Fact Sheet 12 in the Series: Tough Questions about Beef Sustainability

Do feedlots have the largest greenhouse gas impact in the beef value chain?

Ashley Broocks, Megan Rolf and Sara Place
Oklahoma State University

The beef value chain is a complex system, which includes the production of feed, the raising of beef cattle on grass and in feedlots, processing plants, retailers, food service operations, and the consumer. Broadly, the beef value chain can be split into pre-farm gate (all the processes and activities prior to the harvest of the beef animal) and post-farm gate (all the processes and activities that take place once the beef animal leaves the farm, ranch, or feedlot). Approximately 80% of greenhouse gas (GHG) emissions produced per unit of beef in the United States occur in the pre-farm gate part of the beef value chain.[1] The pre-farm gate portion of the beef value chain can be split into three major phases: the cow-calf phase, the stocker or backgrounding phase, and the feedlot or finishing phase.

Feedlots are often believed to be responsible for the largest portion of beef's GHG emissions. In reality, the cow-calf phase is responsible for most (approximately 70%, **Figure 1**) of the GHG emissions in the beef value chain prior to the harvest of beef cattle.[2-5] Factors that influence GHG emissions in each phase deal with three primary components: the number of animals maintained in each phase at any given time, the diet of the animals in each phase, and efficiency of feed conversion.

Animals in the cow-calf phase are either pregnant or lactating cows, replacement heifers, growing

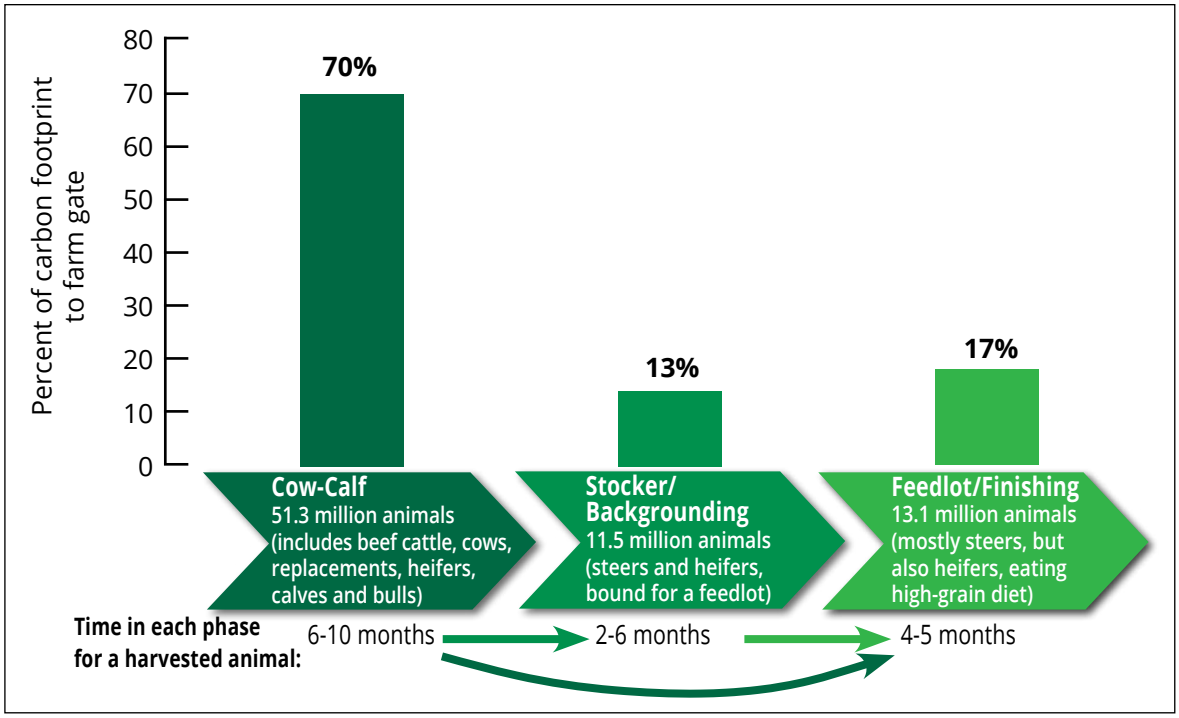

Figure 1. Average percentage[2-5] of the carbon footprint to the farm gate (i.e., greenhouse gas emissions generated per pound of beef prior to harvest of the cattle) due to the cow-calf, stocker/backgrounding, and feedlot/finishing phases of beef production and number of animals in each phase, as of January 1, 2015.[7]

calves, or bulls. Cows that are lactating have higher daily energy and nutrient requirements than other mature, non-lactating animals. Cattle in the cow-calf phase of the industry are largely raised on pasture, consuming mostly forages that are typically of lower quality or digestibility. It has been well established by scientific research that cattle consuming feed with low digestibility tend to generate more methane emissions (a GHG 28 times more potent at trapping heat in the earth's atmosphere than carbon dioxide[6]) as compared to cattle eating more digestible feed (e.g., cattle in feedlots eating high-grain diets).[5] While cattle in the cow-calf phase produce more methane emissions per animal due to their diet of mostly grass and hay, those feeds are also unsuitable for human consumption; therefore, there is a sustainability tradeoff between methane emissions and the ability of cattle to convert grass into human usable products (e.g., beef, leather).[2]

From the cow/calf sector, cattle are typically weaned and sold and enter the stocker/backgrounding phase, where they spend additional time grazing forage. However, the GHG emissions from the stocker/backgrounding phase are lower because the number of animals maintained in this phase is smaller, and they spend a shorter amount of time in this phase. To put this in perspective, cattle generally have one calf per year as a function of their gestation interval (which is similar to that of a person), so an entire herd of cows must be maintained for an entire year to produce one year's worth of cattle that may spend approximately 120 days in the backgrounding phase. Occasionally, weaned animals enter the feedlot directly and skip the stocker/backgrounding phase altogether.

Cattle in feedlots are given a nutritionally balanced diet to optimize growth and feed efficiency, or the conversion of feed into body weight gain. In this stage of production, animals can also receive growth promotants such as hormone implants or feed additives to further improve feed efficiency. Higher feed efficiency leads to lower methane emissions per animal due to improved digestibility, shorter time spent in the phase, and lower animal population in the feedlot/finishing phase as compared to the cow-calf phase which translates into lower GHG emissions (**Figure 1**).

While GHG emissions cannot be eliminated during the production of beef (or any other food product), there are opportunities to reduce GHG emissions throughout the entire beef value chain including both the cow-calf and feedlot/finishing phases. Growth promotants used in the stocker/backgrounding and feedlot/finishing phase have been shown to reduce GHG emissions per unit of beef by 9%.[8] Research using computer models has shown that 17% reductions in GHG emissions per unit of beef may be possible from the cow-calf phase by improving forage quality, land management, and increasing the number of calves weaned per cow every year (currently, not every cow weans a calf each year).[9]

Bottom Line: **Feedlots produce approximately 17% of the GHG emissions in the beef value chain that occur prior to the animal being harvested. The cow-calf phase of beef production produces a larger proportion of GHG emissions per unit of beef as compared to the feedlot phase. This is because there are more animals in the cow-calf phase and animals in the cow-calf phase consume a forage-based diet that increases the methane emissions released per animal.**

Literature Cited

[1]Battagliese, T., J. Andrade, I. Schulze, B. Uhlman, C. Barcan. 2013. More sustainable beef optimization project: Phase 1 final report. BASF Corporation. Florham Park, NJ.

[2]Beauchemin, K.A., H.H. Janzen, S.M. Little, T.A. McAllister, S.M. McGinn. 2010. Life cycle assessment of greenhouse gas emissions from beef production in western Canada: A case study. Agric. Syst. 103:371-379.

[3]Rotz, C.A., S. Asem-Hiablie, J. Dillion, and H. Bonifacio. 2015. Cradle-to-farm gate environmental footprints of beef cattle production in Kansas, Oklahoma, and Texas. J. Anim. Sci. 93:2509-2519.

[4]Rotz, C.A., B.J. Isenberg, K.R. Stackhouse-Lawson, and E.J. Pollak. 2013. A simulation-based approach for evaluating and comparing the environmental footprints of beef production systems. J. Anim. Sci. 91(11):5427-5437.

[5]Stackhouse-Lawson, K.R., C.A. Rotz, J.W. Oltjen, and F.M. Mitloehner. 2012. Carbon footprint and ammonia emissions of California beef production systems. J. Anim. Sci. 90:4641-4655.

[6]IPCC. 2013. Climate change 2013: The physical science basis. Contribution of working group I to the fifth assessment report of the IPCC. Cambridge University Press. Cambridge, UK.

[7]USDA NASS. 2015. January 1 Cattle Inventory. http://usda.mannlib.cornell.edu/usda/nass/Catt//2010s/2015/Catt-01-30-2015.pdf Accessed December 16, 2015.

[8]Stackhouse, K.R., C.A. Rotz, J.W. Oltjen, and F.M. Mitloehner. 2012. Growth-promoting technologies decrease the carbon footprint, ammonia emissions, and costs of California beef production systems. J. Anim. Sci. 90:4656-4665.

[9]Beauchemin, K.A., H.H. Janzen, S.M. Little, T.A. McAllister, S.M. McGinn. 2011. Mitigation of greenhouse gas emissions from beef production in western Canada—Evaluation using farm-based life cycle assessment. Anim. Feed Sci. and Tech. 166-167:663-677.

For more information, contact:

National Cattlemen's Beef Association
Contractor to the Beef Checkoff Program
9110 East Nichols Avenue
Centennial, CO 80112
303.694.0305