Fact Sheet 6 in the Series: Tough Questions about Beef Sustainability

Does grass-finished beef leave a lower carbon footprint than grain-finished beef?

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Even though cattle live the majority of their lives on pasture, the type of finishing system does impact the carbon footprint of beef. The carbon footprint for beef is all the greenhouse gas emissions yielded during the production of beef divided by the total amount of beef produced by the system. Beef production consists of three main phases: cow-calf, stocker/backgrounding, and finishing (**Figure 1**). The first phase of the animal's life is spent nursing and grazing on pasture along with its mother. After calves are weaned, they typically spend additional time grazing crop residue that remains after harvesting grain or grazing forage pastures and grasslands. During this time, known as the stocker or backgrounding phase, they gain additional weight as they prepare to enter the finishing phase. The finishing phase is the final stage before cattle are sent for harvest. Cattle entering the finishing phase are typically 12 to 16 months old, and remain in this phase until they have achieved a level of marbling that will provide a positive eating experience for consumers. The main difference in carbon footprints between grass- and grain-finished beef occurs as a result of the time spent in the finishing phase, the type of feed consumed, and the ending body weight of the cattle in the finishing phase.

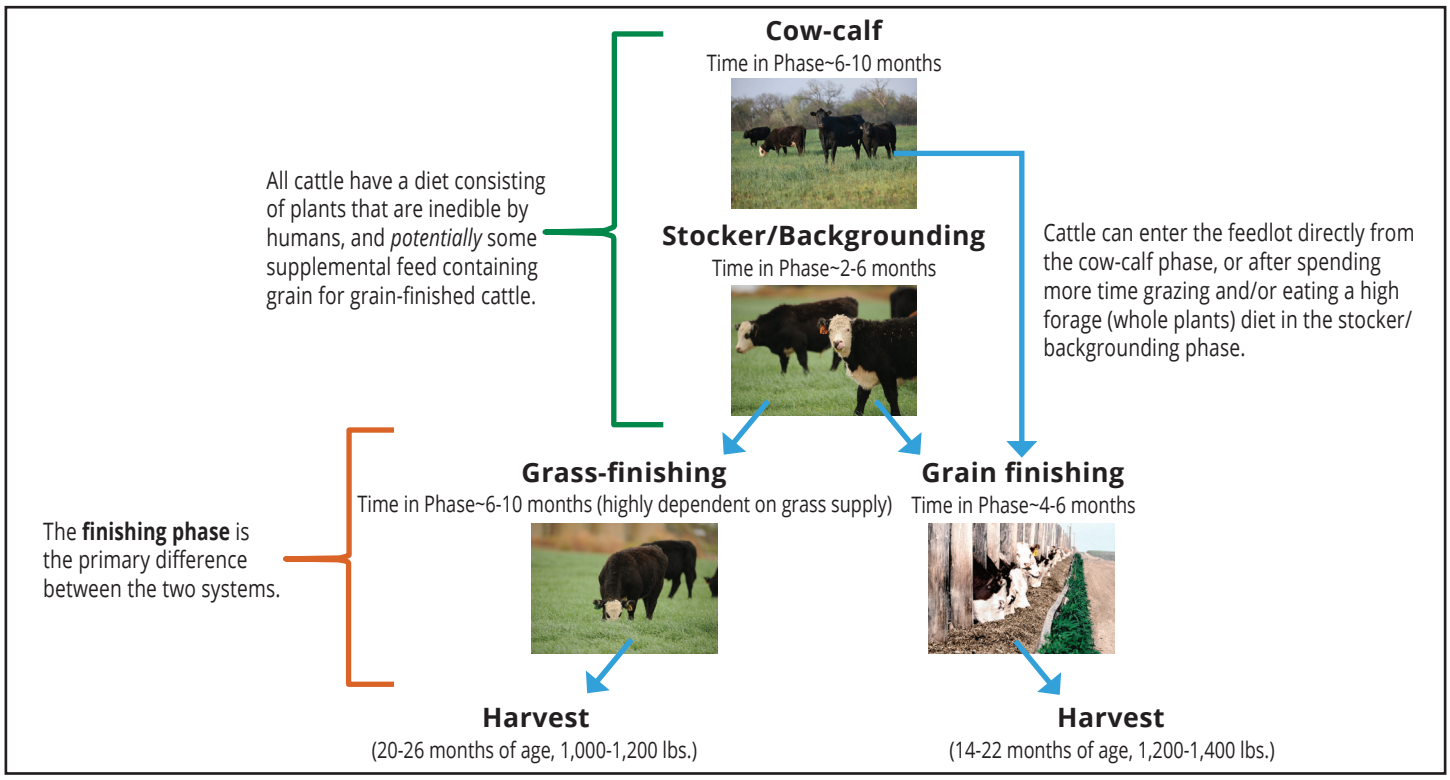

Figure 1. Beef cattle life cycle in the United States for grass-finished and grain-finished beef.

Cattle entering the feedlot for finishing eat a diet that contains corn along with by-products (such as distillers grains leftover after ethanol production), vitamins and minerals, and forage or roughage (such as hay). Grain-finished cattle remain in the feedlot for approximately four to six months and are sent for harvesting at 14 to 22 months of age. Grain-finished cattle reach market weight faster than grass-finished[1,2] because the diet the animals receive is higher in energy, which results in more efficient weight gain. In contrast, grass-finished cattle gain at a slower rate due to the forage-based diet they eat and typically go to harvest at 20-26 months of age and at a lower weight than grain-finished animals. Grass-finished cattle may finish either faster or slower than this age range depending on the forage and grass resources available to the beef producer (e.g., the growing season is shorter in northern U.S. states, which may shorten the finishing period and lead to lighter weights at harvest). The difference in harvest weights translates into different numbers of U.S. citizens that could be fed per animal (**Table 1**). Utilizing forage as the primary source of feed also contributes to an increased carbon footprint for grass-finished beef,[2] because high forage diets (e.g., grass) produce more methane emissions from the animal's digestive tract than higher-energy, grain-based diets. The combination of consuming a higher energy, lower forage diet, shorter time spent on feed during finishing, and heavier carcass weights translate into a 18.5 to 67.5% lower carbon footprint for grain-finished beef as compared to grass-finished beef.[1,2]

Even though grass-finished beef has a higher carbon footprint, it does have some sustainability advantages. Grass-finished animals utilize plants that are inedible by humans as the primary source of energy and nutrients for their entire lifetimes. In contrast, 82% of feed intake per unit of carcass weight for conventional animals occurs from grazing forage, pasture or rangeland.[5] Beef cattle can utilize forage grown on land not suitable for crop production, and thus produce human edible food from a resource that could not otherwise be used to produce food. Additionally, grasslands and pastures can sequester carbon dioxide from the atmosphere, which can help to mitigate global climate change. Research has shown an advantage for grass-finished beef production over grain-finished beef production when expressing feed conversion as human edible energy returned per unit of human edible energy consumed by the cattle.[2,6]

Accounting for carbon sequestration of grass-finished beef that is finished on pastures could lower the carbon footprint of grass-finished beef by 42%.[2] Ultimately, tradeoffs exist between the two beef production systems; however, beef producers using either system can sustainably meet consumer demand for beef by utilizing the resources they have in their part of the country.

Bottom Line: **Tradeoffs occur in different aspects of sustainability when comparing grain-finished and grass-finished beef production systems. Grain-finished beef has a lower carbon footprint than grass-finished beef due to more efficient utilization of feed in the finishing phase, fewer days on feed, and greater amount of beef produced per animal. However, grass-finished beef contributes to sustainable beef production by utilizing forage resources during finishing to produce food from plants that are inedible by humans.**

Table 1. U.S. citizens fed for one year per animal for grass-finished and grain-finished beef.

Finishing system	Harvest live weight, lbs.	Dressing %	Carcass Weight per animal, lbs.	U.S. citizens fed per animal*
Grass-finished	1,100	58%	638	8.0
Grain-finished	1,300	64%	832	10.4

*Assuming 80.1 lbs. of carcass weight availability per capita in 2013[4]

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