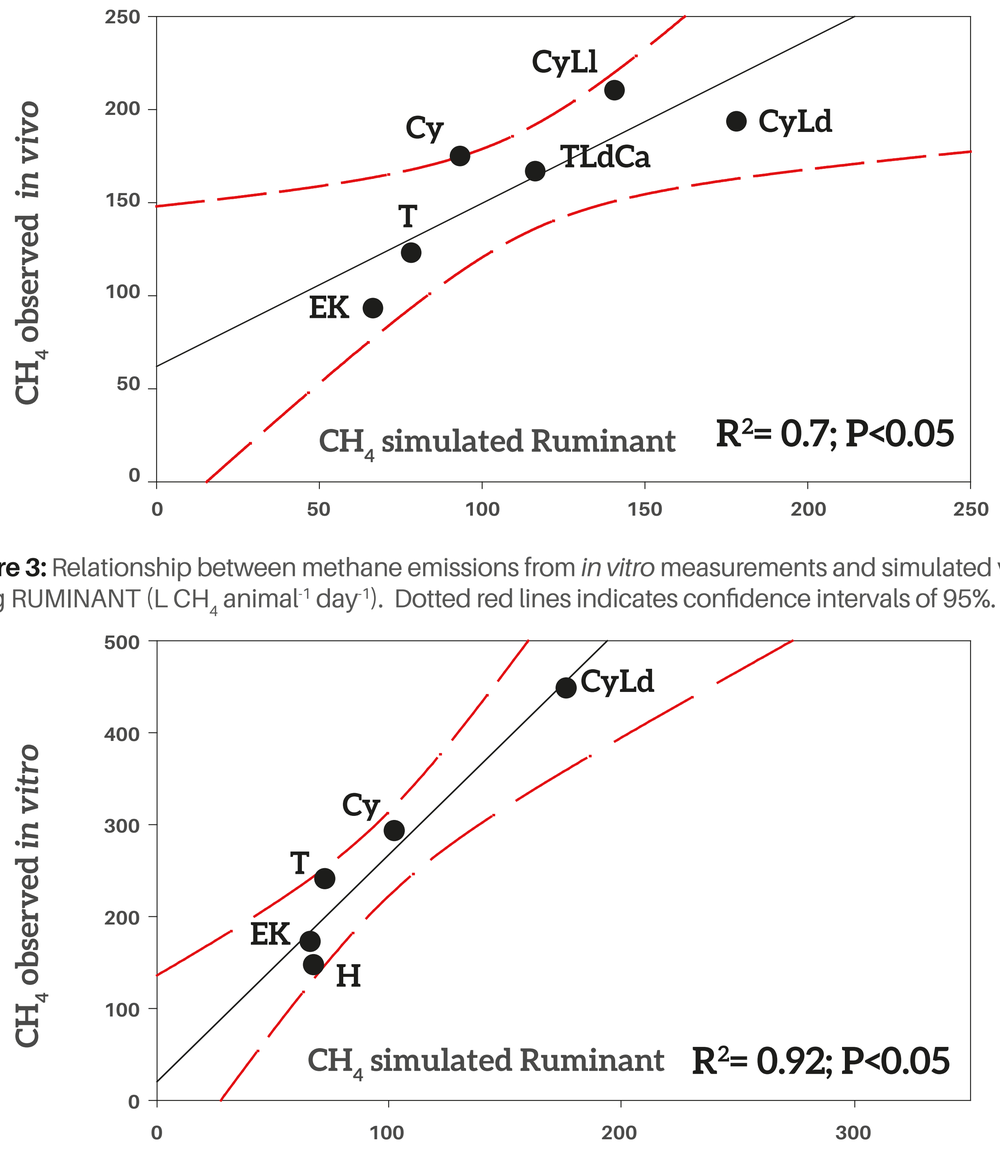

Figure 3: Relationship between methane emissions from *in vitro* measurements and simulated values using RUMINANT (L CH_4 animal^{-1} day^{-1}). Dotted red lines indicates confidence intervals of 95%.

Conclusions and perspectives

The RUMINANT model showed **highly precise** and **medium accuracy in predicting** enteric methane emissions. The model tended to slightly underestimate enteric methane emissions when compared to field measurements conducted using the polytunnel technique.

This model confirmed that the EK diet was able to reduce enteric methane emissions intensity by 20% per productivity unit.

The RUMINANT model has been used in Colombia for the preparation of the Sustainable Bovine Livestock NAMA Information Note, the preparation of the last Colombia's Greenhouse Gas Inventory and could support the MRV phase of the NDCs of Colombia and other countries.

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References

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