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a blog on independent science + practical solutions



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More Chicken or Pork, Less Beef: A Holiday Gift for the Climate

December 20, 2013

Doug Boucher, sr. scientist & dir., Climate Research and Analysis



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Today an article by five co-authors and me was published in the journal *Nature Climate Change*. It's on "Ruminants, climate change and climate policy," and makes the point that political and business leaders concerned about global warming have missed an important part of the problem. This missing piece of the puzzle is the emissions – mostly of **methane, a greenhouse gas that is 25 times as powerful as CO₂** – that come from ruminant livestock, which include sheep, goats, water buffalo, and most importantly cattle.

Reducing the emissions from ruminants, which are mostly associated with [the production of beef](#), could make a big contribution to preventing the worst impacts of global warming. But **what's the alternative?**

This graph – my modification of Figure 2 of our new paper, which shows the emissions associated with different kinds of food – shows how much greater the emissions of beef are, compared to the alternatives. The emissions associated with meat from ruminants (red bars) are all much higher than the other sources of protein (blue bars).

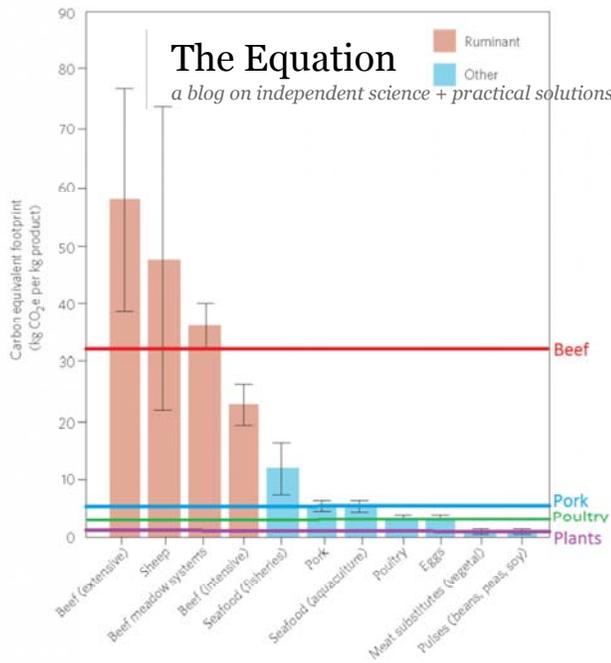


Figure 2 | Average carbon equivalent footprint of protein-rich solid foods per kilogram of product from a global meta-analysis of life-cycle assessment studies. Extensive beef involves cattle grazing across large pastoral systems, whereas intensive beef typically involves feedlots. Meat substitutes are also known as meat analogues, which are high-protein plant products that have aesthetic qualities (such as flavour, texture, appearance) of specific types of meat. Error bars represent standard errors. Data from ref. 17.

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NATURE CLIMATE CHANGE |

Emissions from different sources of animal and plant protein, in kg CO₂e per kg of product. Horizontal lines added by Doug Boucher to indicate mean values for beef (red line), pork (blue), poultry (green) and plant sources (purple). Source: Figure 2 from Ripple et al 2014, Nature Climate Change; original data from Nijdam et al. 2012, Food Policy.

What's most notable is how close to each other – and to zero – the three main alternatives are, compared to the great difference between any of them and beef. In other words, if you want to reduce the emissions associated with the food you eat, the most important step is to reduce your consumption of beef. Compared to that decision, the question of what you replace it with – pork, poultry, or plants only – is much less important.

This comparison can be put into numbers, using the means for pork, poultry, and plants and comparing them to the three different beef production systems and their overall mean. Naturally the biggest reduction comes from replacing beef with plant foods. But the reductions made by moving from beef to chicken are all at least 90 percent as large as the beef-to-plants change. (They range from 92 to 97 percent, depending on the production system of the beef that you started with.)

For switching from beef to pork, the reductions are a bit less but still all at least 80 percent of that achieved by going from beef to plant protein (ranging from 82 to 93 percent).

There are other considerations besides climate footprint that are relevant to the sustainability of kinds of food, of course. We have shown that the alternatives to beef are preferable to it in terms of [land use and health impacts](#), for example, in our recent report on *Climate-Friendly Land Use*. (I should point out that by “we” I mean me and my UCS colleagues, not the co-authors of the new paper, who may or may not agree with this post.) And of course there are important economic and social questions involved as well. But **if Earth's climate is your main concern**, the lesson is pretty clear: **the important point is to eat less beef, no matter what you replace it with.**

And in that spirit, here's a Christmas turkey, with best wishes for **Happy Holidays and a climate-friendly New Year.**



Turkey dinner. Source: texascooking, Flickr.com



Posted in: [Food and Agriculture](#), [Global Warming](#) Tags: [beef](#), [Carbon Emissions](#), [climate-change](#)

About the author: Doug Boucher is an expert in preserving tropical forests to curtail global warming emissions. He has been participating in United Nations international climate negotiations since 2007 and his expertise has helped shape U.S. and U.N. policies. He holds a Ph.D. in ecology and evolutionary biology from the University of Michigan. See Doug's full bio.

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COMMENTS ARE CLOSED. Comments are automatically closed after two weeks.

7 Responses

Wendy Ring says:

December 31, 2013 at 2:04 pm

That's why Climate 911, a national climate action group of health professionals, has included changing federal economic incentives for agriculture to conform to dietary recommendations and reward farming practices that increase carbon sequestration in soil as part of our Prescription for Climate Action. Our group also recognizes that changing energy policy by providing expert advice is a proven failure and instead of repeating the same failed top down approaches to policy, we have to build a grassroots movement strong enough to change the power equation in Washington. We scientific folk have a role to play that is bigger than sending money and supporting research. It would be good to see UCS do more to mobilize its membership to action.

Glenn Gall says:

December 31, 2013 at 12:37 pm

A careful look at IPCC AR4 data shows that natural and fossil extraction methane emissions are each greater than those of ruminants. Only ~13% of total methane emissions are from ruminants.

Ruminant emissions were no doubt a higher percentage of the total before anthropogenic emissions were a factor. A couple of centuries ago, most of the ruminants would have been listed under Natural Sources, not Anthropogenic. Where's the accounting for less wildlife in the article? (I have only read this summary, which does not indicate the type of accounting I am suggesting.)

Furthermore, this is one of a long line of presentations that fails to consider methane emissions in context. The shorter ~10 year lifetime of atmospheric methane means that most of the methane does not accumulate like the longer lived CO₂. AR4 data for the last two decades show that OH and Cl radicals and methaneotropic bacteria sink well over 90% of methane emissions. (By comparison, biomass, soils, and oceans sink about 55% of CO₂ emissions.)

Based on the above, only about 1% of ruminant emissions contribute to atmospheric methane increases. From about 1998 to 2007 there was essentially no increase in atmospheric methane levels, even though, according to FAO figures, there was an increase of over 200 million ruminant animals during that period. According to the NOAA AAGI, radiative forcing due to methane increased 21% from 1979 to 2012, and CO₂ increased 80% during the same period.

This is not a "cows emit methane, therefore bad" simple arithmetic problem. The answer is not to destroy all animals and reduce emissions by 51%, as a 2009 Worldwatch Institute published paper might have us believe. Grazing animals were part of the great prairie and savanna systems that have fed more mammals than any other. They provided the impact that gave us meters deep topsoils, 10%, 20% and more organic matter, and stabilized our ground water. Lack of predation, enclosures, and grain feeding have damaged once thriving ecosystems, and turned our opinion of livestock from a blessing to a curse.

My small ranch turned a depleted, eroding, water shedding, annual cropped, biocide sprayed, Haber-Bosch nitrogen and phosphorous wasting, 1.5% soil organic matter (SOM), hot, highly IR re-radiating field into a ~3.5% SOM, non-eroding, moisture holding, nutrient accumulating, well stocked, perennial pasture in four years. Topsoil went from nothing to an average of 8" (est). "Naturally the biggest reduction comes from replacing beef with plant foods." No. The biggest positive change, including CO₂e reduction and even sequestration, comes from the best farming and ranching practices.

Maybe this study included pastures that weren't as productive. I have seen some that plateau soon after they were established, and others that increase by 0.1 or 0.2% SOM per year. On the other hand, there are remarkable farmers and ranchers that have demonstrated 1% SOM increases and more.

This is a complex, multi-faceted problem. It requires a systems approach, and one that is goal oriented, constantly building on the most effective, holistic solutions. Diverse, well stocked, well managed pastures and rangelands are a critical part of the solution to the multiple earth problems we are experiencing. It's not just climate, but

extinction, desertification, water cycling, and more that are massively hurting us, and rapidly escalating. More life through abundant perennial systems are key. Reducing cattle numbers won't solve the problem. Better management will go a long way. None of the numbers in the above chart are below zero emissions. Better systems can be.

Doug Boucher says:

Andy,

Thanks for your comment. Sounds like a wonderful meal!

Doug

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December 28, 2013 at 6:33 pm



Andy Ferguson says:

December 28, 2013 at 2:52 pm

Our whole family switched to vegetarianism/veganism without any big problems. We all had the same concerns like "I can't go without cheese," or "Will I get enough protein?" None of this turned out to be a big problem for us. While some people probably can't be vegetarians, the difficulties of enjoying a plant based diet are vastly overblown for most people. For our Christmas dinner our main dish was a fantastic mushroom ragout made with shitake and crimini mushrooms, cooked in homemade veg stock, served over scalloped potatoes that were baked with a delicious cashew cream sauce with fresh herbs (thank you Cloe's Kitchen and Greens cookbooks!). It was no harder to prepare than a regular holiday meal. It was the most satisfying holiday meal ever, including all those years we had turkey, etc. And the leftovers were just as delicious!

Doug Boucher says:

December 20, 2013 at 11:32 pm

Scott,

Thanks for your comment. Unfortunately, if you look at the graph in my post above, you'll see that it's not true that grass-fed beef has lower emissions than beef that is fed on both grass and grain. In fact the opposite is the case.

The graph separates out the data for three different kinds of beef production systems: "extensive", "meadow" and "intensive". As explained in the review paper from which the data come, "intensive" systems generally involve feeding supplemental grain and protein sources, while "meadow" systems are those that are based on pasture. "Extensive" systems are mostly those in tropical countries and arid parts of the temperate zone, like shrublands and desert in the western U.S.

As the graph shows, the "meadow" systems actually tend to have higher emissions than the "intensive" ones.

The biological reason for this is that the methane emissions in cattle come from the metabolism of undigested food by certain kinds of micro-organisms in the rumen. What the cow can't digest is turned into methane by these microbes, called Archaea. Since grass is less digestible than grain — it contains large amounts of hard-to-break-down cellulose, as opposed to the starch in grains — the more grass a cow eats, the more it emits methane.

You can find more on this comparison in the review paper from which the data in the graph is taken: Dirk Nijdam et al. (2012) The price of protein: Review of land use and carbon footprints from life cycle assessments of animal food products and their substitutes. *Food Policy* 37: 760-770. Another article that just appeared also discusses this literature; it's by Mario Thornton et al. (2013) Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems. *Proceedings of the National Academy of Sciences, Early Edition*, online at <http://www.pnas.org/cgi/doi/10.1073/pnas.1308149110>

This situation is unfortunate because in other ways, the feedlot-based production on which many intensive beef systems are based are damaging to the environment. See, for example, the UCS report by Doug Gurian-Sherman (20) CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations. (on our web site at http://www.ucsusa.org/assets/documents/food_and_agriculture/cafos-uncovered.pdf). But the data from many studies make it clear that it's the case, and the microbiological reasons for it are fairly well understood by the scientific community.

Doug

mememine69 says:

December 20, 2013 at 7:55 pm

Remaining Climate Blame Believers;

When you look your child in the eyes and tell them science agrees a crisis will happen for them it becomes a moral judgment for science has NEVER agreed it will happen. It's just you and news editors and politicians agreeing it WILL be a crisis. Prove us wrong and find us one single IPCC warning that agrees beyond "could be" a crisis. Believe all you like but do as science does and NEVER say a crisis WILL happen, only could.

Get up to date:

*Occupywallstreet now does not even mention CO2 in its list of demands because of the bank-funded and corporate run carbon trading stock markets ruled by politicians.

*Canada killed Y2Kyoto with a freely elected climate change denying prime minister and nobody cared, especially the millions of scientists warning us of unstoppable warming (a comet hit).

*Julian Assange is of course a climate change denier.

*Obama had not mentioned the crisis in two State of the Unions addresses.

Deny that.

Scott Supak says:

December 20, 2013 at 7:01 pm

Actually, the greenhouse gasses from beef come from factory farmed, corn fed beef. Grass fed beef doesn't have this problem. Even though a recent study that showed that grass fed beef helps lower GHG emissions was debunked, grass fed cows do not contribute methane like corn fed animals do. Cows are not designed to eat corn.

So, people could switch to grass fed and help a lot. We like to say that grass fed is better for you, the animal, and the planet.

And pork is an environmental nightmare for many other reasons, mostly solid waste problems, since their anatomy is more like ours, and their waste cannot be used as easily as fertilizer.