

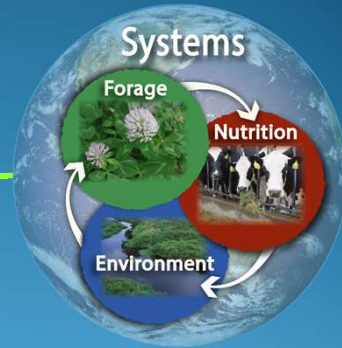


United States Department of Agriculture

What If There Were No Animal Agriculture?

Mary Beth Hall, PhD

U.S. Dairy Forage Research Center
USDA - Agricultural Research Service



DPC 11/8/19

Livestock In The U.S.



- ☀ Employs 1.6 million people
- ☀ \$31.8 billion in exports
- ☀ Recycle 47.6 million tons of human-inedible by-products of food, fiber, & biofuel
- ☀ Adhesives, ceramics, cosmetics, fertilizer, germicides, textiles, ointments, heart valves, etc.
- ☀ Convert resources that people cannot use into things we can.



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Livestock In The News



Is the Livestock Industry Destroying the Planet?

SMITHSONIAN.COM

Our results suggest that vegetarians have a significantly lower ischemic heart disease mortality (29%) and overall cancer incidence (18%) than nonvegetarians.

Huang et al. (2012) *Annals Nutr. & Metab.* 60:233-240



Researchers Say Only Way to Guarantee Enough Food in 2050 Is if the World Turns Vegan

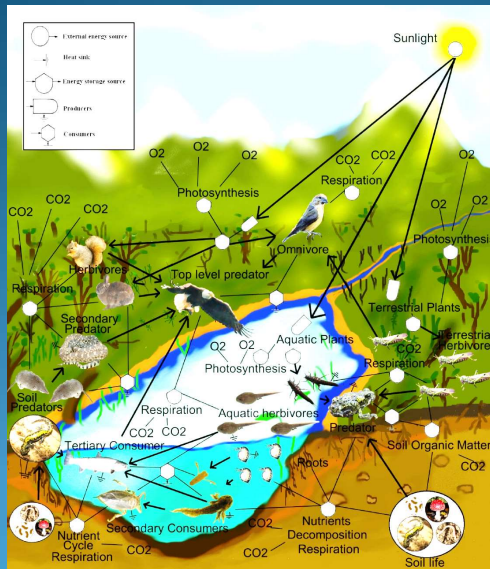
Livestock pollute water & air, erode land, cause deforestation, are inefficient, compete with people for food & water....



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Food Webs & Sustainability



Food webs show how resources cycle through natural systems.

Balance within a system determines sustainability.

By Thompsma (Own work) [CC0], via Wikimedia Commons

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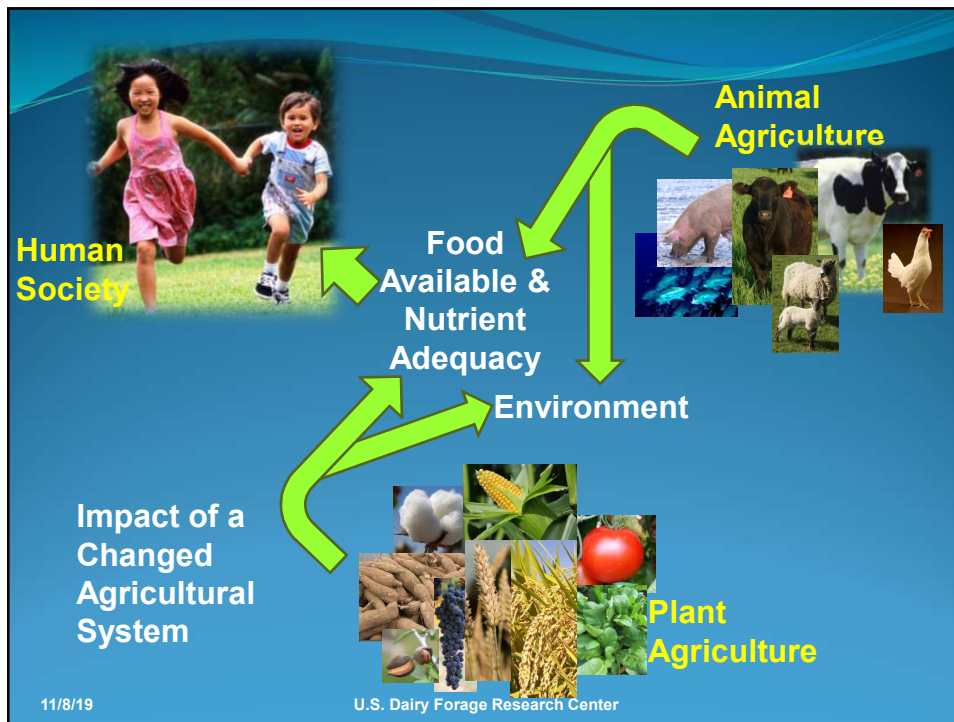
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What would U.S. food supply, meeting U.S. nutrient requirements, and green house gas production look like if we removed farmed animals?

Modelled with freely available data, No outside funding, fewest assumptions, sets bounds

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- ## Data Sources
- 
- USDA-Economic Research Service
 - USDA-National Agricultural Statistics Service
 - USDA Food Composition Database
 - Published life cycle analyses
 - U. S. Census of Agriculture
 - UN Food and Agriculture Organization (FAO)
 - US Food and Drug Administration (FDA)
 - US Environmental Protection Agency
 - Other published data
- 11/8/19 U.S. Dairy Forage Research Center White and Hall, 2017




U.S. Population


- 316 million people
- 36 nutrients
- Requirements 1 year

Land

Millions of acres:


- 56.2 tillable for animals
- Reallocated to 89 crops
- 1.76 added fruits & veg
- 4.4 horse hay
- ~~415.3 nontillable pasture or range~~






Food


- 26 animal, 89 plant
- All crops except seeds, industrial use, & aflatoxin corn
- Max edible portion
- Nutrients only from foods
- Least cost diets to meet needs



69.9 dogs
74.1 cats
8.3 birds
89.4 other
10.2 horses

Rendered products
Protein 727.5 K tons
Fats 143.3 K tons








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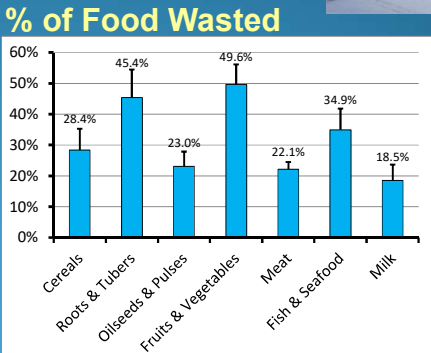
Why Not More Fruits & Vegetables?

- ☀ US imports 51% of fruits, 39% of vegetables.
- ☀ Weather/Climate/Temp
- ☀ Soil quality/Elevation/Slope
- ☀ Water availability (70% irr.)
- ☀ Food waste
- ☀ Profitability / Risk
- ☀ 3562.5-5.4% ? Conrad et al., 2017









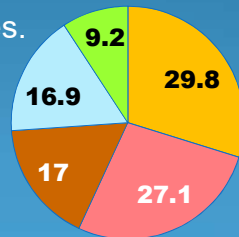
Food Category	% of Food Wasted
Cereals	28.4%
Roots & Tubers	45.4%
Oilseeds & Pulses	23.0%
Fruits & Vegetables	49.6%
Meat	22.1%
Fish & Seafood	34.9%
Milk	18.5%

Greenhouse Gas (GHG)



- 9% U.S. greenhouse gas is from agriculture
- ~50% of 9% from animal agriculture
- Removal of animals, new crops.
- Synthesis of fertilizer to replace manure.
- Incineration of human-inedible byproducts; P & K recycled to fertilizer.
- Published lifecycle analyses.

From Manure:
 N 4.42
 P 1.86 millions
 K 2.07 of tons
 S 0.31



- Industry
- Transportation
- Commercial
- Residential
- Agriculture

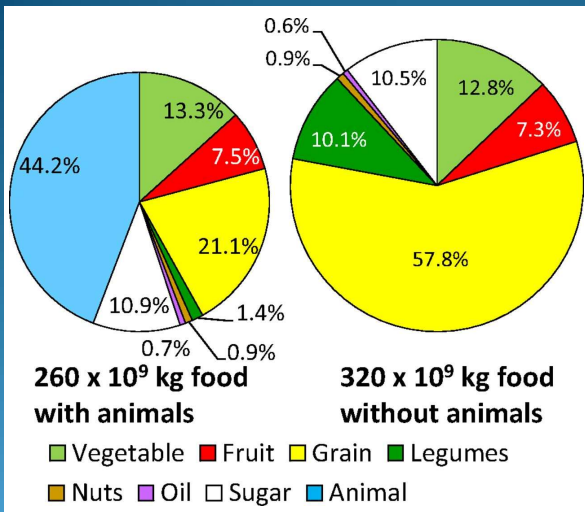
2013 CO₂ equivalents, EPA, 2017

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Results: Food Production



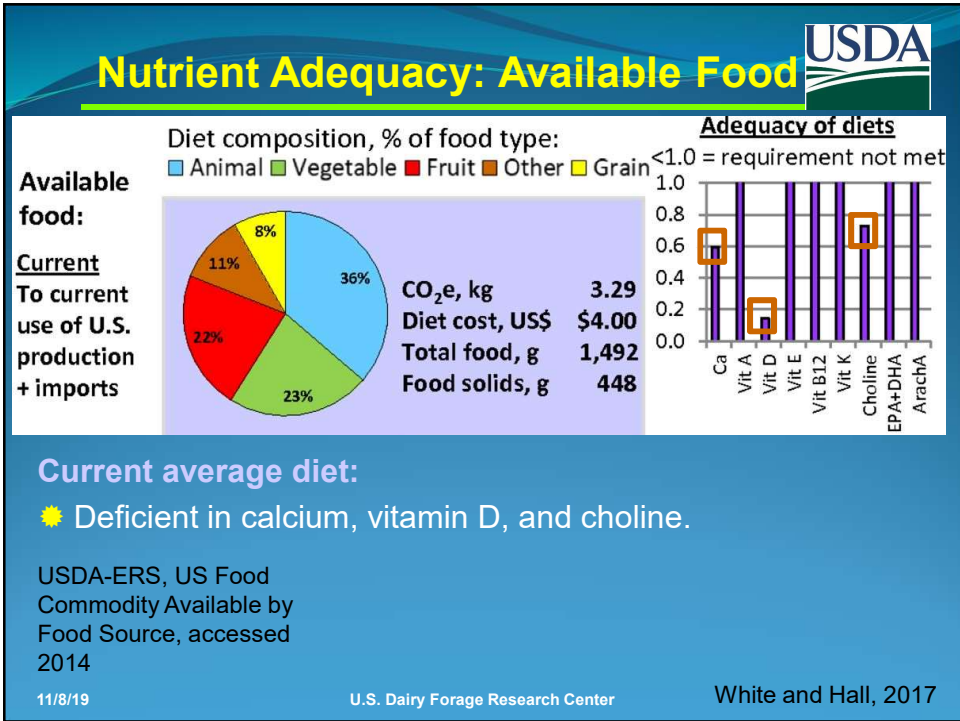
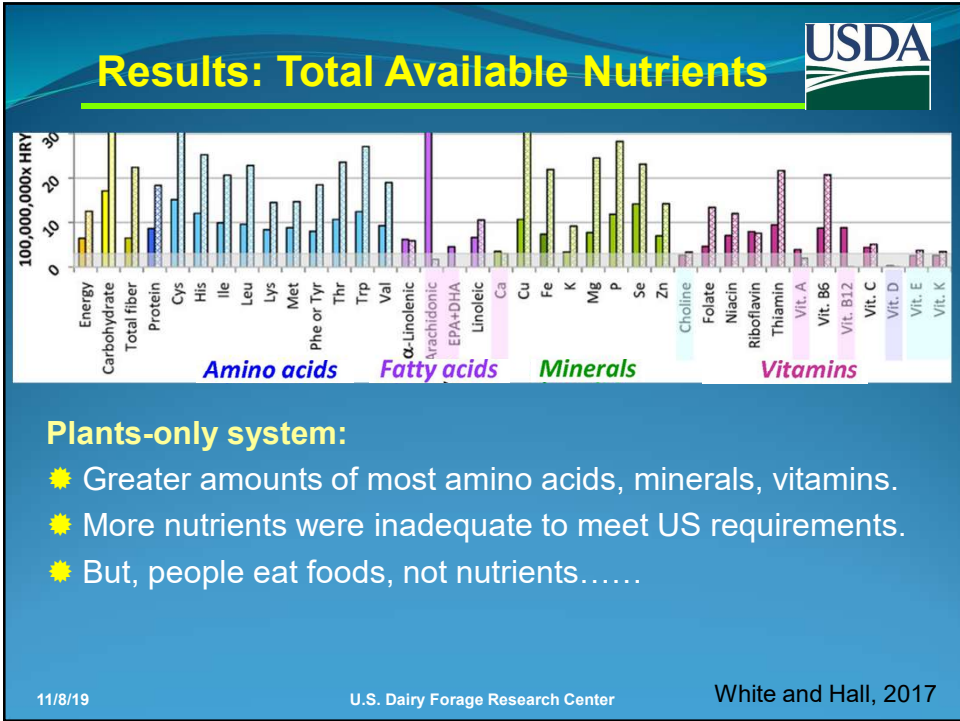
Plants-only system:

- Increased 23%, primarily as grain.
- Grain: 77% corn.
- Legumes: 92% soy and soy flour.

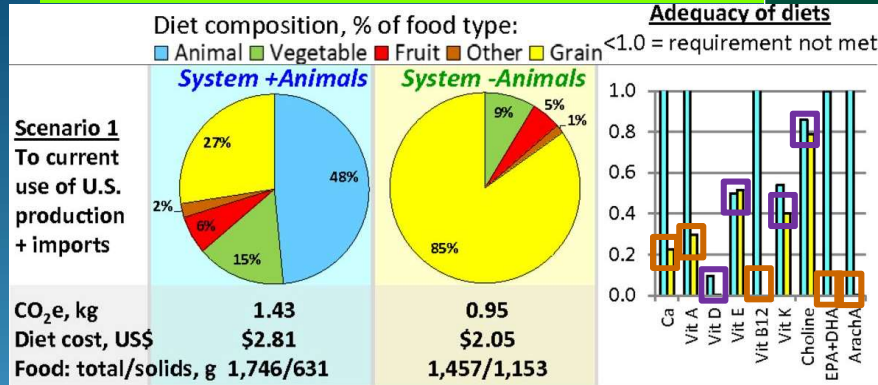
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Results: Diets From Available Food



Plants-only system:

- Lower diet cost & greenhouse gas equivalents per person.
- Deficient in more nutrients. Cifelli et al. 2016, NAHNESA, D, Ca, protein
- Greater food & calorie (145 to 230%) intakes; **density**.

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Plants-Only: Nutrient Deficiency



- Plants do not have, or have low concentrations of some nutrients.
- Without animals, everyone would have to take supplements.
- Children: a vulnerable population.



Long Chain Fatty Acids

Omega-3: EPA & DHA

Infants: Cognitive & visual development

Adults: Cardiovascular health

Omega-6: Arachidonic

Infants: Visual acuity

Calcium

Bone, electrolyte, milk
 Many physiological functions

Vitamin B12

Brain & nervous system
 Red blood cell formation

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Ca --Weaver et al., 1999

Not Considered: Protein Quality



- ☀ DIAAS: Digestible Indispensable Amino Acid Score.
- ☀ An index of nutritional quality of amino acid based on % in protein, ileal digestibility, and requirement.
- ☀ Replaces PDCAAS (Protein Digestibility-Corrected Amino Acid Score).

Food	DIAAS*
Whole milk powder	115.9
Beef	111.6
Peas	64.7
Soybean	99.6
Sunflower cake	46.4
Rapeseed cake	70.2
Wheat	42.4

*Req't for a 6 month – 3 yr old child

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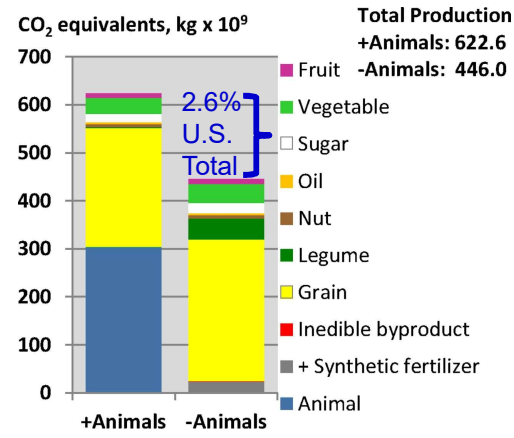
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Results: Greenhouse Gas



Agricultural GHG



Plants-only system:

- ☀ US National GHG ↓2.6%.
- ☀ Agricultural GHG ↓28%, but not the ~50% associated with animals.
- ☀ Counterbalanced by fertilizer synthesis & all land now allocated to food production and different crops.

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A Change Creates Other Changes



Agriculture Without Animals:

- ☀ More total food.
- ☀ Small U.S. GHG decline.
- ☀ The food produced would not support U.S. nutrient needs without **supplementation**.
- ☀ Not like studied vegan diets.
- ☀ Agriculture is a system. Need to look at many more factors and how they fit together: direct and collateral impacts.



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“Essentially, all models are wrong, but some are useful.”

Box and Draper, 1987




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USDA

Not Considered

- ☀ Nutrient bioavailability
- ☀ Food waste
- ☀ Nonfood products: alternatives
- ☀ Supplement: production & supply
- ☀ Life cycle analysis applicability
- ☀ Water availability
- ☀ Economic impact
- ☀ Non-GHG impact
- ☀ Cropping viability
- ☀





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USDA

Quantitative & Integrative

- ☀ Meet nutritional needs of the population. Supplements? All agricultural products.
- ☀ Profitability
- ☀ Land/resource use sustainability
- ☀ Environmental impact
- ☀ Use all acceptable tools
- ☀ Evaluate actual feasibility

 Ideology



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Questions?



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www.ars.usda.gov/mwa/madison/dfrc