Journal club

45 minutes to read

5-10 minutes to present

- What does the paper speak about and why does it matter ?
- Methodology
- Main results
- Conclusion

SUSTAINABILITY

Reducing food's environmental impacts through producers and consumers

J. Poore[1,2]* and T. Nemecek[3]

Article https://doi.org/10.1038/s41467-023-43452-3

Risk to rely on soil carbon sequestration to offset global ruminant emissions

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Focus on Fig.S1, Fig.1 (or Fig.S3), Fig.2 A&B and if you have time, Fig.S6

SUSTAINABILITY

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Focus on Fig. 1, Fig.4, and Fig. 3 (or S2) if you have time (and compare with current cattle head/ha)

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Focus on Table 1, Panel 2, Fig.1 & Table 6 and include Title picture from the ‘*EAT-Lancet Commission Brief for Everyone*’

Food in the Anthropocene: the EAT–*Lancet* Commission on healthy diets from sustainable food systems

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SUSTAINABILITY

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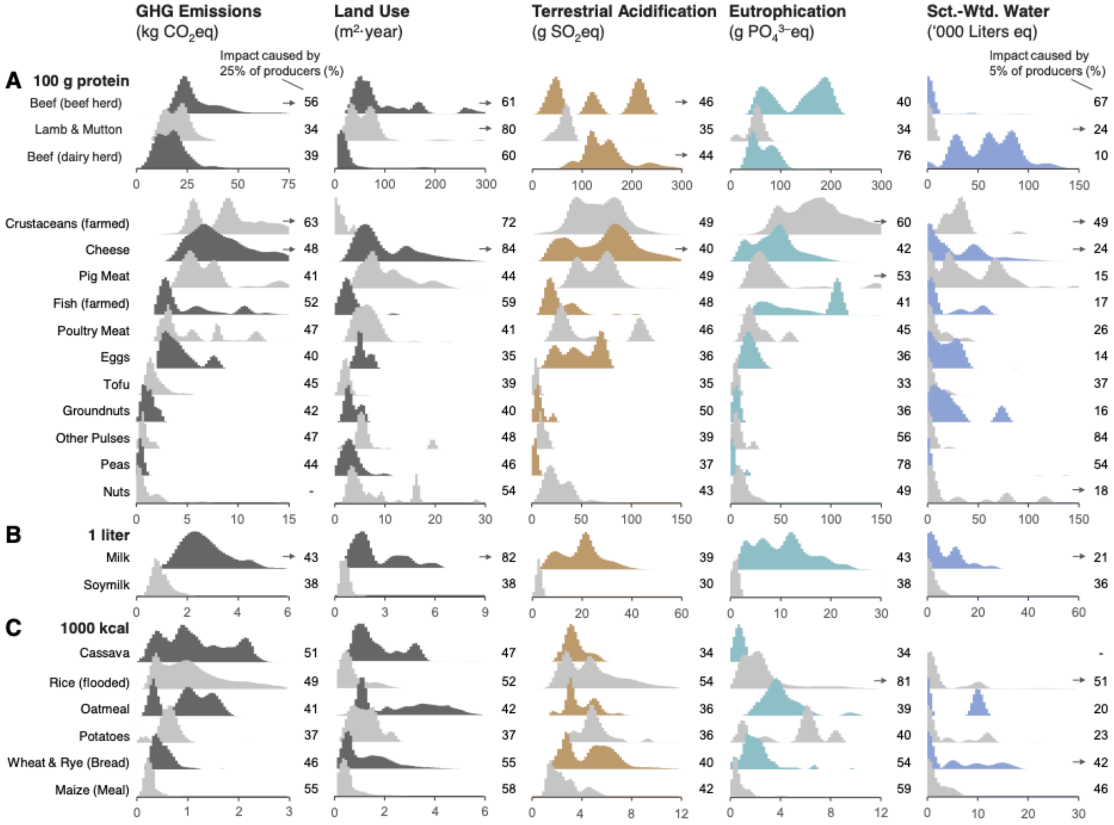
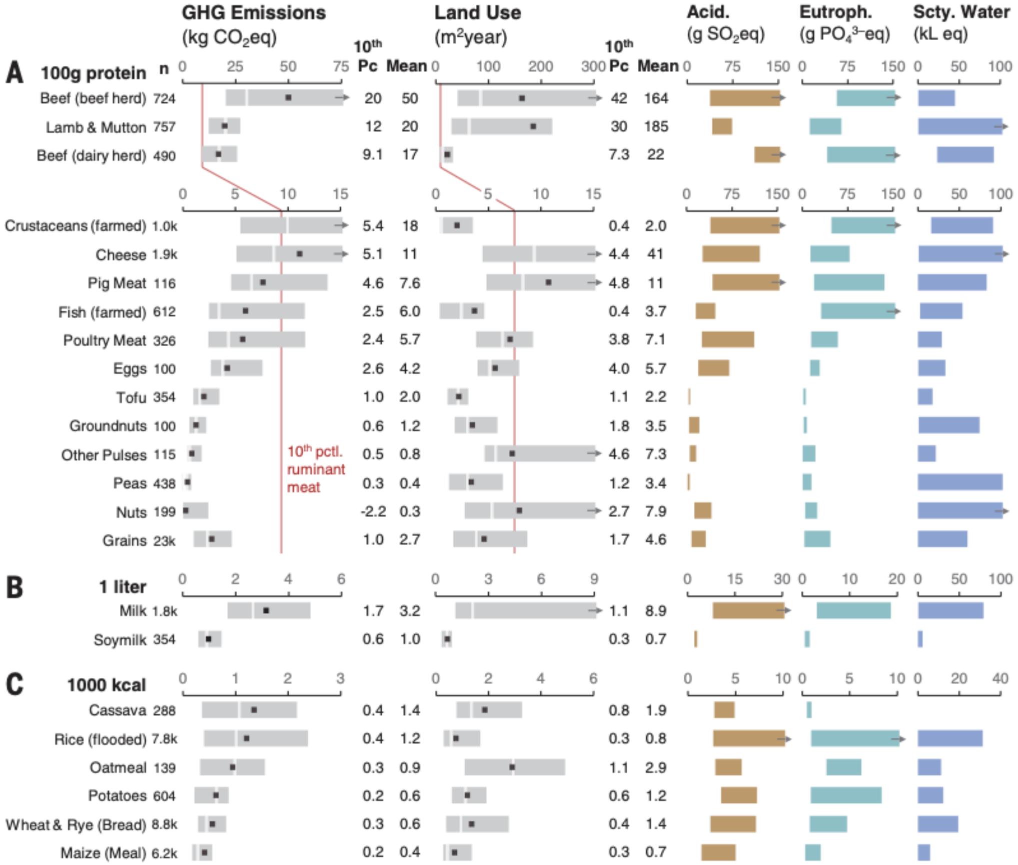
Large dataset





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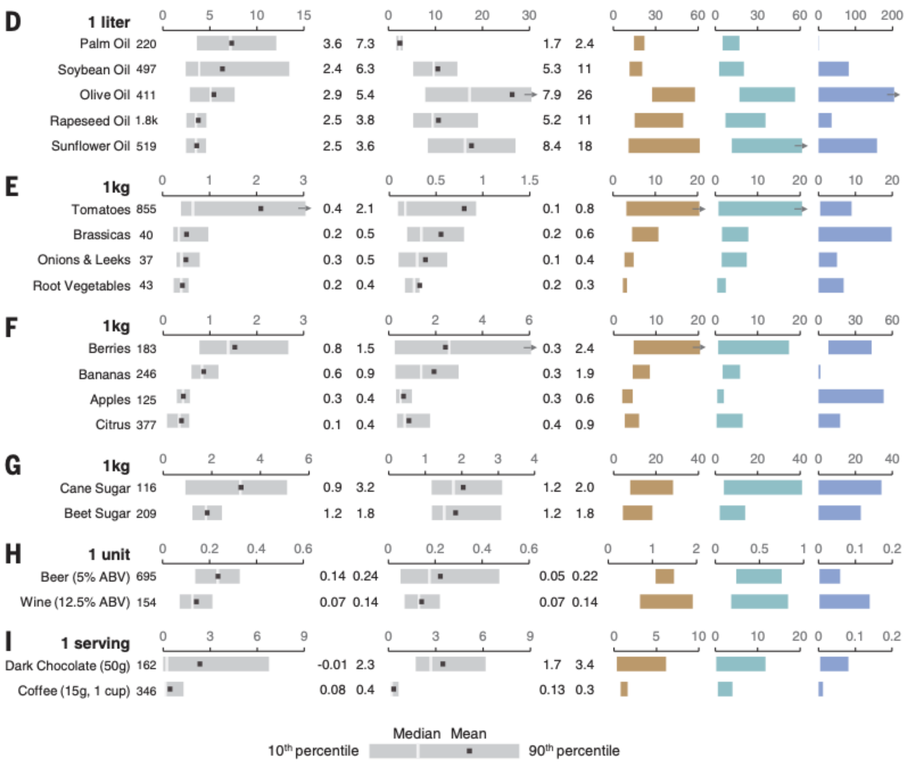
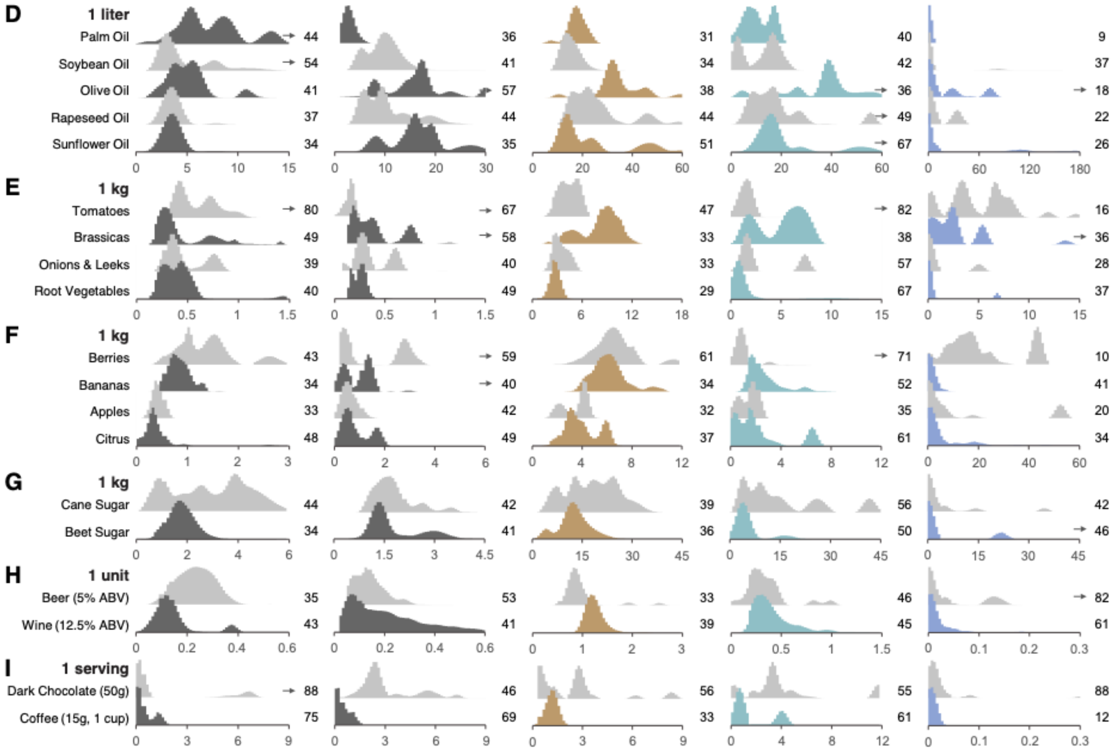




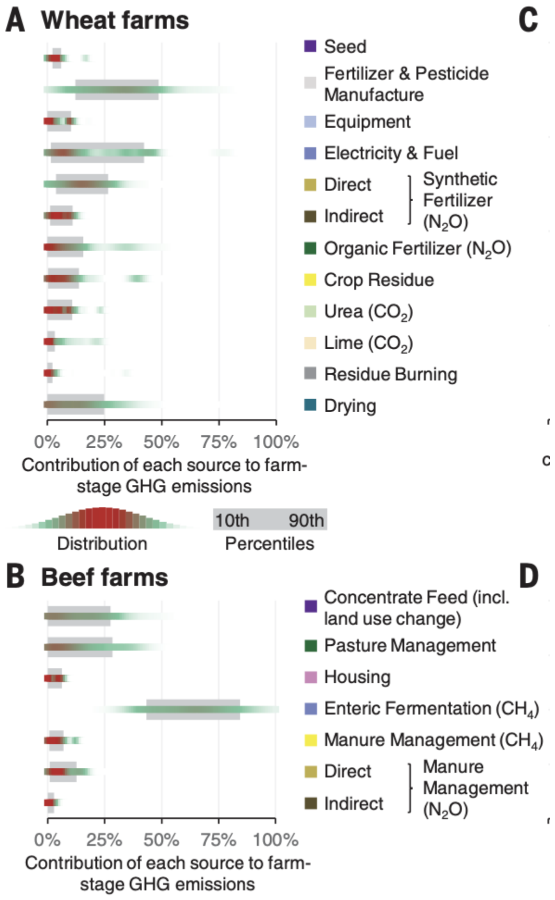


Fig. 2. Contributions of emission sources to total farm-stage GHG emissions. (**A** and **B**) Gray bars show 10th- and 90th-percentile contributions. Shaded bars represent the distribution. For example, the 90th-percentile contribution of organic fertilizer N_2O to farm-stage emissions is 16%, but for most wheat producers the contribution is near 0%. Density is estimated using a Gaussian kernel with bandwidth selection performed with biased cross-validation. (**C** and **D**) Contributions of emission sources for example producers with below-median GHG emissions.

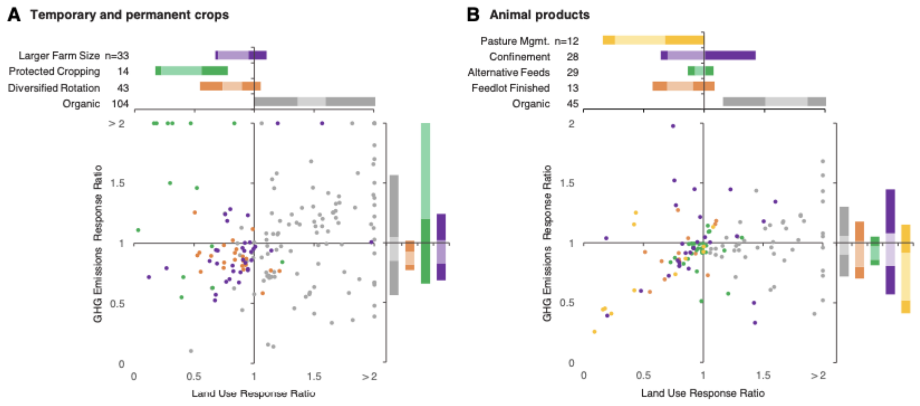
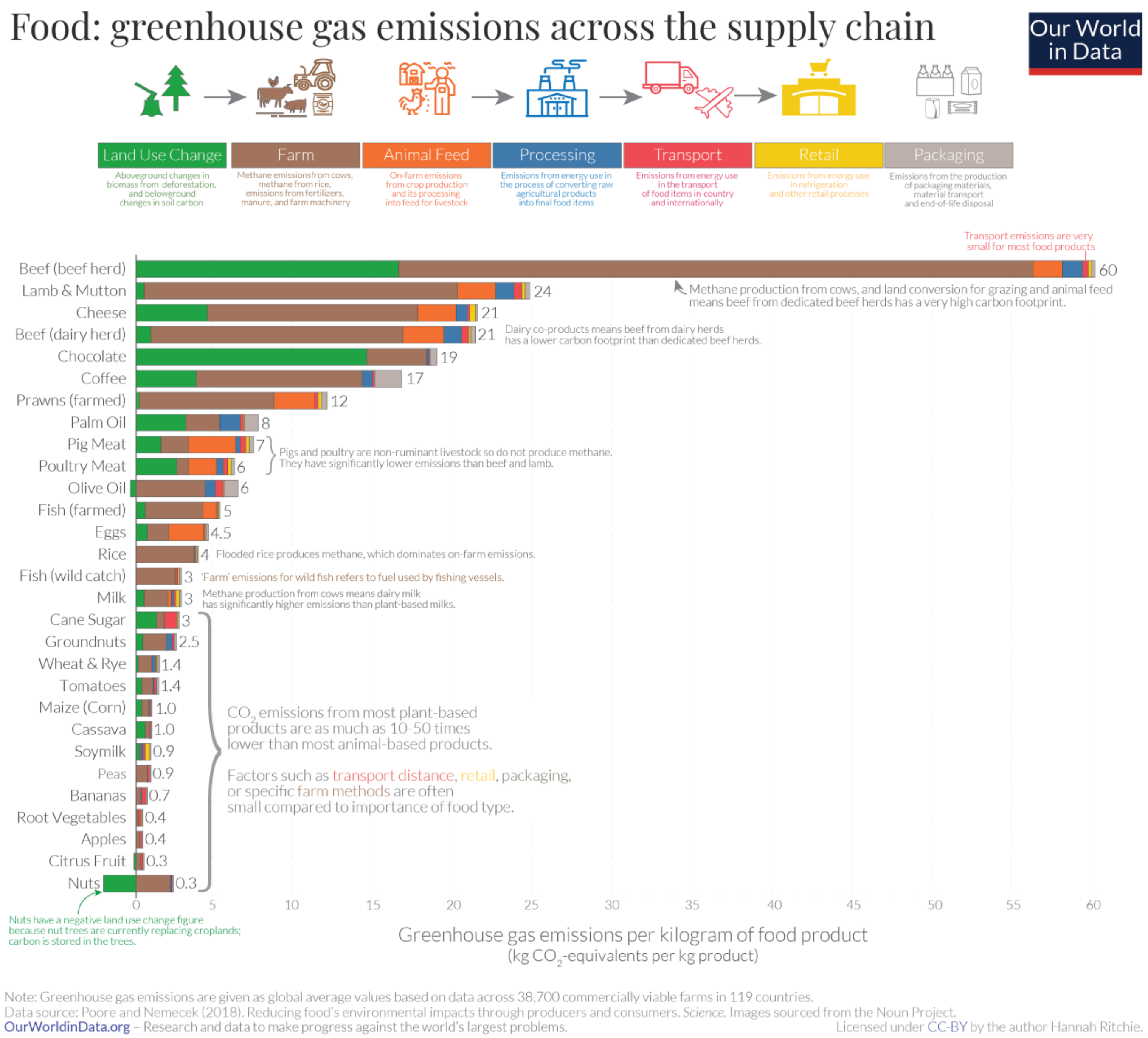


Fig. S6. Effect of practice changes on environmental impact. (**A**) Effect of four commercially viable practice changes for crops (larger vs. smaller farms; protected vs. open-field cropping; diversified rotation vs. monoculture; organic vs. conventional). Studies are included only if they assess specific farms in the same location and year. Dark shaded bars represent the 10th- and 90th-percentiles. Light shaded bars represent the 95% confidence interval of the logged and back-transformed response ratio. *n* = observation pairs. (**B**) Same as (A) but for animal products (improved vs. unmanaged or degraded pasture; confinement vs. grazing or free-range; alternative feed vs. current feed (e.g., European legumes vs. imported soy); feedlot finished vs. grass finished beef; organic vs. conventional). For animal products, GHG emissions include land use change and cultivated organic soils associated with feed.



Food: greenhouse gas emissions across the supply chain
Our World in Data
Land Use Change
Aboveground changes in biomass from deforestation, and belowground changes in soil carbon
Farm
Methane emissionsfrom cows, methane from rice, emissions from fertilizers, manure, and farm machinery
Animal Feed
On-farm emissions from crop production and its processing into feed for livestock
Processing
Emissions from energy use in the process of converting raw agricultural products into final food items
Transport
Emissions from energy use in the transport of food items in-country and internationally
Retail
Emissions from energy use in refrigeration and other retail processes
Packaging
Emissions from the production of packaging materials, material transport and end-of-life disposal
Transport emissions are very small for most food products
Beef (beef herd) 60
Lamb & Mutton 24
Cheese 21
Beef (dairy herd) 21
Chocolate 19
Coffee 17
Prawns (farmed) 12
Palm Oil 8
Pig Meat 7
Poultry Meat 6
Olive Oil 6
Fish (farmed) 5
Eggs 4.5
Rice 4
Fish (wild catch) 3
Milk 3
Cane Sugar 3
Groundnuts 2.5
Wheat & Rye 1.4
Tomatoes 1.4
Maize (Corn) 1.0
Cassava 1.0
Soymilk 0.9
Peas 0.9
Bananas 0.7
Root Vegetables 0.4
Apples 0.4
Citrus Fruit 0.3
Nuts 0.3
Methane production from cows, and land conversion for grazing and animal feed means beef from dedicated beef herds has a very high carbon footprint.
Dairy co-products means beef from dairy herds has a lower carbon footprint than dedicated beef herds.
Pigs and poultry are non-ruminant livestock so do not produce methane. They have significantly lower emissions than beef and lamb.
Flooded rice produces methane, which dominates on-farm emissions.
'Farm' emissions for wild fish refers to fuel used by fishing vessels.
Methane production from cows means dairy milk has significantly higher emissions than plant-based milks.
CO_2 emissions from most plant-based products are as much as 10-50 times lower than most animal-based products.
Factors such as transport distance, retail, packaging, or specific farm methods are often small compared to importance of food type.
Nuts have a negative land use change figure because nut trees are currently replacing croplands; carbon is stored in the trees.
0 5 10 15 20 25 30 35 40 45 50 55 60
Greenhouse gas emissions per kilogram of food product
(kg CO_2-equivalents per kg product)
Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries.
Data source: Poore and Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*. Images sourced from the Noun Project.
OurWorldinData.org – Research and data to make progress against the world's largest problems.
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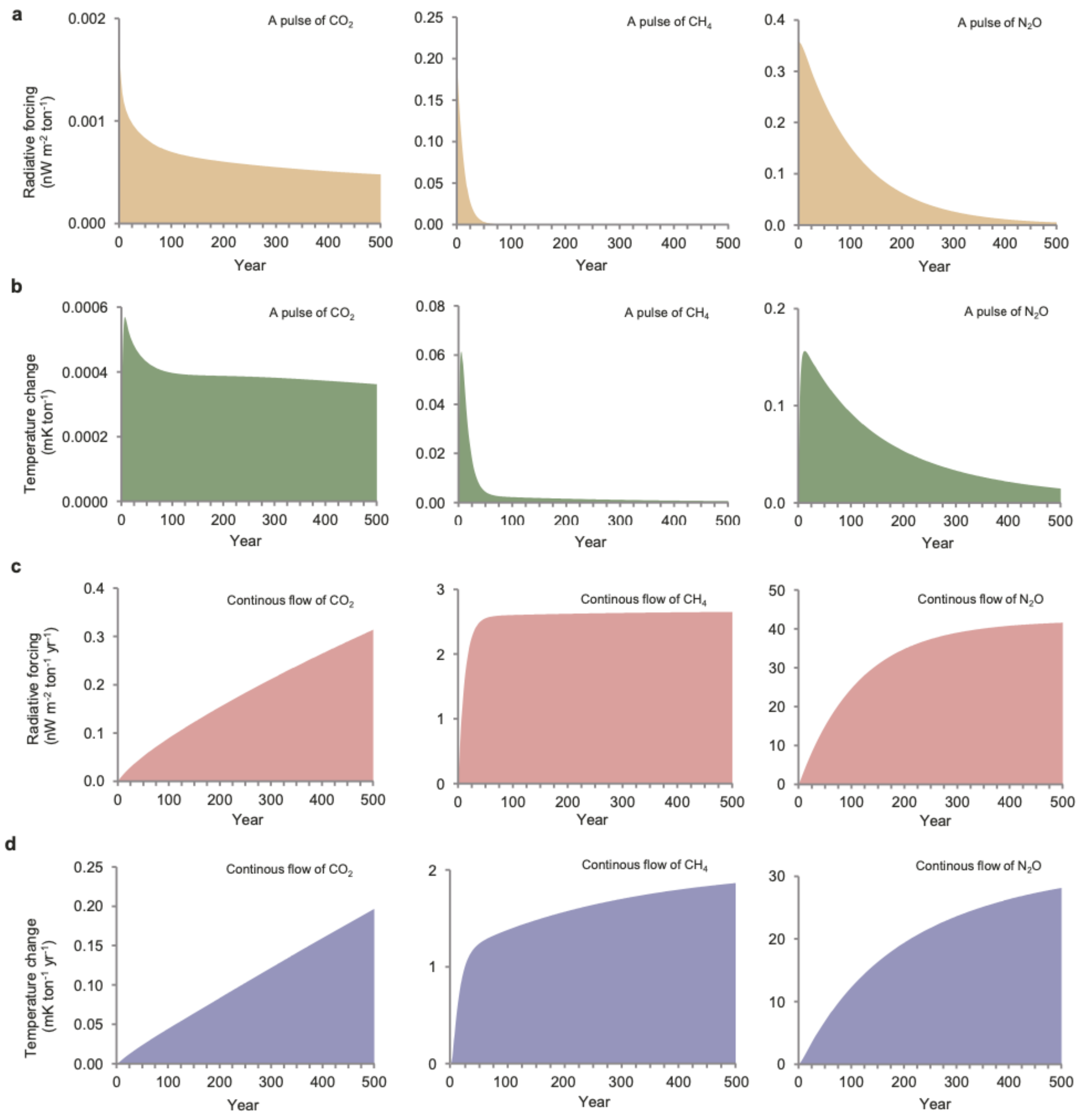


Fig. 1 | Climate impact related to the emission of a greenhouse gas (GHG) including CO_2, CH_4 and N_2O. **a** Radiative forcing of one pulse emission of a tonne (t) of GHGs during 500 years. The area under the graph represents the cumulative radiative forcing. **b** Global surface temperature change of one pulse emission of a t of GHGs during 500 years. **c** Cumulative radiative forcing of a continuous yearly emission of one t of GHGs during 500 years. **d** Cumulative global surface temperature change of a continuous yearly emission of one t of GHGs during 500 years. Note the difference in scale on the y-axis. The calculations are based on a simple climate model[27]. Source data are provided as a Source Data file.

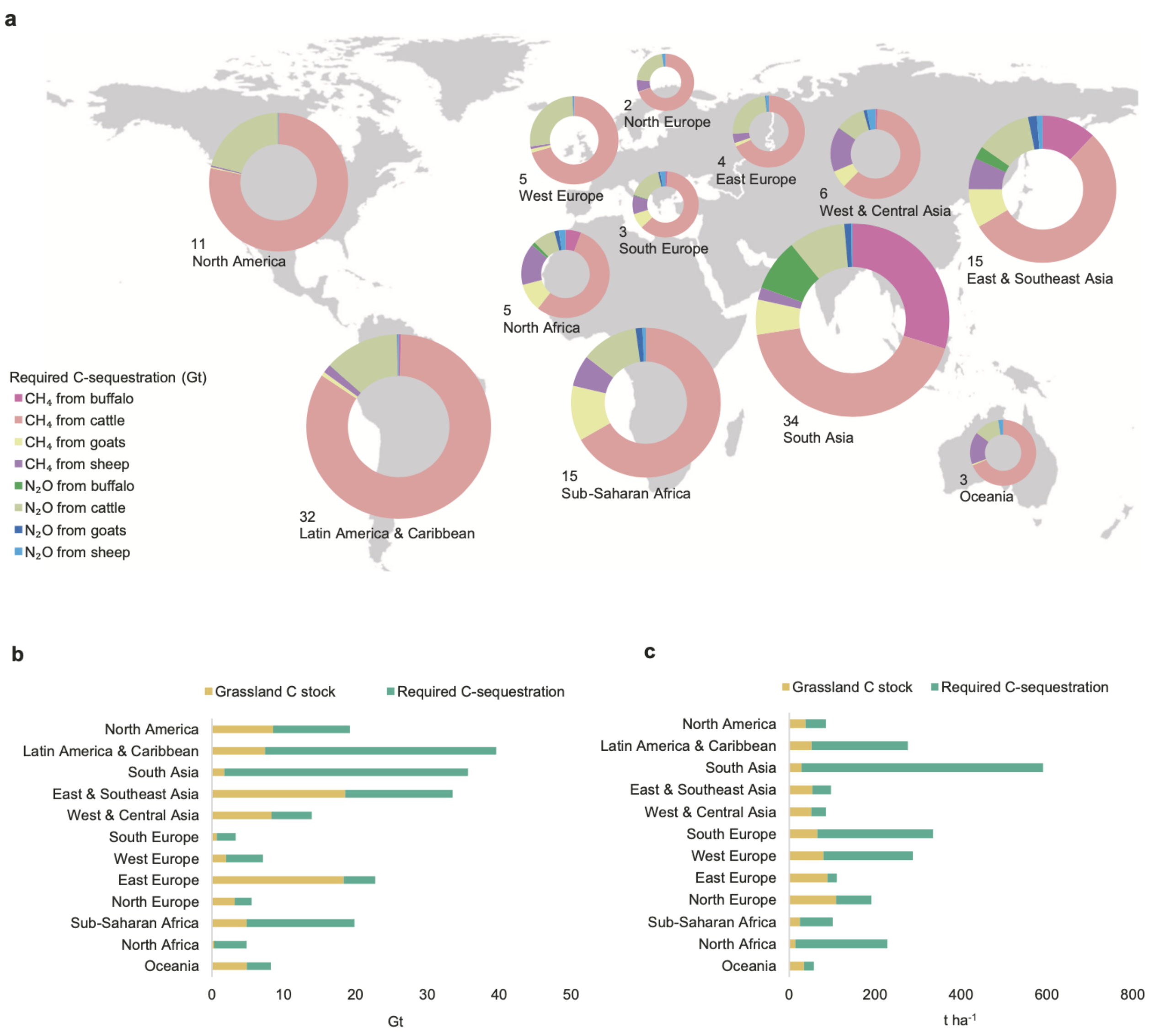
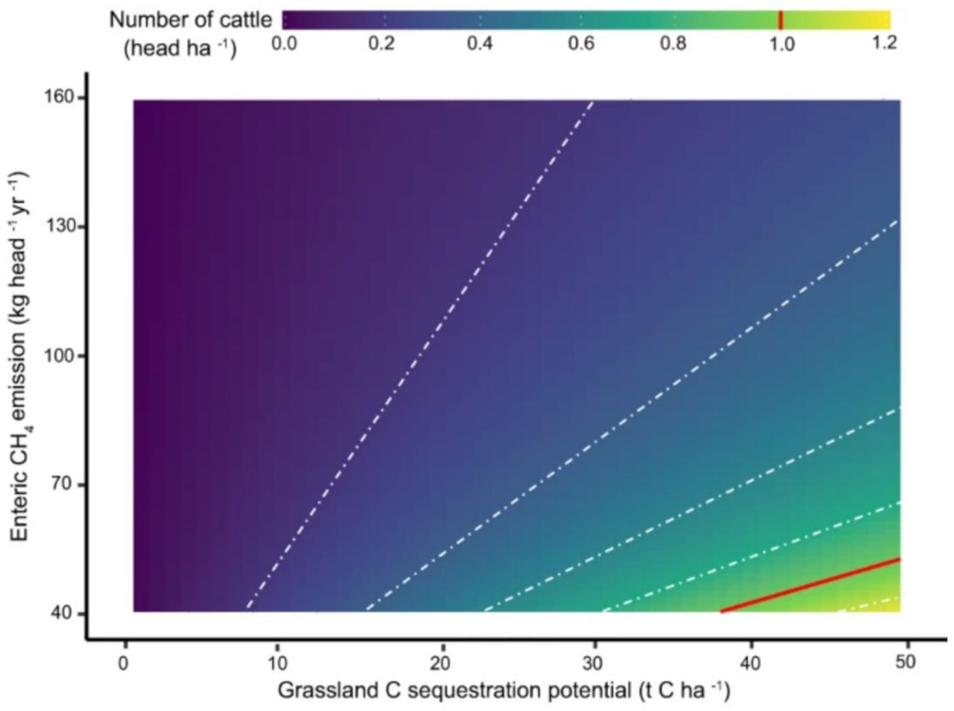
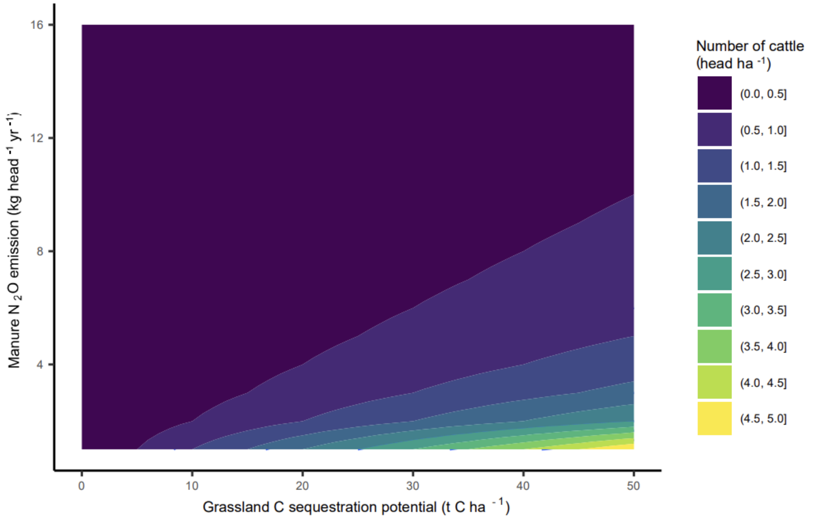


Fig. 4 | Soil carbon (C) having gaps for ruminant systems across the globe. a The required amount of C-sequestration to offset the continuous emissions of CH_4 and N_2O from ruminants in different world regions over 100 years. The sizes of doughnut charts reflect the total amount (in gigatonnes, Gt) of required C-sequestration and the compositions of the doughnut charts explain the contributions of different ruminant species and different gases. The calculations were based on the Global Livestock Environmental Assessment Model (GLEAM 3.0)[36] and this study. The base map for global regions was derived from Esri datasets. **b** The required soil C-sequestration and current soil C stock in managed grasslands, in terms of total amount for each region. **c** The required soil C-sequestration and current soil C stock in managed grasslands, in terms of per hectare of land for each region. The data for soil C stock was derived from Global Soil Sequestration Potential Map (GSOCseq V1.1)[40].

Fig. 3: Number of cattle 'allowed' for a given (maximum) soil carbon (C) sequestration in grasslands to offset the climate impact in a range of possible enteric CH_4 emissions per cattle.





Supplementary Fig.2 | Number of cattle 'allowed' for a given (maximum) soil carbon (C) sequestration in grasslands to offset the climate impact of a possible range of manure N_2O emissions per cattle. Manure N_2O emissions include direct and indirect N_2O emissions from the storage and treatment of cattle manure. The values represent a wide range of cattle types, regions and manure systems. It was assumed that one tonne (t) of C would offset a continuous emission of 0.1 kg N_2O per year over 100 years, based on a simple climate model [1]. Source data are provided as a Source Data file.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
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Eidgenössisches
Volkswirtschaftsdepartement EVD
Agroscope

Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

FiBL

hepia
Haute école du paysage, d'ingénierie et d'architecture de Genève

WSL

zh aw

Soil carbon sequestration in Switzerland: analysis of potentials and measures (Postulate Bourgeois 19.3639)

Sonja G. Keel*[1], Alice Johannes*[2], Pascal Boivin[3], Stéphane Burgos[4], Raphaël Charles[5], Frank Hagedorn[6], Beatrice Kulli[7], Jens Leifeld[1], Andrea Saluz[7], Stephan Zimmermann[6]

Table 8: Literature-derived mean carbon (C) sequestration rates of different agricultural management (mean ± standard deviation). Most numbers are from Wiesmeier et al. (2020).

Measure	Soil C sequestration rate (t C ha^{-1} yr^{-1})	Area (ha)	Total soil C sequestration rate (Mt CO_2-equivalents yr^{-1})	Soil depth (cm)	Data source
Conservation agriculture	0.63 0.4–0.8	356580	0.52–1.05	0–30 0–20	*Autret et al. (2016)*; section 2.2.2.1
No-tillage as single factor	No change	356580	0	>30 0–40	*Baker et al. (2007); Luo et al. (2010)*
Cover crops as single factor	0.32 ± 0.08	158480	0.19	21 ± 7	*Poeplau & Don (2015)*
Agroforestry	0–0.86	39620	0–0.12	51	*Upson & Burgess (2013); Cardinael et al. (2017); Seitz et al. (2017)*
Land use change (cropland to grassland conversion)	0.73 ± 0.17	19810	0.05	29 ± 5	*Conant et al. (2001); Poeplau et al. (2011); Lugato et al. (2014)*
Deep tillage	0.93[a] 8.95[b]	19810	(0.07–0.65)[c]	50–90 0–150	*Alcántara et al. (2016); Schiedung et al. (2019)*

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Panel 2: Feasibility of reference diet

Although the reference diet, which is based on health considerations, is consistent with many traditional eating patterns, for some individuals or populations this diet might seem extreme or not feasible. However, from a global perspective the features of this diet, which could include strict vegetarian diets and consumption of modest amounts of animal source foods, have well established traditions in various regions. The best studied example is the Mediterranean diet, similar to the diet of Crete in the mid-20th century. This diet was low in red meat (average intake of red meat and poultry combined was 35 g/day)[A1] and largely plant-based, but high in total fat intake (about 40% of energy) consumed mainly as olive oil.[A2] Greeks had one of the longest life expectancies at the time.[A3]

Many other traditional diets, such as those in Indonesia, Mexico, India, China, and West Africa, also include little red meat, which might be consumed only on special occasions or as minor ingredients of mixed dishes.[A4–6] Some of these cultures have also consumed few or no dairy foods, often corresponding with lactose intolerance and lower rates of bone fracture than have countries with high dairy consumption.[A7] High consumption of nuts is traditional in some West African populations (ie, about 100 g/day in Niger) and large amounts of soy foods are consumed in many Asian populations (ie, 46 g/day in Taiwan).[A5] Legume consumption has traditionally been high in many cultures, such as Mexico, India, and Rwanda.[A4,A8] Thus, ample precedent exists for the ranges of food intakes represented by the reference diet, and the culinary experiences of different regions provide many opportunities to learn new ways of preparing diets that are healthy and enjoyable.

References cited in this panel can be found in the appendix (p 27)

	Macronutrient intake (possible range), g/day	Caloric intake, kcal/day
Whole grains*		
Rice, wheat, corn, and other†	232 (total gains 0–60% of energy)	811
Tubers or starchy vegetables		
Potatoes and cassava	50 (0–100)	39
Vegetables		
All vegetables	300 (200–600)	..
Dark green vegetables	100	23
Red and orange vegetables	100	30
Other vegetables	100	25
Fruits		
All fruit	200 (100–300)	126
Dairy foods		
Whole milk or derivative equivalents (eg, cheese)	250 (0–500)	153
Protein sources‡		
Beef and lamb	7 (0–14)	15
Pork	7 (0–14)	15
Chicken and other poultry	29 (0–58)	62
Eggs	13 (0–25)	19
Fish§	28 (0–100)	40
Legumes		
Dry beans, lentils, and peas*	50 (0–100)	172
Soy foods	25 (0–50)	112
Peanuts	25 (0–75)	142
Tree nuts	25	149
Added fats		
Palm oil	6·8 (0–6·8)	60
Unsaturated oils¶	40 (20–80)	354
Dairy fats (included in milk)	0	0
Lard or tallow‖	5 (0–5)	36
Added sugars		
All sweeteners	31 (0–31)	120

For an individual, an optimal energy intake to maintain a healthy weight will depend on body size and level of physical activity. Processing of foods such as partial hydrogenation of oils, refining of grains, and addition of salt and preservatives can substantially affect health but is not addressed in this table. *Wheat, rice, dry beans, and lentils are dry, raw. †Mix and amount of grains can vary to maintain isocaloric intake. ‡Beef and lamb are exchangeable with pork and vice versa. Chicken and other poultry is exchangeable with eggs, fish, or plant protein sources. Legumes, peanuts, tree nuts, seeds, and soy are interchangeable. §Seafood consist of fish and shellfish (eg, mussels and shrimps) and originate from both capture and from farming. Although seafood is a highly diverse group that contains both animals and plants, the focus of this report is solely on animals. ¶Unsaturated oils are 20% each of olive, soybean, rapeseed, sunflower, and peanut oil. ‖Some lard or tallow are optional in instances when pigs or cattle are consumed.

***Table 1*: Healthy reference diet, with possible ranges, for an intake of 2500 kcal/day**

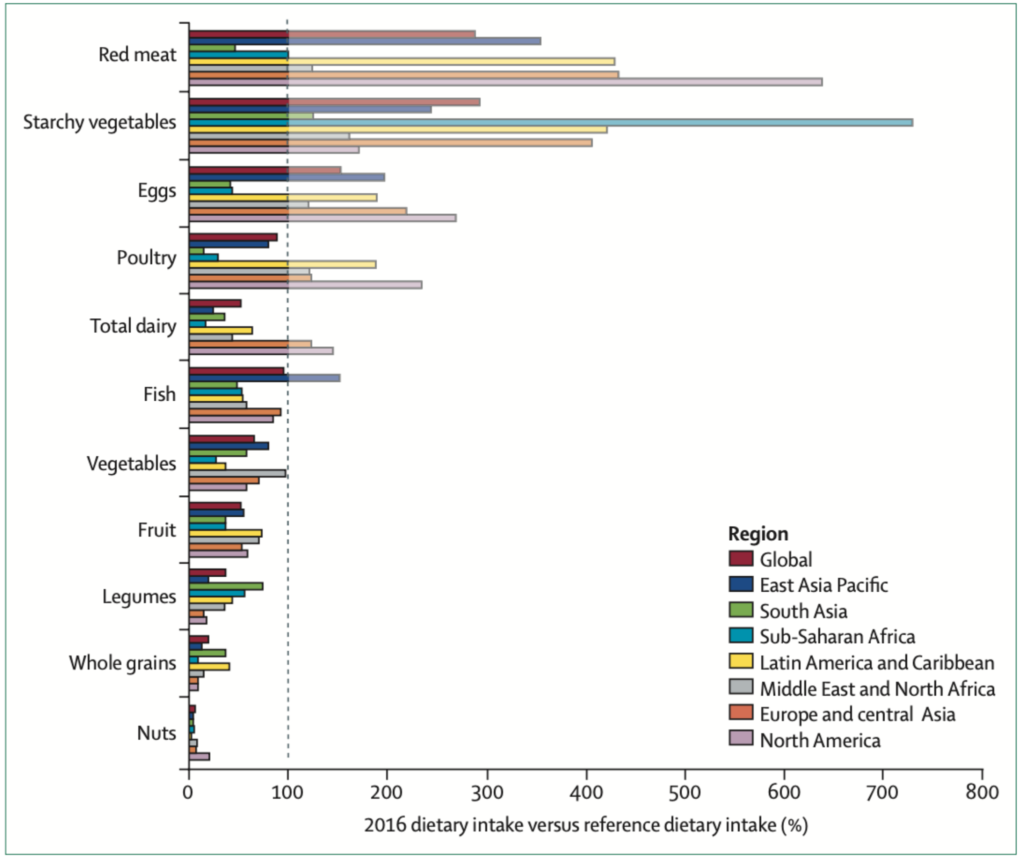


Figure 1: **Diet gap between dietary patterns in 2016 and reference diet intakes of food**

	Description	Indicative government role	Indicative industry role	Indicative civil society role
Eliminate choice	Channel actions only to the desired end and isolate inappropriate actions	Set goals for a zero or negative-effect food system	Withdraw inappropriate products; diversify the business	Win public support for elimination of unhealthy diets
Restrict choice	Remove inappropriate choice options	Model choice editing or rationing on a population scale	Allocate funding to favour sustainable and healthy products	Campaign for banning and pariah status of key products and processes
Guide choices through disincentives	Apply taxes or charges	Develop multicriteria interventions, building on existing developments such as carbon and sugar taxation, and scoping others such as marketing controls, carbon-calorie connections	Use of contracts and conditions to shape supply chains	Disinvestment campaigns
Guide choices through incentives	Use regulations or financial incentives	Interagency, cross-government engagement with the consuming public	Consumer reward schemes	Build cultural appeal for healthy diets from sustainable food systems
Guide choice by changing default policy	Provide better options	Recognise the problem but not give it high priority	Already being pioneered by retailers in their own-label products, and by in food service actors through menu planning, reformulation	Legislative change campaigns
Enable choice	Enable individuals to change behaviour	The market economics position, currently manifest via logos and branding appeals	Focused marketing on only healthy and sustainably produced foods	Campaign for alternative products
Provide information	Inform or educate the public	Mass, public information campaigns	Prioritisation of brands which appeal to eat differently,	Led by NGOs, brands and some commercial interests
Do nothing	No action or only monitor situation	The all-too common baseline of inactivity, which can be maintained by vested interest support	Rely on public relations or media advisers to alert as to coming difficulties	Ignore the wider picture and stick to narrow spheres of interest

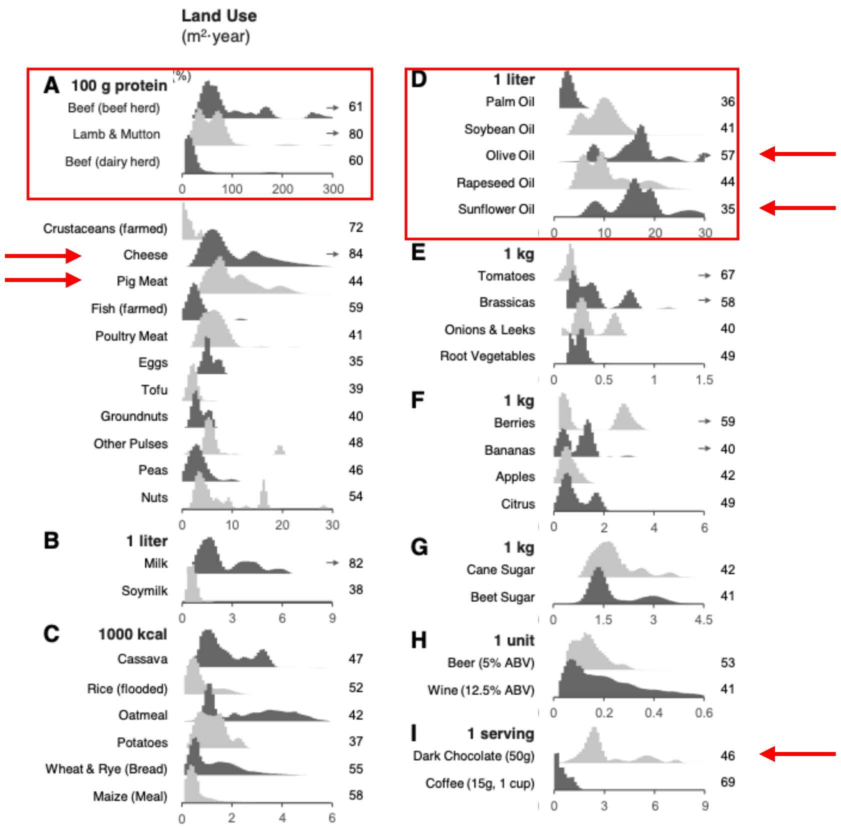
Interventions are hard to soft from top to bottom.[276] NGO=Non-governmental organisation.

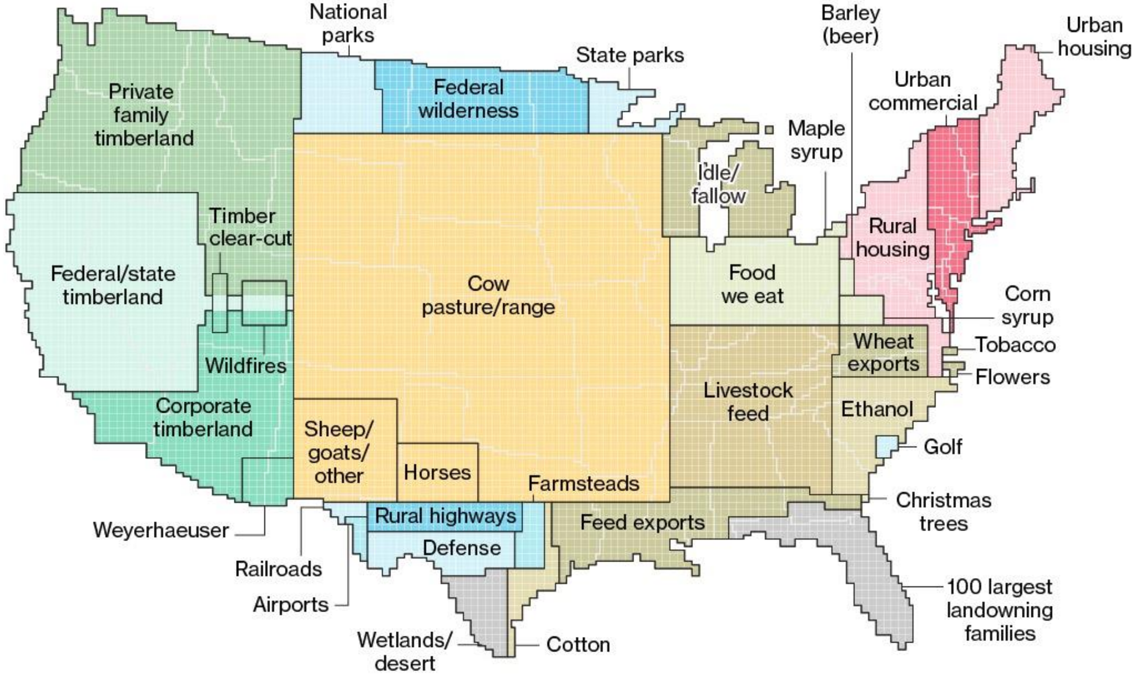
Table 6: **Applying the Nuffield Ladder of Policy Intervention to Health Diets from Sustainable Food Systems**

Supplementary slides

But GHG emissions are not the only problem

- Land use





Merril D. & Leatherby L., «Here's how America Uses Its Land», *Bloomberg*, 13.07.2018