Beef’s role in a sustainable food system

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Beef’s cattle’s upcycling superpower
Enteric methane emissions account for nearly half of US beef’s carbon footprint.
Enteric methane emissions in the context of US GHG emissions

According to the UN FAO STAT database, enteric methane emissions from U.S. beef cattle have declined by 34% since 1975.

Source: US EPA GHG Emissions Inventory, 2016
What is enteric methane?

Methane emissions naturally created by microorganisms in the rumen/digestive tract.

95-98% of the methane exits the animal’s mouth.

Cattle diets that contain **more high-fiber forages**, like hay and grasses, **increase methane emissions**.

Cattle diets that contain **more grains**, like corn, **decrease methane emissions**.
Cattle are upcyclers: more than simply recycling they are upgrading plant proteins (incl. plant leftovers) into higher quality protein for people.

Solar energy

1 lb. human edible protein

Upcycling

1.19 lb. human edible protein

High quality protein, B vitamins, iron, zinc

Human edible and inedible plants

Greater than 90% of what grain finished beef cattle eat is not in competition with the human food supply – upcycling is the fundamental value beef brings to a sustainable food system!

Source: CAST, 1999 and NASEM, 2016
Why feed cattle corn? Because they upgrade the protein

<table>
<thead>
<tr>
<th>Essential amino acid</th>
<th>Corn grain, g/kg</th>
<th>Beef, g/kg of choice grade carcass weight</th>
<th>% more essential AA in kg of beef compared to kg of corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tryptophan</td>
<td>0.67</td>
<td>2.01</td>
<td>300%</td>
</tr>
<tr>
<td>Threonine</td>
<td>3.54</td>
<td>7.46</td>
<td>211%</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>3.37</td>
<td>7.67</td>
<td>228%</td>
</tr>
<tr>
<td>Leucine</td>
<td>11.55</td>
<td>13.76</td>
<td>119%</td>
</tr>
<tr>
<td>Lysine</td>
<td>2.65</td>
<td>14.43</td>
<td>545%</td>
</tr>
<tr>
<td>Methionine</td>
<td>1.97</td>
<td>4.3</td>
<td>218%</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>4.63</td>
<td>6.7</td>
<td>145%</td>
</tr>
<tr>
<td>Valine</td>
<td>4.77</td>
<td>8.42</td>
<td>177%</td>
</tr>
<tr>
<td>Histidine</td>
<td>2.87</td>
<td>5.79</td>
<td>202%</td>
</tr>
<tr>
<td>Arginine</td>
<td>4.7</td>
<td>11.2</td>
<td>235%</td>
</tr>
</tbody>
</table>

Source: National Nutrient Database for Standard Reference Release 28
Livestock: On our plates or eating at the table?

- 86% of what livestock eat globally isn’t in competition with human food
- Contrary to commonly cited figures, 1 kg of meat requires 2.8 kg of human-edible feed for ruminants and 3.2 for monogastrics (e.g., pigs, chickens)
- For every 0.6 kg of human edible protein cattle eat, they return 1 kg of human edible protein in the form of beef

Beef cattle allow us to produce food on land unsuitable for cultivation, while enhancing ecosystems.
770 million acres of rangeland unsuitable for growing crops in the United States

Source: USDA-ERS
70.9% of cow-calf operations in Midwest and Northern Plains graze crop residues

Source: Asem-Hiablie et al., 2016. Prof. Anim. Sci. 32:736-749
~1.9 million cattle graze small grains in KS, OK, and TX

Source: USDA-NASS
The United States has the most environmentally-efficient beef production system in the world.

And the U.S. beef community continues to shrink its environmental footprint.

Source: US Beef Sustainability Assessment
Livestock’s Long Shadow

“The Livestock sector is a major player, responsible for 18% of GHG emissions measured in CO$_2$e. This is a higher share than transport” (FAO 2006)

- Used Life Cycle Assessment
  - Included “land use change”
Clearing the air...

- Livestock's Long Shadow is a global assessment, should not be applied regionally
  - US: 3.8% of GHG emissions (beef = 2%)
  - Paraguay: ~50%
  - Ethiopia: ~90%
- Transport was not analyzed with LCA method

One of the authors of Livestock's Long Shadow, FAO livestock policy officer Pierre Gerber, told BBC News he accepted Dr. Mitloehner's criticism.

"I must say honestly that he has a point - we factored in everything for meat emissions, and we didn't do the same thing with transport, we just used the figure from the IPCC," he said.
Carbon footprint of US beef is lower than many parts of the world

Figure S 47. GHG efficiency of bovine meat production (expressed in kg CO₂eq/g protein) in the year 2000

Achieving U.S.-level productivity around the world would improve sustainability

Number of beef and dairy cattle in the world

- Current global beef production and cattle herd
- Current beef production with U.S. efficiency
- Doubled beef production with U.S. efficiency
- Cut beef consumption in half with current global efficiency

Pounds of global beef production

Source: UN Food and Agriculture Organization FAOSTAT database
Achieving the average emission intensity of the 10th percentile for beef and dairy production would lower global GHG emissions 3% with no change in beef and dairy product output!

Source: UN FAO, 2013. Tackling Climate Change through Livestock
US cattle inventory and beef production trends (1930 – 2015)

Compared to 1975, 33% fewer cattle were required to produce the same amount of beef in 2015.

Source: USDA-NASS
The Beef Checkoff Program launched a comprehensive lifecycle assessment to quantify and benchmark environmental, social and economic aspects of beef industry sustainability from 2005 - 2011. Improvements included:

- 10% Emissions to water
- 7% Emissions to soil
- 2% Greenhouse gas emissions
- 32% Occupational illnesses and accidents
- 2% Energy use
- 2% Resource consumption
- 3% Water use

How was sustainability improved?

- Increased use of precision farming techniques
- Improvements in crop yields
- Improved genetics, health and nutrition for cattle
- Increased use of biogas capture and conversion
- Improved implementation of right-sized packaging

Future opportunities to further increase sustainability:

- Continue to increase waste and water recovery and biogas capture
- Explore additional packing alternatives to reduce inputs
- Reduce food waste
- Continue to optimize nutrient application to soil and crop yields
- Further adoption of water efficient irrigation systems

Committed to a journey of continuous improvement

Source: Beef Industry Sustainability Lifecycle Assessment, funded by the beef checkoff
How much water does it take to produce beef?

Range of water use estimates in the literature: 317 – 23,965 gallons per lb. of boneless beef

Blue water = surface and groundwater

Green water = evapotranspiration water (precipitation)

Gray water = water required to dilute out pollutants

Figure 1. Examples of opportunities to reduce the water footprint of beef throughout the beef value chain.*

Beef production is responsible for about 2% of U.S. greenhouse gas emissions.

Source: U.S. EPA GHG Inventory, 2016
Continuing to reduce the environmental footprint of beef, and all foods, is important.

But, are we missing other important “food system” sustainability issues, by focusing only on environmental footprints of individual foods?
If every American went vegan, we’d reduce U.S. greenhouse gas emissions 2.6% (which is 0.36% of global emissions)*

*This assumes all livestock in the U.S. would disappear

“Overall, the removal of animals resulted in diets that are nonviable in the long or short term to support the nutritional needs of the US population without nutrient supplementation.”

The sustainability of our food systems requires balancing multiple important criteria.

Overarching needs:
- Whole systems approaches
  - Focus on the nexus of different aspects of sustainability
- Characterize and quantify interrelatedness of food, fiber, and fuel industries
- Recognize the role of value judgments and uncertainty

Environment:
- Environmental footprints
- Ecosystem services/biodiversity
- Multi-functionality of land use
- Considering feed use from a human edible standpoint

Economic:
- Producer economic viability
- Contributions to rural economies
- Affordability of beef to consumers

Social:
- Nutritional quality
- Animal welfare
- Antibiotic/technology use
- Culture/traditions of producers and eaters
Bottom line:

• Beef production affects the environment as does all food production and human activity

• Environmental impacts per unit of beef have been declining over the past several decades

• U.S. beef production has one of the lowest carbon footprints in the world

• Higher “footprints” of beef (land, carbon, water) are driven by the unique biology of cattle that allows them to upcycle protein and produce food on land unsuitable for cultivated agriculture
  • Sustainability is about tradeoffs and nuance (e.g., land used for beef production is multifunctional)
Safe, nutritious, high quality beef production while balancing economic viability, environmental stewardship, and social responsibility.

All systems can be sustainable – focus is on continuous improvement within all systems.
THANK YOU

For more information, please visit:
http://beefresearch.org/beefsustainability.aspx