# Beef Consumption at Boston College: A Discussion on Carbon Footprint and Alternative Agricultural Practices

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## Purpose:

The primary objective of this study was to calculate the carbon footprint ($CO_2e$) of beef consumption within Boston College Dining Services from May 28, 2017 to May 26, 2018. During the early stages of this project, the Office of Sustainability demonstrated a need to quantify the impact of current beef consumption levels at BC in order to comply with the evolving state-level and national sustainability standards. A vast majority of beef consumed at BC is raised in a conventional system (e.g., grain-fed, finished in feedlots, utilizing growth-enhancing technology), which yields expansive environmental consequences, particularly in relation to climate change inducing greenhouse gas emissions. The primary question of this study was whether or not alternative practices (e.g grass-fed or locally raised beef production) and beef substitutes would be less carbon intensive than conventional methods and if BC should transition beef procurement and consumption practices to these alternatives.

## Methods:

Using BC Dining's 2017-2018 Sysco Usage report from Juli Stelmaczyk, Sustainability Director for BC Dining, we were able to isolate total beef used throughout the academic year by distributor/vendor from a list of 1,629 food products. Through calls with each vendor, along with company website information, we were able to determine whether items originated from grass-fed or grain-fed beef, and in some cases, whether it was locally sourced. To estimate proportion of beef weight from each food item, we used Tselmaczyk's methodology to convert total food product weight to beef weight (E.g. soups).

We found a range of agreement in the literature when determining lbs. of $CO_2e$ to use in estimating BC's carbon footprint from beef. We applied an average lb $CO_2e$ metric derived from the most well-cited sources for conventionally raised (grain-fed) beef systems.

To find a point of comparison for grass-fed systems, we examined a New England-based study that quantified the difference in GHG emissions between production systems as a ratio and applied that ratio to our grain-fed pounds of $CO_2e$ factor. We were confident in this factor after observing consistent findings from other sources.

To convert from "live" weight, we found literature demonstrating that the consumer benefit found in the dining hall after carcass weight and trimming is removed enhances total emissions per lb by a factor we applied to our findings in Table 1.

## Results:

| Study | Lbs CO2e/lb Live Weight | Live Weight to Consumer Benefit | CO2e/lb Consumer Benefit |
|---|---|---|---|
| Lynch, 2019 | 7.60 | 3.45 | 26.21 |
| Rotz et al. 2013 | 4.94 | 3.45 | 17.05 |
| Grain-fed lbs CO2e: | | | **21.63** |
| Grass Fed Emissions Factor[1] | | | 1.68 |
| Grass-fed lbs CO2e: | | | **36.24** |
| [1] Capper, 2012 | | | |

**Table 1:** Approximated CO2 Equivalents for Grass and Grain-fed Systems

Out of 26 beef vendors, only three were found to source from grass-fed beef farms, comprising just **11%**, or 19,600 lbs. of total beef out of **180,628 lbs.** of beef sourced during the '17-'18 collection period. Only one vendor, Maine Family Farms, sourced beef locally to Boston College, composing **10,580 lbs.**, or **5.9%** of total beef.

"Cradle-to-Gate" life cycle analyses findings yield an average $CO_2e$ of **21.63** lbs. $CO_2e$/ lb of Consumer Benefit for conventional Grain-fed sources. This includes energy expended in the production of the farm machinery, feed, land, waste, and transportation. Less than 10% of the total $CO_2e$ from the beef life cycle results from transportation, making the sourcing location less significant than farm-specific land-use practices.

Grass-fed beef production emissions were found to be higher, at **36.24** lbs. $CO_2e$/lb of Consumer Benefit (Capper 2012). The literature revealed that when using a shorter time horizon in calculating $CO_2e$ through GTP20 or GWP20 methods, the increased enteric methane emissions from the cow's longer growth period on grass-feed without growth hormone exceeded the advantages of pastureland's role as a carbon sink. This is because a shorter 20 year calculation period lends itself to methane's shorter residence time in the atmosphere. However, the scope of this project in calculating a $CO_2e$ value does not include benefits of local and grass-fed systems, such as reduced water use and toxic waste build-up that decreases beef's ecological impact.

**180,628** lbs of Beef Consumed at BC

**4,194,906** lbs CO2e resulting from Beef Consumption

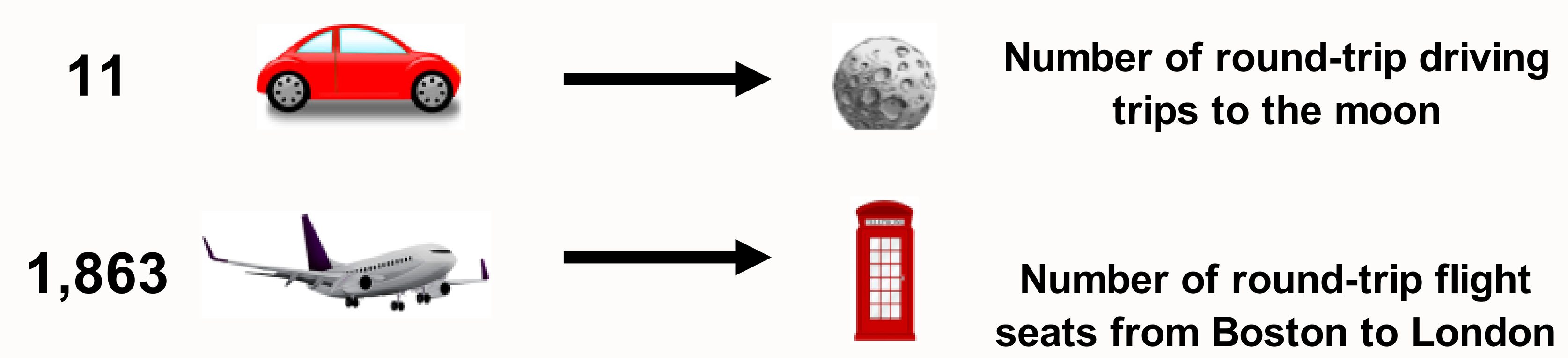


**Figure 1:** Contextualizing BC Dining Lbs of CO2e from Beef Production

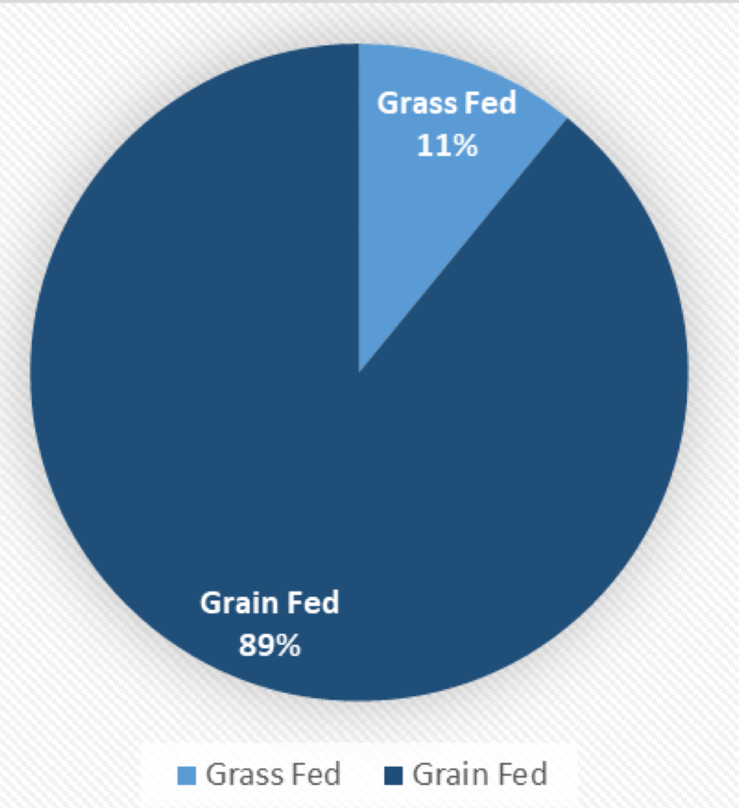


**Figure 2:** Grass fed vs. grain fed beef sourcing to BC

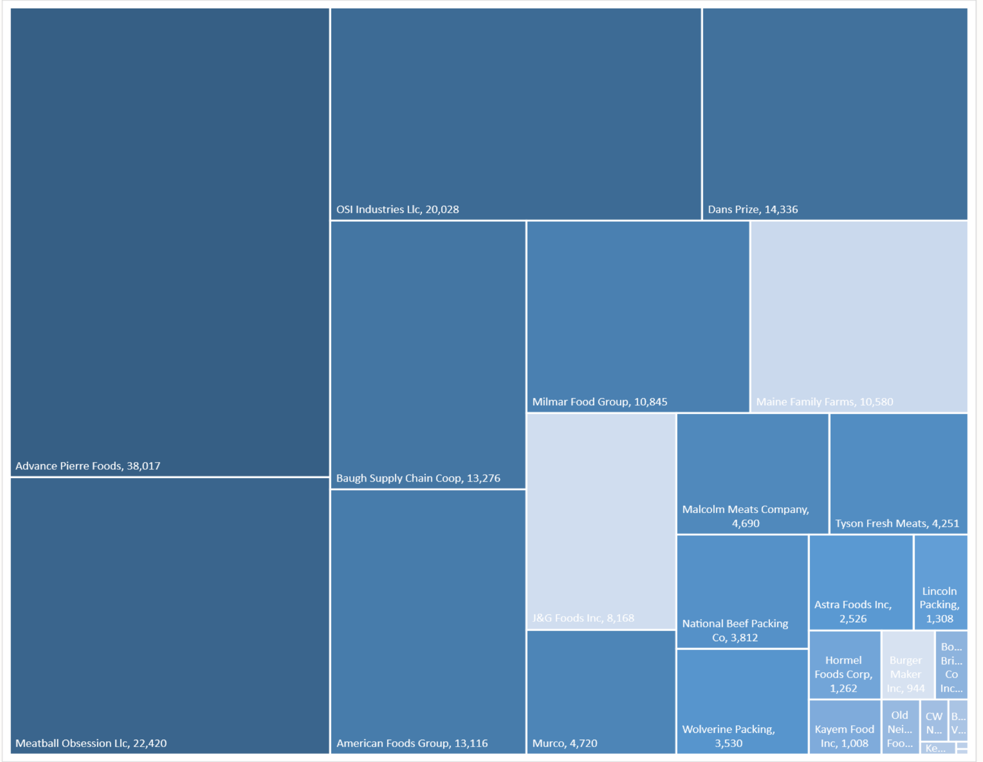


**Figure 3:** Beef Supply to Boston College (lbs) categorized by vendor

## Recommendations:

We recommend that BC increasingly incorporates grass-fed and locally-sourced beef products into their annual supply. This supports the wider transition to more sustainable consumption habits across New England and in institutions across the nation. However, it is clear that any level of beef consumption has a significant carbon footprint, and therefore **we suggest that BC also transitions to plant-based food product substitutions**. For example, by **omitting hamburgers** on campus for just one day per week, BC **would reduce its carbon footprint by 122,717 lb. $CO_2e$**.

**Figure 4** below illustrates the impacts of substituting the caloric intake of beef for the 2017-2018 year with the same caloric intake of **chicken**, **lentils**, and **soybeans**. Figure 4 demonstrates the advantages in delivering the equivalent caloric benefit with much lower emissions intensity for lentils and soybeans over beef and chicken. This suggests that **plant-based options** are the **primary path to reducing BC Dining's carbon footprint**.

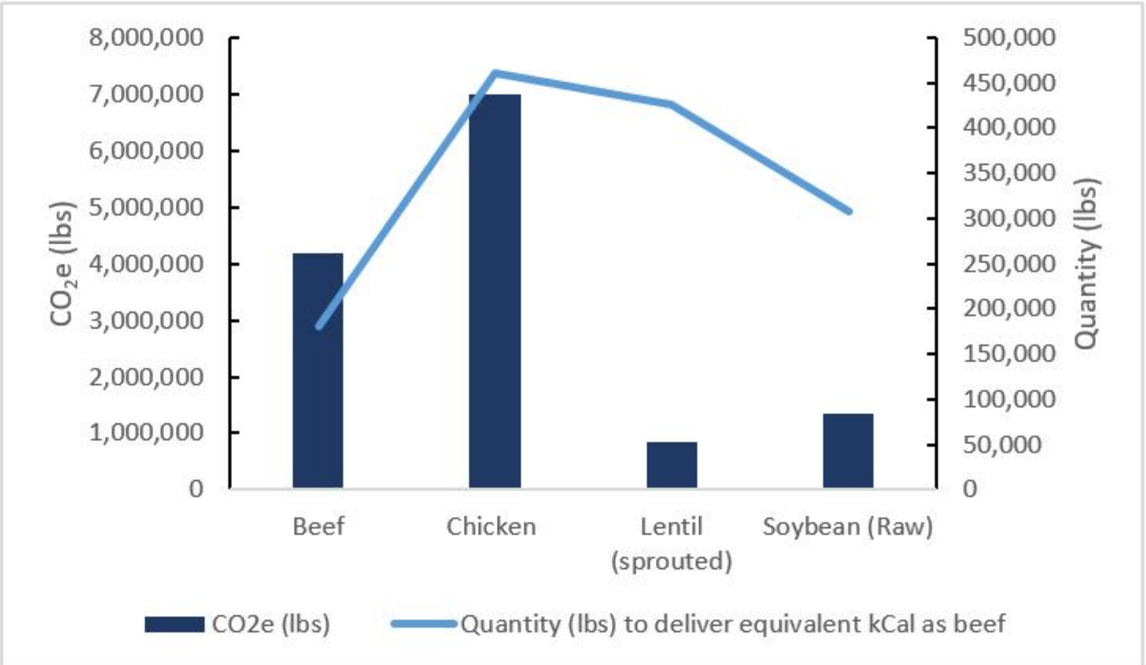


**Figure 4:** GHG emissions for beef substitutes based on equivalent caloric value

## Discussion:

The discrepancies in $CO_2e$ estimates between conventional and grass-fed systems may be surprising to the general consumer.

Grass-fed has long been considered the ethical and sustainable way to raise beef, but the results of this study suggest otherwise. This is primarily due to the **longer time it takes for grass-fed cattle to mature**, the **increase land use**, and the **need to graze on marginal land regions** (Chapman et al. 2017).

Although the GHG emissions appear to be greater in grass-fed conditions, these systems yield a significant number of positive environmental benefits, including the **capacity for carbon sequestration**, **nutrient cycling**, **water management**, and **biodiversity and soil health restoration and preservation** (Clark & Tilman 2017).

A key challenge in this study was the **lack of transparency** between vendors (e.g. processors and distributors) and their clients and consumers. In collecting information via company websites and phone calls, it became clear that the **production method, feed type, and geographic sourcing of beef products was not intended for public knowledge**.

Eventually, a source from Dans Prize revealed that **graded USDA Select beef** is assumed to be **conventionally-raised, grain-fed beef**, validating our final results.


## Acknowledgements:

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