# The Ecological Impacts and Solutions with Food Systems

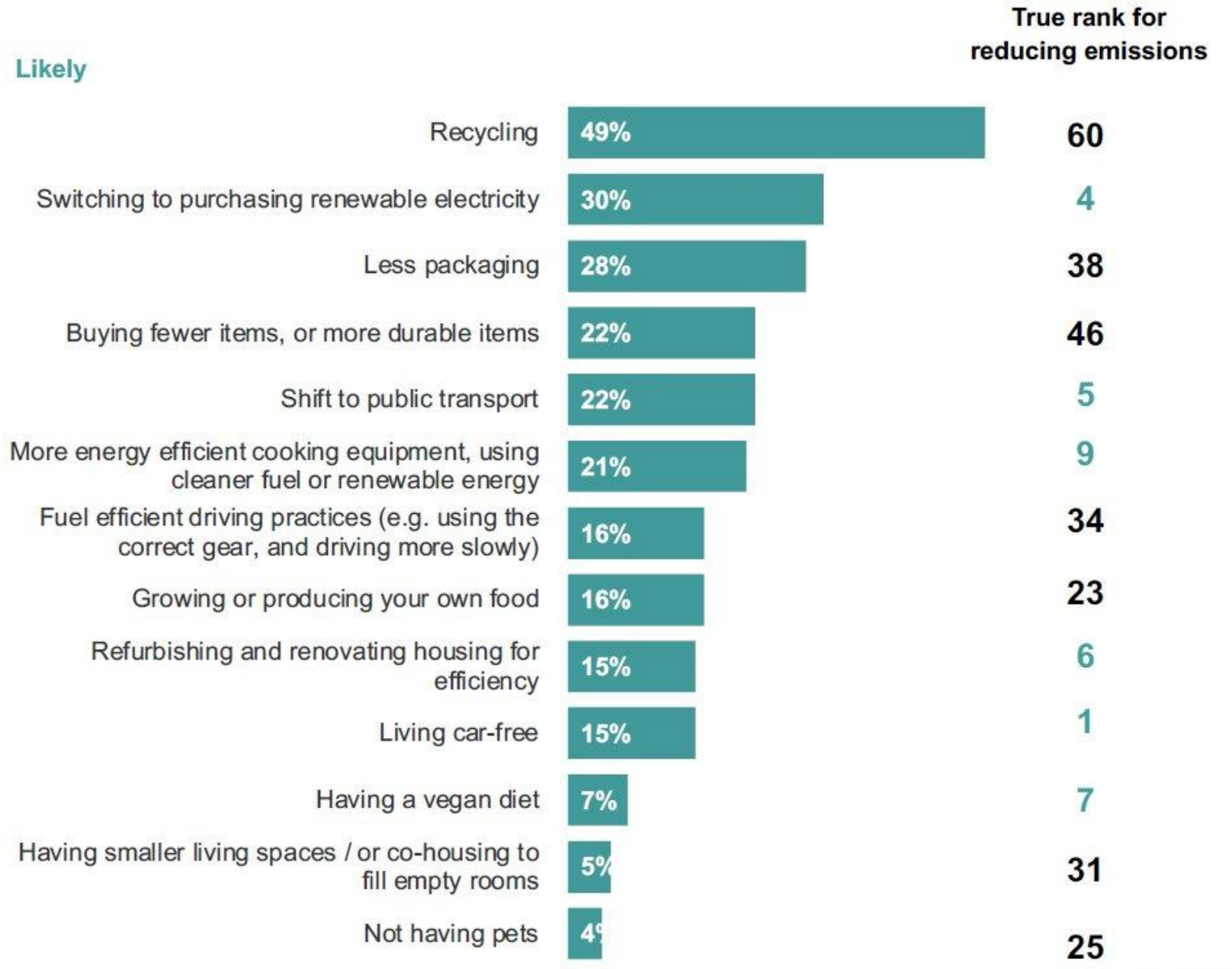
Nicholas Carter

# The public perceive many actions as having a far greater impact on reducing emissions than they do

**Global Country Average**

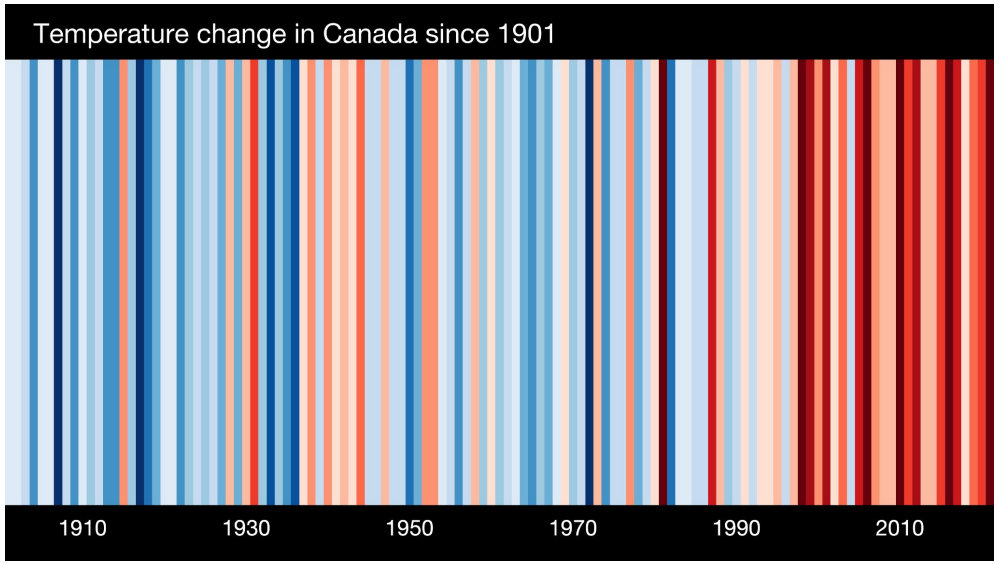
Q. Which three of the following actions, if any, do you think would have most impact on reducing greenhouse gas emissions?

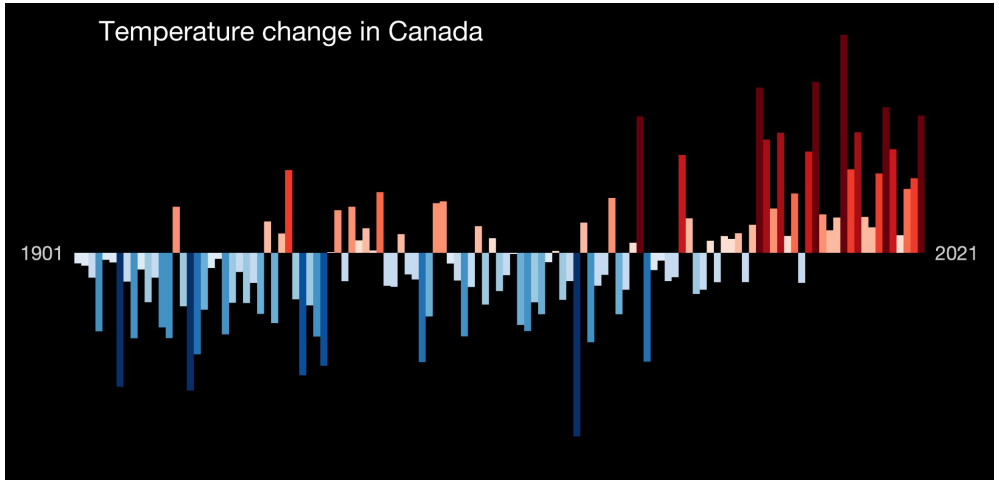
(Diana Ivanova *et al.*, 2020)




*Base: 23,577 online adults across 31 countries, 18 Feb – 4 Mar 2022. NB surveyed adults aged 16-74 in 30 countries, adults aged 16-99 in Norway. *Source: Ivanova et al., 2020. Quantifying the potential for climate change mitigation of consumption options. Available here: https://iopscience.iop.org/article/10.1088/1748-9326/ab8589/pdf*

# Agenda



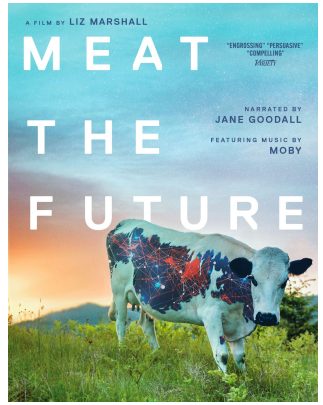

1. Perceptions vs. reality in protection of land & oceans
2. Land Use: Now the key environmental issue
3. Animal agriculture's dominance in the food system crisis
4. The Extinction Crisis
5. Greenwashing and corporate influence of environmental science
6. Solutions: Stock-free organic, rewilding, food tech innovations
7. Comments on the scientific consensus

# About Me

- Co-founder and Ecological Researcher at **PlantBasedData.org**
- Led the opening of a new climate adaptation data centre in eastern Canada

- Panelist at recent events by:
  - Center for Biological Diversity alongside Dr. Tara Garnett from Oxford University
  - Launch of the documentary Meat the Future along with the Jane Goodall Institute, the Good Food Institute, and BluNalu.

- Science researcher and writer for A Well Fed World, the European Climate Foundation, and a number of food & environment books and documentaries (The Proof is in the Plants, Half Earth Socialism, Milked, etc.)





*I have no conflict of interest for this presentation or the topics discussed and Plant Based Data receives no direct or indirect funding from food industry sources nor has any other financial conflicts of interest.*

# What ocean and land is protected vs. perceptions?



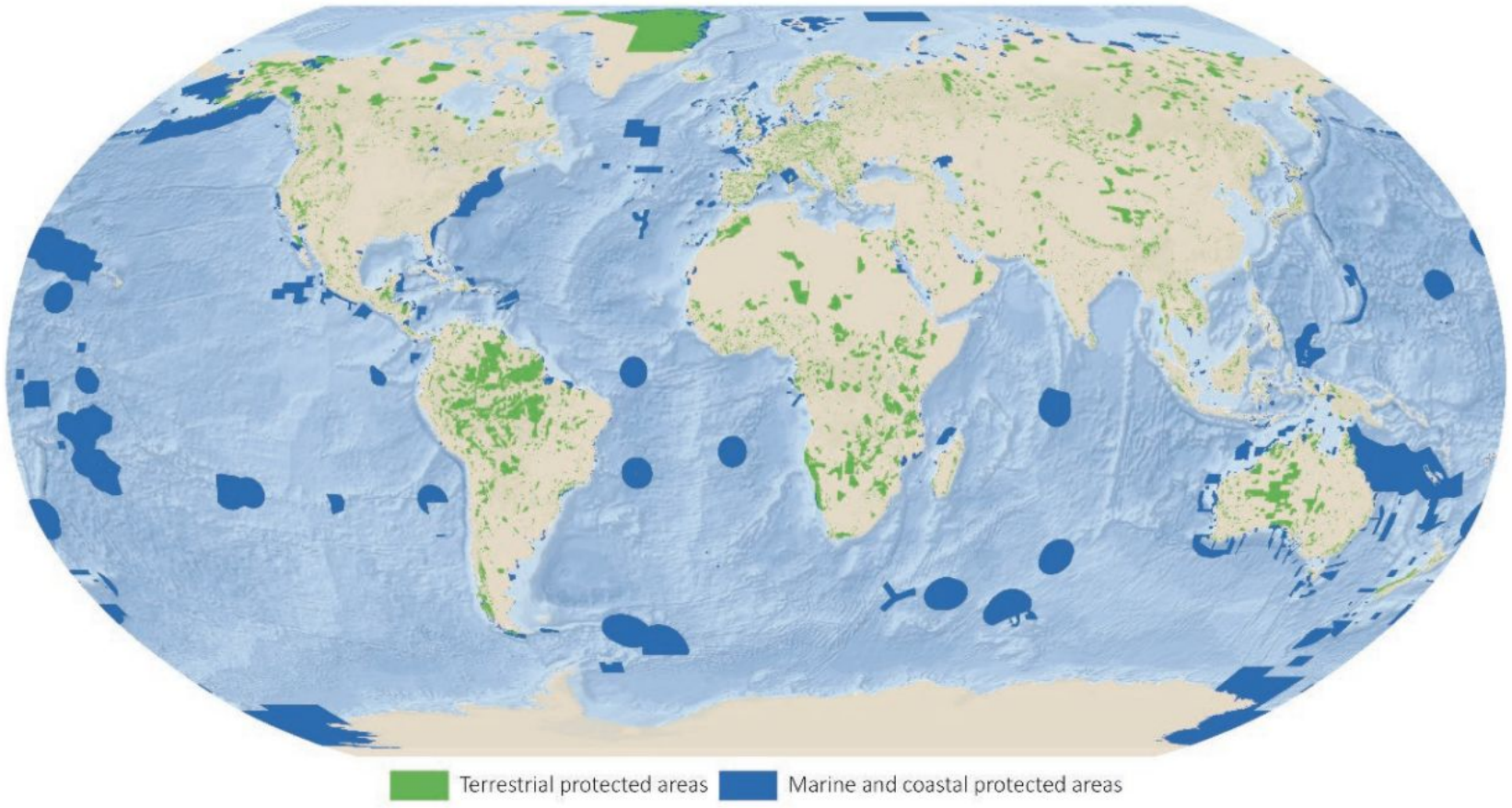
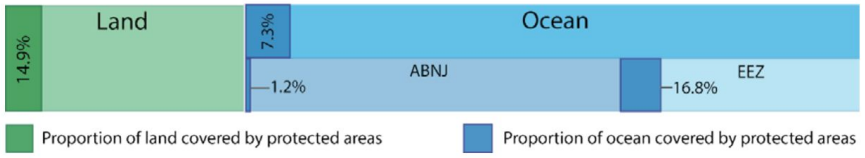



***Figure 1**. Spatial distribution of the world's protected areas. Source: UNEP-WCMC and IUCN, 2018a.*[2]

Protected areas are found in all countries, but some countries and regions (e.g. Africa, South America, Australia, Greenland and Russia) contain some very large reserves, whereas other regions (e.g. Europe) tend to have a higher number of small protected areas (Figure 1).

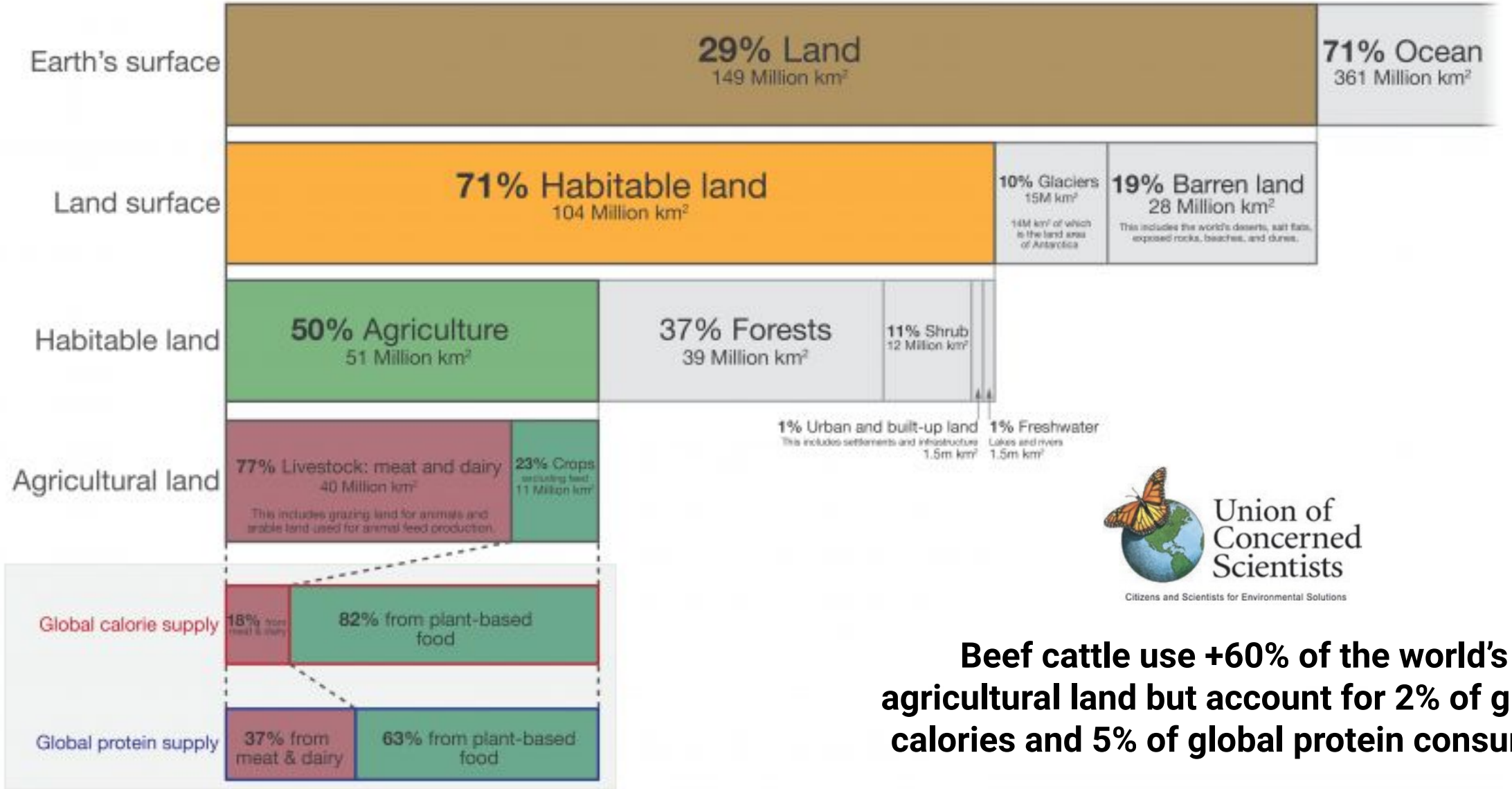



**<u>Ocean</u>**
**Perception = ~35%**
**Reality = 7%**

**<u>Land</u>**
**Perception = ~45%**
**Reality = 15%**

(Protected Planet Report, 2018);
(Akerlof, Winch, Parker, & Buckland, 2015)

# Global land use for food production




Data source: UN Food and Agriculture Organization (FAO)
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Our World in Data

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

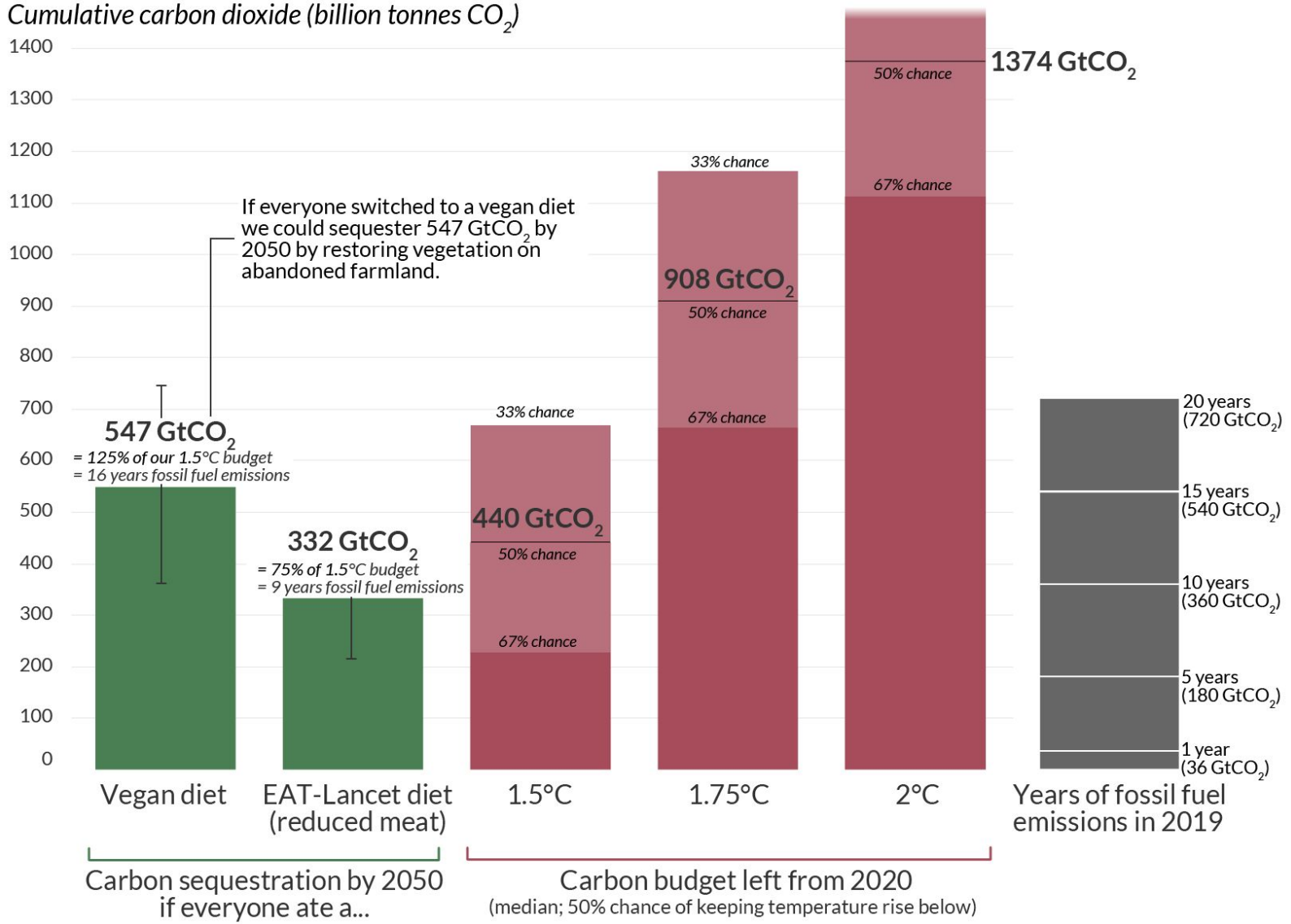
**Beef cattle use +60% of the world's agricultural land but account for 2% of global calories and 5% of global protein consumed**

(Boucher et al., 2012)

# How much carbon could we sequester with dietary change?

Carbon sequestration from dietary changes only includes carbon storage in vegetation – it does not include reductions in greenhouse gas emissions from food production. Soil carbon sequestration is not included.

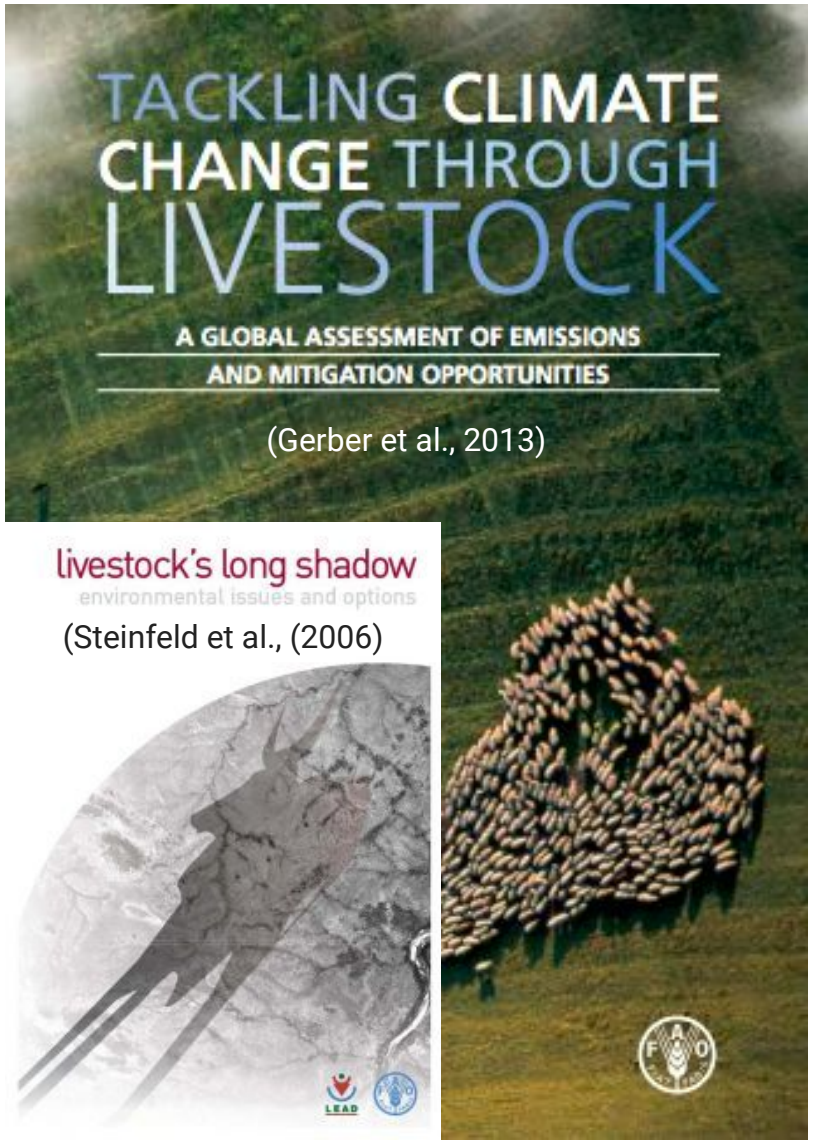
Our World in Data




Data Sources: Carbon sequestration from Hayek et al (2020); Carbon budgets from Matthews et al. (2021); Fossil fuel emissions from the Global Carbon Project.

# How much direct GHGs come from Animal Agriculture?






The most quoted 2013 FAO report states that Livestock represents **14.5%** of human induced GHGs.

This should be considered an absolute base figure, not just because the data used is over 14 years old now...

The authors admitted to under-counting in land use changes as well as using outdated and underestimated figures in other areas (many references from the 90s)

Food and Agriculture Organization of the United Nations

English Français Español

leap LIVESTOCK ENVIRONMENTAL ASSESS PERFORMANCE PARTNERSHIP

Private Sector

- International Feed Industry Federation – IFIF
- International Meat Secretariat – IMS
- International Dairy Federation – IDF
- International Poultry Council – IPC
- International Egg Commission – IEC
- International Wool and Textiles Organization – IWTO**

# The contributions of animal agriculture (AA) to climate change – Overview of various papers

## FAO 2013
## 14.5%

Main issues:

(1) No integration of carbon opportunity costs of AA (- - - -)
(2) Omission of big parts of carbon dioxide emissions caused by fire clearings (- - -)
(3) Use of the Global Warming Potential for methane over 100 years and without carbon cycle feedbacks (- -)

FAO is steered and sponsored by all animal industries worldwide.

## FAO 2006
## 18%

Main issues:

(1) No integration of carbon opportunity costs of AA (- - - -)
(2) Use of the Global Warming Potential for methane over 100 years and without carbon cycle feedbacks (- -)

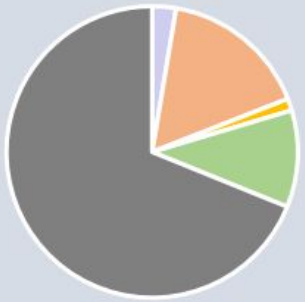
FAO is steered and sponsored by all animal industries worldwide.

## Oxford 2018
## 28%

Main issues:

(1) Use of the Global Warming Potential for methane over 100 years (- -)
(2) Base (total emissions across all sectors) for calculating share of AA does not include carbon opportunity costs. (+ +)

## LWJ 2021
## 31%



Main issues:

(1) No integration of fossil fuel emissions for fertilizer production and animal transport and processing (-)
(2) Use of an instantaneous GWP for methane (+).

## WWI 2009
## 51%

Main issues:

(1) Higher GWP20 for methane is not applied to industries other than AA, resulting in a lower basis for calculating AA share (+ +)
(2) Integration of GHG emissions along the life cycle of animal products and side-effects, but possibly not applied similarly to alternate products (+)
(3) Use of the Global Warming Potential for methane over 20 years and without carbon cycle feedbacks (-)

## CLH 2019
## 87%

Main issues:

(1) Carbon opportunity costs were calculated by multiplying a figure for a diet of a Northern European citizen by the world population (+ + + +)
(2) Base (total emissions across all sectors) for calculating share of AA does not include carbon opportunity costs (+ + + +)
(3) Rest of calculation incl. issues is based on the 2009 WWI analysis (+ +)

'- - - -' means high omissions/miscalculations and '+ + + +' means high overvaluations/miscalculations

Direct $CO_2$ emissions (AA) | Direct $CH_4$ emissions (AA) | Direct $N_2O$ emissions (AA) | Carbon opportunity costs (AA) | Non AA emissions

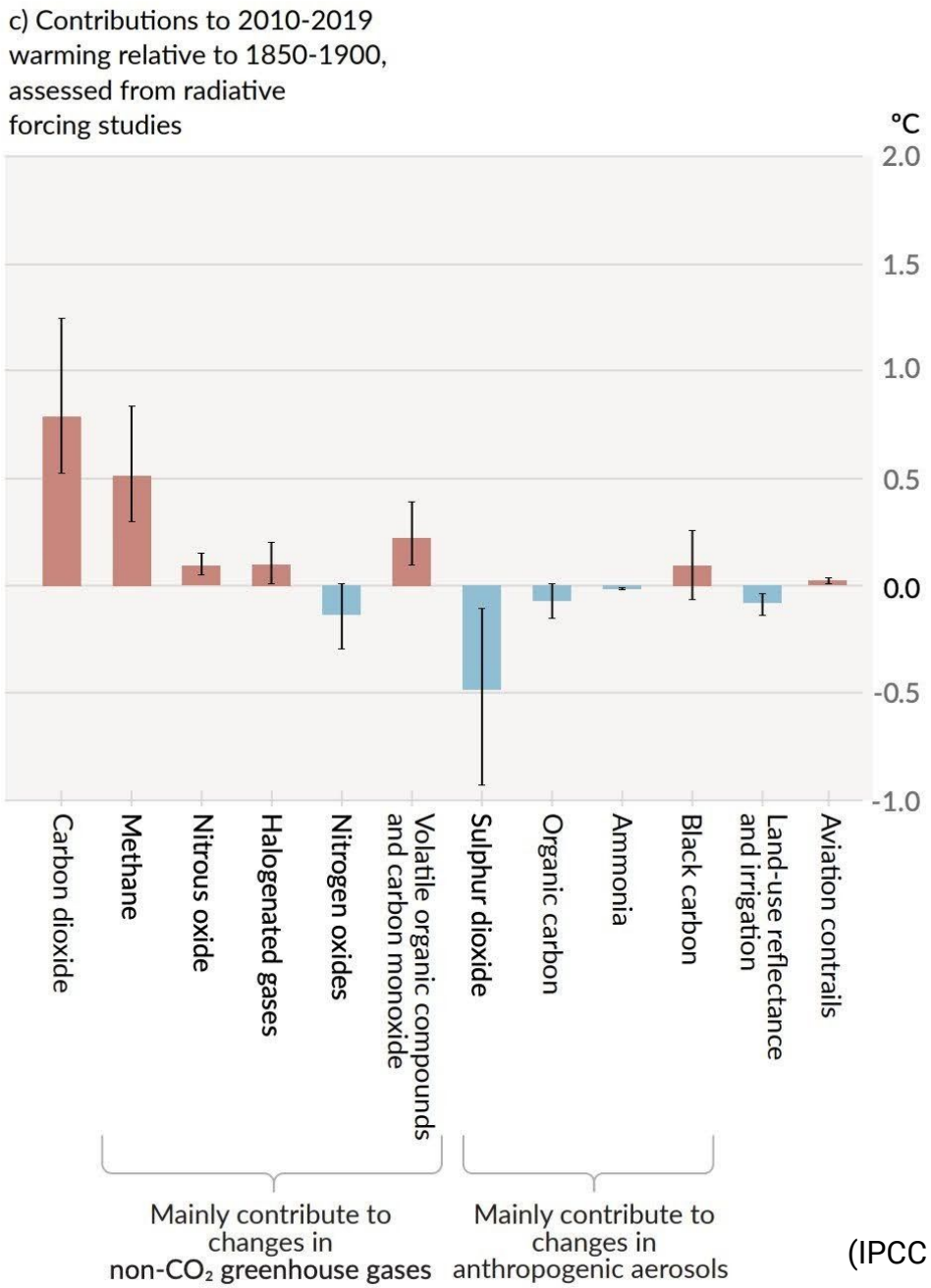
Reference: landwirtschaft.jetzt (2021): The contributions of animal agriculture to climate change - Detailed overview of various papers (go to https://landwirtschaft.jetzt > Resources > Downloads)



**Diagram and analysis here done by Martin Müller (m.mueller@industryfootprint.org) https://landwirtschaft.jetzt/en/umwelt/**

# Methane (CH4)

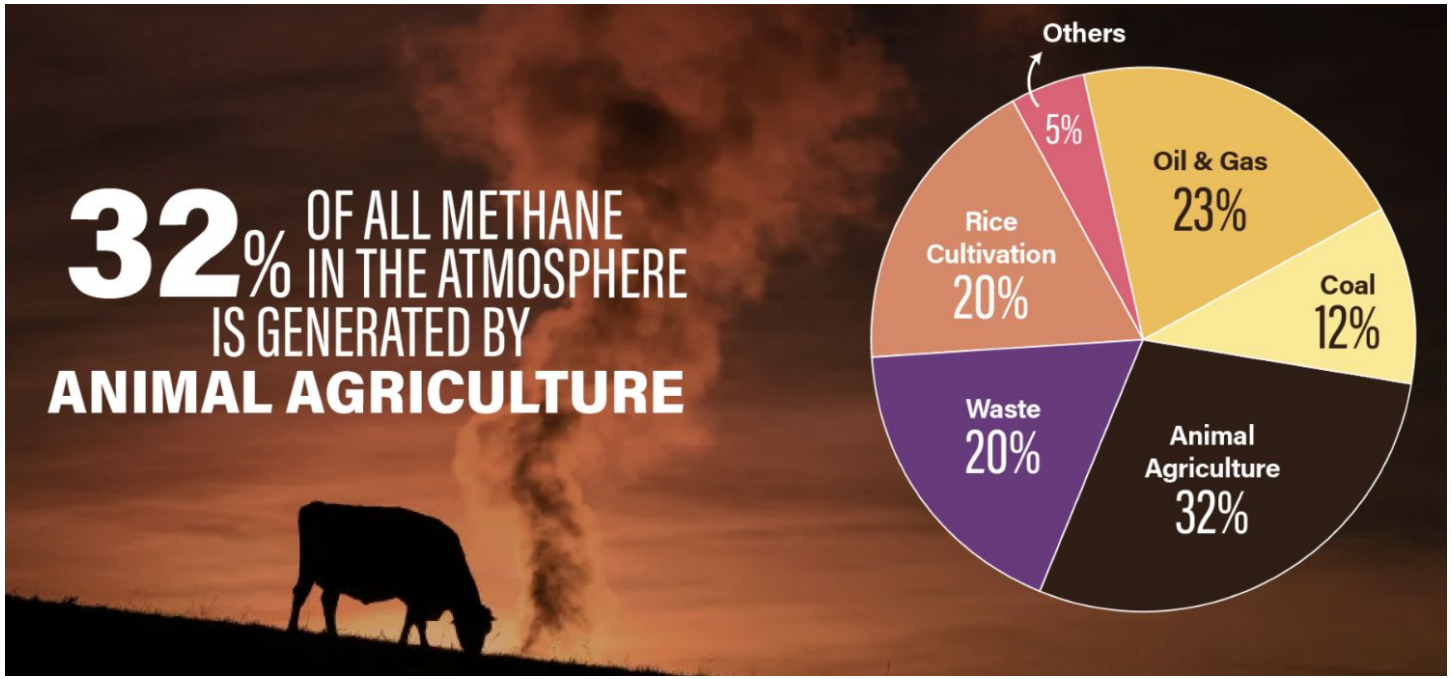





(IPCC AR6 WG1, 2021)

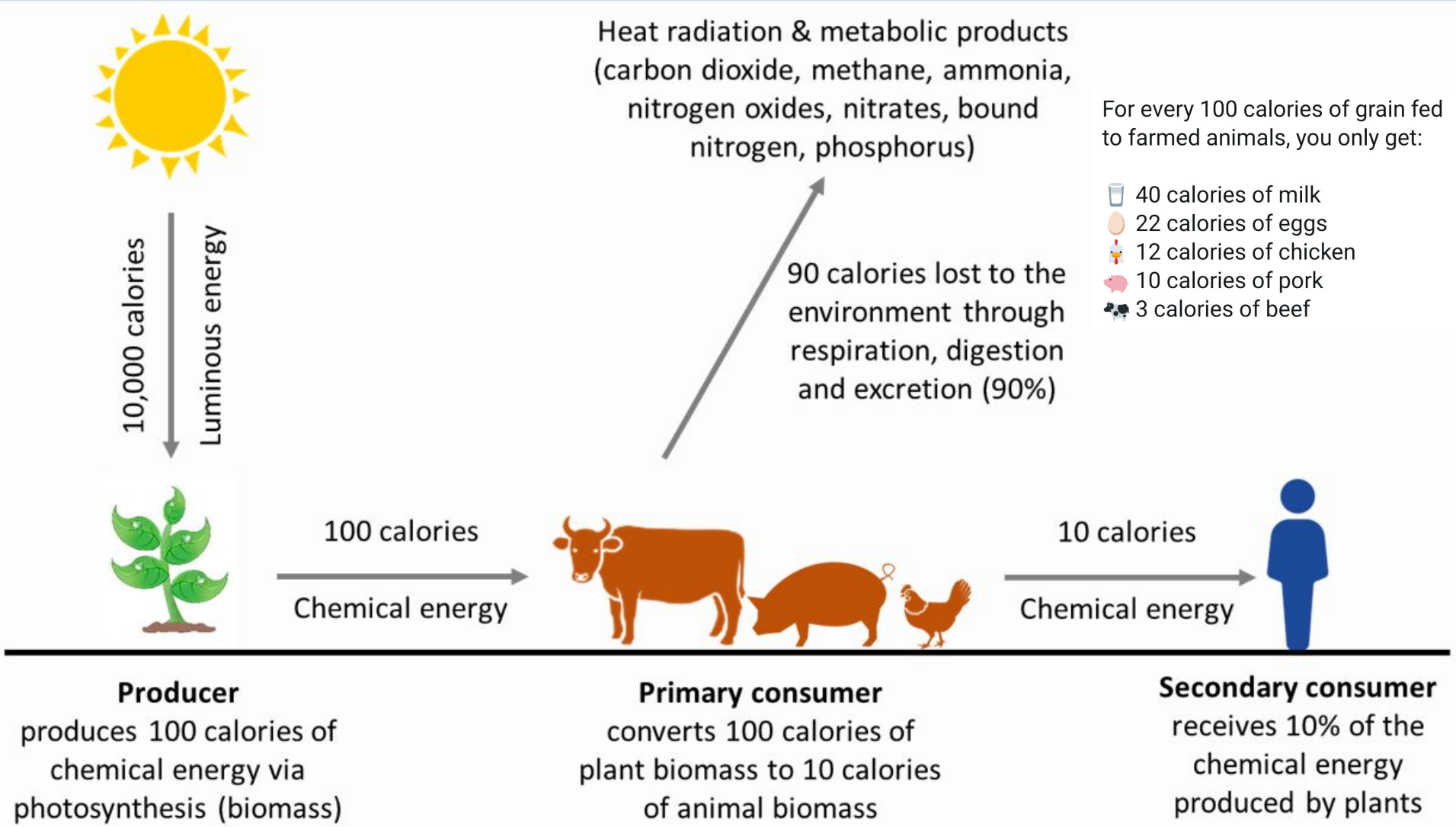
## Reducing methane is the fastest way to reduce climate change and avoid passing climate tipping points

IPCC AR6 & the UN Methane Assessment Report




Graphic from Dr. Anita Krajnc's University of Toronto lecture (Nov 2022)
Share estimate from United Nations Environmental Programme

# Energy losses in the consumption of animal products according to the 10% law



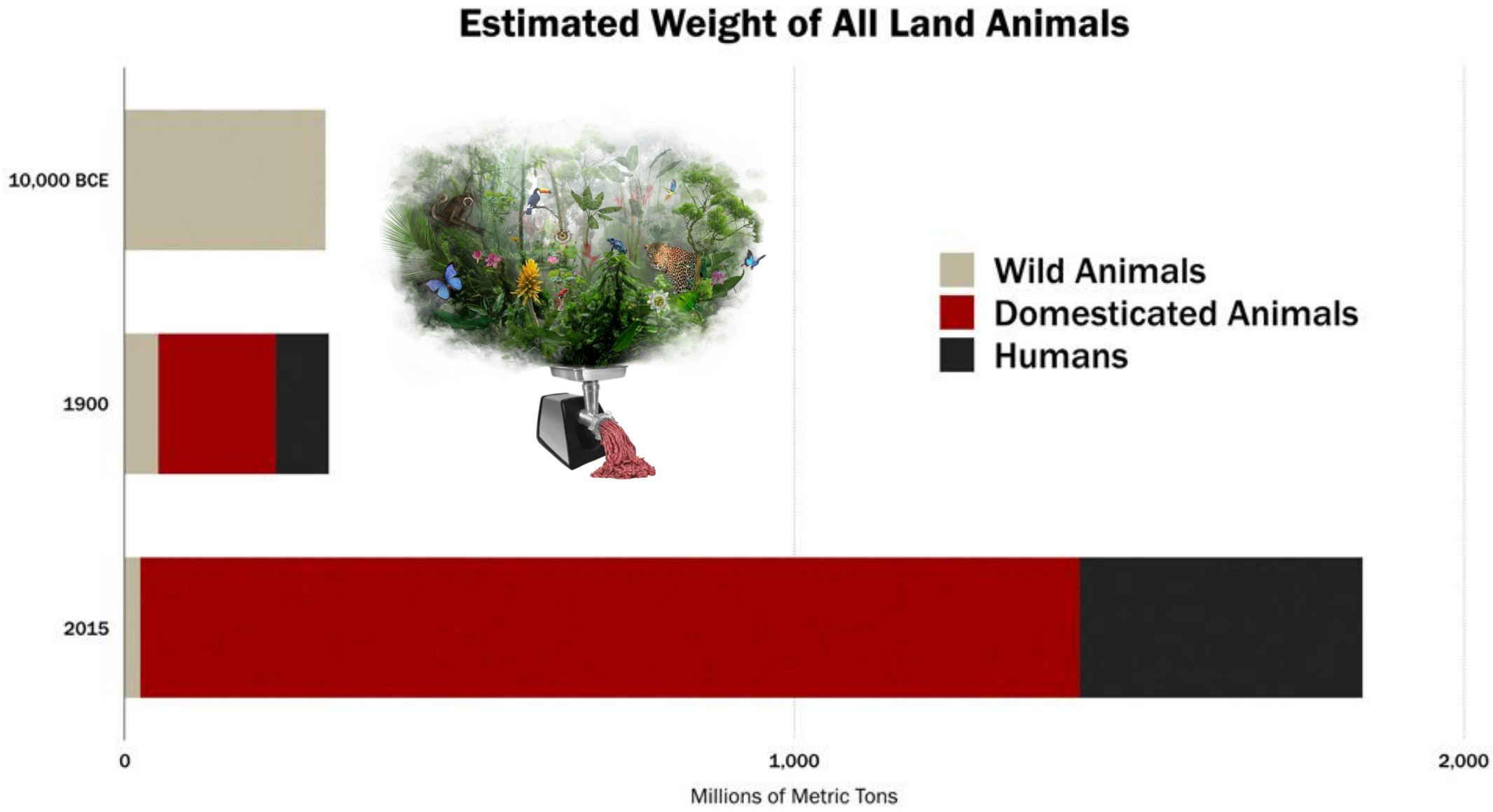

Resources: (1) Wikipedia (2020): Ecological efficiency, (2) Lindeman Raymond L. (1942): The Trophic-Dynamic Aspect of Ecology.



Cassidy, E. S., West, P. C., Gerber, J. S., & Foley, J. A. (2013). Redefining agricultural yields: from tonnes to people nourished per hectare. Environmental Research Letters, 8(3), 034015.

# The 6th Mass Extinction - What's the Leading Driver?






Smil, 2012; Bar-On, Phillips, & Milo, 2018; Ritchie & Roser, 2021; Machovina, Feeley, & Ripple, 2015; Barnosky, 2008.

# Biodiversity



It's not just how many species we are losing.

Species are going extinct at rates 100-1,000x faster than the Earth's past.

Those 400 vertebrate species that went extinct in the last century should have taken 800-10,000 years to naturally disappear.

(Pimm et al., 2014).


The biodiversity of species and their rates of extinction, distribution, and...
science.sciencemag.org

Of 19,859 species of terrestrial vertebrates, this new study projected that 87.7% of them will lose habitat to agricultural expansion by 2050.

Their region-specific solutions:

- Eating less/no meat,
- Reduce food loss, &
- Increase crop yields

(Williams et al., 2021)

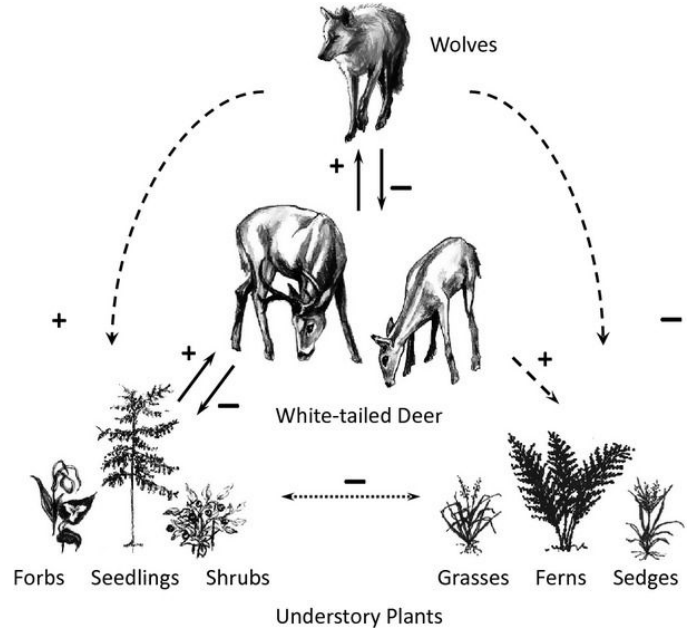
nature sustainability
ARTICLES
https://doi.org/10.1038/s41893-020-00656-5
Check for updates

**Proactive conservation to prevent habitat losses to agricultural expansion**

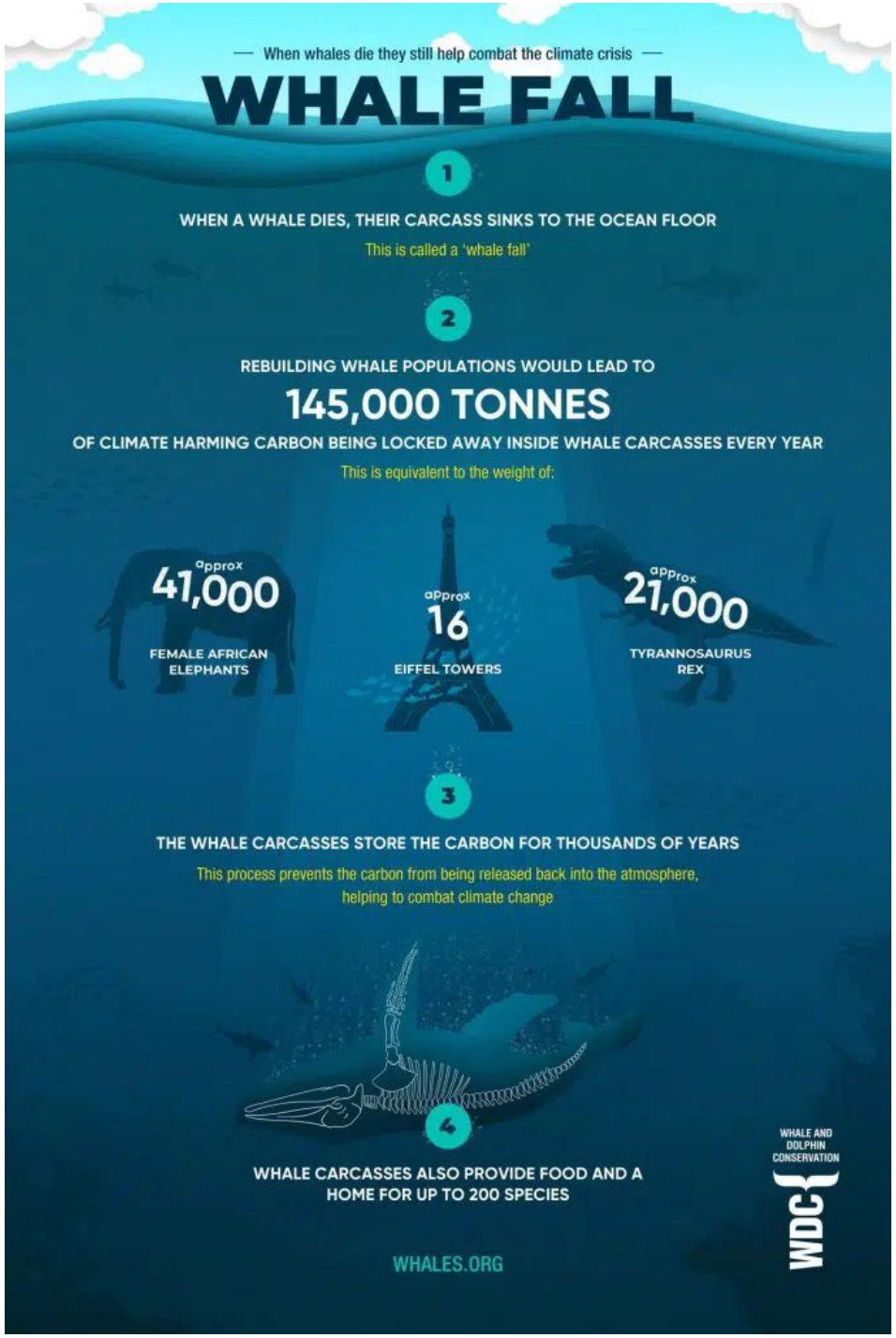
David R. Williams[1,2,9] ✉, Michael Clark[3,9] ✉, Graeme M. Buchanan[4], G. Francesco Ficetola[5,6], Carlo Rondinini[7] and David Tilman[2,8]

# Protecting Biodiversity Addresses Climate Change



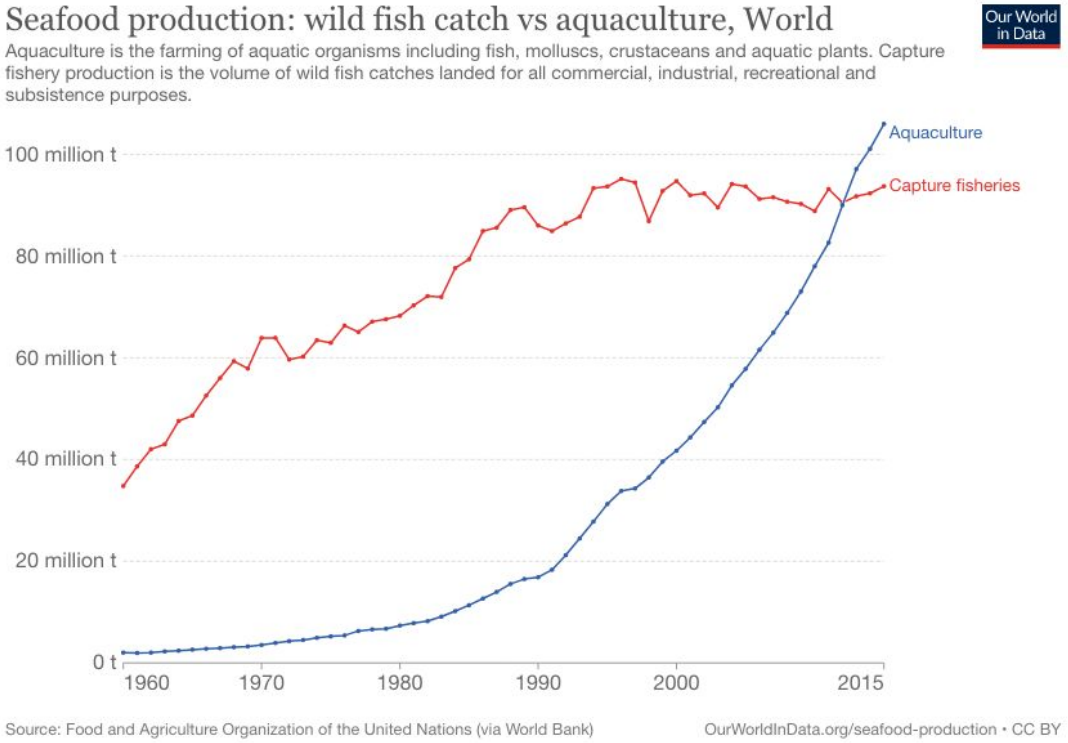


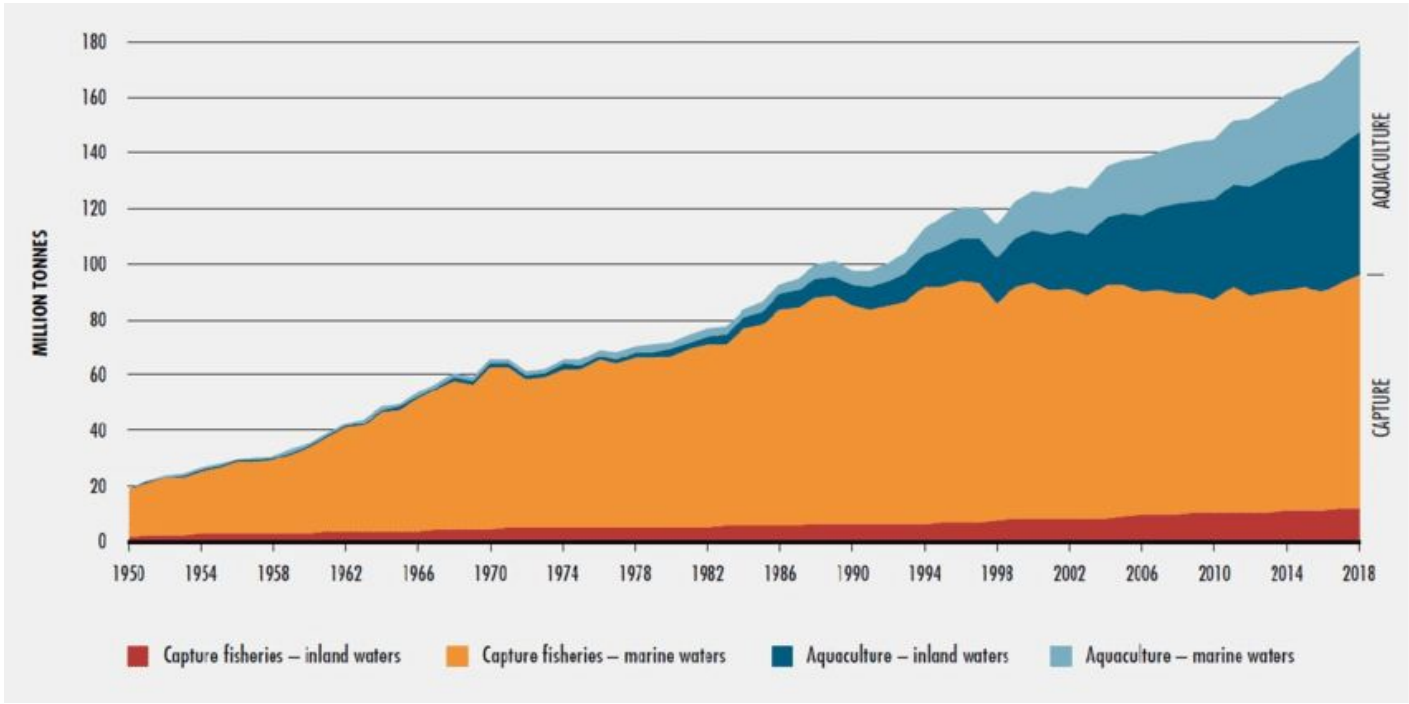

(Pershing et al., 2010)

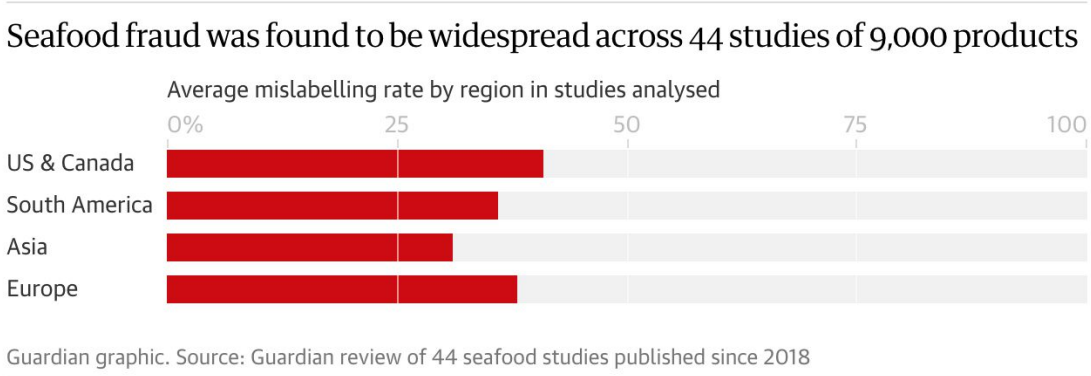


# The Ocean's Biodiversity Collapse






(Cawthorn, Baillie, & Mariani, 2018)

Report: The State of the Ocean

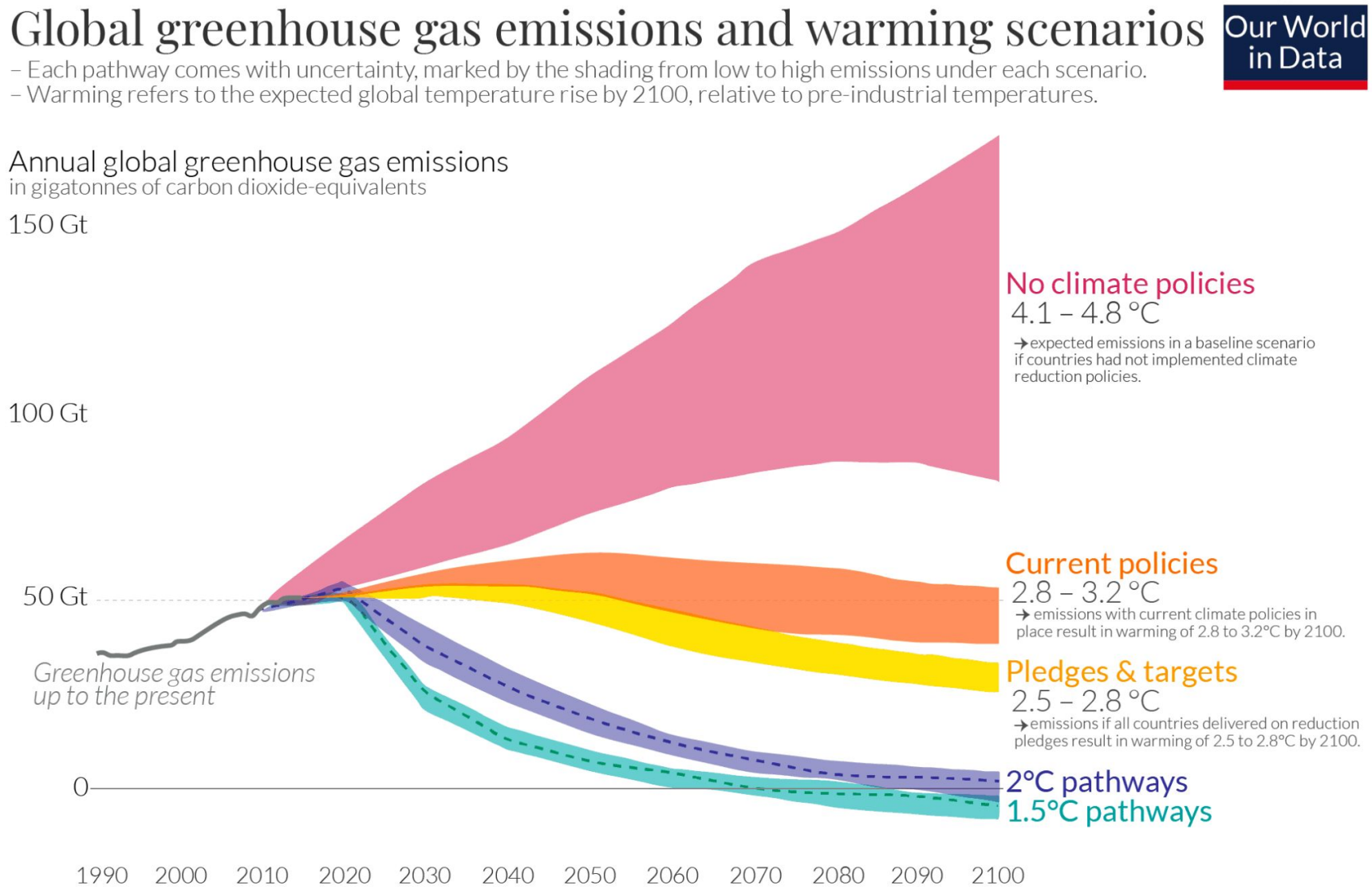
**plantbaseddata.org/post/stateoftheocean**

Impact of Wildlife Extraction and Aquaculture on Global Marine Ecosystems

By Plant Based Data | Contributors: Nicholas Carter, Spencer Roberts, Nital Jethalal, Dr. Tushar Mehta

# Why we need to also **adapt** to prepare for environmental impacts



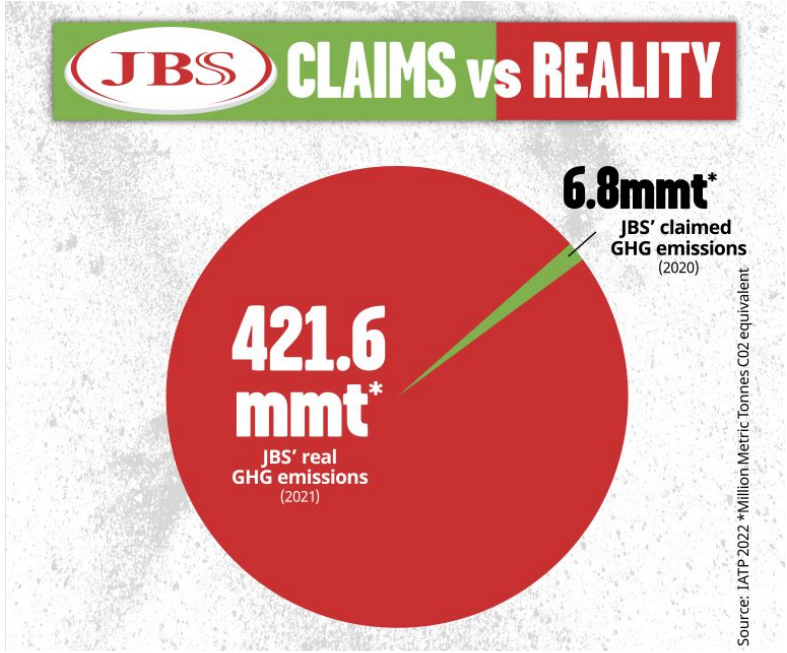


# Adapt to Climate Change through Diet Change

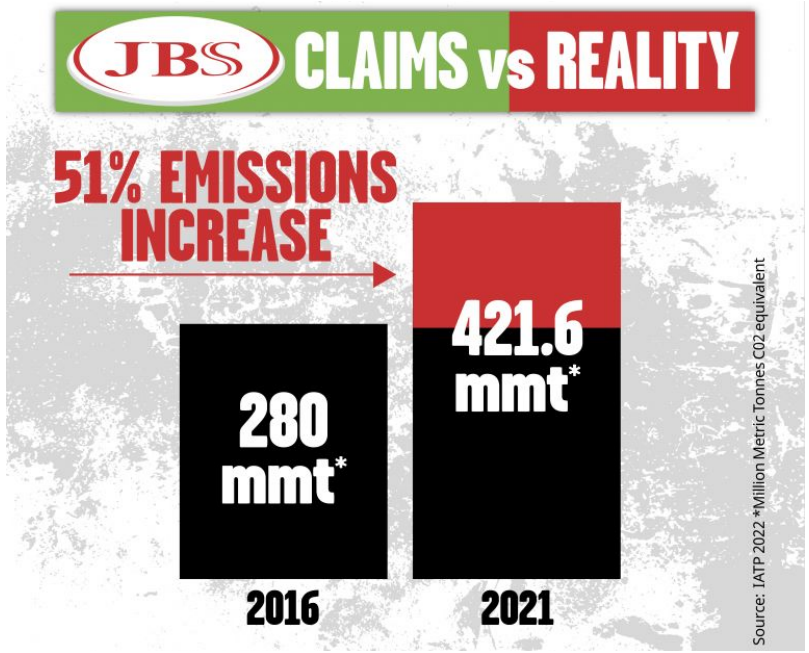


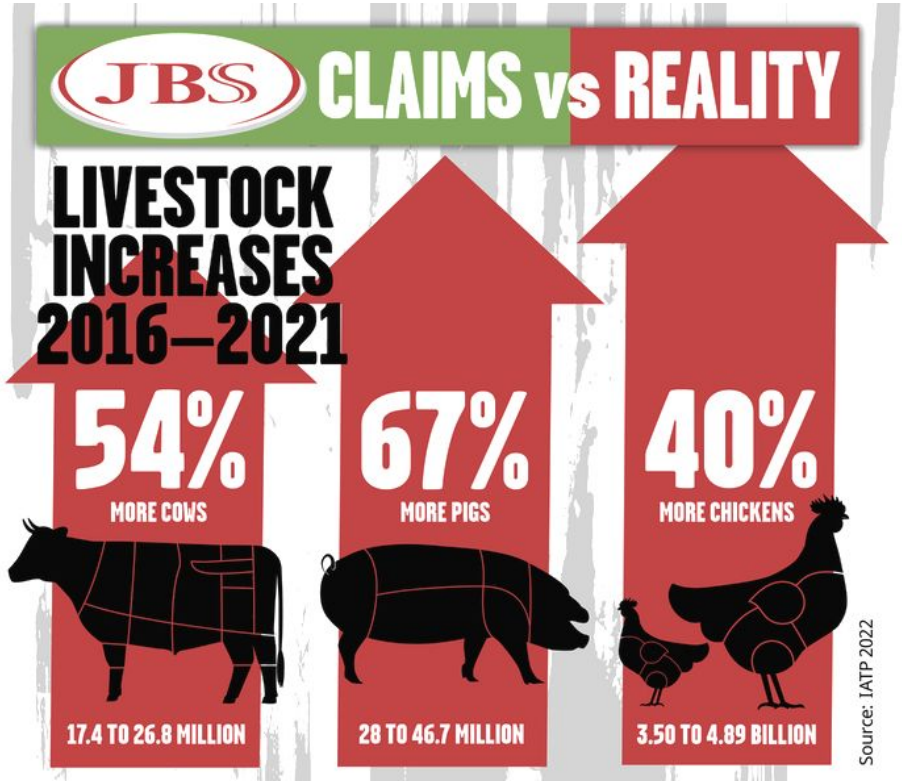

**"Dietary changes from current diets to healthy diets are likely to substantially benefit human health, averting about 10.8–11.6 million deaths per year, a reduction of 19.0–23.6%."**

Willett et al., 2019; Springmann et al., (2016)




(Lazarus, McDermid, & Jacquet, 2021; IATP, 2022; )




GOOD NEWS

**"Several countries appeared to be reaching peak consumption of some meats, and three (New Zealand, Canada, and Switzerland) have reached this."**

Based on 2000–2019 trends in 35 countries monitored by the Food and Agriculture Organization and the Organisation for Economic Co-operation and Development. Specific to Beef, Pork, Lamb, and other meats, but not necessarily peak meat for chicken.

Whitton, C., Bogueva, D., Marinova, D., & Phillips, C. J. (2021). Are We Approaching Peak Meat Consumption? Analysis of Meat Consumption from 2000 to 2019 in 35 Countries and Its Relationship to Gross Domestic Product. *Animals*, *11*(12), 3466.


# AGRICULTURAL CLIMATE SOLUTIONS

## $185M/10 years

to reduce GHG emissions & help support climate-smart agriculture

# ON-FARM CLIMATE ACTION FUND

## $200M (2021-2024)

to support on-farm action on nitrogen management, cover-cropping & rotational grazing practices

#COP26

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

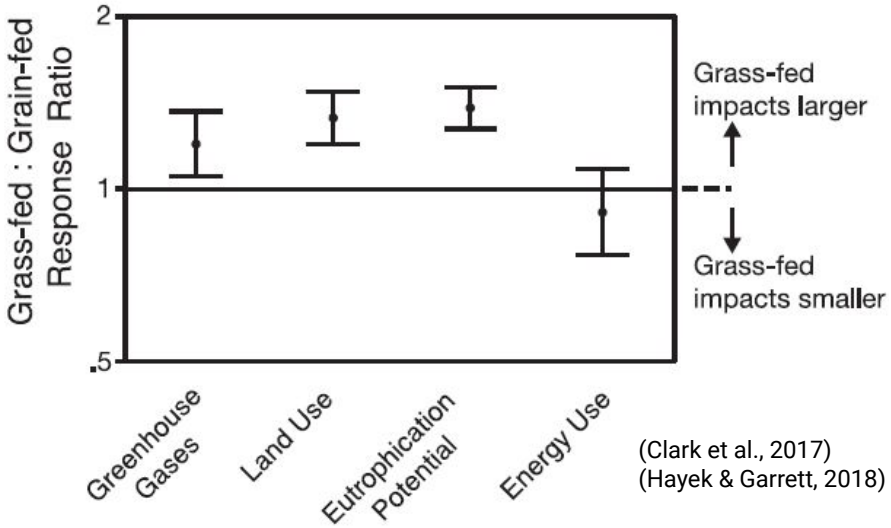
Canada

# ‘Regenerative’ Grazing & ‘Cow’s Reverse Climate Change’ Claims



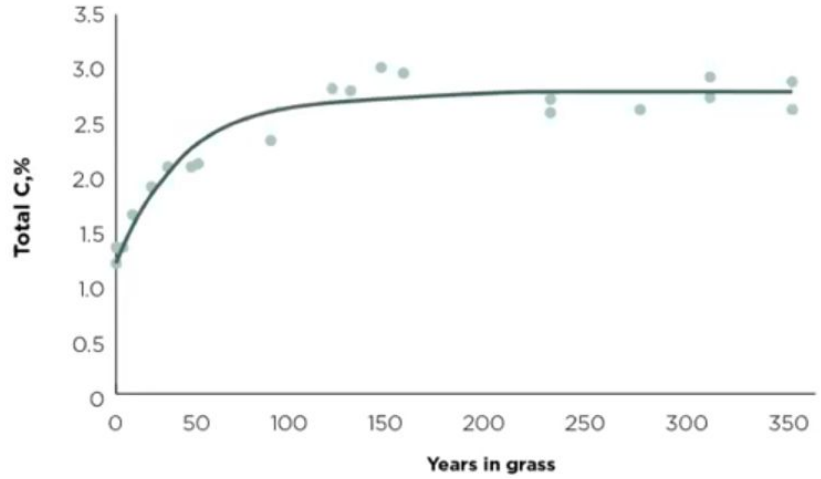
**General consensus on a shift to grass-finished beef:**

- Methane would increase by ~43% (per unit)
- More land (~25%)
- Not scalable (~27% of current US beef)

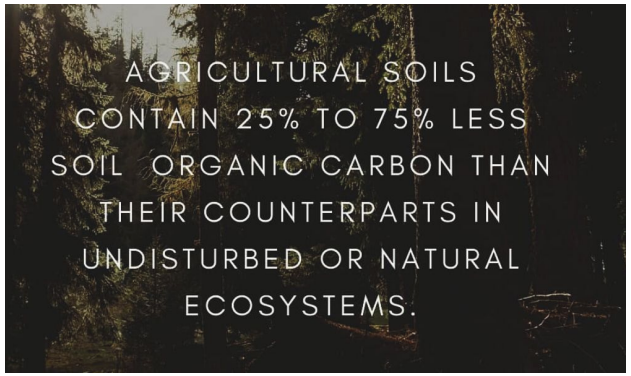



(Clark et al., 2017)
(Hayek & Garrett, 2018)

## Soils stop sequestering carbon after a while




*Note: This graph show the increase in organic carbon (% C to 23 cm depth), calculated from total N values presented in Johnson et al. (2009),[83] assuming a C:N ratio of 10:1. Total N values were from a number of silky clay loam soils sown to grass from cropland at various times and for various periods at Rothamsted, UK.*



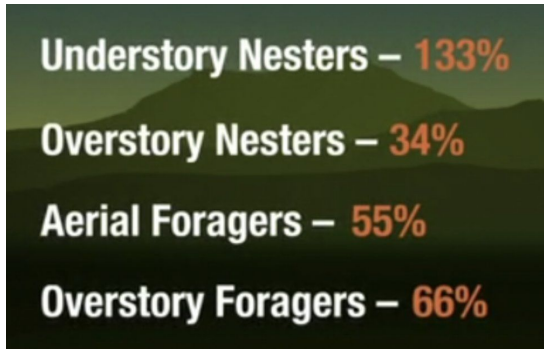

Lal (2010)

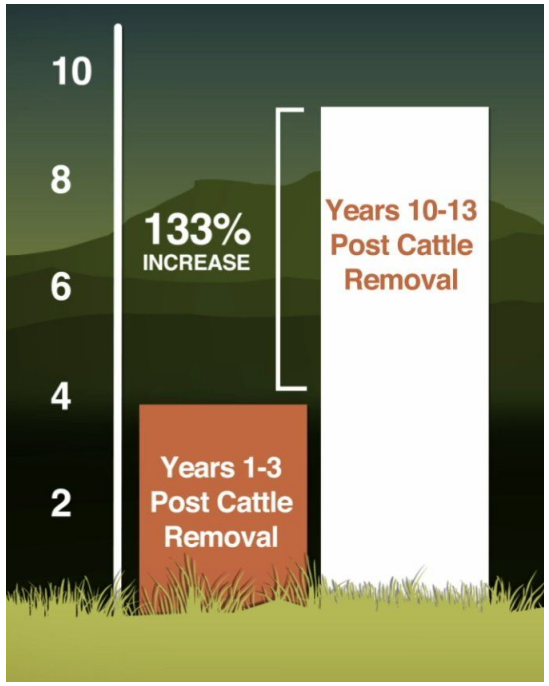
The inescapable conclusion of this report is that while grazing livestock have their place in a sustainable food system, that place is limited. Whichever way one looks at it, and whatever the system in question the anticipated continuing rise in production and consumption of animal products is cause for concern. With their growth, it becomes harder by the day to tackle our climatic and other environmental challenges.

(Garnett et al., 2017, p. 125).

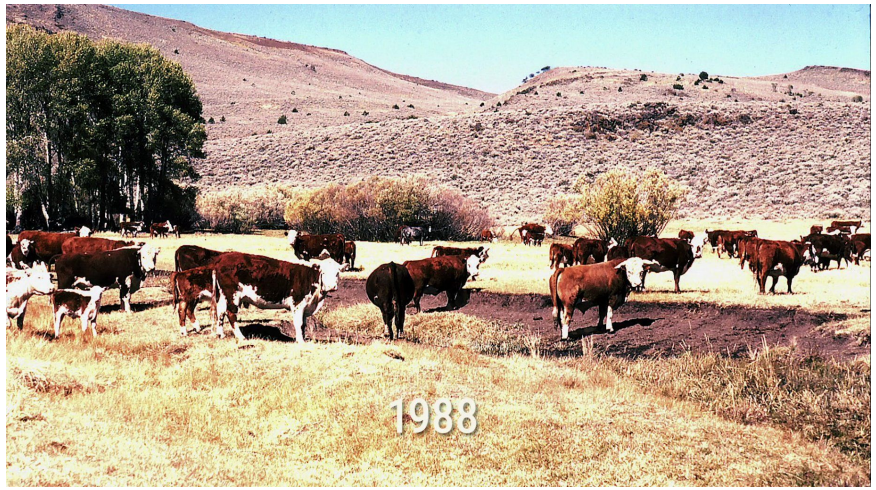
# Instead, Rewilding is What Truly Restores Ecosystems

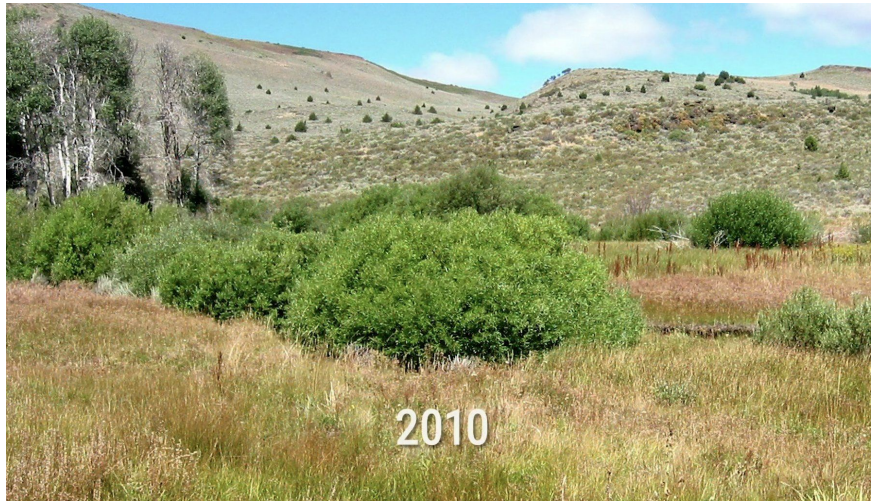





In 1990, contrary to pressures by cattle groups, the land conservation stewards in an area of the American West (Hart Mountain) voted to ban cattle grazing based on the science showing its ecological degradation to this riparian land. The result:



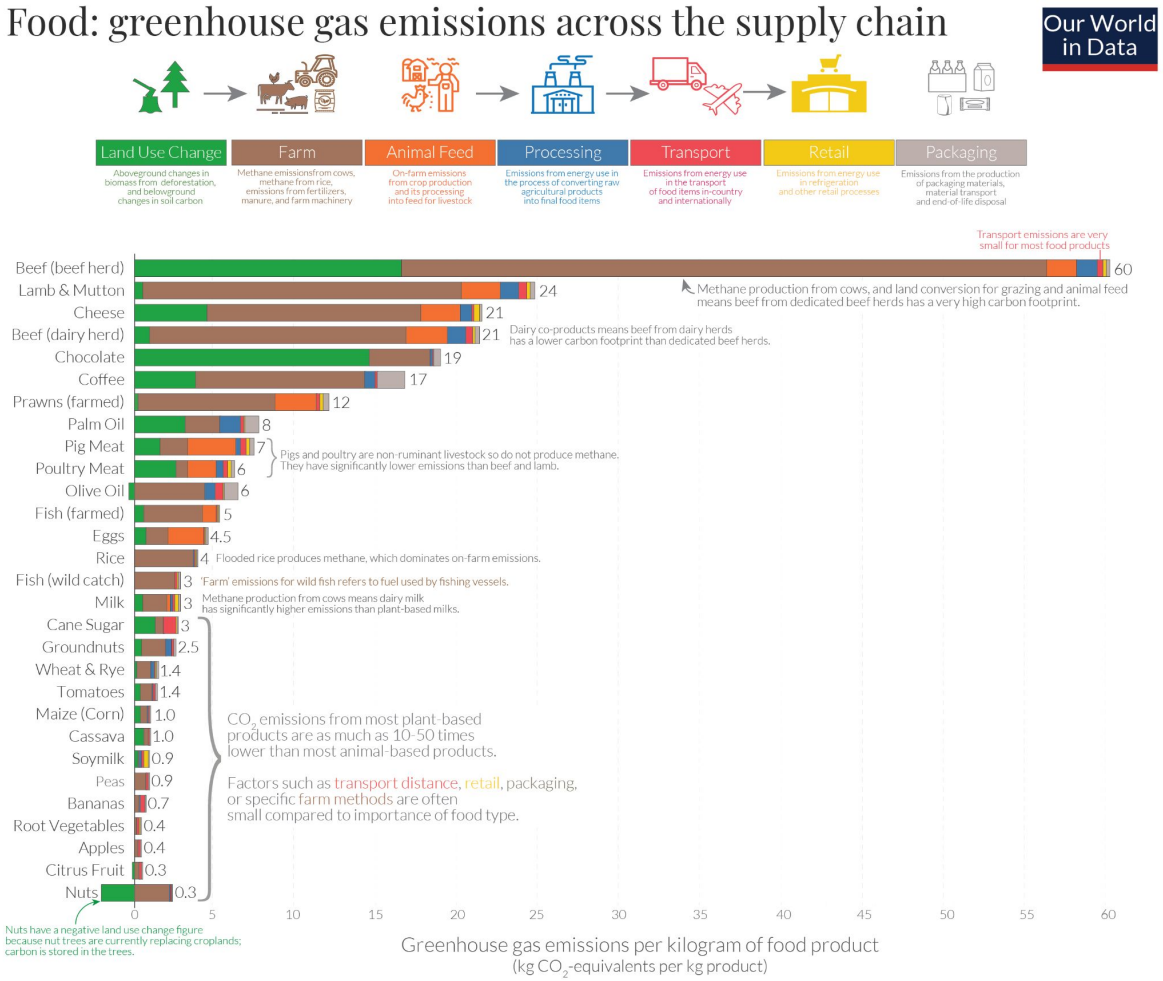


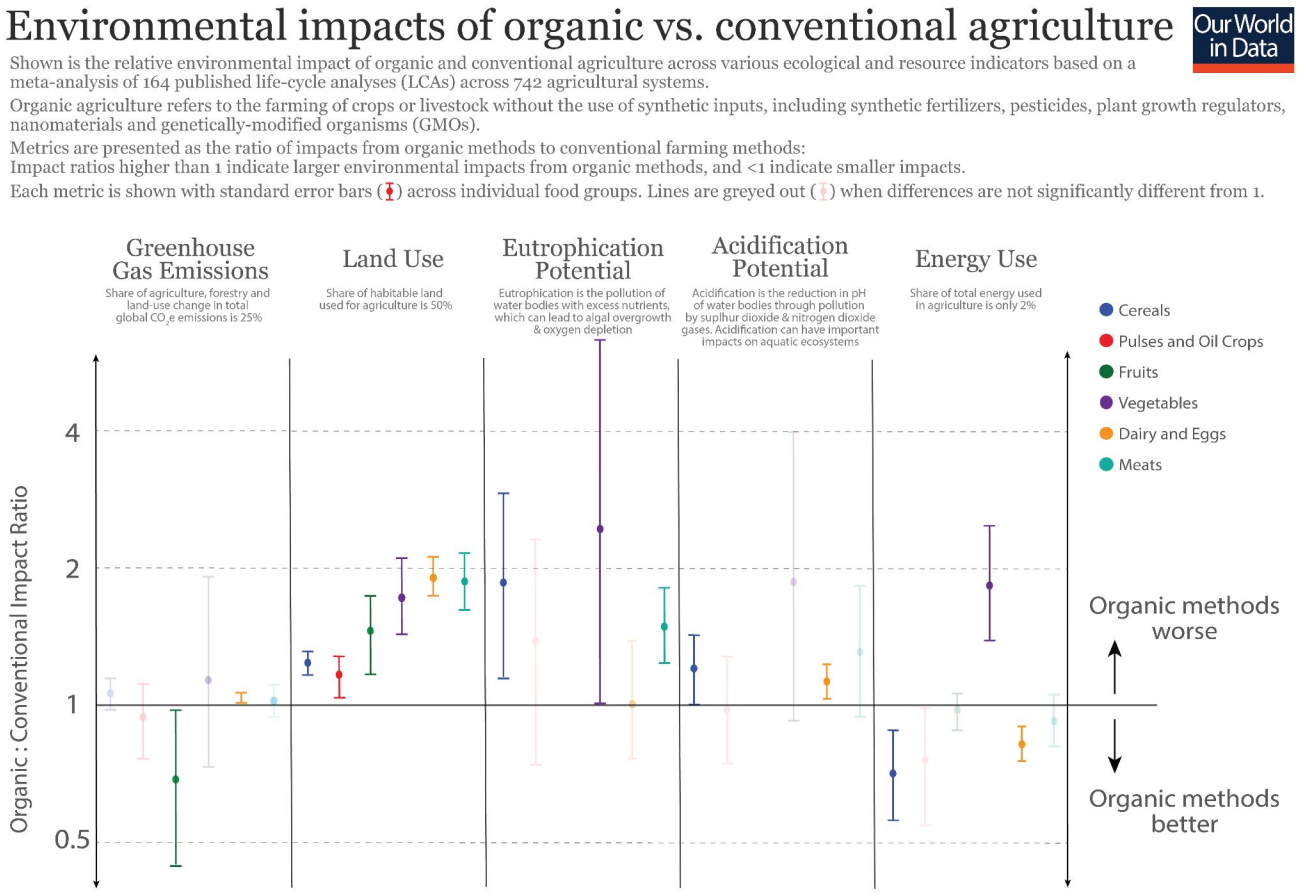
**"Across all animals, livestock exclusion increased abundance and diversity"**

(Ripple et al., 2022; Filazzola et al., 2020)

# Buy Local & Organic Claims





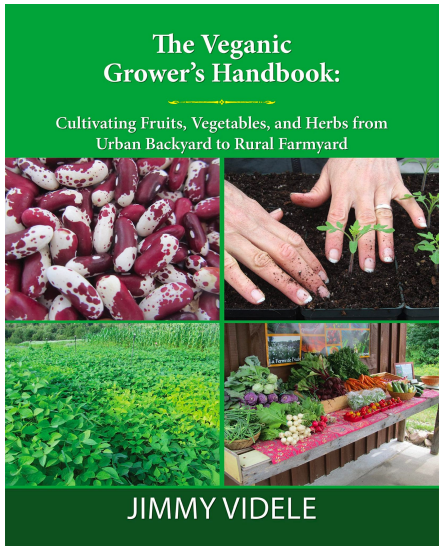

Ritchie, 2021; Clark & Tilman, 2017; Poore & Nemecek, 2018; Weber & Matthews, 2008

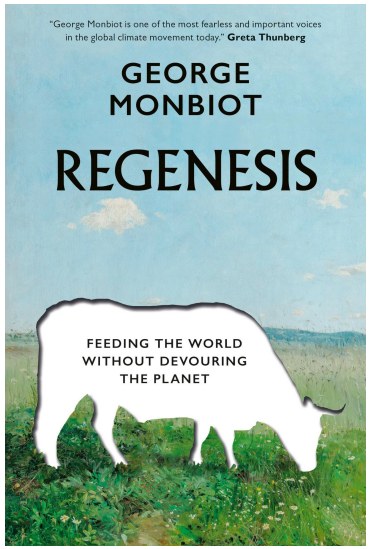
# Regenerative Agriculture: The Veganic Way





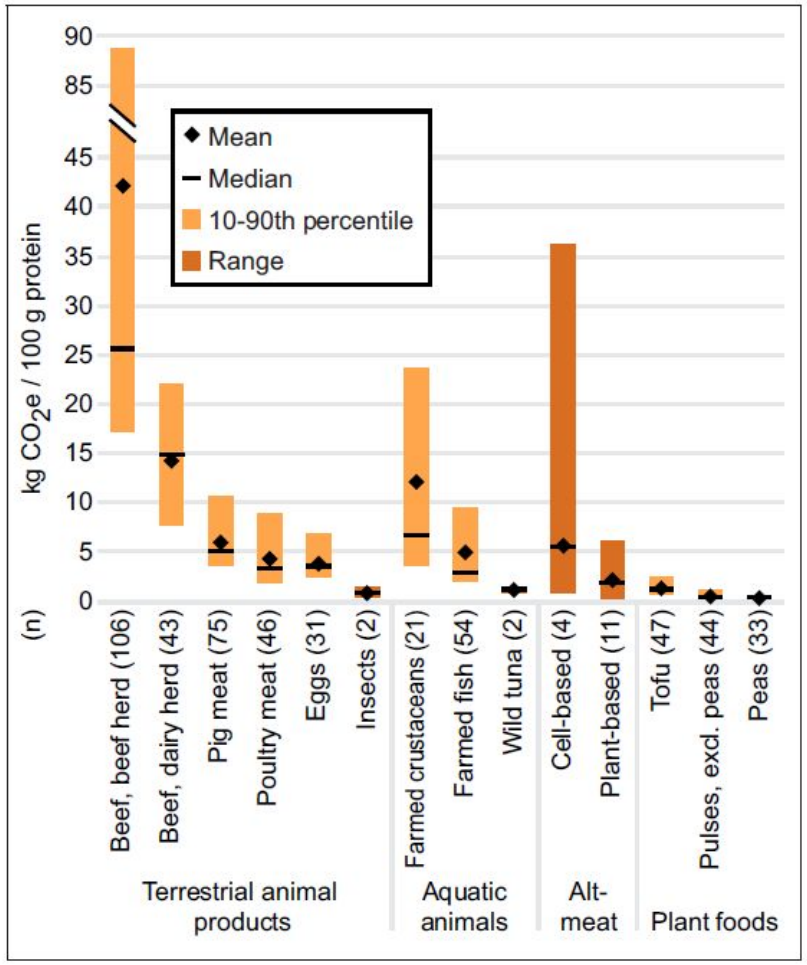

*biocyclic-vegan.org*



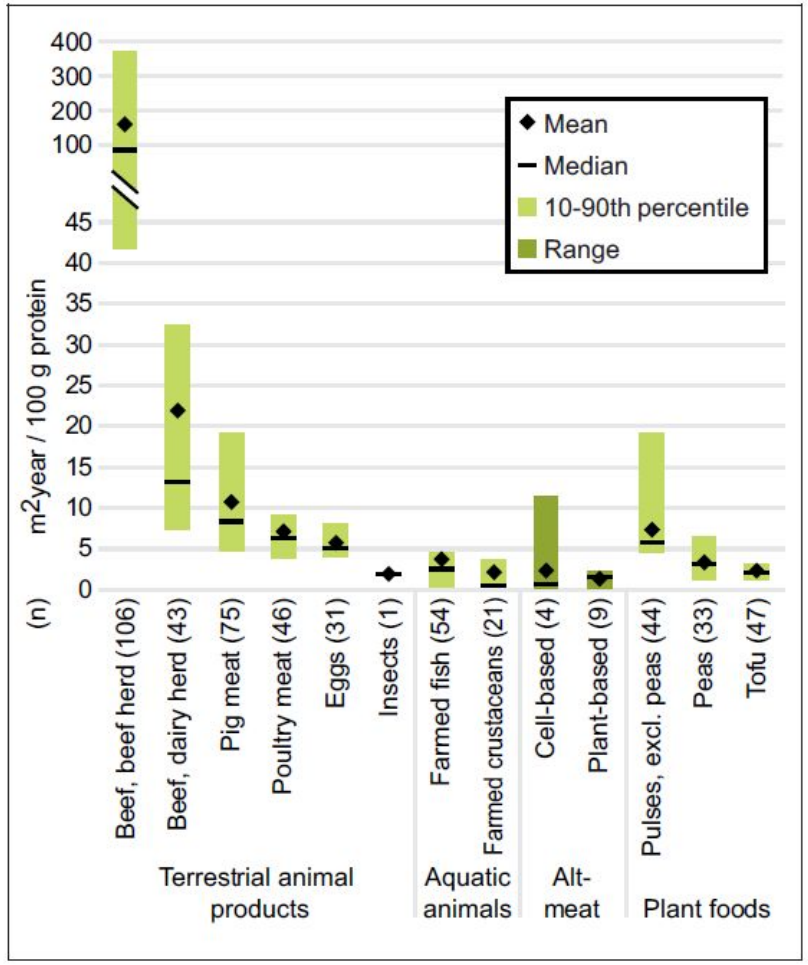



# The Rise of Plant Based and Cultured Meat Alternatives

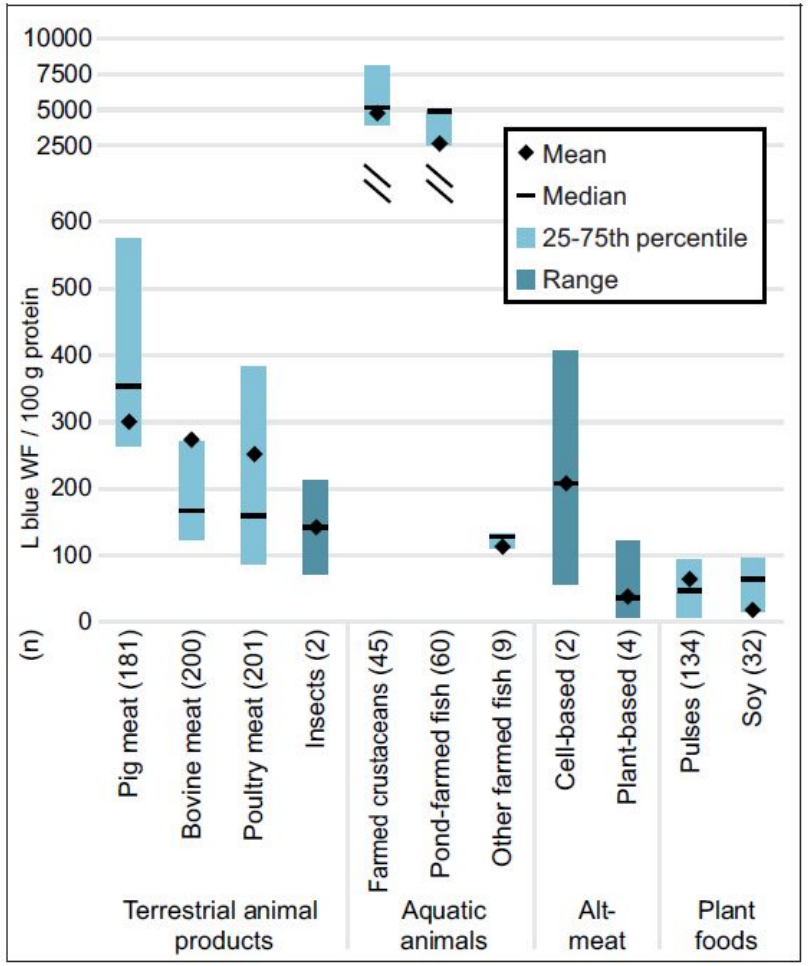





Cradle-to-processing gate GHG footprints (wherever possible) per 100 g protein.




Land use per 100 g protein.

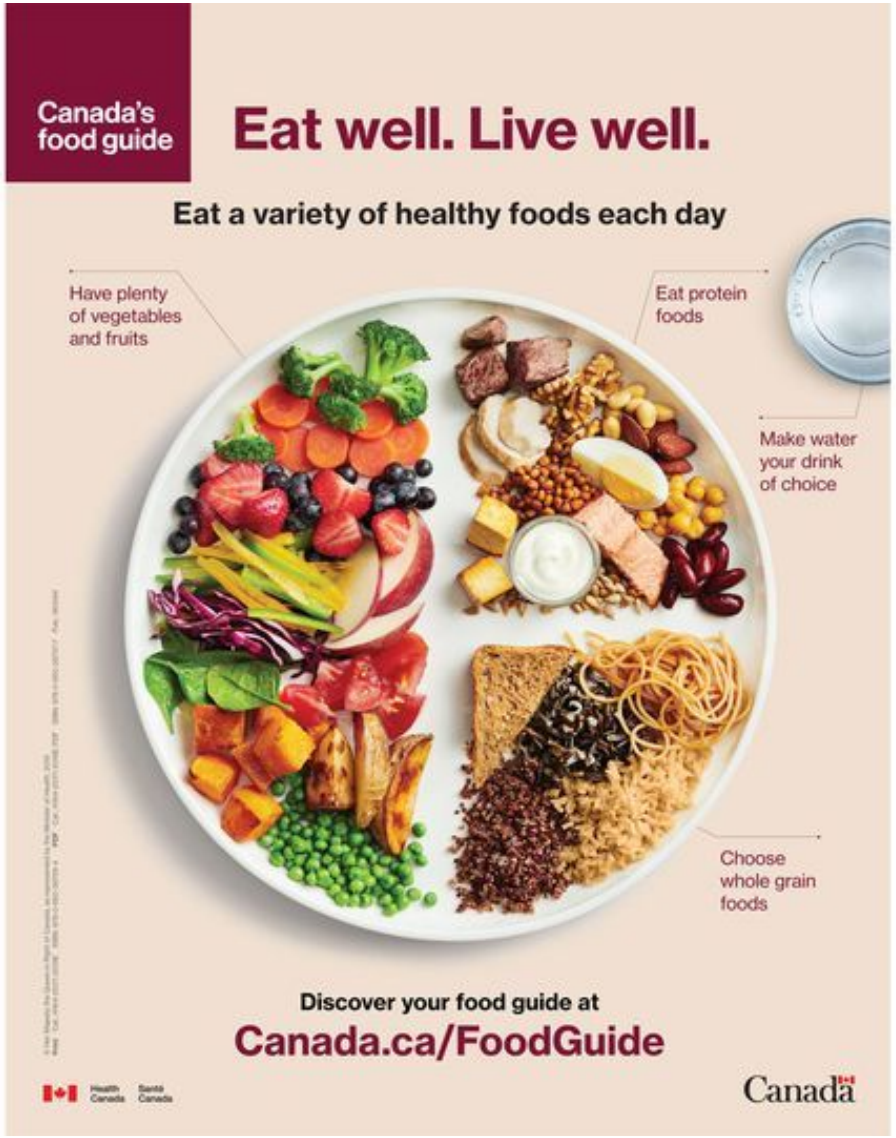


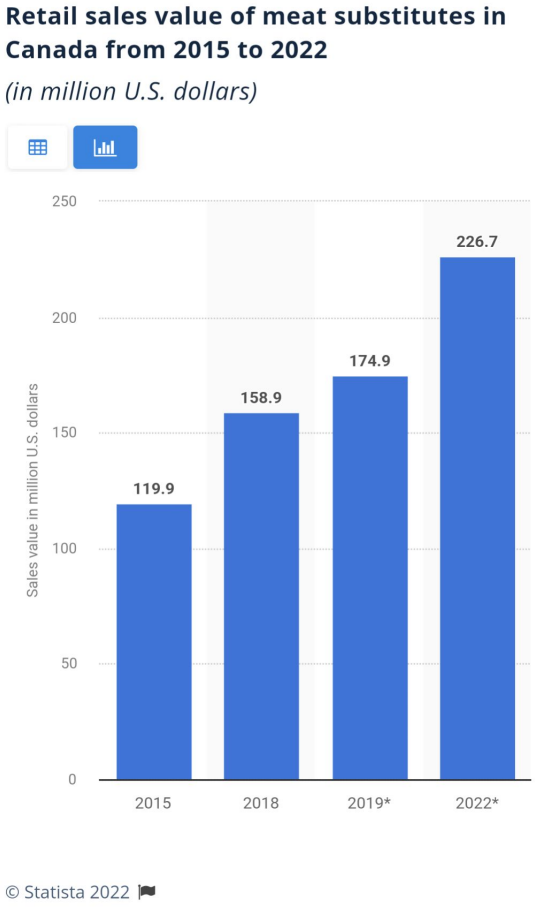

Blue water footprints per 100 g protein.

(Santo et al., 2020)

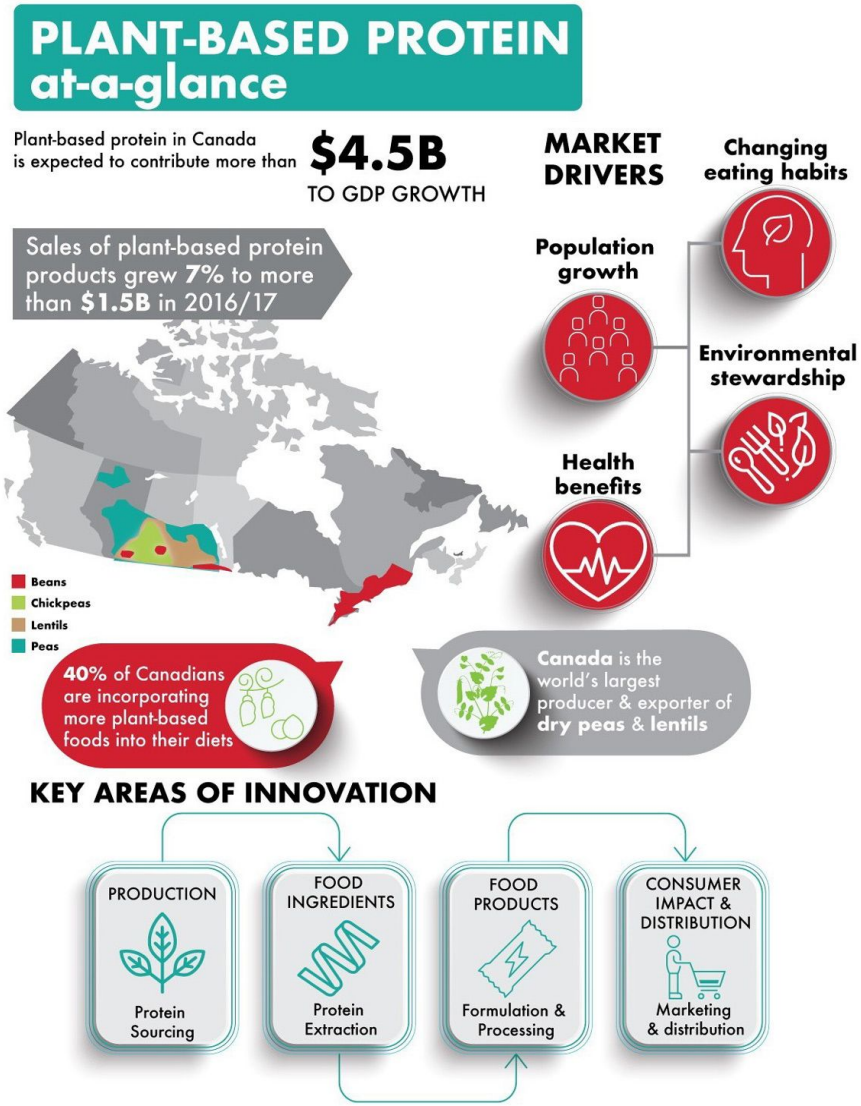
# Operationalizing New National Food Guides






National Research Council Canada (2019)



# Behavioural Nudges



Lisa Simpson’s attempt to not eat animals is met with the only veg option: a hot dog bun. Familiar?

“Lisa the Vegetarian" Episode 133, Season 7

## All New York City Hospitals Now Serve Vegan Food As Default

**So far, the plant-based meals have gone down well with hospital patients**

BY POLLY FOREMAN

11TH OCTOBER 2022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# The Eat-*Lancet* Planetary Diet & Other Global Academics



There's widespread acknowledgement from the UN's IPCC, Eat-*Lancet*, and various academic institutions, from Oxford to Harvard, all urging a major shift to plant-based diets.

EAT

**Diets for a Better Future:**

Rebooting and Reimagining Healthy and Sustainable Food Systems in the G20


(Loken et al., 2020)

Scientist and Project Drawdown's leader Dr. Jonathan Foley states that "nothing else we do has come close to how food, agriculture, and land use are causing global environmental harm. **Without major changes, our food system will continue to push Earth well beyond its planetary boundaries."**

The report, Diets for a Better Future, by Eat Lancet, states that:

"**Global food production is the single largest human pressure on Earth**, threatening local ecosystems, driving a sixth mass extinction of species, and impacting the stability of the entire Earth system."

# What is the Scientific Consensus?



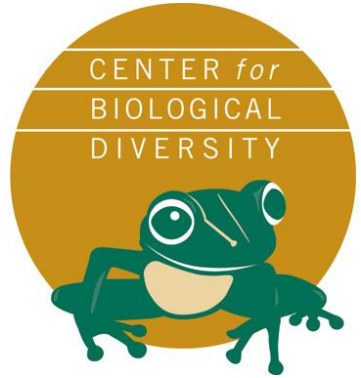






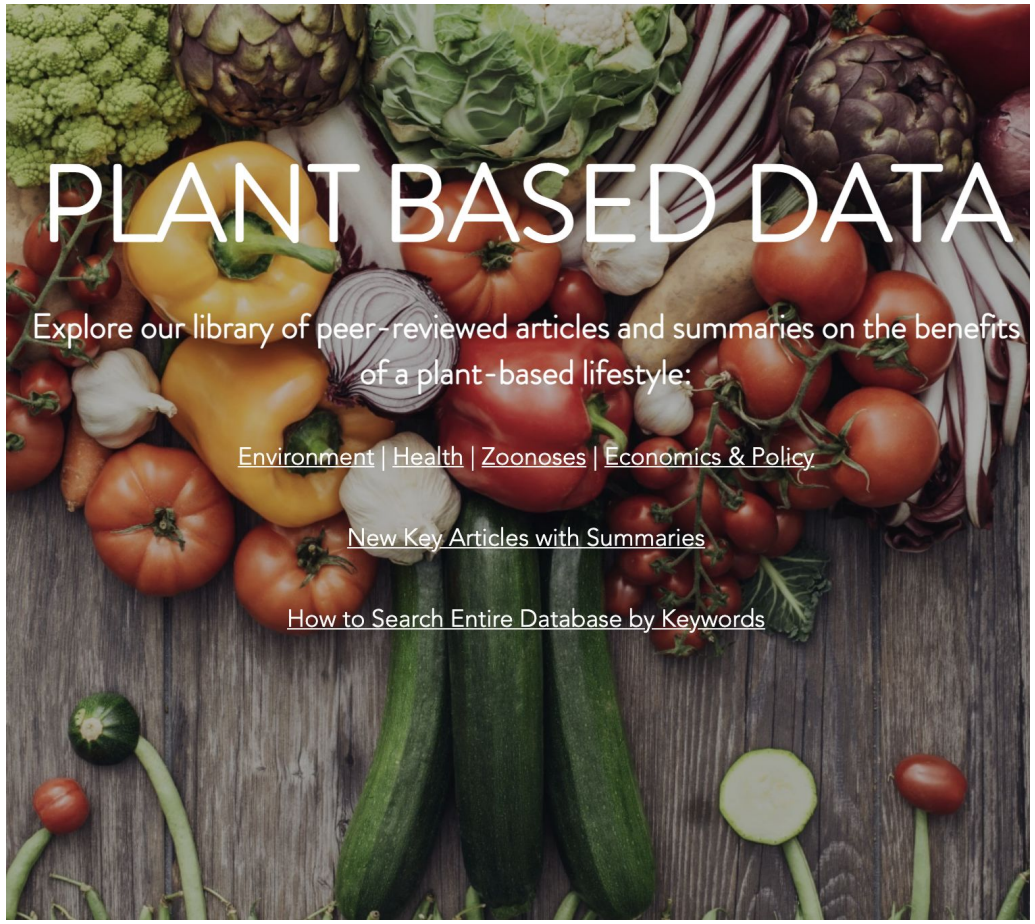






# Closing Remarks






- Advocate non-judgmentally, but boldly, for the transformational environmental, health, and ethical changes we need
- While acting as an example, urge evidence-based, solutions oriented, systemic changes to governments and businesses
- Demand transparency from food companies and be wary of constant greenwashing
- Know that perfection is the enemy of good. A major shift towards a plant-rich diet, especially within a society that normalizes the alternative, is significant progress.

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