Country-Specific Estimates of How Much the Land Sector Can Contribute to Post-2020 Mitigation

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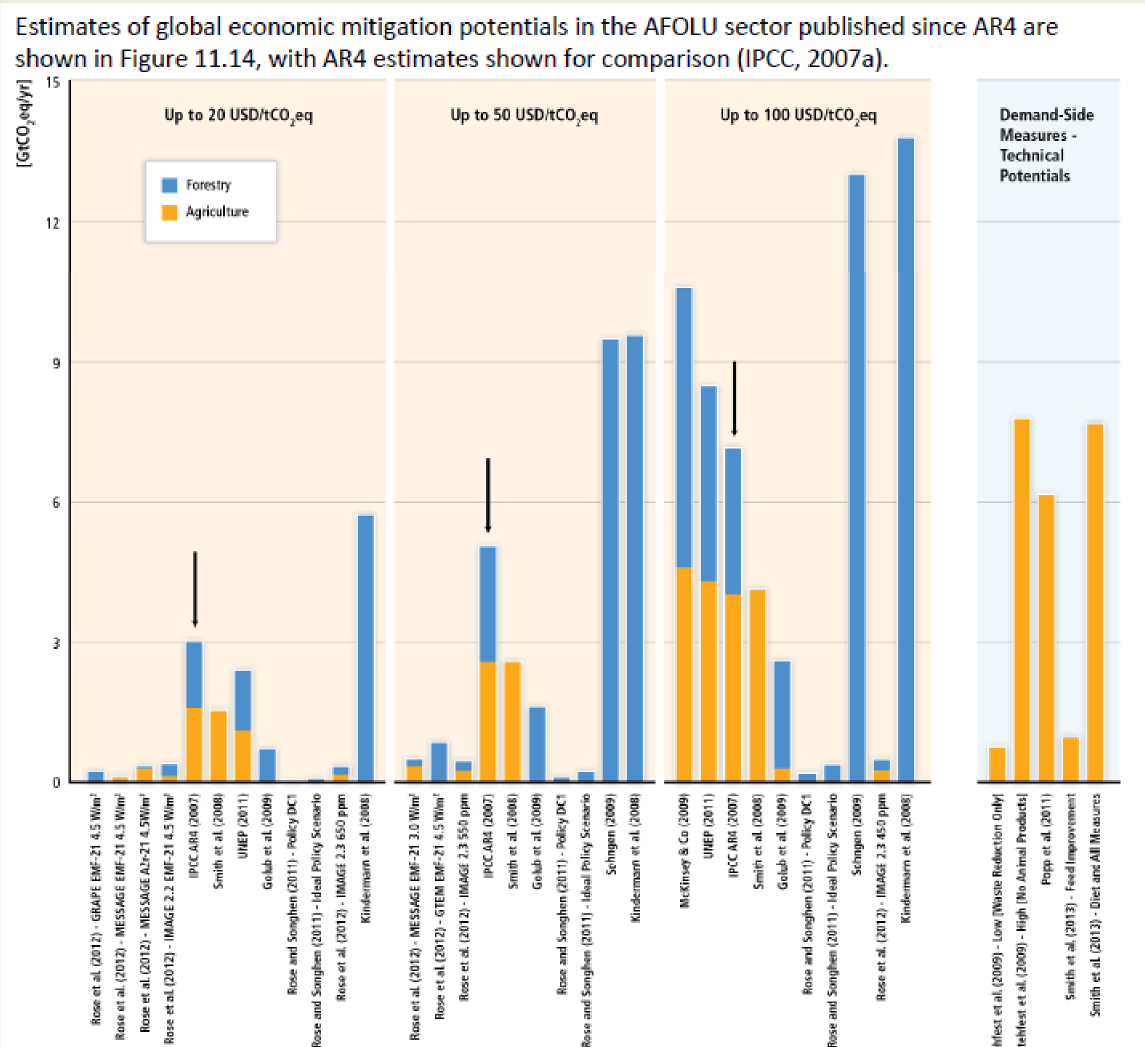
What I'll be presenting today

- Country-specific estimates of mitigation potential
  - for the post-2020 period
  - from the land sector (AFOLU – Agriculture, Forestry and Other Land Use)
  - for 8 major emitters (US, Indonesia, China, India, Brazil, European Union, Mexico and the Democratic Republic of the Congo)
  - whose land-sector emissions make up 57% of the global total
- Comparison of the total for these eight to the UNEP emissions gap estimates (2020, 2030)

The global estimates – IPCC 2014



Source: IPCC AR5 WG3, Figure 11.14

Estimates of global mitigation potential range from less than 1 to more than 13 Gt CO2eq, depending on carbon price and which sub-sectors and kinds of approaches (e.g. supply vs. demand-side) were included.

Few estimates are country-specific.

The Emissions Gap (UNEP 2014)

Shows the difference between what countries have already pledged to do, and what is necessary to achieve the 2 degree goal

Estimated at:

- 8 to 10 Gt CO_2eq for 2020
- 14 to 17 Gt CO_2eq for 2030

Our Methods (in brief)

We reviewed the literature (both journal and "gray") seeking country-specific estimates of mitigation potential in AFOLU

- Subsectors include:
  - Reducing deforestation and forest degradation
  - Reducing direct emissions from agriculture
  - Reforestation and restoration (sequestration)
- Approaches include both supply-side (production) and demand-side (e.g. reduced food waste, changing diet trends)

We assembled a database of the estimates and used it to calculate country totals, their medians and their ranges, for both 2020 and 2030

We then totaled the medians for the 8 major emitters and compared them to the emissions gap estimates for those years

Detailed Methods and Database are online at: www.ucsusa.org/halfwaythere

Methods were constrained by those of the studies we found, e.g.:

Years chosen for analysis – most were for 2020 and/or 2030, not 2025

Modeling approaches, etc. vary among studies

Scenarios chosen represent technical potential, or the highest carbon price in the study

Thus, these estimates assume that **the needed finance is made available**

These choices of years, BAU, etc. do **not** necessarily represent UCS' policy preferences!

Results (1)

Table 1 – Quantitative estimates of the post-2020 climate mitigation potential of AFOLU, by country and summed across all countries studied. Units are $GtCO_2eq$/year.

Year / Country	2020 Low	2020 High	2020 Median	2030 Low	2030 High	2030 Median
United States			**1.9**	0.4	5.8	**3.1**
Indonesia	0.6	2.8	**1.7**	0.6	1.3	**0.8**
China			**1.2**	0.8	1.2	**1.0**
India			**1.0**	0.4	1.0	**0.7**
Brazil	0.3	0.5	**0.5**	0.3	1.6	**0.5**
European Union	0.2	0.7	**0.4**	0.2	0.7	**0.4**
Mexico	0.1	0.4	**0.2**	0.2	0.3	**0.2**
DRC			**0.02**			**0.02**
Sum	5.2	8.4	**6.8**	2.8	11.9	**6.7**
Sum as % of Gap			**76%**			**44%**

Results (2)

TABLE. Climate Mitigation Potentials of AFOLU Subsectors, Globally and by Country

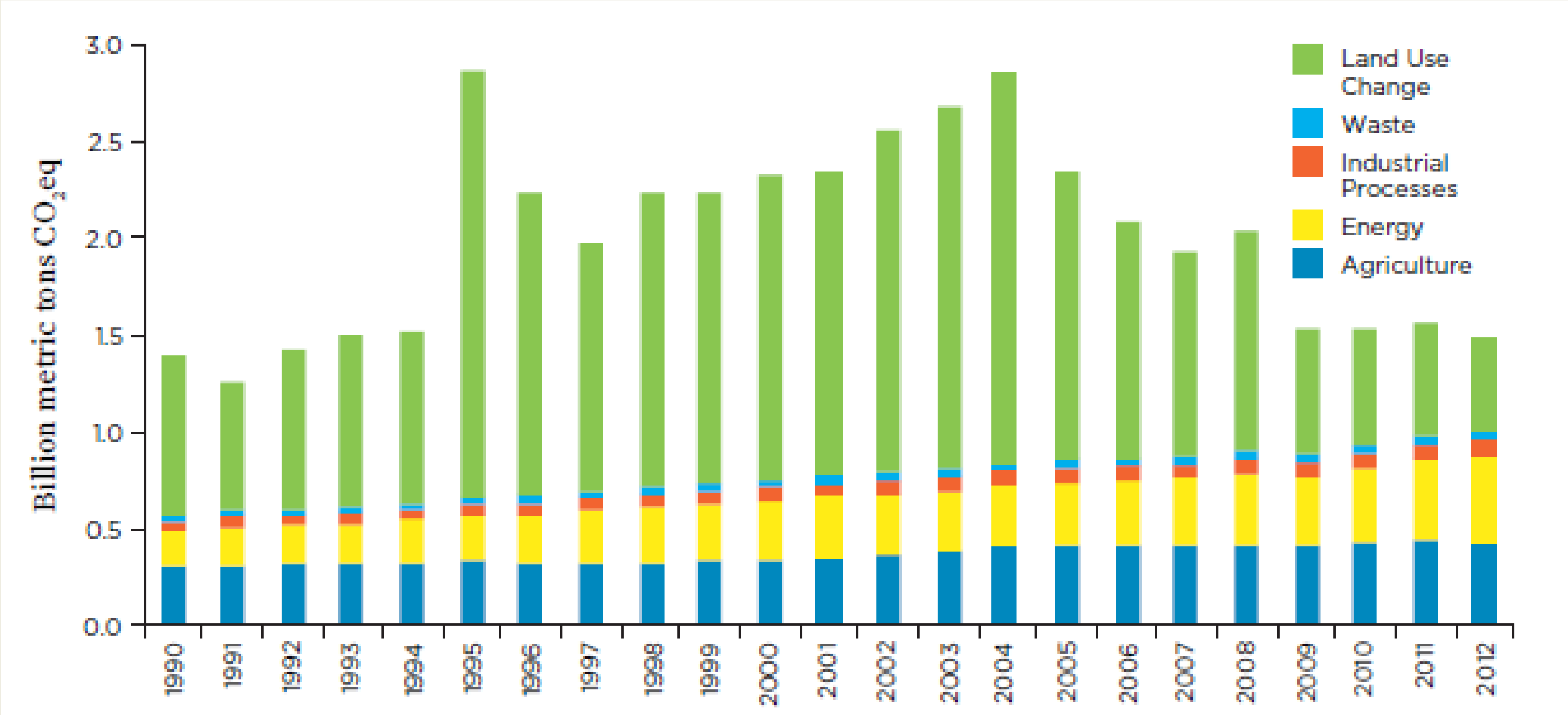
	Ruminant methane	Rice methane	Soil N_2O and CO_2	Deforestation and degradation	Peat	Sequestration from regrowth
Global	**	*	**	**	**	**
United States	**		**			**
Indonesia		*		**	**	*
China	**	*	**			*
India	**	*	*			*
European Union (28 countries)	**		*		*	*
Brazil	**		*	**		**
Mexico	*		*	*		*
Democratic Republic of the Congo				*		

** = *High potential, generally 100s of Mt to Gt CO2eq/year*

* = *Moderate potential, generally 10s of Mt to 100s of Mt CO2eq/year.*

Notes: Because these estimates are for the post-2020 period, they take into account both actions to date and those expected before 2020. The ruminant methane subsector includes enteric fermentation and manure as well as both supply- and demand-side approaches. The soil N_2O and CO_2 subsector includes synthetic fertilizer, manure, and other soil management options both on cropland and pasture—but only on mineral soils (not peat). The peat subsector includes reduced clearing and restoration. The sequestration from regrowth subsector includes reforestation, afforestation, and restoration in nonforest ecosystems.

Post-2020 mitigation potential is lower for several countries because of what they have already done



Total emissions in Brazil have already declined by 40% in the last decade

Source: Analysis of Tasso Acevedo, using data from SEEG/Observatorio do Clima

Uncertainty and Comparability

The number of studies found with usable country-specific data was very small (n = 13), so small differences (a few tenths of a Gt CO_2eq) between countries and time periods should not be considered significant

There is undoubtedly some double-counting between the mitigation potential estimates and the emissions gap calculations, particular for Brazil and Indonesia in 2020. Thus, a conservative interpretation of the potential as a percent of the gap, is that it's about 50% for both 2020 and 2030

Thus the title, *Halfway There?*

Conclusions

The largest potential is in the United States, followed by Indonesia, China and India. Brazil and the European Union also have substantial potential to help close the emissions gap from their AFOLU sectors.

We hope that this information will be useful in the preparation and analysis of INDCs

THANK YOU!

The Executive Summary of *Halfway There?*, with links to the detailed description of its Methods, the complete Database, and my blog post about it, are available at: www.ucsusa.org/halfwaythere

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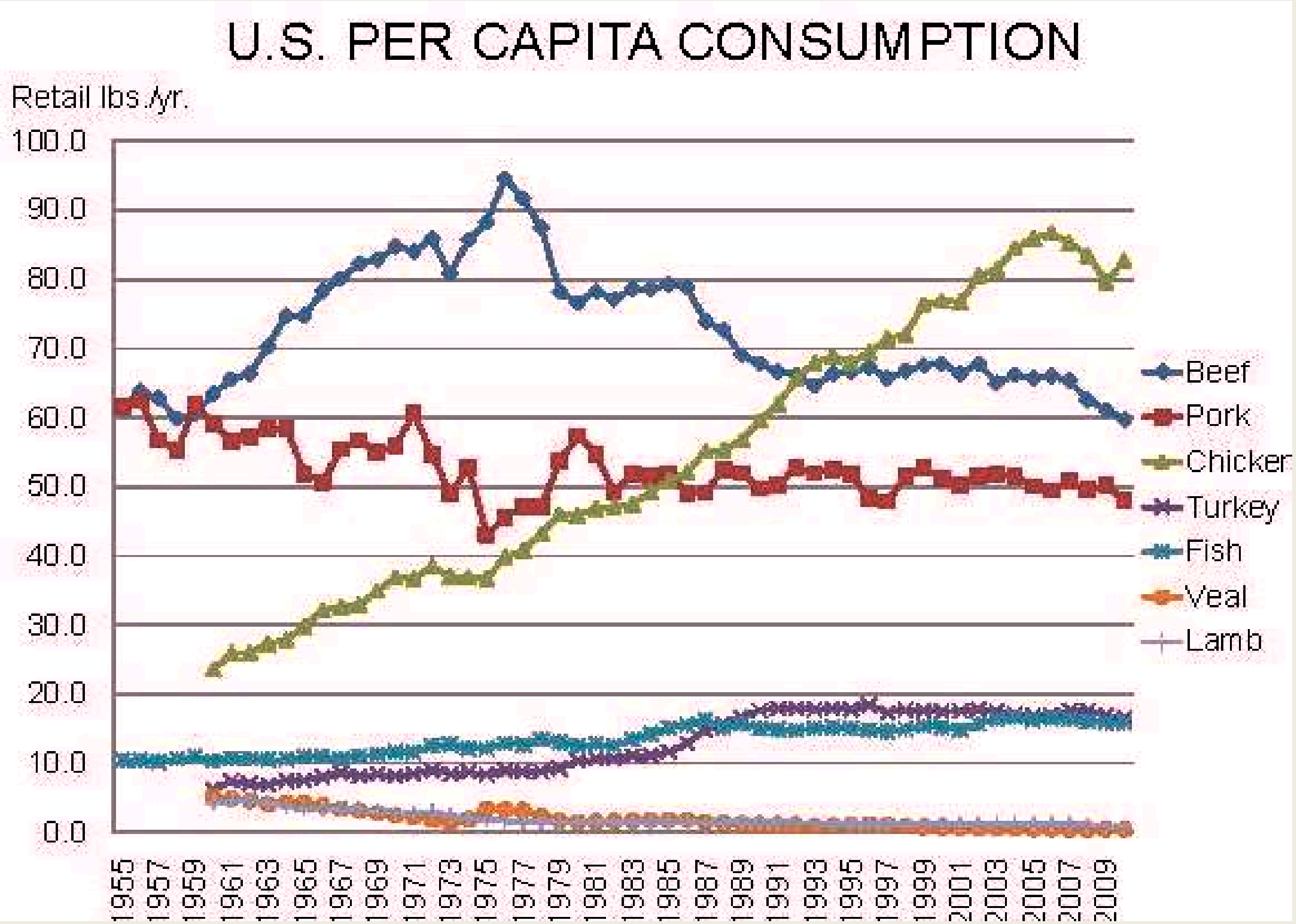
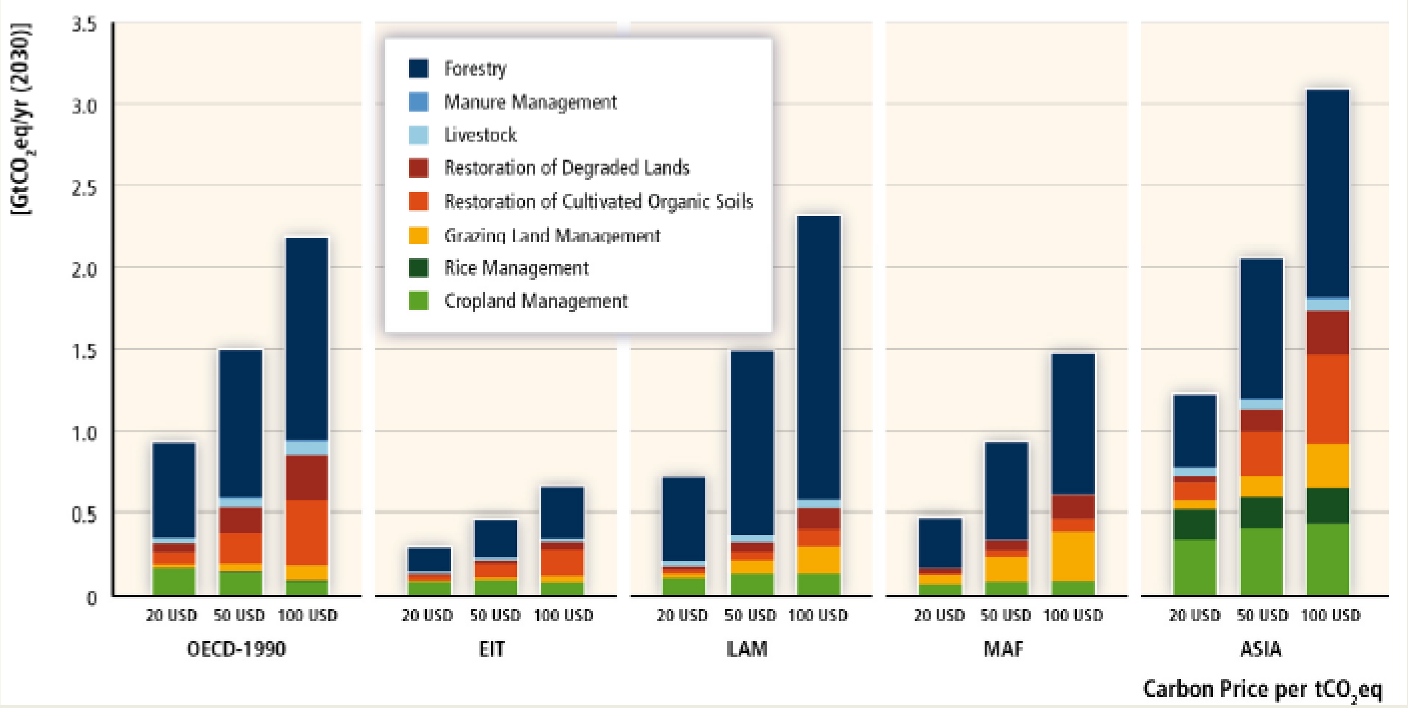
Diets have been changing, very rapidly, throughout the world

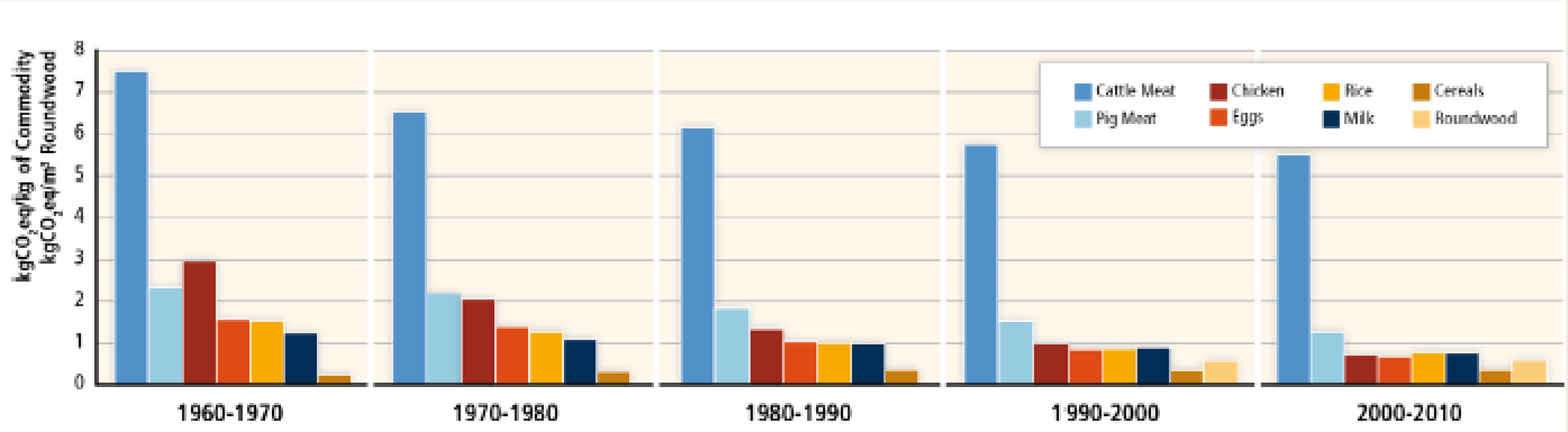


The IPCC's estimates of regional AFOLU mitigation potential, by carbon price

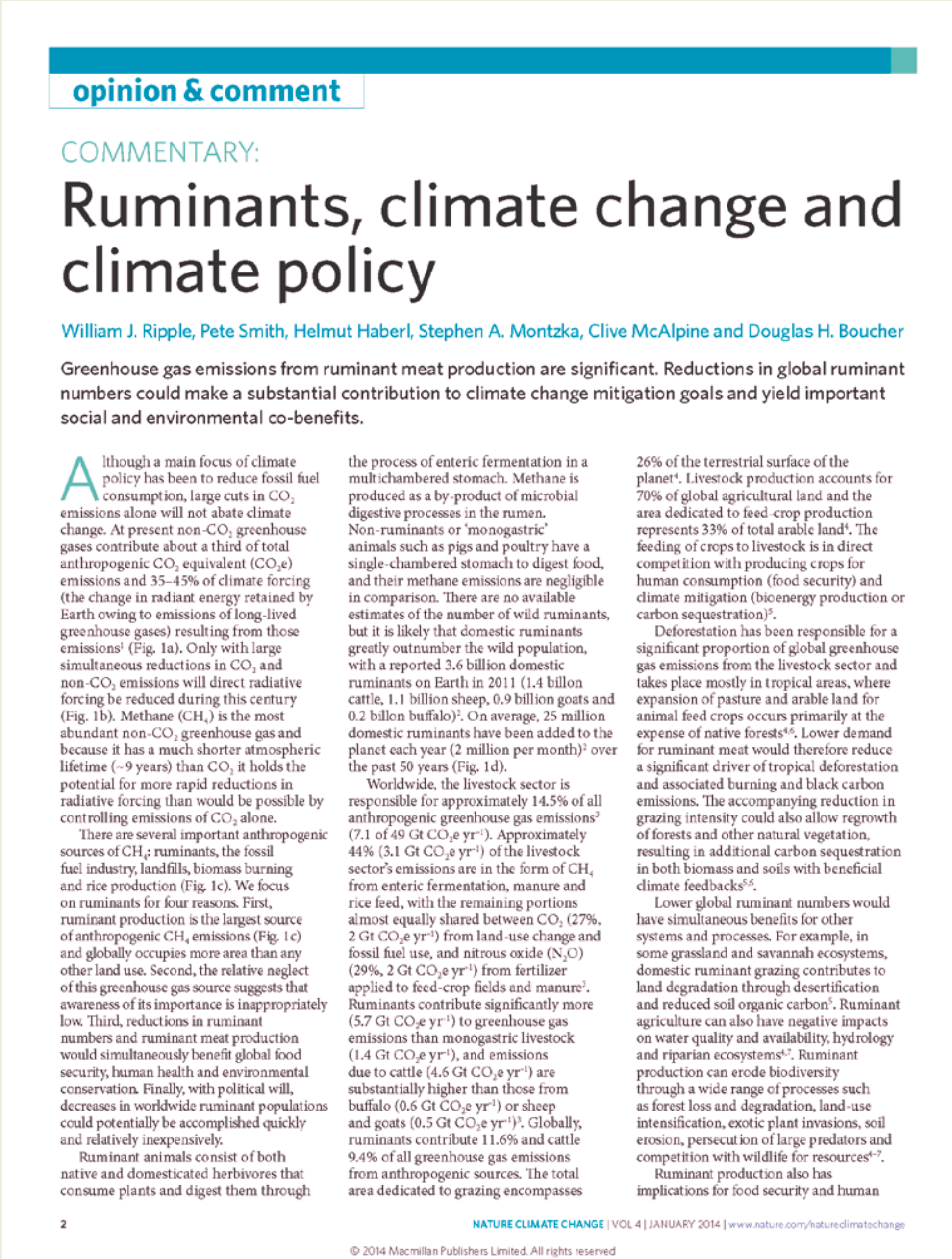


Source: IPCC AR5 Working Group 3 Report, Figure 11-17

The IPCC reported that the greenhouse gas emissions associated with beef consumption are much higher than for alternative foods, both plant and animal, and have been for several decades



Source: IPCC AR5 Working Group 3 Report, Figure 11-15



opinion & comment

COMMENTARY:

Ruminants, climate change and climate policy

William J. Ripple, Pete Smith, Helmut Haberl, Stephen A. Montzka, Clive McAlpine and Douglas H. Boucher

Greenhouse gas emissions from ruminant meat production are significant. Reductions in global ruminant numbers could make a substantial contribution to climate change mitigation goals and yield important social and environmental co-benefits.

Although a main focus of climate policy has been to reduce fossil fuel consumption, large cuts in CO_2 emissions alone will not abate climate change. At present non-CO_2 greenhouse gases contribute about a third of total anthropogenic CO_2 equivalent (CO_2e) emissions and 35–45% of climate forcing (the change in radiant energy retained by Earth owing to emissions of long-lived greenhouse gases) resulting from those emissions[1] (Fig. 1a). Only with large simultaneous reductions in CO_2 and non-CO_2 emissions will direct radiative forcing be reduced during this century (Fig. 1b). Methane (CH_4) is the most abundant non-CO_2 greenhouse gas and because it has a much shorter atmospheric lifetime (~9 years) than CO_2 it holds the potential for more rapid reductions in radiative forcing than would be possible by controlling emissions of CO_2 alone.

There are several important anthropogenic sources of CH_4: ruminants, the fossil fuel industry, landfills, biomass burning and rice production (Fig. 1c). We focus on ruminants for four reasons. First, ruminant production is the largest source of anthropogenic CH_4 emissions (Fig. 1c) and globally occupies more area than any other land use. Second, the relative neglect of this greenhouse gas source suggests that awareness of its importance is inappropriately low. Third, reductions in ruminant numbers and ruminant meat production would simultaneously benefit global food security, human health and environmental conservation. Finally, with political will, decreases in worldwide ruminant populations could potentially be accomplished quickly and relatively inexpensively.

Ruminant animals consist of both native and domesticated herbivores that consume plants and digest them through the process of enteric fermentation in a multichambered stomach. Methane is produced as a by-product of microbial digestive processes in the rumen. Non-ruminants or 'monogastric' animals such as pigs and poultry have a single-chambered stomach to digest food, and their methane emissions are negligible in comparison. There are no available estimates of the number of wild ruminants, but it is likely that domestic ruminants greatly outnumber the wild population, with a reported 3.6 billion domestic ruminants on Earth in 2011 (1.4 billon cattle, 1.1 billion sheep, 0.9 billion goats and 0.2 billon buffalo)[2]. On average, 25 million domestic ruminants have been added to the planet each year (2 million per month)[2] over the past 50 years (Fig. 1d).

Worldwide, the livestock sector is responsible for approximately 14.5% of all anthropogenic greenhouse gas emissions[3] (7.1 of 49 Gt CO_2e yr^{-1}). Approximately 44% (3.1 Gt CO_2e yr^{-1}) of the livestock sector's emissions are in the form of CH_4 from enteric fermentation, manure and rice feed, with the remaining portions almost equally shared between CO_2 (27%, 2 Gt CO_2e yr^{-1}) from land-use change and fossil fuel use, and nitrous oxide (N_2O) (29%, 2 Gt CO_2e yr^{-1}) from fertilizer applied to feed-crop fields and manure[3]. Ruminants contribute significantly more (5.7 Gt CO_2e yr^{-1}) to greenhouse gas emissions than monogastric livestock (1.4 Gt CO_2e yr^{-1}), and emissions due to cattle (4.6 Gt CO_2e yr^{-1}) are substantially higher than those from buffalo (0.6 Gt CO_2e yr^{-1}) or sheep and goats (0.5 Gt CO_2e yr^{-1})[3]. Globally, ruminants contribute 11.6% and cattle 9.4% of all greenhouse gas emissions from anthropogenic sources. The total area dedicated to grazing encompasses 26% of the terrestrial surface of the planet[4]. Livestock production accounts for 70% of global agricultural land and the area dedicated to feed-crop production represents 33% of total arable land[4]. The feeding of crops to livestock is in direct competition with producing crops for human consumption (food security) and climate mitigation (bioenergy production or carbon sequestration)[5].

Deforestation has been responsible for a significant proportion of global greenhouse gas emissions from the livestock sector and takes place mostly in tropical areas, where expansion of pasture and arable land for animal feed crops occurs primarily at the expense of native forests[4,6]. Lower demand for ruminant meat would therefore reduce a significant driver of tropical deforestation and associated burning and black carbon emissions. The accompanying reduction in grazing intensity could also allow regrowth of forests and other natural vegetation, resulting in additional carbon sequestration in both biomass and soils with beneficial climate feedbacks[5,6].

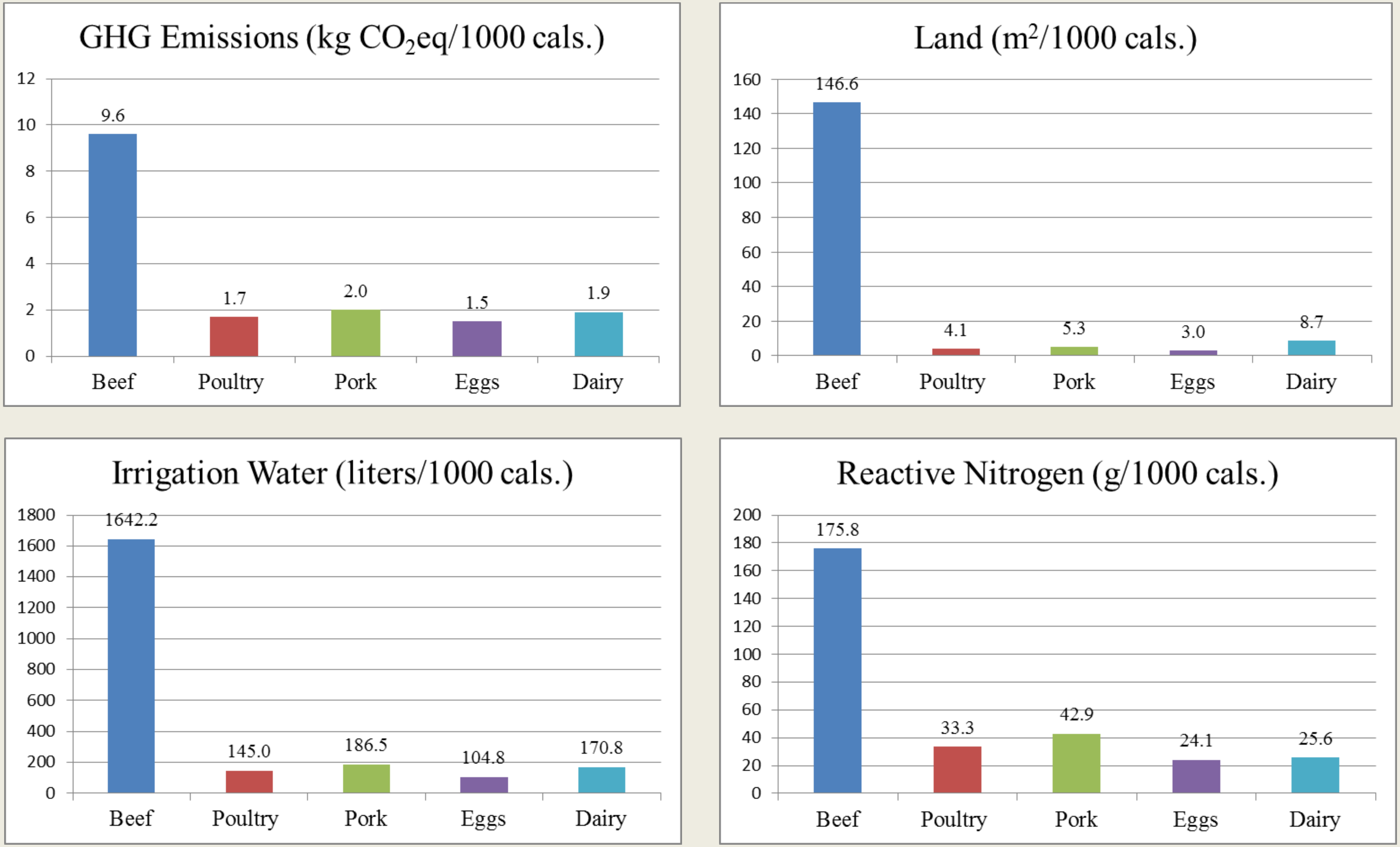
Lower global ruminant numbers would have simultaneous benefits for other systems and processes. For example, in some grassland and savannah ecosystems, domestic ruminant grazing contributes to land degradation through desertification and reduced soil organic carbon[5]. Ruminant agriculture can also have negative impacts on water quality and availability, hydrology and riparian ecosystems[4,7]. Ruminant production can erode biodiversity through a wide range of processes such as forest loss and degradation, land-use intensification, exotic plant invasions, soil erosion, persecution of large predators and competition with wildlife for resources[4–7].

Ruminant production also has implications for food security and human

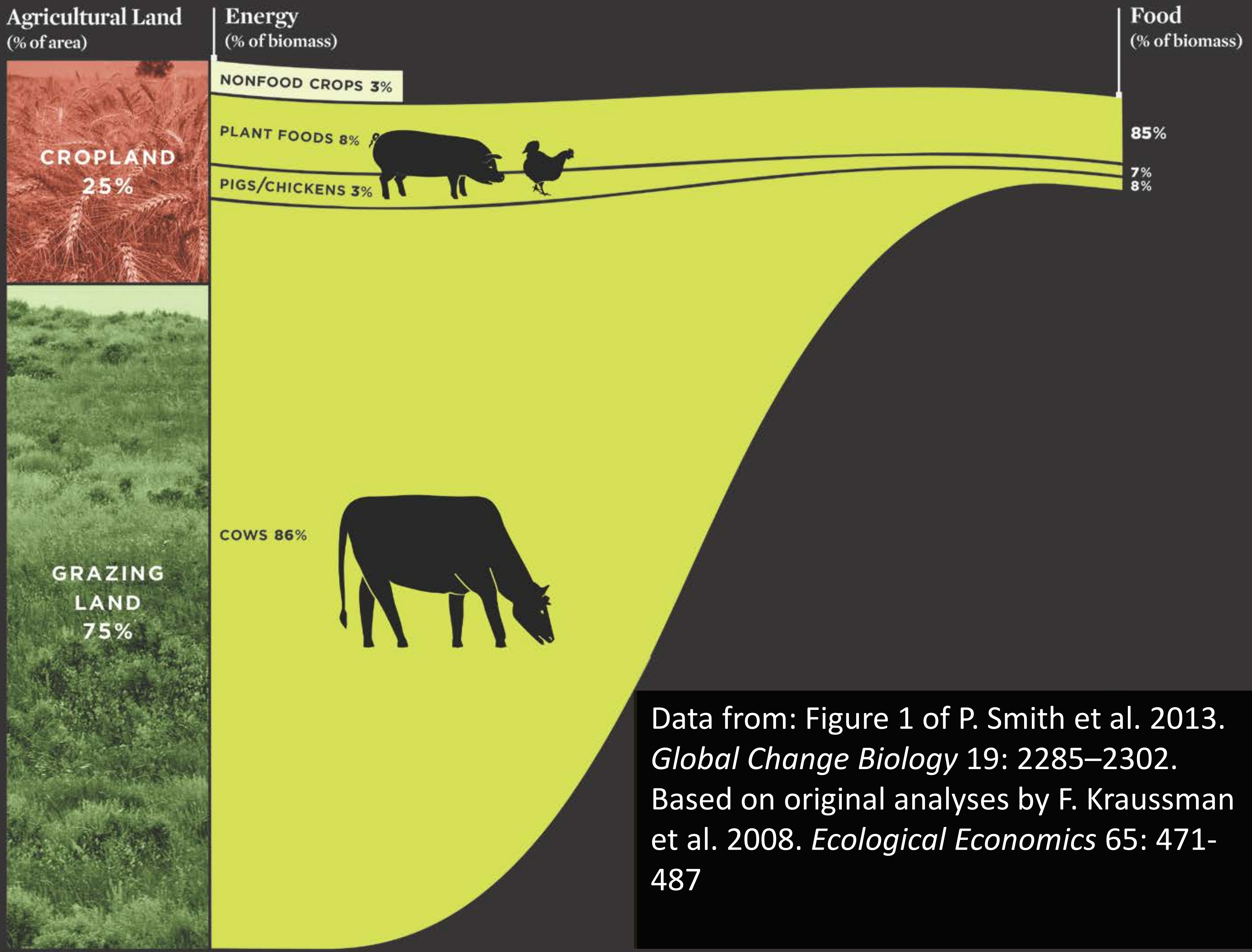
Ruminants – sheep, goats, buffalo and especially cattle – are the source of **the majority of global emissions from agriculture**, from:

- Enteric methane
- Methane in manure
- N_2O in manure
- Feed (grains, soy, hay, etc.)
- Deforestation

The environmental hoofprint of beef is much larger than for the animal food alternatives in the U.S.



Data of Eshel et al. 2014. *PNAS*. www.pnas.org/cgi/doi/10.1073/pnas.1402183111



Data from: Figure 1 of P. Smith et al. 2013. *Global Change Biology* 19: 2285–2302. Based on original analyses by F. Kraussman et al. 2008. *Ecological Economics* 65: 471-487