The Elevated Environmental-Sustainability Benefits of Grass-finished Beef, Intensive Grazed on Organic Pastures:

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Introduction

This paper summarizes current scientific evidence of the unique ability of grass-finished beef, produced through the application of intensive grazing practices on organic pastures, to contribute to environmentally-sustainable food production systems. These contributions are categorized into four indicators – **Greenhouse Gas Emissions**, **Carbon Sequestration**, **Water Quality**, and **Utilizing Otherwise Unproductive Farmland**.

GHG Emissions

Today there is widespread consensus within the scientific community about the impact of livestock production on greenhouse gas (GHG) emissions. However, it did not start out this way. In 2006 the first well-publicized report on this topic by the UN Food and Agriculture Organization (FAO) claimed that 18% of GHG emissions, a higher percentage than the amount generated by global transportation, was due to livestock production. However, after release of this report, it was discovered that the authors used a flawed analysis. Although they used a comprehensive life-cycle analysis to estimate livestock GHG emissions, they left out the embedded GHG emissions associated with transportation. In March 2010, FAO published a revised report correcting these errors and stating that the actual contribution by global livestock production is closer to 14.5% and that all agriculture is responsible for 24% of GHG emissions world-wide.

In the United States, where agriculture and livestock production are relatively efficient, livestock production is responsible for only 3.9% to our Nation's GHG emissions; and all of U.S. agriculture is responsible for 9% of GHG emissions. On the other hand, transportation, electricity generation and industrial fossil fuel consumption account for 79% of our GHG emissions (29%, 28%, 22% respectively) [https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions]. In contrast, the percent contribution in less developed countries, where fossil-fuel consumption is much lower and livestock production is less efficient, is much higher – e.g., 50% in Paraguay and 90% for some countries in Africa.

Comparing the GHG emissions of grass-finished beef with grain-finished beef, it is true that grass-finished beef generate more methane per pound of meat than grain-finished beef. This is because a bovine's digestive system produces more methane when it consumes forage than it does when consuming grain. In addition, grain-finished beef are slaughtered at an earlier age – 18-24 months, and so have shorter lives. However, whereas most grass-finished cattle are slaughtered at 30+ months of age, intensively grazed grass-finished bovines are slaughtered at only 23-29 months – not much longer than grain-finished animals.

Further, grain-finished beef production is often accomplished in concentrated animal feeding operations (CAFO) which generate large amounts of liquid manure (the manure is moved by adding water to it) that is stored in tanks or lagoons before application to fields. While in storage, the liquid manure is under anaerobic conditions that result in methane production and emissions. In contrast, dry manure, such as the manure left by grazing animals, is under aerobic conditions and emits very little methane.

In addition, nitrous oxide (N_2O) is about 12 times more potent greenhouse gas than methane. The U.S. Dept. of Energy reports that more than 75% of farming's N_2O emissions result from the production of nitrogen-based fertilizer used to grow corn and soy (mostly corn) for livestock feed.

Carbon Sequestration

The production of row crops such as corn often requires tilling of the soil. This is especially true in Vermont where much of the soil is heavy clay. Unfortunately, tilling facilitates the oxidation of carbon in the soil, leading to CO_2 emissions and reducing the soil's carbon (humic) content and thereby reducing soil fertility. As a consequence, more nitrogen fertilizer, usually non-organic, must be added to the soil.

Intensively-grazed cattle on perennial forages minimize the volatilization of soil carbon and instead, actually add carbon to the soil. This is accomplished as the result of leaving forage residues on the field, leaving viable root systems in the ground, and the deposition of manure.

One study determined that White Oak Pastures, an intensively-grazed grass-fed beef farm in Georgia, sequesters more carbon in its soil than its cattle emit (http://blog.whiteoakpastures.com/blog/carbon-negative-grassfed-beef). The study compared the carbon footprint of White Oak Pasture's beef with that of other protein-rich foods (values are in Kg CO_2-equivalent emissions per Kg fresh meat)…

grain finished beef (US)	+33
pork (CA)	+9
chicken (US)	+6
Beyond Burger™	+4
soy	+2
White Oak Pastures beef	-3.5

In addition, methanotrophic bacteria, which metabolize methane, are only found in abundance in well-managed, grass-based livestock systems. In short, well-managed livestock are necessary to ensure that mankind's agricultural lands are carbon sinks. Further, intensively-grazed grass-fed livestock on organic pastures increase soil fertility by increasing both the soil carbon (humic) content and soil biodiversity. The ability of pasture-based livestock agriculture to enhance farmland fertility in a sustainable manner is termed 'regenerative agriculture.'

Water Quality

According to USDA's Natural Resources Conservation Service, every 1% increase in soil organic matter (i.e., carbon) content allows each acre to hold onto and filter an additional 25,000 gallons of water. The following practices help increase soil organic matter:

- Use perennial plants to cover the soil year-round and act as a whole-land buffer for precipitation and nutrients under extreme weather conditions.
- Manage pasture disturbances by allowing adequate plant recovery periods that facilitate the growth of deep roots and increase root density thereby building a thick soil carbon "sponge" to catch, hold and filter precipitation.
- A diversity of perennial plants with varying root depths will cycle nutrients year round and hold soil in place. Plant diversity also fosters a broad spectrum of soil microbes and increases soil organic matter.

Increasing the water holding capacity in soils also increases the land's resilience to changing climate because it increases its drought tolerance and reduces the negative impacts of concentrated rainfall events. Well-managed pastures have been shown to inhibit the loss of soil or nutrients to nearby bodies of water.

Utilizing Otherwise Unproductive Farmland

Livestock that turn grasses and forages, which humans cannot digest, into edible and nutritious fats and proteins for human nutrition. In addition, these self-propelled transformers of otherwise indigestible plant matter can consume forage on lands that are very difficult or impossible to cultivate for food crops. These include the vast rangelands of the western United States as well as the thinly-soiled, rocky and hilly pastures on our own farm and throughout New England. According to the FAO, as much as 70% of all agricultural land globally is range land that can only be utilized as grazing land for ruminant livestock.

Much of the solar energy captured by terrestrial plants is used to produce cellulose, which is the most abundant organic molecule in the biosphere but is also indigestible by humans. Only certain microorganisms can digest cellulose; and fortunately bacteria ruminants carry around with them an incredible diversity of microorganisms in their rumens to do the hard work of breaking down cellulose in plants and plant residues that we cannot eat.

The mutually-beneficial relationship between ruminant livestock and their microbes means humans can get food from grassland landscapes on which plant foods such as grains, vegetables, and beans cannot grow. In that way, ruminant livestock help us unlock solar energy for our food system.

Summary

The use of intensive grazing practices to produce grass-finished beef on organic pastures offers environmental benefits that exceed what is possible from the production of other foods. The benefits positively impact greenhouse gas emissions, carbon sequestration, water quality, and the utility of our farmlands.

Other benefits include protection of wildlife habitat and improved animal health by virtue of a diet more consistent with what ruminant animals evolved eating and through management practices that allow full expression of their natural behaviors within a natural habitat.

Further, all these benefits are completely sustainable.

Certainly, no one in Vermont and no environmentalist should feel guilty about consuming modest and healthy amounts of grass-finished beef that is locally-produced using intensive grazing practices on organic pastures, particularly on farms that also adhere to high standards for animal welfare.

The consumers and wholesale customers who purchase from our farm, and from other farms like ours, are among today's environmental Health Heroes!