

Food and Climate

Shaina Rogstad
PhD Candidate UMass Amherst

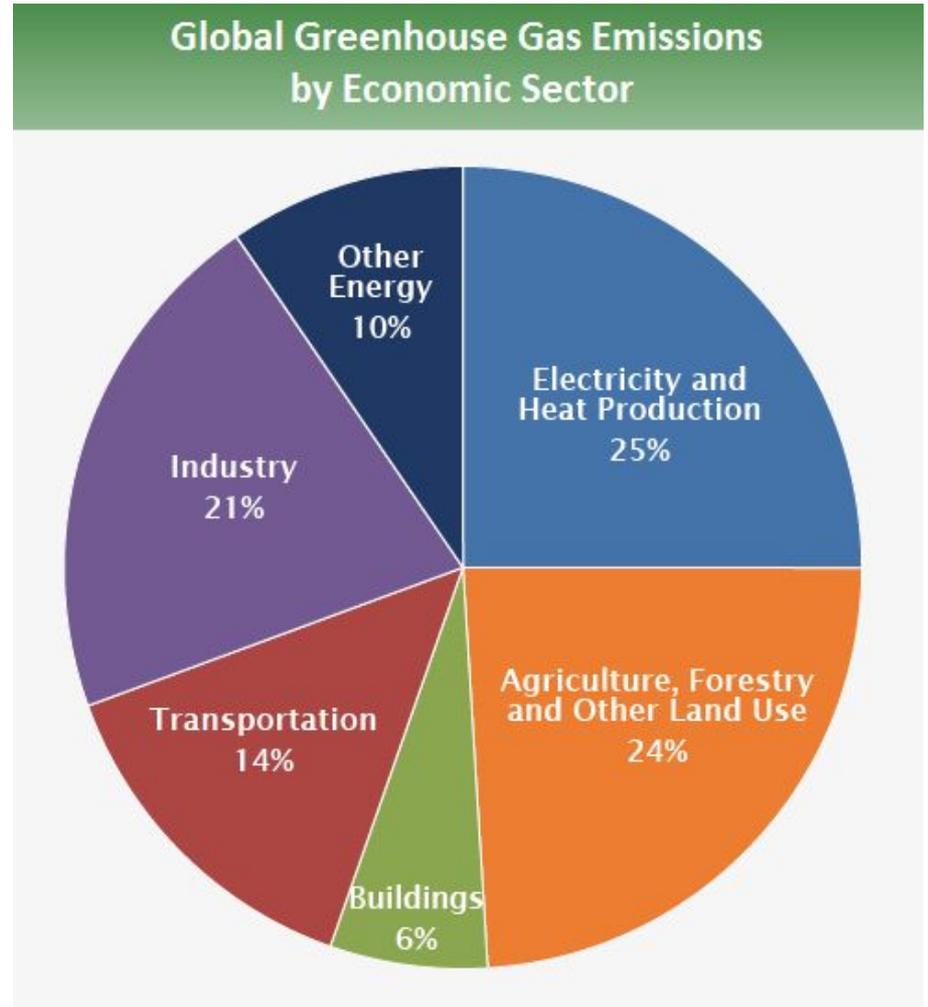


Emissions by sector

Agriculture, forestry, and land use account for 24% of total global emissions

That is roughly the same amount as all transportation

Plot from EPA site, but based off IPCC AR5 chart



Emissions by type

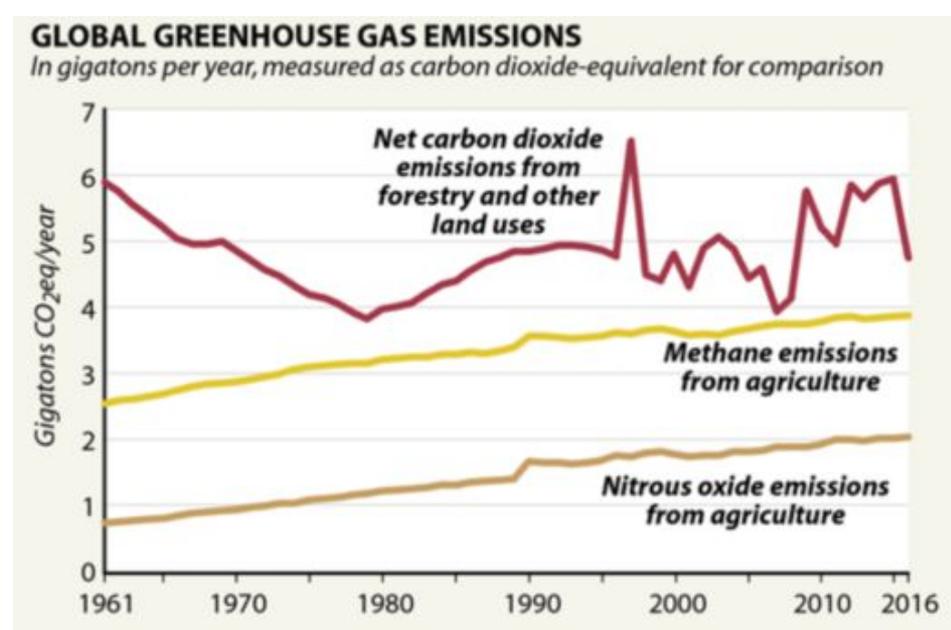
Three main greenhouse gases result from agricultural practices:

CO₂- land use change, energy to power farms and equipment

CH₄- ruminant animals, manure, rice production

N₂O- manure, fertilizers

Plot from ICN, based of SRCCL Report



Greenhouse Gas (GHG)	Atmospheric Lifetime (yrs)	Global Warming Potential (GWP)
Carbon dioxide (CO ₂)	50-200	1
Methane (CH ₄)	12±3	21
Nitrous oxide (N ₂ O)	120	310

Agriculture and climate change

Agricultural practices are a source of greenhouse gas emissions, and they will also be impacted by changes in the climate system.

How do we reduce emissions? How do we make sure everyone has enough food?

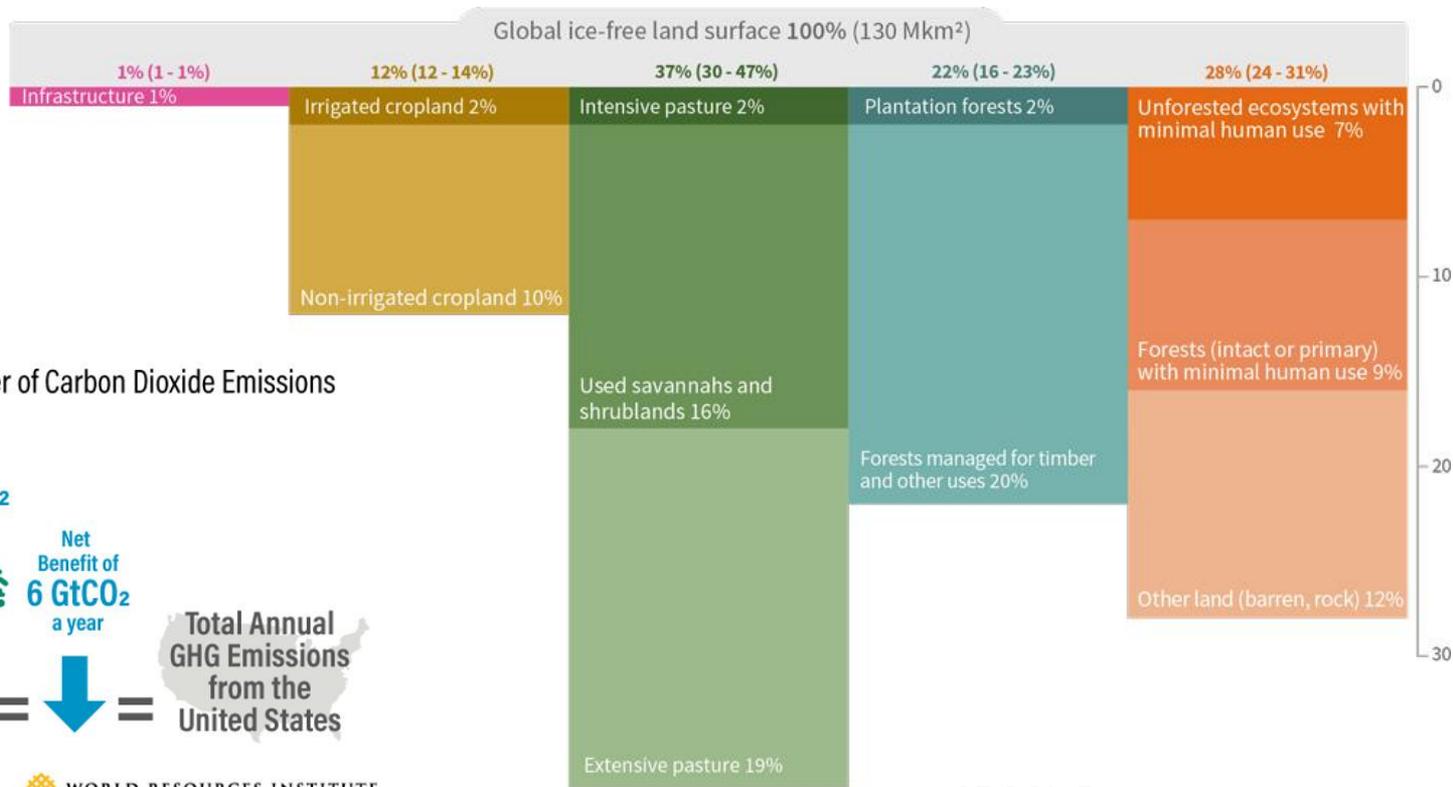
Agriculture impact on climate:

- Tropical deforestation
- Enteric fermentation
- Manure management
- Rice cultivation
- Transport and refrigeration
- Food loss/waste
- Fertilizers
- Soil management

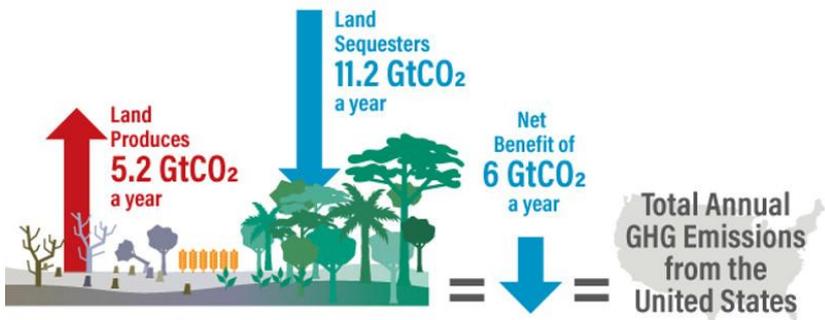
Agriculture impacted by climate:

- Changes in precipitation patterns
- Heat waves and drought
- Heat stress to animals used for food and workers in agricultural fields
- Decreased yields under high CO₂

How is land being used?



Land is Both a Powerful Sink and Emitter of Carbon Dioxide Emissions



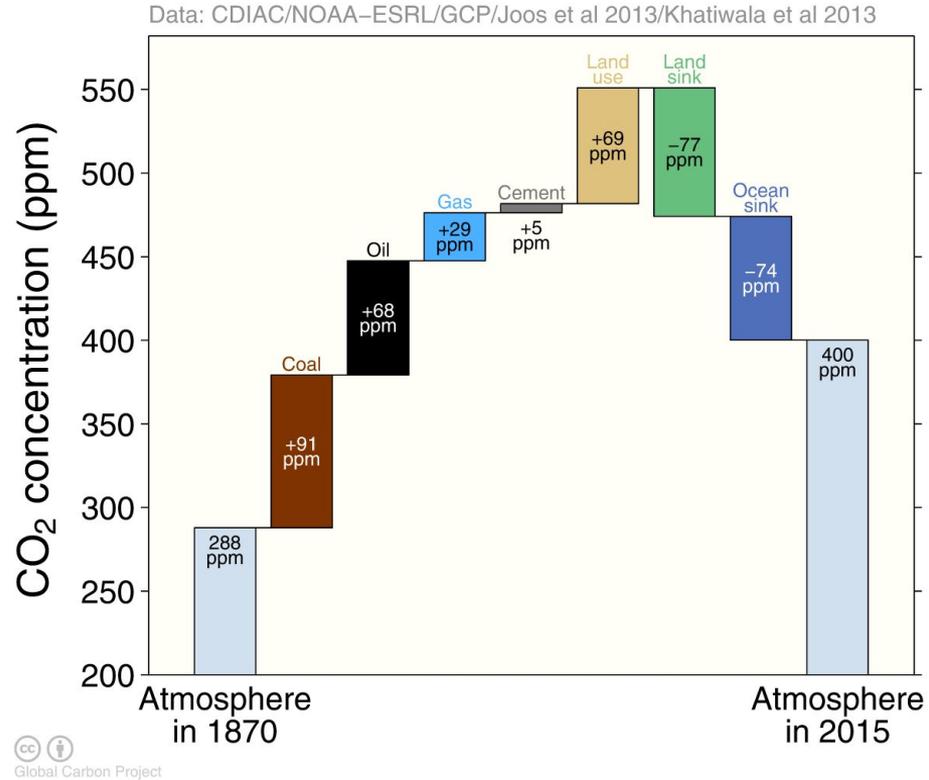
Note: Values are an average over 2007-2016
 Source: IPCC Special Report on Climate Change and Land

Enhancing land sinks

Land can store carbon. Humans can help by:

- Preserving forests
- Planting trees
- No till agriculture
- Composting

Thinking about managing land requires thinking about how we use it for food.



Tropical deforestation

The largest source of food and land use emissions.

Main drivers:

- Cattle ranching
- Soy production (mainly for cattle feed)
- Palm oil plantations

Emissions are generated from loss of carbon sequestration

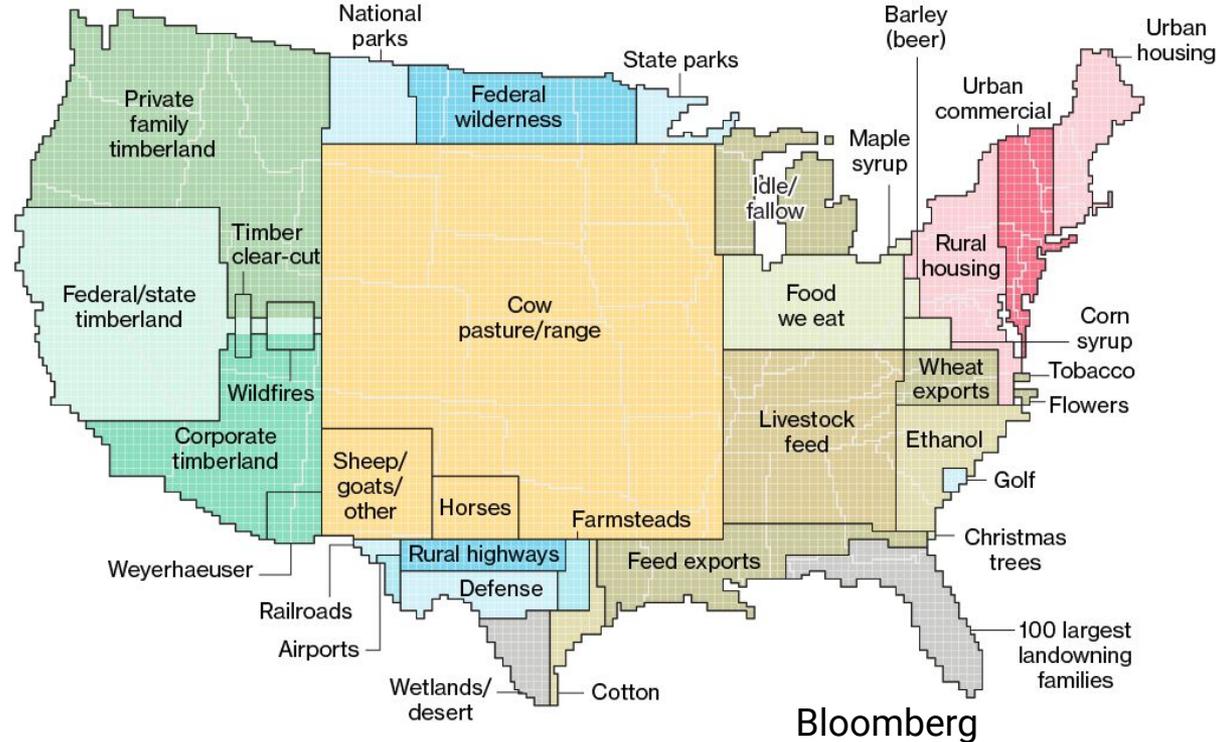


Land use in the US

To meet climate goals we need to preserve forests, reforest areas, and grow enough food for everyone.

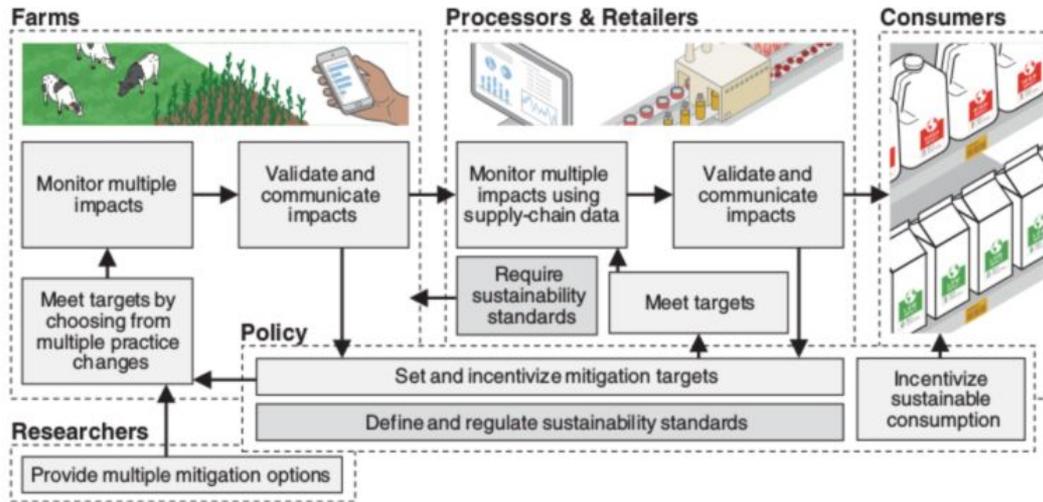
How is land being used in the US?

Is this optimal? What would you change?



Production and consumption

We need action in both phases.



“Impact can vary 50-fold among producers of the same product...”

Producers have limits on how far they can reduce impacts. Most strikingly, impacts of the lowest-impact animal products typically exceed those of vegetable substitutes, providing new evidence for the importance of dietary change.”

-Poore et al., Science 360, 987–992 (2018)

Fig. 4. Graphical representation of the mitigation framework.

Production side

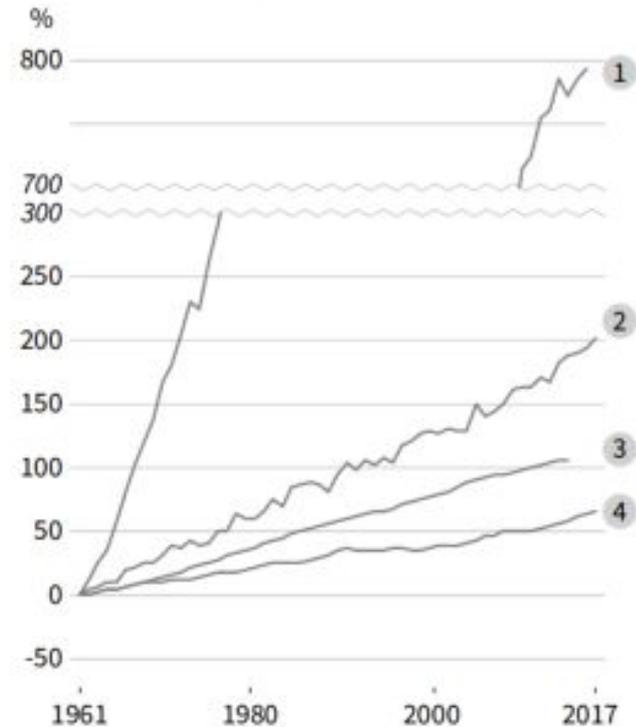
Many options for emissions reduction. Two important ones:

Nitrogen fertilizers- made from fossil fuels, they cause nitrous oxide production. It is a GHG 300x stronger than CO₂.

Soil carbon sequestration- tilling soil can release stored carbon.

CHANGE in % rel. to 1961

- 1 Inorganic N fertiliser use
- 2 Cereal yields
- 3 Irrigation water volume
- 4 Total number of ruminant livestock



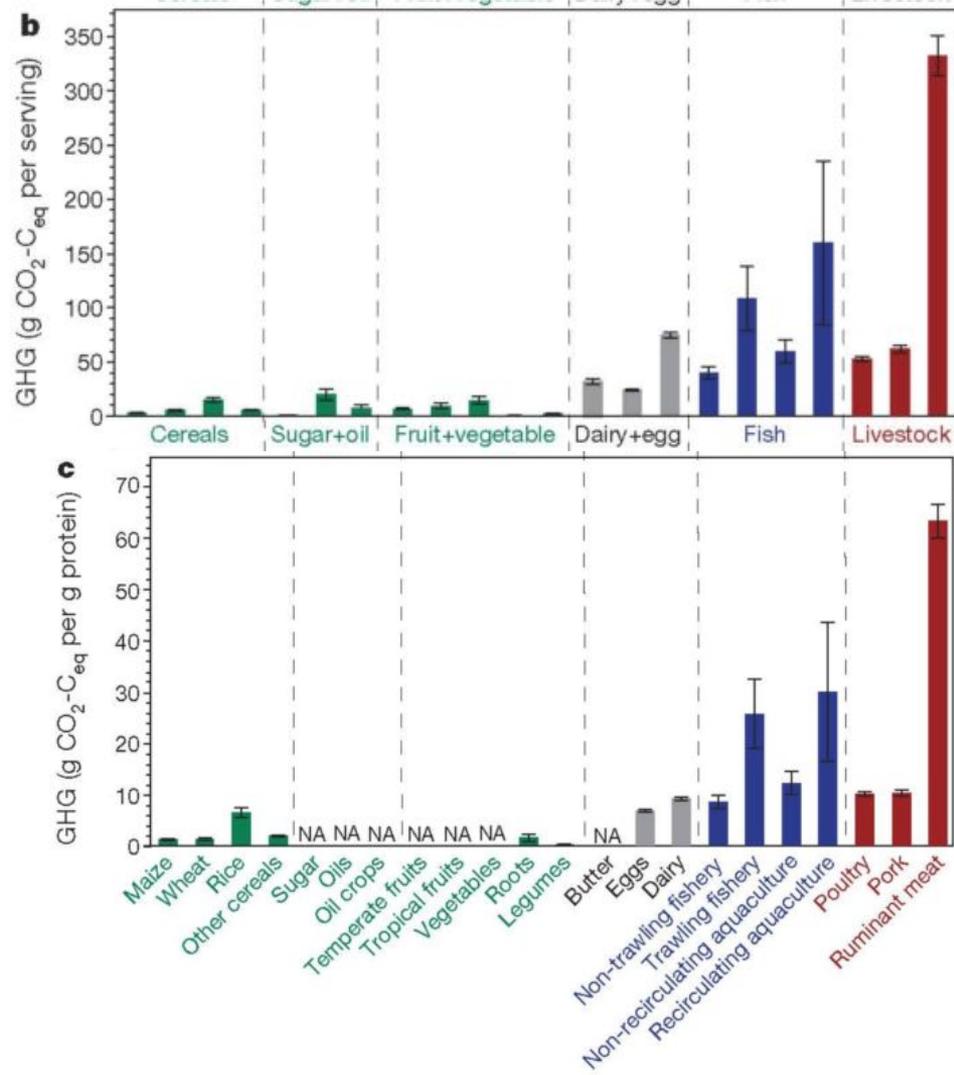
Food type

Enteric fermentation is the second largest emissions culprit in agriculture

You can see emissions (on average) per serving and per gram of protein for different types of food.

What trends do you see?

Tilman and Clark



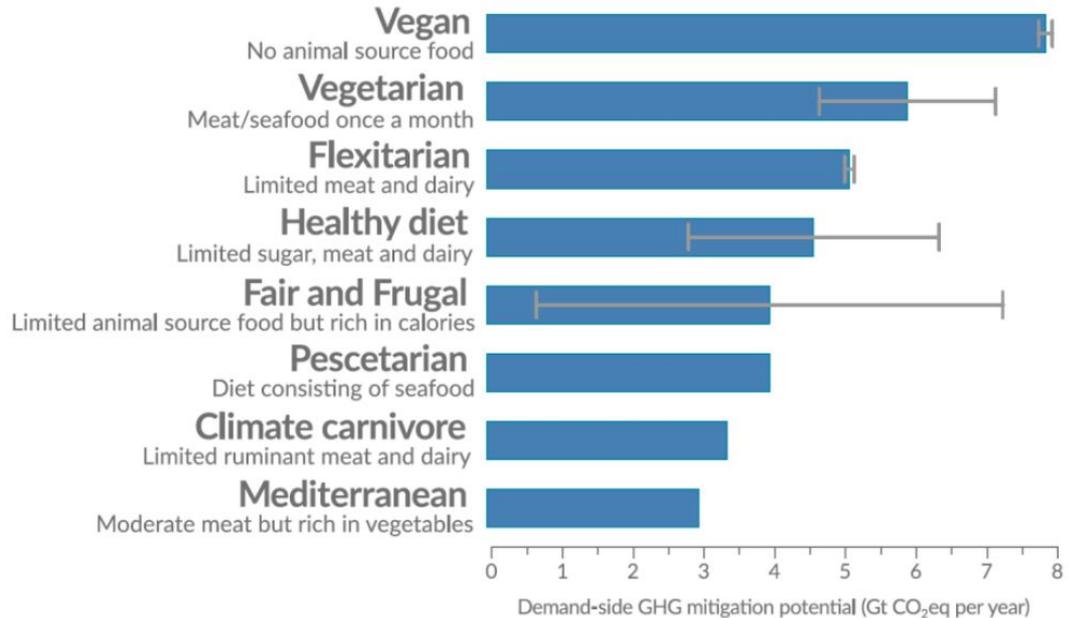
Consumption side

Emissions reduction from production won't be enough. Consumption patterns need to change as well to shift to primarily plant based diets.

Here are emissions reductions potentials of different diets.

Demand-side mitigation

GHG mitigation potential of different diets



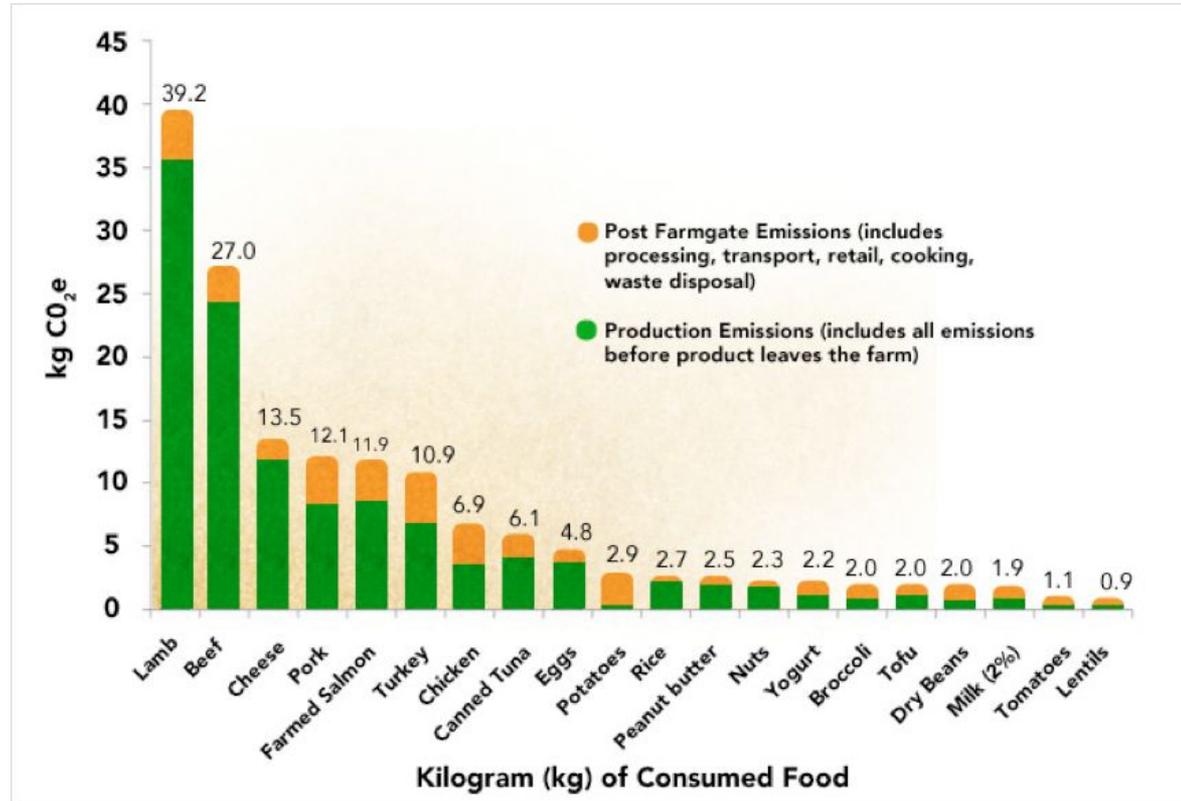
Buying local



What trends do you notice?

What does this mean for emissions reductions?

Does the impact of buying local vary depending on food type?



Food waste

1/3 of food is wasted.

This can happen at any part of the supply chain.

Food loss from production to retail
10%

Food loss from retail to
consumption- 30% for vegetables,
40% for meat



25-30 %

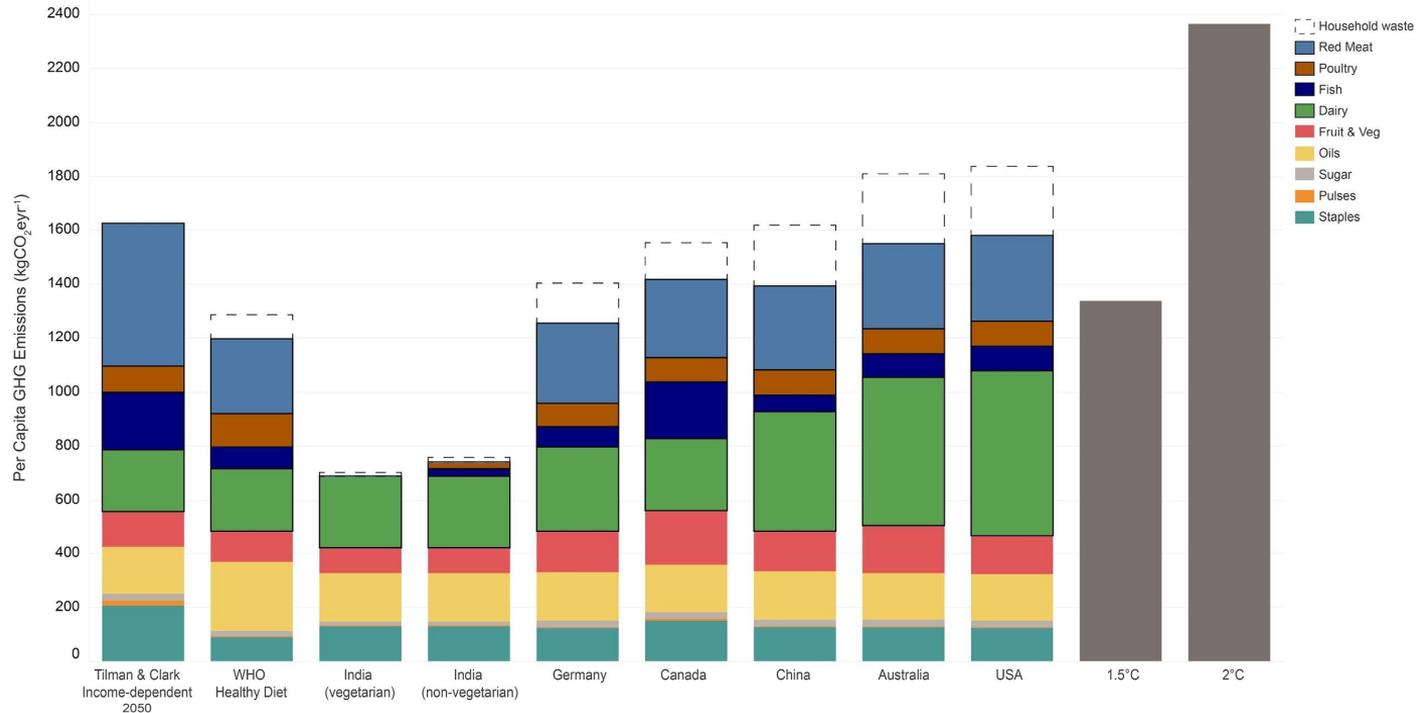
Of our food is lost or wasted globally.

From 2010 - 2016, global food loss and waste accounted for **8-10%** of total anthropogenic GHG emissions.



Policy impact on food emissions

Types of foods emphasized by different countries food pyramids can impact whether food emissions will be in line with Paris Agreement goals.

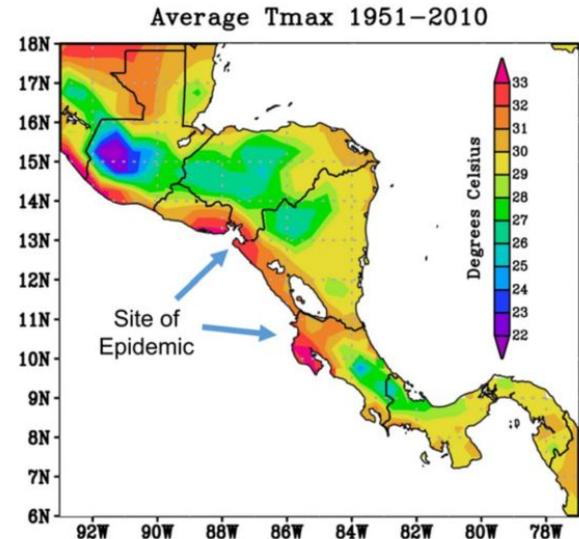


Ritchie et. al

Other considerations

Workers in agricultural fields are extremely at risk from heat related medical issues, as are animals used for food

Intertwined issues with agriculture-working conditions, wages, healthcare, immigration, etc



Top-AFP
Left-
Glaser et.
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(An extra slide we didn't get to)

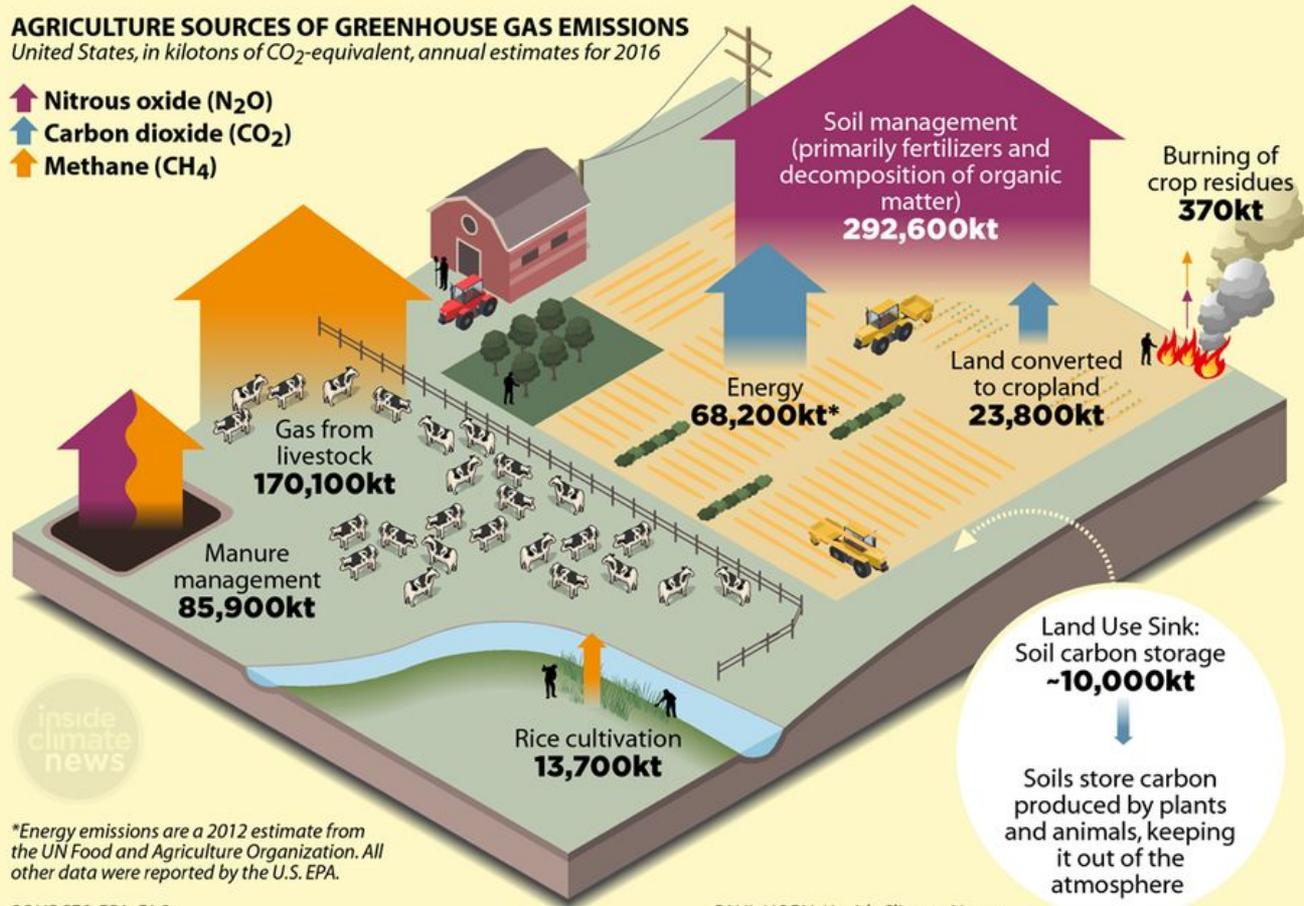
How Farms Contribute to Climate Change

Agriculture today is responsible for nearly a quarter of the world's greenhouse gas emissions. It's also threatened by climate change and uniquely positioned to fight it.

AGRICULTURE SOURCES OF GREENHOUSE GAS EMISSIONS

United States, in kilotons of CO₂-equivalent, annual estimates for 2016

- ↑ Nitrous oxide (N₂O)
- ↑ Carbon dioxide (CO₂)
- ↑ Methane (CH₄)



*Energy emissions are a 2012 estimate from the UN Food and Agriculture Organization. All other data were reported by the U.S. EPA.

SOURCES: EPA; FAO

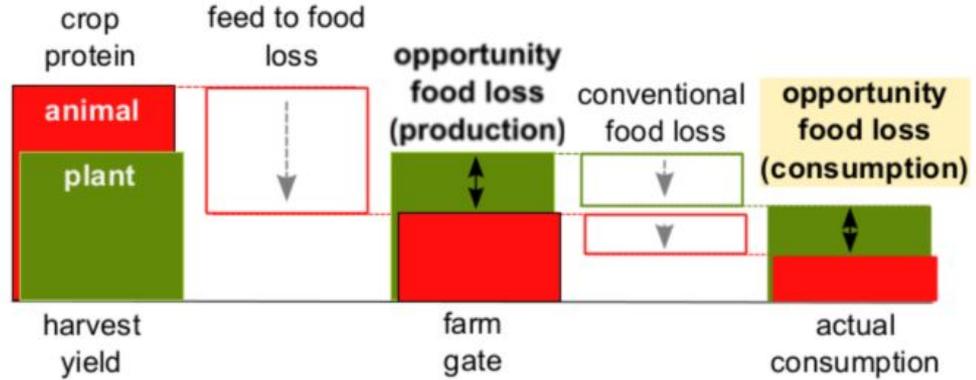
PAUL HORN / InsideClimate News

Opportunity losses

'The opportunity cost of animal based diets exceeds all food losses' Shepon 2018

Production per gram of protein from animal sources is an order of magnitude higher than from plant sources

Reallocation of resources for all animal agriculture has the potential to feed an additional 350 million people in the US



(An extra slide we didn't get to)