Ruminant agriculture: A tool for climate change mitigation

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Abstract:

The quest to address and mitigate climate change has been dubbed a "wicked problem" as it involves many interconnected processes requiring a multifaceted, comprehensive approach. Animal agriculture contributes roughly 15% to CO2 equivalent (CO2e) emissions; as a result, a concerted effort is being made to develop and promote more climate-friendly production practices. These practices include species diversification in grasslands, improving grazing rotation, adding nitrogen amendments, and the use of feed additives to reduce enteric fermentation. Successful inter-seeding of legumes and deep-rooted native grasses increases soil organic carbon (SOC) pools in many systems by increasing the biological carbon inputs to the rhizosphere. Rotational grazing increases the concentration of ruminant waste in smaller areas resulting in a more uniform application of nutrients and forage use. The rotational grazed pasture allows for longer pasture recovery, thereby increasing SOC stocks indirectly through increased root and aboveground biomass growth. Fertilization of pasturelands with nitrogen-only fertilizers increases SOC stocks. Enteric methane emission makes up over 44% of animal agriculture's carbon footprint (Tubiello et al. 2013) and can be reduced using novel feed additives to mixed rations for confined cattle consumption. It's important to consider that none of these management practices is a silver bullet that works in any situation; instead, these can be effective tools to draw down carbon emissions. Many barriers, particularly financial ones, have kept land managers from implementing these climate-improving practices. To help growers address these barriers to adoption Agoro Carbon™ Alliance is implementing carbon offset projects, which provide both financial incentives and education that facilitate the adoption of multiple, improved agricultural management practices involving animal agriculture.

Introduction:

Animal agriculture is vital to helping support the world's food and textile needs. Enteric methane accounts for 44% of the carbon footprint of animal agriculture (Tubiello et al. 2013). As the world's consumption of fossil fuels and industrialized production of goods increases as a direct result of increased population the demand for food also increases. Each of these situations pushes the needle further past equilibrium in-terms of greenhouse gas emissions, resulting in greater impacts to global climate change.

Terrestrial soils can sequester 333.2 Pg of Carbon (Lal et al. 2018). Of that agricultural land (crop and grassland) can sequester 121.1 Pg of Carbon through alterations in management practices. Grassland agriculture, often associated with grazing of livestock, is estimated to sequester 63.1 Pg of Carbon or 1.9 Pg of C per year until we return to equilibrium (Lal et al. 2018). Management practices that support carbon sequestration in grassland production systems are improved grazing management (148-699 megatons of CO2 equivalents (CO2e) per year, 147 megatons of CO2e per year when new forage species are introduced (increased biodiversity) (Bai et al. 2022) and minimal N management (Soussana et al. 2004) (table 1). Agoro Carbon Alliance is promoting agricultural practice change in grasslands to promote soil carbon storage. The supported practices for producers are improved rotational grazing, improving biodiversity, and utilizing nitrogen inputs to nitrogen limited systems to improve microbial activity and forage quality. By offering carbon credit incentives to producers, they can improve their management systems prolonging their livelihood through management practices that reduce atmospheric greenhouse gasses and sequester carbon.

Table 1. Potential carbon sequestration of grassland management practices.

	Mg CO2e per year
Improved Rotational Grazing	148-699
Increased Biodiversity	147
Minimal Nitrogen use	0.8

As the population of the world will continue to increase and the demand to increase yield on agricultural goods continues, science must find ways to improve the main agricultural media, soil while solving climate change. This can be done through management opportunities in terrestrial grasslands that support ruminant animal production.

Method:

Overview

Starting 2021 producers contracted their acres for carbon credit generation. Over a ten-year period, Agoro Carbon Alliance will obtain soil data that will monitor carbon sequestration in various spatial, temporal and ecosystem regions across the United States. This data, obtained through standard testing methods, will help to assess management practices' role in climate change mitigation and support ruminant animals' job in enhancing carbon sequestration as a mitigation strategy for increasing greenhouse gas emissions.

Producer Enrollment

Ruminant animal producers from the contiguous United States in grassland production systems can sign their management system acres up with Agoro Carbon Alliance. This program requires producers to consign their acres for 10 years to either one or a combination of: improved rotational grazing, increased biodiversity, and use of nitrogen in grassland systems.

Soil Carbon Analysis

Agoro Carbon Alliance samples the contracted acres to obtain a baseline sample of soil organic carbon using standard methods (Nelson et al. 1996). This is repeated at year 5 and 10 of management practice implementation. The change in soil carbon is then determined and producers are paid for that carbon they stored.

Carbon Credit Generation

The final step is selling carbon credits to businesses that need to offset their carbon footprint. These credits must be verified. Agoro Carbon Alliance has spent time creating and registering a project description with Verra to ensure that carbon credits can be generated, verified, and sold. Through rigorous testing, management system monitoring and third-party verification carbon credits can be generated.

Results and Discussion:

Monitoring soils for soil carbon in grassland production systems that utilize ruminant animals provides a starting point for monitoring how improved grazing, biodiversity increase, or minimal nitrogen input can support carbon sequestration. Over the 10-year contract period of nationwide acres that utilize ruminant animals for grazing we will obtain data on how soil carbon sequestration is altered by the enrolled management practice; how temporal and spatial regions alter the sequestration and how ecosystem biodiversity (or lack of it) can alter soil carbon levels.

This data will be able to improve climate, soil nutrient and agricultural production system models. Moreover, through monitoring of soil carbon on enrolled production acres that contain grasslands and ruminant animals, producers will be able to diversify their income streams by obtaining

carbon credit payments. The long-term benefit of carbon sequestration and the carbon generation market is soil health that promotes increased yield, water holding capacity and forage production that ensures an equilibrium between livestock production and atmospheric greenhouse gas mitigation from human consumption.

Implications:

Carbon sequestration in soil, to mitigate atmospheric greenhouse gas emissions, is vital to the future of agriculture and humanity. Designing rotational grazing systems that optimize forage and animal carrying capacity, while improving biodiversity and improving soil health stimulate soil carbon storage. Overtime, forage systems improve, animal health improves and grassland production systems of the world store carbon offsetting detrimental atmospheric greenhouse gas. Ranchers use grasslands to produce food, textiles, and other human consumables; through improved management greater carbon can be stored allowing for a diversified income stream to producers that ensures the longevity of livestock agriculture.

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