Final Technical Report

FCEB Project #47

Evaluating the carbon balance, greenhouse gas emissions and global warming potential of typical Florida cow-calf production systems.

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1. PROJECT OVERVIEW

In Florida, over 4.4 million acres (52% of the agricultural lands) are used for cattle production, distributed in 1.4 million acres as native rangelands, used during the winter as source of standing dry forage for open cows, and 3 million acres as planted pastures with Bahiagrass as the dominant specie. These ecosystems in addition to providing food to millions of people, also provide clean water, soil protection, habitat for wildlife, preservation of biodiversity, and recreation; however, because of the extensive areas occupied, and significant soil carbon stocks, it is important to understand the potential tradeoffs between pasture productivity and greenhouse gas emissions, and the role these ecosystems used for cow-calf production may play offsetting carbon dioxide and greenhouse gas emissions.

Our main objectives were to:

1) *Evaluate ecosystem carbon balance (difference between the amount of carbon fixed during photosynthesis and carbon losses by respiration, Net ecosystem production NEP) and water use efficiency (amount of carbon assimilated as plant biomass produced per unit of water used*) *associated with typical pasture-based cow calf production systems in Florida.*
2) *Evaluate the greenhouse gas emissions and balance (sink/source) of typical pasture-based cow-calf production systems in Florida.*

This proposal addressed FCA priority Ecosystems services of grazing lands: Greenhouse gas mitigation.

2. PROJECT ACTIVITIES

Experimental Setup

The study was conducted in an established USDA, LTAR site located in Ona, FL (ABS-UF LTAR site 27°23′76″N, 82°56′11″ W). The experimental areas, which includes a 54 acres native rangeland and a 46 acres Bahiagrass pasture have been consistently maintained for over 20 years. The native rangeland was grazed (stocking rate = 13 acres/animal) from November to February using cull cows, and the bahiagrass pasture was grazed year-round (stocking rate = 1.5 acres/animal) using adult cows. Eddy covariance towers equipped to measure carbon dioxide and methane fluxes were used. Data presented in this report cover two years (2022 – 2023) of carbon balance and methane exchange from both sites.

Key variables

Net ecosystem productivity (NEP), the net carbon dioxide exchange, and **methane fluxes** at ecosystem level are presented over monthly and yearly time frames. Methane fluxes were converted to carbon dioxide equivalent (CH_4_Ceqv) according to the IPCC 2014 guidelines. Green house gas balance (GHG_B) was calculated by integrating NEP and methane fluxes. Fluxes are reported as pounds of carbon per acre per month or year (NEP in lbs. C $acre^{-1}$ yr^{-1}) or pounds of carbon equivalent per acre per month or per year for methane and GHG_B (lbs. Ceqv $acre^{-1}$ $year^{-1}$). Negative NEP indicates net carbon gain by the ecosystem.

3. RESULTS

Monthly NEP and methane carbon equivalent fluxes

The Native Rangeland was always a C sink most of the months during the two years (Figure 1), reaching the highest NEP (-300 − -325 lbs. C $acre^{-1}$ $month^{-1}$) during the spring of each year; however, a prescribed fire in June 2023 induced the rangeland to be a carbon source (NEP = + 265 lbs. C $acre^{-1}$ $month^{-1}$); however, it recovered its carbon uptake capacity three months after fire and remained a strong carbon sink through the end of the year. The bahiagrass pasture site showed a strong seasonality in NEP with the highest values between February and September, when maximum monthly C uptake was greater than 1000 lbs. C $acre^{-1}$. However, the Bahiagrass was a carbon source during the dormant season, while the native Rangeland was always a carbon sink during the same period. The native Rangeland acted as a small methane sink during the driest months of the year and was a small methane source during wet months, while Bahiagrass pasture site was a continuous methane source during the two years. Maximum methane

emissions from both sites were registered in September 2022 after hurricane Ian flooded the area, the rangeland emitted 46 g CH_4-Ceqv while the Bahiagrass pasture site emitted 644 lbs. CH_4-Ceqv, more than 10 times higher. When carbon dioxide and methane fluxes were integrated (GHG_B), Bahiagrass pasture site was a strong carbon source in September and October of 2022 and remained as source until January of 2023, and again a source from October to December of 2023.

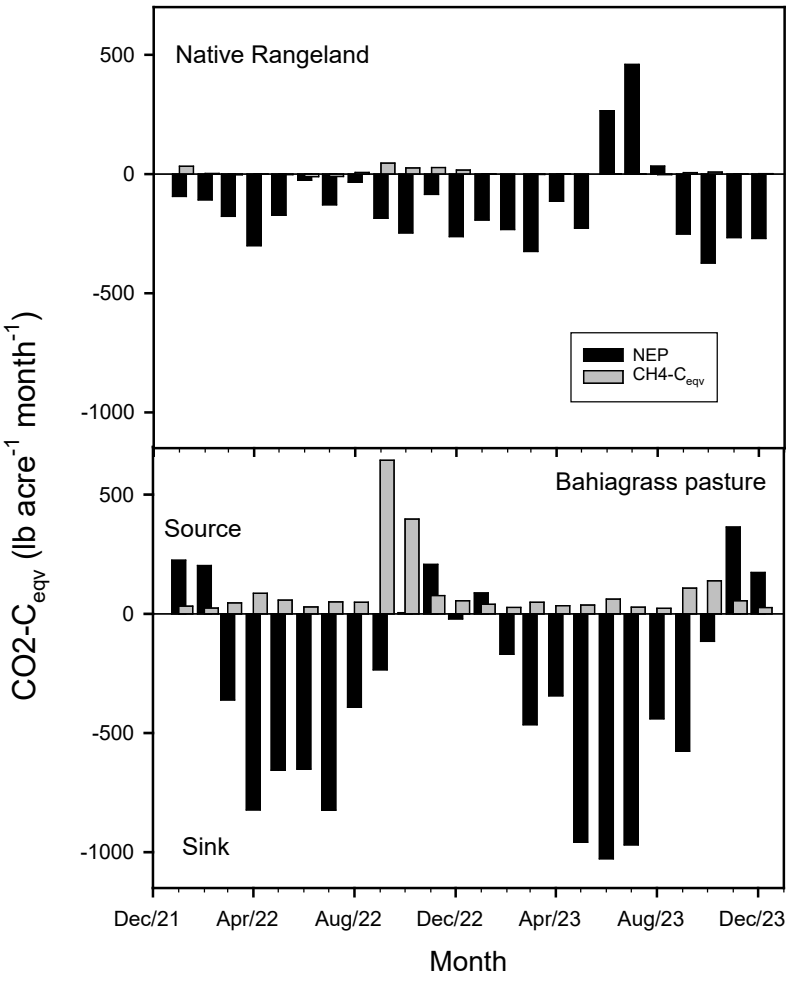

Figure 1. Monthly net ecosystem production (NEP) and methane emissions (CH4-Ceqv) from a Native Rangeland and a Bahiagrass pasture, two typical cow-calf production systems in Florida.

Annual balance, NEP and Greenhouse gas balance (GHG_B)

Both ecosystems were carbon sinks (Negative NEP) during the two years (Table 1); however, Bahiagrass site was 2 – 3 times more productive than the native rangeland in 2022 and 2023, respectively. Methane emissions (CH_4_Ceqv) were higher at each site in 2022 after the flooding by hurricane Ian and decreased more than ten times at the native rangeland and by more than twice at the Bahiagrass pasture site during the second year. The greenhouse gas balance (GHG_B) indicated that both sites were carbon sinks of similar magnitude in 2022 and more than double at the Bahiagrass pasture site in 2023.

Table 1. Annual net ecosystem production (NEP), carbon dioxide equivalent methane emissions (CH_4-Ceqv) and greenhouse gas balance (GHG_B) from a Native Rangeland and a Bahiagrass pasture, two typical cow-calf production systems in Florida. All values in pounds per acre per year (lbs. $acre^{-1}$ $year^{-1}$).

	Native Rangeland			Bahiagrass pasture		
Year	NEP	CH4_Ceqv	GHG_B	NEP	CH4_Ceqv	GHG_B
2022	-1823	130	-1693	-3324	1547	-1778
2023	-1494	8	-1486	-4439	626	-3813

4.- SUMMARY AND CONCLUSIONS

Complete simultaneous measurements of carbon dioxide exchange (NEP) and methane emissions (CH_4-Ceqv) using eddy covariance approach were taken during 2022 and 2023. Results indicated that the two cow-calf production systems located inside the Rangeland Cattle Research and Education Center, University of Florida, Ona, were significant carbon sinks during the two years under the current management strategies, where Bahiagrass site had twice as much carbon dioxide uptake (Higher NEP). Seasonal flooding, as typical in Florida due to the presence of tropical storms, exacerbate methane emission from these production ecosystems. Although methane emissions from the Bahiagrass site can exceed between 10 and close to 100 times those from the native rangeland, Bahiagrass still is a stronger carbon dioxide sink because of its higher capacity to uptake carbon dioxide than the Native Rangeland. However, **both cow-calf production systems can be a viable option to help on the fight for carbon dioxide mitigation as they provide many other services like food, biodiversity and water protection among many others.** However, climatic variability is very broad in the region, with the presence of

multiyear droughts or very wet periods. Consequently, long-term research aimed to cover the climatic variability and its interaction with management practices is required.

ACKNOLEDGEMENTS

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5. PERCENTAGE COMPLETION OF PROJECT DELIVERABLES: 100%

PRESENATIONS

Rosvel Bracho, María L. Silveira. Carbon balance of typical Florida cow-calf production system. Annual Florida Cattlemen's Association meeting, Marco Island, FL. June 2024.

Rosvel Bracho. Carbon dynamics in Florida's ecosystems. University of Florida, IFAS Carbin meeting. University of Florida, January 2024.

REFERENCES

IPCC, 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change, Geneva, Switzerland.

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Principal Investigator:	Bracho-Garrillo,Rosvel
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Award End Date:	07/31/2024
UF FEIN:	59-6002052

Sponsor Award ID:	47
Award Title:	Evaluating the carbon balance, greenhouse gas emissions and global warming potential of typical Florida cow-calf production systems.
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Note:	Jim Handley, Contract Manager jim@floridacattlemen.org

Invoice #	I000130448
UF Award #	AWD15800
Primary Project #	P0324614
Primary Department:	60460000
Current Invoice Amount:	$23,302.37

Description	Current	Cumulative
Personnel - Salary	$9,199.53	$18,773.14
Personnel - Fringe Benefits	$2,695.42	$5,500.46
Consultant Services	$7,000.00	$7,000.00
Domestic Travel	$1,910.75	$1,910.75
Direct Cost	$20,805.70	$33,184.35
Facilities and Administrative Costs	$2,496.67	$3,,982.11
Total	$23,302.37	$37,166.46

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P0324614	60460000	AG-SCHL FOR, FISH, & GEOMATICS	$23,302.37	$37,166.46