A view on the sustainability of U.S. beef production

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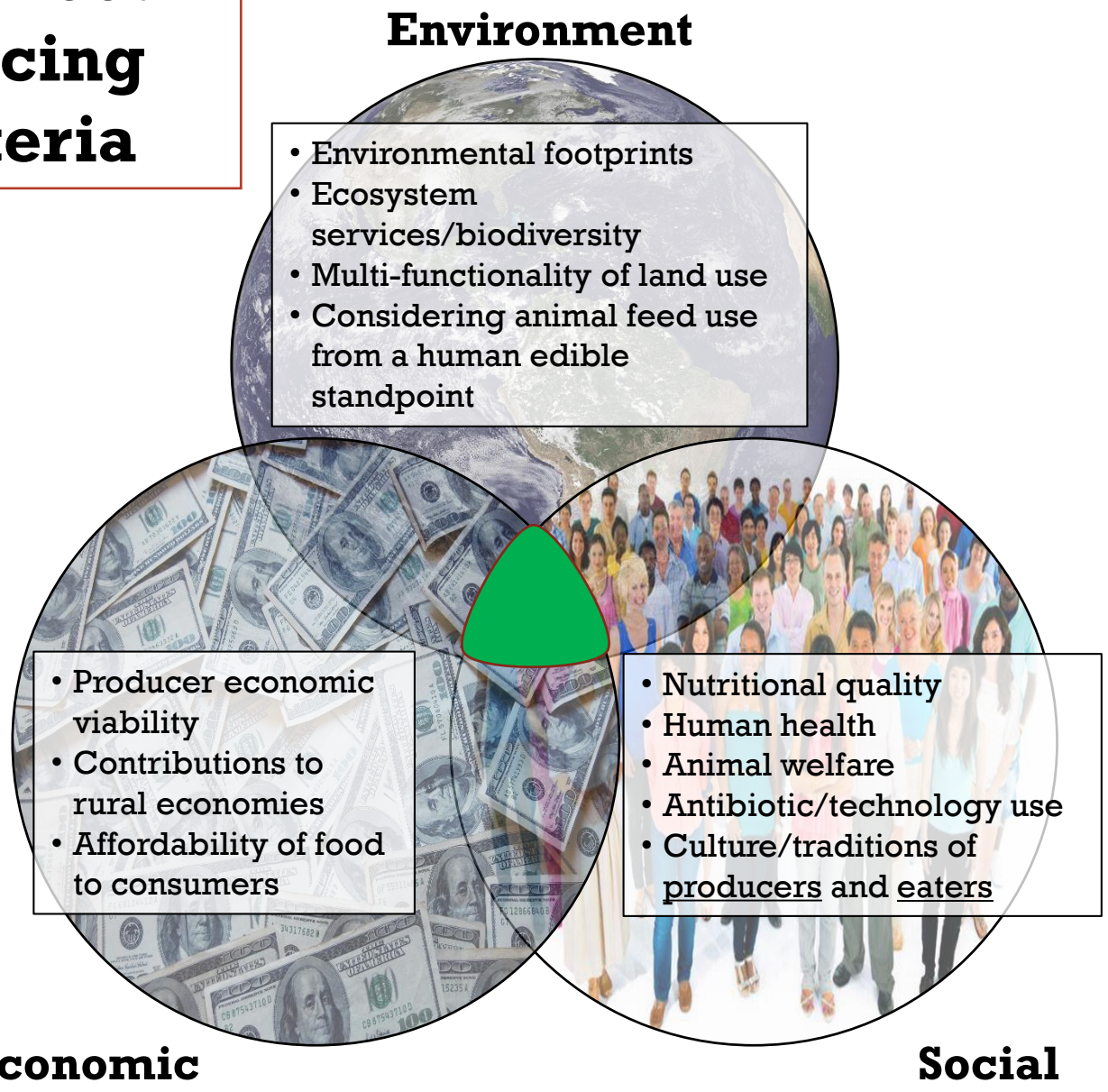
National Cattlemen's Beef Association, a contractor with the Beef Checkoff

Funded by Beef Farmers & Ranchers

The sustainability of our food systems requires balancing multiple important criteria

<u>Overarching needs</u>:

- Whole systems approaches
  - Focus on the nexus of different aspects of sustainability
  - Characterize and quantify interrelatedness of food, fiber, and fuel industries and integration of plant and animal agriculture
- Recognize the role of value judgments and uncertainty



Cattle inventory on January 1st, 2017

(excluding the 4.7 mil. dairy replacement heifers and 9.3 mil. dairy cows)

Cow-calf segment

(grazing or high forage diet [e.g., hay in winter months])

- Beef cows – 31,213,200
- Beef replacement heifers – 6,368,200
- Bulls – 2,243,600
- Calves <500lbs. – 14,386,300
- **Total in segment on Jan. 1, 2017: 54,211,300**

Stockers/backgrounding

(grazing or high forage diet)

- **Steers and heifers bound for a feedlot, but consuming high forage diet (cheap body weight gain): 12,326,300**
- This segment is in flux continuously – length of time in the stocker phase is determined by market conditions and the availability of cheap forage/grass

Cattle on feed

(in feedlots, consuming grain-based diet)

- **Steers and heifers eating grain-based diet for 4-6 months: 13,067,000**
- Cattle on feed inventory will fluctuate throughout the year (peaks in the fall), but is typically in the 13 to 15 million head range all year. These are the only cattle in the US eating a grain-based diet.
- Avg. diet for US feedlot cattle: 55% grain, 30% plant leftovers (e.g., distillers grains) 10% forage, 5% minerals and vitamins (NASEM, 2016)

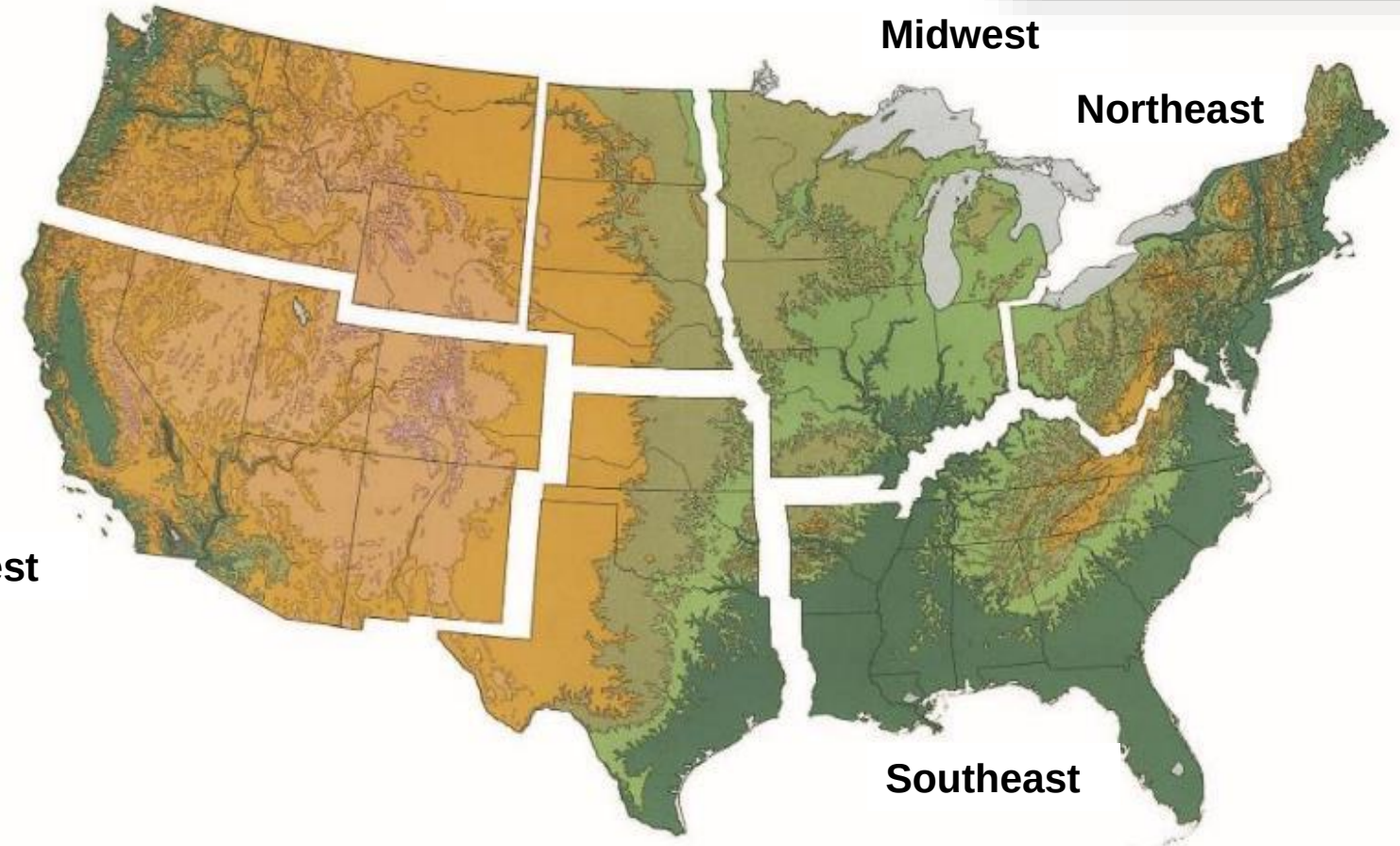
Source: USDA NASS January Cattle report

Northwest

Northern Plains

Midwest

Northeast



Southwest

Southeast

Southern Plains

Agricultural Systems
Volume 169, February 2019, Pages 1-13

Environmental footprints of beef cattle production in the United States

C. Alan Rotz [a], Senorpe Asem-Hiablie [a], Sara Place [b], Greg Thoma [c]

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https://doi.org/10.1016/j.agsy.2018.11.005

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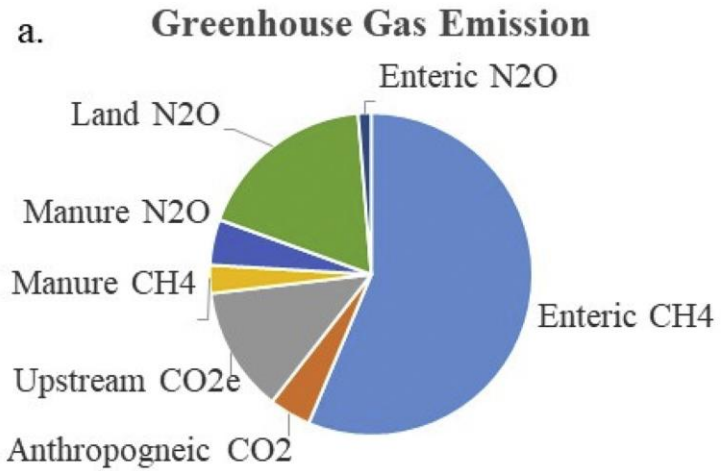
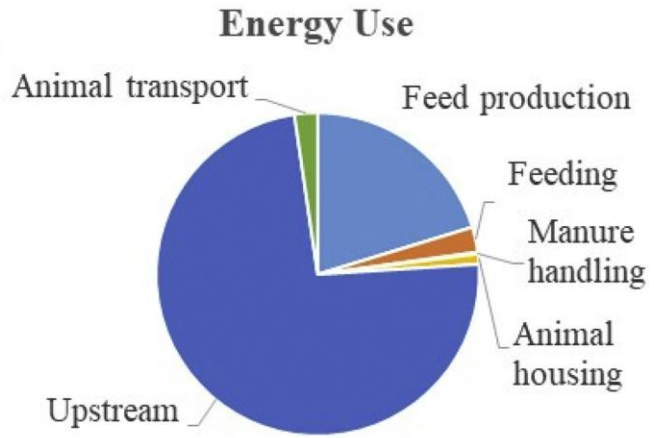
Distribution of environmental footprint across sources (regional ranges)

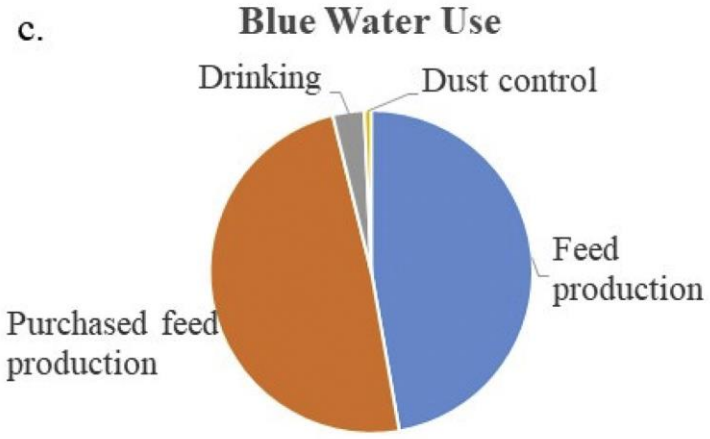
17 - 27 kg CO_2e / kg carcass weight

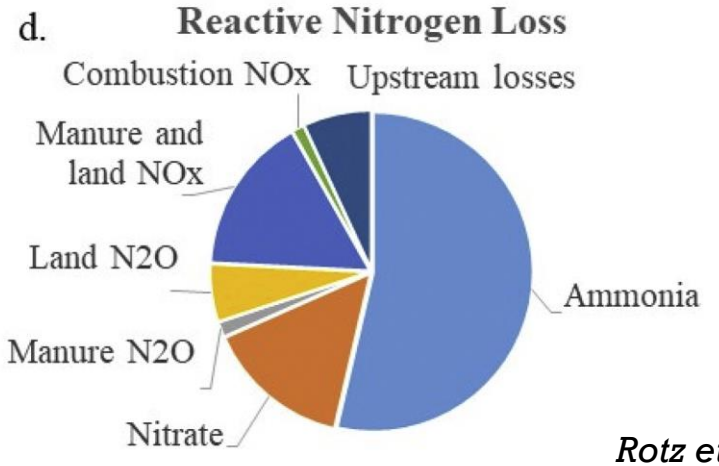




40-60 MJ / kg carcass weight

200 – 5,800 L/kg carcass weight

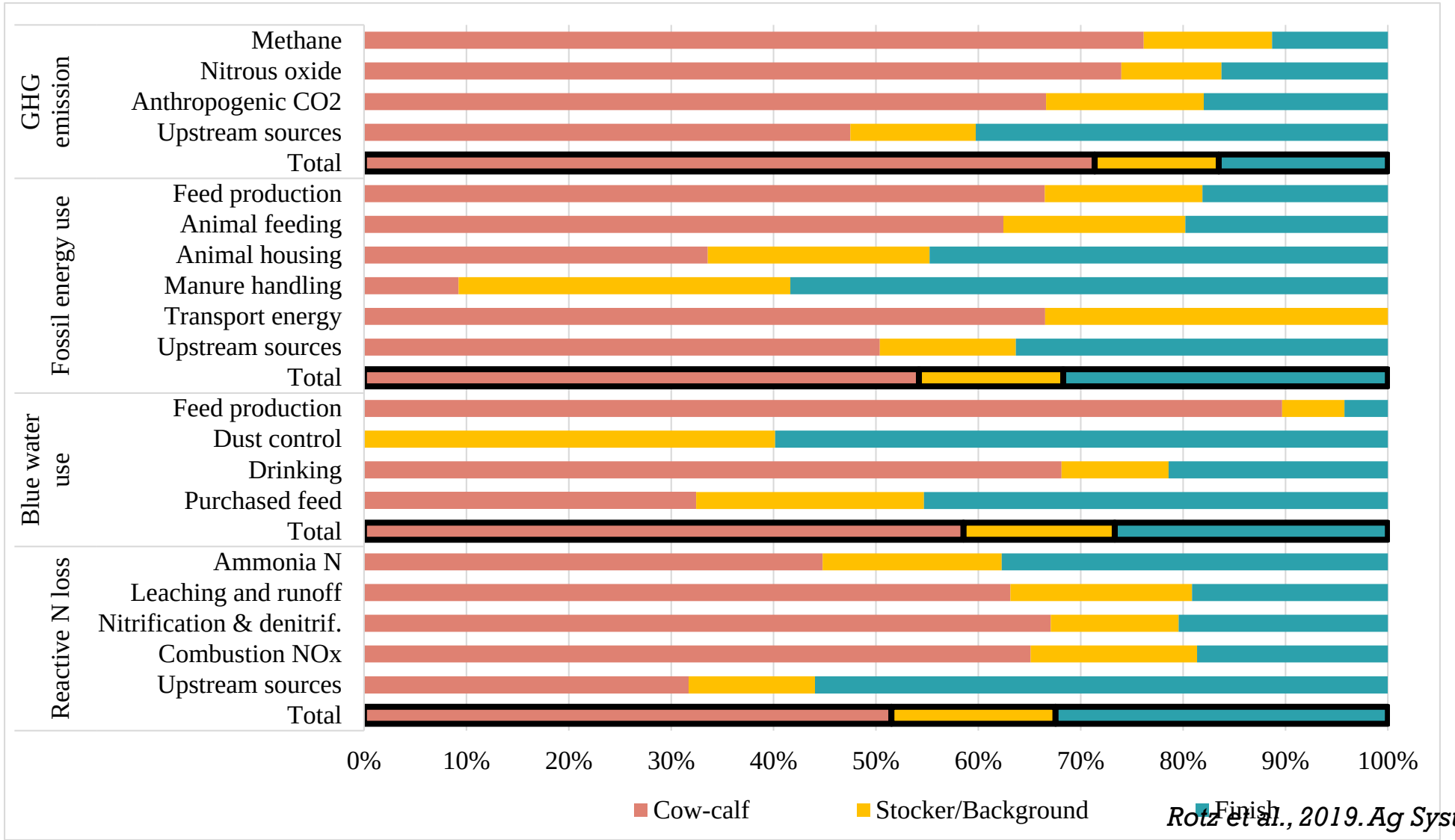




121 – 257 g N / kg carcass weight

Rotz et al., 2019. Ag Syst. 169 (Feb.):1-13.

Distribution among Phases



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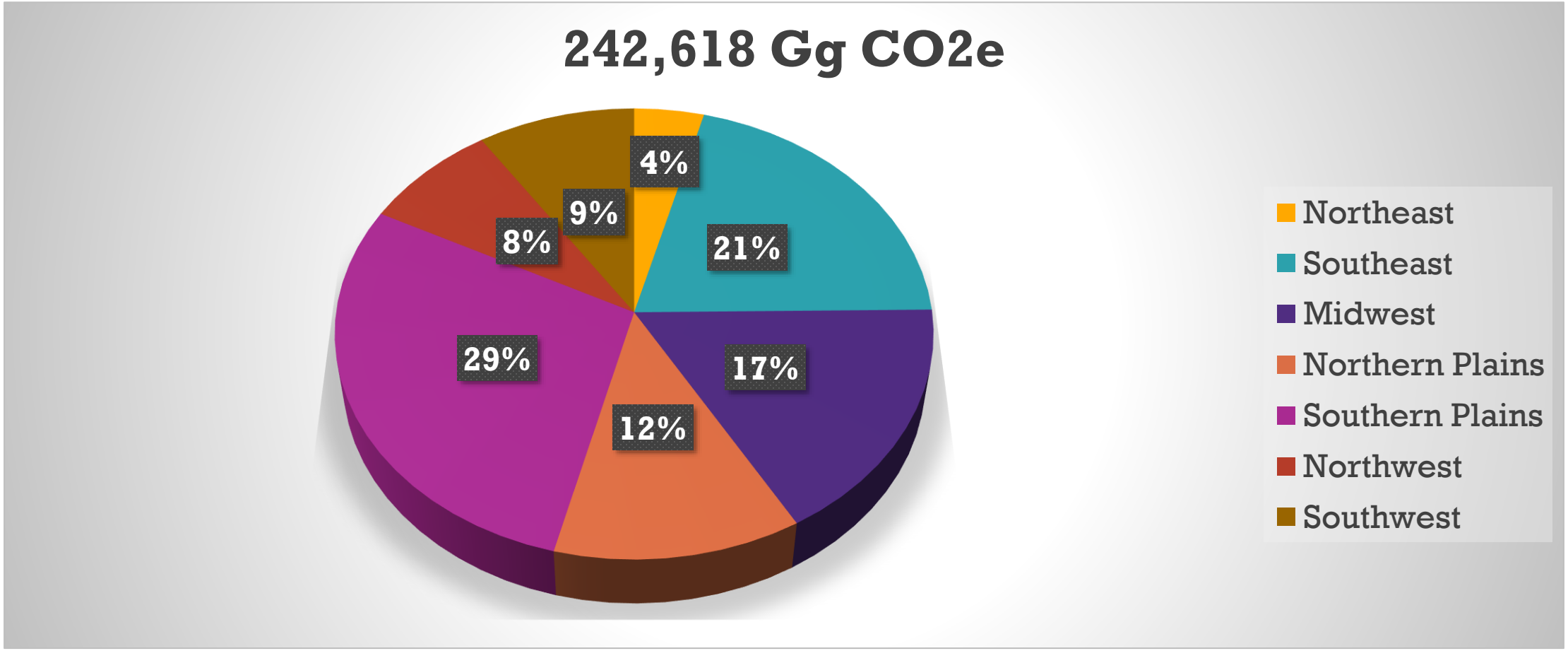
Greenhouse Gas Emission



3.3% of US GHG emissions

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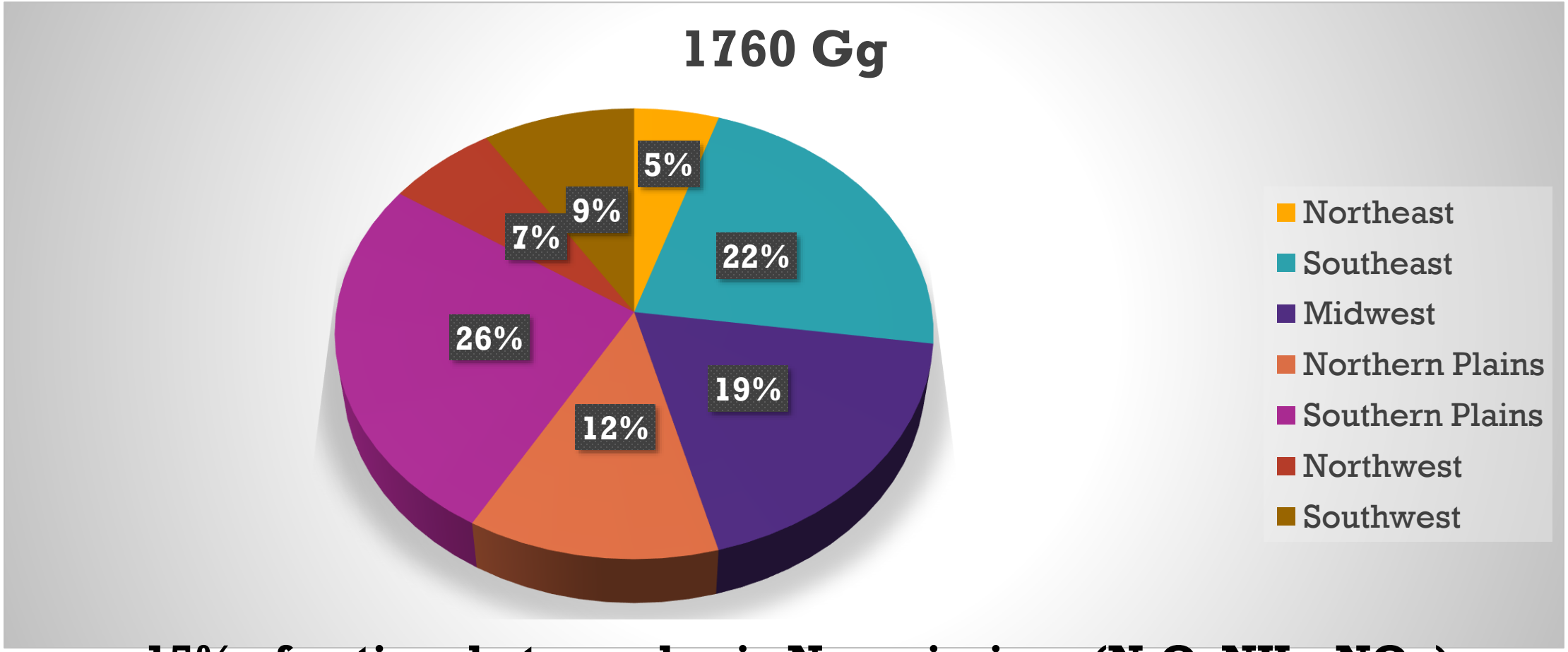
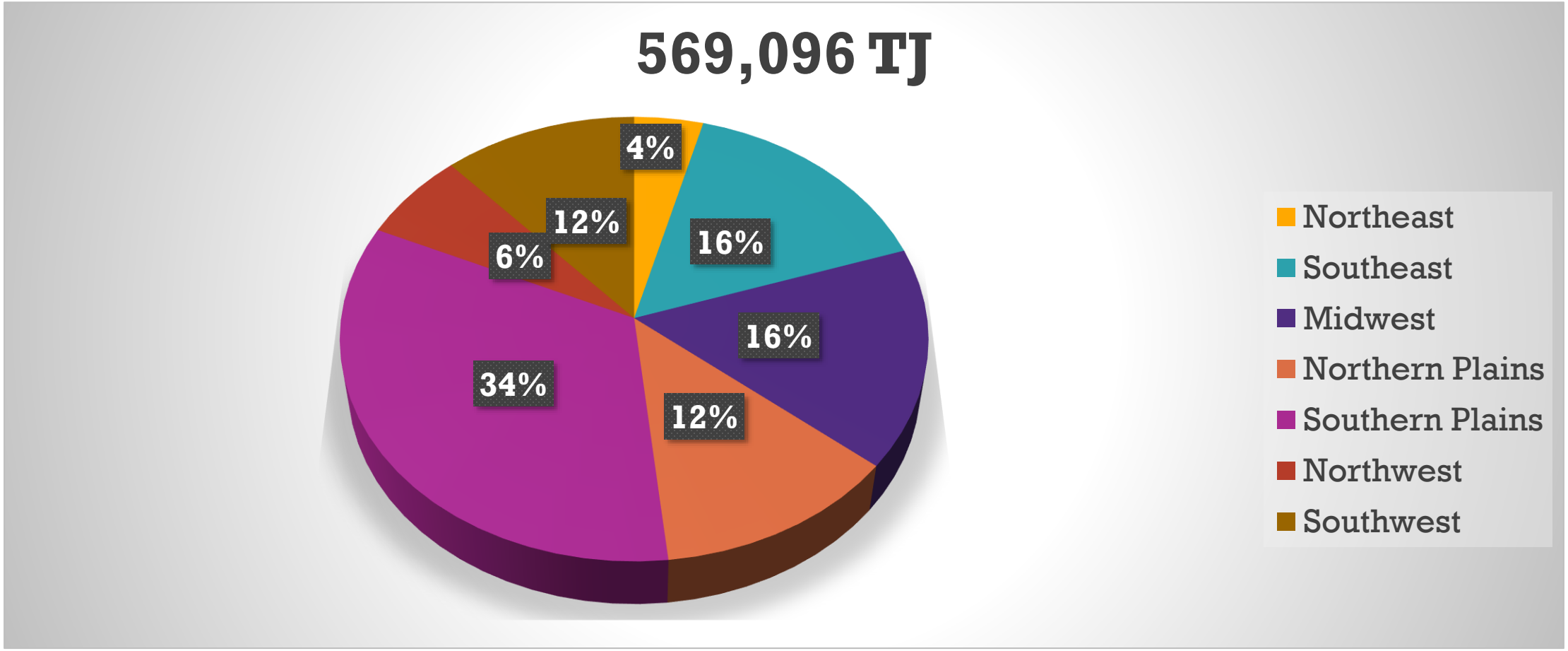
Reactive Nitrogen Loss



~15% of national atmospheric Nr emissions (N_2O, NH_3, NOx) estimated by Reis et al., 2009

Rotz et al., 2019. Ag Syst. 169 (Feb.):1-13.

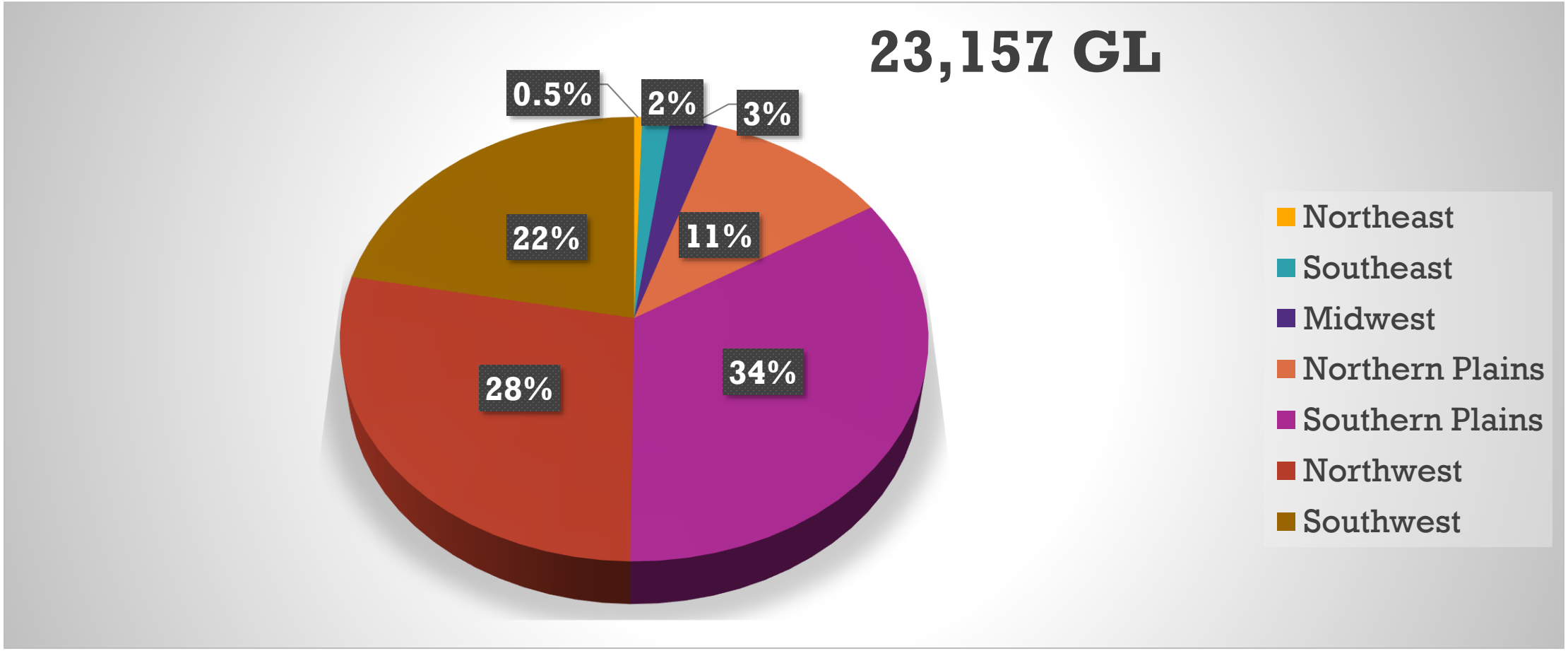
Fossil Energy Use



0.7% of US fossil fuel combustion

Rotz et al., 2019. Ag Syst. 169 (Feb.):1-13.

Blue Water Consumption



~5% of US water withdrawals

Rotz et al., 2019. Ag Syst. 169 (Feb.):1-13.

National average feed consumption for beef

Life cycle dry matter feed requirements per kg of beef carcass weight (CW) produced in the United States

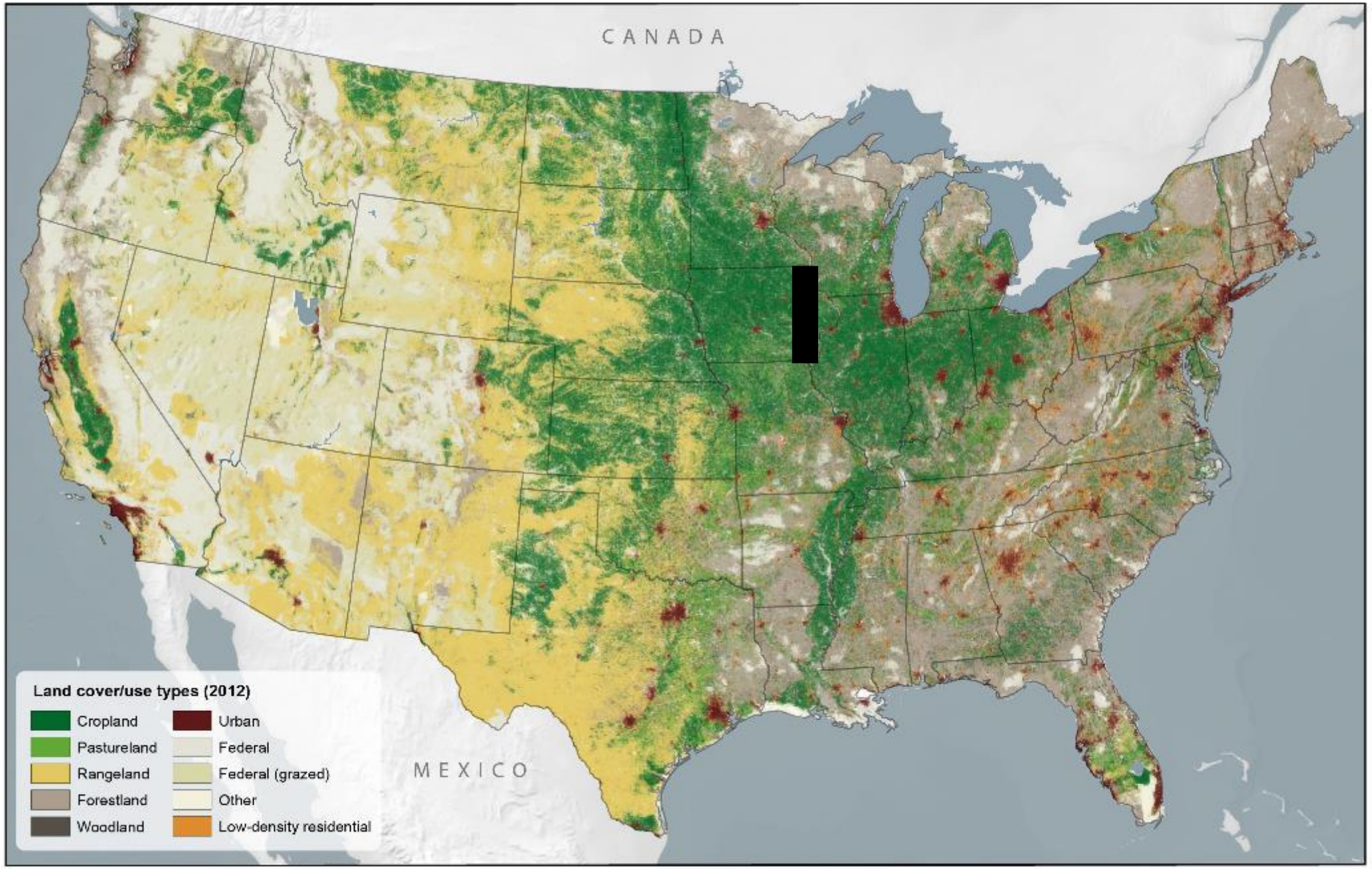
Feed consumption	Cow-calf	Stocker or background	Finish	Total
Grazed forage	12.3	0.89	0.00	13.2
Harvested forage	3.2	1.30	0.62	5.1
Grain concentrate[a]	0.2	0.15	2.22	**2.6**
Other feed[b]	0.5	0.12	0.87	1.5
Total	16.2	2.36	3.72	22.3

[a] Primarily corn, but may include other grains fed to cattle.
[b] Distillers grain, other byproduct feeds (corn gluten feed, soybean meal, cottonseed, etc.) and waste (bakery, potato, almond hulls, etc.) unsuitable for human consumption.

Rotz et al., 2019. Ag Syst. 169 (Feb.):1-13.

	Pounds of feed per pound of product, live weight	Pounds of human-edible feed (e.g., corn, soy) per pound of product, live weight	Net protein contribution** (values > 1 mean more high quality protein generated than used)
U.S. average grain-finished beef *(full life cycle)** 	**13.8**	**1.6**	**2.53**
Broiler chicken *(Avigen ROSS 308 @ 40 days)* 	**1.6**	**1.4**	**0.85**
Pork *(Wilkinson, 2011)* 	**2.5**	**2.0**	**0.70**

*From *Rotz et al., 2019. Ag Syst. 169 (Feb.):1-13.* **Using DIAAS from Ertl et al., 2016



Source: https://www.farmland.org/initiatives/farms-under-threat

Estimation of human-edible protein conversion efficiency, net protein contribution, and enteric methane production from beef production in the United States

Jessica R Baber, Jason E Sawyer, Tryon A Wickersham

Translational Animal Science, Volume 2, Issue 4, 1 October 2018, Pages 439–450, https://doi.org/10.1093/tas/txy086

Published: 07 July 2018

HOARD'S DAIRYMAN INTEL Oct. 29 2018 08:04 AM

33

Cattle quadruple the protein value of corn

BY ABBY BAUER, ASSOCIATE EDITOR

It takes approximately 1,400 pounds of corn to finish out a steer. Would we be better off feeding that corn to humans instead?

"Our results suggest that each individual beef sector and the entire value chain produce more high-quality HeP (human-edible protein) than is consumed in production. **Accordingly, beef is a net contributor to meeting human protein requirements**."

So, how many 3-year-olds could reach their protein requirements, or more specifically their amino acid requirements, with 1,400 pounds of corn?

Wickersham said that amount of corn would meet the annual protein requirement for half a child. He was quick to point out that half a child is still valuable; however, he also explained that to consume 1,400 pounds of corn in one year, a child would have to eat nearly 4 pounds of corn per day, which is a lot.

"In general, humans are not deficient in calories. They tend to be more deficient in nutrients," Wickersham noted. That child would likely become obese before reaching the protein requirement if he or she ate that much corn.

On the other hand, if we feed the corn to a steer and it converts those nutrients into beef, that amount of beef would meet the annual amino acid requirements of two children. By moving that corn through cattle, we are able to quadruple the amount of human-edible protein, and it's in a format that is more nutrient efficient (less calories) and more desired by most people.

Ecosystem services

Ecosystems are communities of living organisms interacting with their physical environment and one another.

Ecosystem services are the benefits which people obtain from the ecosystem. In most cases, ecosystems provide these services at little or no financial cost & the benefits can accrue to an individual or to society as a whole.

Ecosystem service category	Examples of ecosystem services within category
Provisioning	Food; Fresh water; Fiber; Fuelwood;
Supporting	Cycling of nutrients; Soil building, preservation, and fertility renewal; Photosynthesis
Regulating	Regulation of disease carrying organisms; Climate stability; Moderation of weather extremes; Agricultural pest control; Air and water purification; Polination of natural vegetation and crops; Decomposition and detoxification of wastes
Cultural	Support of spiritual and cultural heritage; Educational, aesthetic and recreational opportunities

Source: Goodman and Reuter, 2017.

Ecosystem services

"…an estimated total economic value of ecosystem services for beef cattle ranching of $57.67 per acre of pasture and rangeland. Applying this per-acre value to the 257 million acres of pasture and rangeland used for beef production by ranching and farming operations in the United States, results in an estimated $14.8 billion in total ecosystem services provided annually."

BEEF FACTS: SUSTAINABILITY | BEEF RESEARCH

The Economic Value of U.S. Beef Cattle Ranching– and Farming-Based Ecosystem Services

David T. Taylor, Nicolas Efrain Quintana Ashwell, Kristie Maczko, and John Tanaka
University of Wyoming, College of Agriculture

Introduction

The 2012 Census of Agriculture classified nearly 620,000 agricultural operations in the United States as beef cattle ranches and farms (USDA, 2014). These ranches and farms managed 337 million acres of land, excluding grazing land used under government permits on a per-head basis. This land represents one in every five acres of non-metro, non-urban land in the nation. This land supported 20.4 million head of beef cows in 2012. The production from these ranches and farms generated $33.9 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches and farms in the United States was estimated to be $523.4 billion. U.S. beef cattle ranches and farms also employed 1.9 million workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching and farming. Additional economic values associated with beef cattle ranching and farming also include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. Due to the sustainable nature of beef cattle ranching and farming, these operations provide a flow of ecosystem services that would not be available from most other potential alternative land uses. The purpose of this report is to summarize, to the extent possible, the economic value of U.S. beef cattle ranching- and farming-based ecosystem services. This checkoff-funded project was commissioned by the National Cattlemen's Beef Association, a contractor to the Beef Checkoff, and includes a state-by-state analysis of ecosystem services from beef cattle ranching.

Methodology

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreational benefits. Because many of these ecosystem service attributes are not traded in a formal market, it is difficult to comprehensively quantify the economic values of all of these attributes.

However, building on the work by Rashford et al. (2013), it is possible to estimate the economic value of several major aspects of beef cattle ranching- and farming-related ecosystem services using readily available data. Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in the United States. Forage production values are based on National Agricultural Statistic Service pasture rental rate data (NASS, 2018). General ecosystem services values are based on USDA, Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to

Results

Table 1 summarizes the value of U.S. beef cattle ranching- and farming-based ecosystem services. The per-acre economic values of annual ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in the United States are estimated to be $12.43, $7.14, and $38.11, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $57.67 per acre of pasture and rangeland. Applying this per-acre value to the 257 million acres of pasture and rangeland used for beef production by ranching and farming operations in the United States, results in an estimated $14.8 billion in total ecosystem services provided annually. On a per-head basis, this represents $726.01 of ecosystem services per beef cow per year. On a per-pound basis, this represents $0.86 of ecosystem services per pound of retail beef. In summary, beef cattle ranching and farming in the United States is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

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Table 1. Value of U.S. Beef Cattle Ranching and Farming Ecosystem Services

Forage Production (Per Acre)	$12.43	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$7.14	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	281,884,000	(USFWS)
Economic Value Per Day	$94.93	(USFWS)
Hunting Economic Value	$26,759,214,671	
Fresh Water Fishing Days	443,223,000	(USFWS)
Economic Value Per Day	$52.50	(USFWS)
Fishing Economic Value	$23,268,809,061	
Wildlife Watching Days	335,625,000	(USFWS)
Economic Value Per Day	$38.83	(USFWS)
Watching Economic Value	$13,033,980,583	
Total Wildlife Value	$63,062,004,315	
Habitat Acres	1,654,690,539	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$38.11	
Total Value Per Acre	$57.67	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	256,861,597	(2012 Census of Ag)
Total Value Per Acre	$57.67	
Cattle Ranching Economic Value	$14,813,875,051	
Cattle Ranching Economic Value	$14,813,875,051	
Beef Cows	20,404,406	(2012 Census of Ag)
Economic Value Per Beef Cow	$726.01	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.86	

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