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Transforming beef farming systems: Advances in grazing management for sustainable production

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Introduction

- 61% of the global livestock greenhouse gas emissions (GHGE) comes from beef production, putting these systems under particular attention.
- In Colombia, cattle sector contributes to 24% of the agricultural and 1.9% of the national gross domestic product (GDP).
- Córdoba (caribbean region) is the largest beef-producing department, with a total of 2.2 million animals representing 7.8% of the national beef cattle herd and 26.2% of the beef cattle inventory of the region.
- Although the beef cattle sector plays an important role in Cordoba's economy, cattle farming relies on low levels of technology adoption leading to low productivity indexes and high GHGE intensities.
- Identifying sustainable strategies to mitigate GHGE in the cattle sector will help the Colombian government meet its national emissions reduction goal by 2030. However, the environmental evaluation of farms with better cattle management practices has not been performed yet.

Objective

1. To calculate the carbon footprint (CF) of beef fattening farms, by applying a cradle-to-farm gate LCA with primary data collected from producers.
2. Benchmarking the productive and GHGE performance in cattle farms with natural pastures vs. high-yield improved pastures implemented.
3. To estimate the benefit-cost ratio (B/C) for the implementation of improved pastures and good cattle husbandry and pasture management practices, integrating the monetary values of reducing the system's CF.

Methodology

LCA approach, system boundary definition, functional unit, allocation rule

- The beef CF of 20 farms was evaluated by using the attributional LCA methodology, in a "cradle to farm-gate" perspective.
- 25% most productive farms were included in the "best farms" category while the rest of the farms were grouped into the "traditional farms".

Economic analysis

- To estimate CF value, market price method was applied by consulting the most important global carbon markets, the carbon tax in Colombia, the minimum price recommendation for carbon credits of the IMF, among others.
- For the economic evaluation, information about unit production costs and meat sales prices was used.

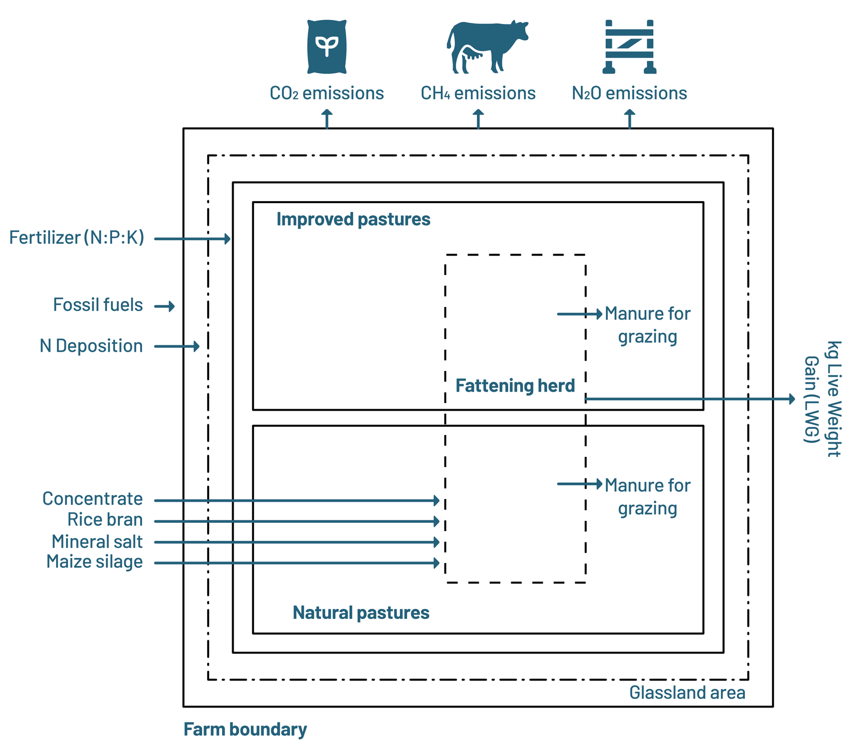

Figure 1. System boundaries, functional units, and flows accounted for in the estimation of CF in the cattle systems in a "cradle to farm-gate" approach.

Estimation of emissions

ipcc INTERGOVERNMENTAL PANEL ON climate change

CO_2-e

Methane (CH_4): 28
Nitrous oxide (N_2O): 265
Carbon dioxide (CO_2): 1

The IPCC'S Fifth Assessment Report

Results

Table 1. Beef CF, total GHG emissions economic value (EV) and CF EV of studied beef cattle farms

Farm #	Carbon footprint*	Total GHGE EV (US$)	CF EV**	Farm #	Carbon footprint*	Total GHGE EV (US$)	CF EV**
1	17.5	241,521	0.70	11	10.3	20,776	0.41
2	13.9	14,412	0.61	12	9.2	8,352	0.37
3	14.0	11,483	0.45	13	10.1	19,356	0.41
4	16.1	26,494	0.47	14	20.8	7,125	0.99
5	17.1	166,530	0.69	15	22.4	6,534	1.02
6	16.3	319,038	0.66	16	9.4	164,116	0.38
7	14.4	195,707	0.58	17	13.5	10,143	0.54
8	14.4	3,532	0.58	18	26.5	95,007	0.55
9	43.4	10,276	0.46	19	14.3	3,146	0.64
10	38.0	71,519	0.86	20	12.1	12,058	0.41

$^*KgCO_2eq\ kgLWG^{-1}$; $^{**}US\$ / kgLWG^{-1}$

Table 2. Economic analysis of 20 beef cattle farms classified by groups.

Parameter	Best	Traditional	Difference
Live weight gain (kg/animal/year)	373	241	132
Production cost (US/kg)	1.54	1.65	-0.12
Production cost per animal (US/animal/year)	573	399	175
Sale price (US/kg)	2.00	1.89	0.11
Income per animal (US/animal/year)	745	455	291
Economic benefit (US/animal/year)	172	56	116
Economic result (B/C ratio)	1.30	1.14	0.16
Carbon footprint ($KgCO_2eq\ kgLWG^{-1}$)	9.9	16.2	-6.4
Carbon footprint cost ($US/KgCO_2eq\ kgLWG^{-1}$)	0.40	0.65	-0.3
Emission per animal ($KgCO_2eq$)	3,678	3,908	-231
Environmental cost (US/animal/year)	148	157	-9
Environmental benefit (US/animal/year)	9	0	9
Economic + environmental income (US/animal/year)	755	455	300
Economic + environmental benefit (US/animal/year)	182	56	125
Economic + environmental result (B/C ratio)	1.32	1.14	0.18

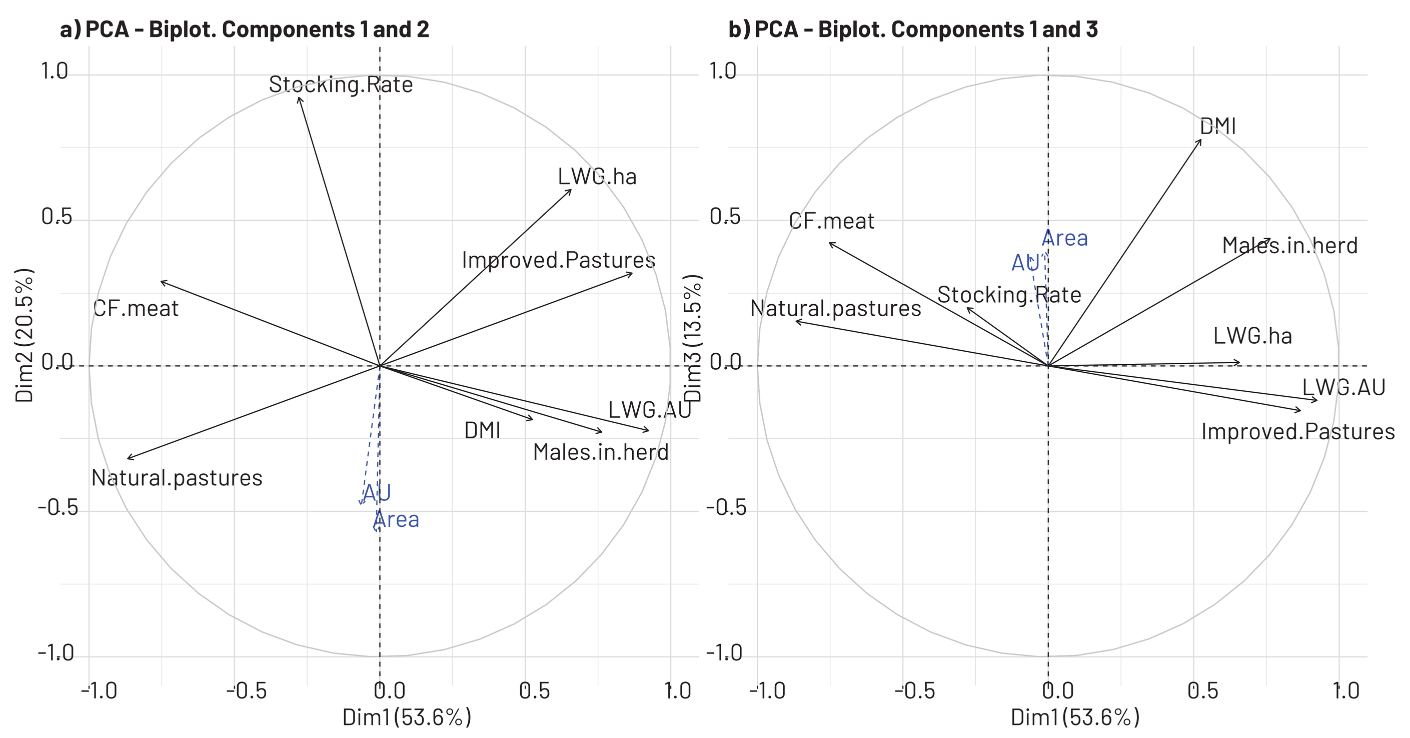

Figure 2. Biplot for the principal component analysis (PCA) with information from 20 beef cattle farms in Cordoba – Colombia for the (a) principal components 1 and 2; and (b) principal components 1 and 3.

Conclusions

- Farms assessed were characterized as pasture-based systems, with a feed basket composed of native/naturalized and improved pastures – in different proportions –, with little inclusion of supplemental feeds.
- Farms with better cattle management practices, and higher adoption of technology (including improved pastures) showed the highest live weight gains, pasture productivity, and B/C ratios, and the lowest beef CF.
- The inclusion of improved pastures increases both the quality of the animal diet and animal productivity, leads to higher profitability, and reduces greenhouse gas emissions (GHGE) per unit of beef.
- A more widespread adoption of improved pastures in beef production systems could thus result in an important mitigation option for beef cattle systems located in the Colombian lower tropics.

Acknowledgments
This work was carried out as part of the CGIAR Initiative on Livestock and Climate. We would like to thank all the donors who globally support our work through their contributions to the CGIAR System. We are thankful to AGROSAVIA-CIAT Forages Network.

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Poster prepared for:
Tropentag 2023
September 20-22, 2023
Berlin (Germany)