Farming's Carbon Footprint

In the 1970s, U.S. Secretary of Agriculture Earl Butz famously told family farmers that it was time to "get big or get out." He wanted farmers to increase production of crops and other agricultural products, relying on export markets to handle the surpluses[1]. His words, the relaxation of certain laws, the addition of farm subsidies, and other factors have helped increase the carbon footprint of America's farmland. Today, agriculture — one of five large economic sectors in the United States next to commercial, industry, residential, and transportation — contributes 9%[2] – 10.5%[3] of all greenhouse gas emissions. Following are the emissions, the sources, the farming methods most implicated, and the carbon footprint of food transportation.

Emissions

Agricultural emissions can be broken down into three different kinds: carbon dioxide, nitrous oxide, and methane. Although the agricultural sources for these emissions can overlap, generally speaking, they break down like this: carbon dioxide arises from farm activities, such as tilling soil, converting grassland or forests to cropland, thereby releasing stored carbon, burning fuel to run farm equipment, and using electricity to operate machines; nitrous oxide is emitted through the process of storing and spreading manure and nitrogen fertilizer (both organic and inorganic); and methane is created as manure and plant material decomposes and as a byproduct, mainly burps, of cow digestion.

Not all agricultural greenhouse gas emissions are created equal, though. Their contribution to climate change depends on how long they linger in the atmosphere and how much "climate-warming" energy they absorb. To put them on a level playing field, scientists use the term "global warming potential,"[4] or GWP, to describe their ability to warm the atmosphere over a period of 100 years. Methane has a GWP that's 27-30 times greater than carbon dioxide on that time scale, and nitrous oxide has a GWP that's 273 times greater. So, although agriculture produces more carbon dioxide than methane or nitrous oxide, reducing those more potent greenhouse gases should be a high priority.[5]

Farming Methods

Around the same time that U.S. Secretary of Agriculture Earl Butz was telling farmers to go big, laws that regulated mergers and acquisitions were loosening up, making it easier for industries to consolidate and increase efficiencies. From this ethos arose the factory

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[1] https://thehill.com/opinion/finance/464856-we-must-reject-the-go-big-or-go-home-mentality-of-modern-agriculture/
[2] https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-chapter-5-agriculture.pdf
[3] https://www.ers.usda.gov/data-products/charts-of-note/chart-detail?chartId=110340#:~:text=From%202021%20to%202022%2C%20agricultural,the%20entire%20U.S.%20economy's%20emissions
[4] https://www.epa.gov/ghgemissions/understanding-global-warming-potentials
[5] https://cfpub.epa.gov/ghgdata/inventoryexplorer/index.html

farm, also known as a concentrated animal feeding operation, or CAFO. Today, 99%[6] of all farmed animals are raised on factory farms.

In these warehouse-sized facilities, thousands, if not millions of animals — mainly pigs, cows, chickens, turkeys — are housed indoors shoulder-to-shoulder or wing-to-wing and treated as insentient components in a long supply chain from insemination to slaughter. The animals are raised indoors and do not roam fields, where they drop their waste to decomposes slowly by the forces of air, sun, and aerobic bacteria (called regenerative or pasture-based farming conditions).

Instead, the waste is hosed from concrete floors and stored in lagoons or in vats by the millions of gallons. Anaerobic bacteria break down excrement without oxygen in a process that produces methane, carbon dioxide, and other gases[7]. Factory farm animal production accounts for 33% of agricultural methane emissions and 13% of total U.S. methane emissions.[8]

The type of food farmed also plays a role in greenhouse gas emissions. Farming sheep, lamb, dairy cows and beef cattle has the largest carbon footprint[9]. These animals are ruminants, meaning they have four stomachs with a digestive process that produces a lot of methane. Beef is twice as carbon intensive as lamb because it takes longer to grow a calf into an adult, requiring more feed and other resources. Larger animals also produce more waste, which must be stored and then spread as fertilizer. On the other hand, vegetables, fruits, and nuts have a low carbon footprint in comparison. Emissions from plant-based foods are 10 to 50 times smaller than those from animals[10].

Although growing plants for food has a much smaller impact on climate change, monoculture practices, which involve growing one crop species in a field season after season, lead to soil depletion, reducing the soil's ability to sequester carbon, and requires excessive use of inorganic fertilizers, which increases nitrous oxide. Monoculture farming methods developed alongside the growth of CAFOs. It should be noted, too, that in the United States, 75%[11] of cropland supports plants, such as soy and corn, that feed farmed animals.

Transporting Food

As part of the 20th Century effort to consolidate farming, corporations have moved the food industry overall away from a local model to a global one. Transportation options, improved logistics, and efficient refrigeration have made it possible to move farmed animals, animal products, and crops long distances between farm and market. The further

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[6] https://www.sentienceinstitute.org/us-factory-farming-estimates
[7] https://extension.psu.edu/biological-manipulation-of-manure-getting-what-you-want-from-animal-manure
[8] https://www.iatp.org/time-us-eu-regulate-factory-farms-greenhouse-gas
[9] https://interactive.carbonbrief.org/what-is-the-climate-impact-of-eating-meat-and-dairy/index.html#:~:text=Meat%20and%20dairy%20specifically%20accounts,will%20be%20necessary%2C%20scientists%20say
[10] https://www.science.org/doi/10.1126/science.aaq0216
[11] https://www.pnas.org/doi/10.1073/pnas.1720760115

the journey, the bigger the carbon footprint. But just how far and how to calculate the emissions has been a topic of debate. The Leopold Center for Sustainable Agriculture at Iowa State University developed a method for calculating "food miles"[12] and, in 2011, published a study "Food, Fuel, and Freeways[13]" that provided averages for how far produce traveled to a Chicago market. The results were eye-opening.

Grapes traveled 2,143 miles
Apples traveled 1,555 miles
Peaches traveled 1,674 miles
Lettuce traveled 2,055 miles

On average, food produced in the United States and sold in the United States travels about 1,500 miles[14]. That doesn't take into account exports or imports, nor does it take into account foods made of multiple ingredients sourced and processed in different parts of the world. If one could more accurately calculate the miles, what would the carbon footprint look like? A comprehensive 2022 study published in the journal Nature Food[15] attempted to do just that by assessing the entire food supply chain, meaning emissions from transporting fertilizers, machinery and animal feed as well as from moving the food itself. They estimated that in a single year, global food miles were responsible for 3bn tons of CO2 equivalent emissions, a number that was 3.5-7.5 times larger than previous estimates. By their estimates, "high income nations" like the United States represent only about 12.5% of the world's population produce 52% of international food miles and 46% of the associated emissions.

As the world faces the challenges of climate change, it is crucial to reevaluate agricultural systems and food supply chains. Reducing emissions from agriculture will require a multifaceted approach, including adopting more sustainable farming practices, promoting plant-based diets, and prioritizing local food production to minimize transportation-related emissions. By addressing these issues, a more environmentally friendly and resilient food system can emerge that balances productivity with sustainability, ensuring food security while mitigating the impacts of climate change.

[12] https://www.leopold.iastate.edu/files/pubs-and-papers/2005-03-calculating-food-miles-multiple-ingredient-food-product.pdf
[13] https://dr.lib.iastate.edu/entities/publication/51ef6421-3062-487f-af1a-29125328f7a5
[14] https://attra.ncat.org/publication/food-miles-background-and-marketing/
[15] https://www.nature.com/articles/s43016-022-00531-w