The environmental impacts of our food choices – do they even matter?

Introducing Environmental Nutrition: the emerging frontier of public health

Helen Harwatt, PhD

May 2015

Contents

- Why focus on food?
  - resource use
  - environmental degradation
- Are there any solutions?
- What are we doing about it?

Resource use

water	energy	land
Agriculture uses 70% of fresh water – 38% in US	Food production uses 16% of all energy in US	>45% available land is used for food production

Processes that cause environmental impacts: life cycle

Our food uses up a significant chunk of natural resources…

So what?

Can’t we just change other things and leave our food alone?

Planet under pressure

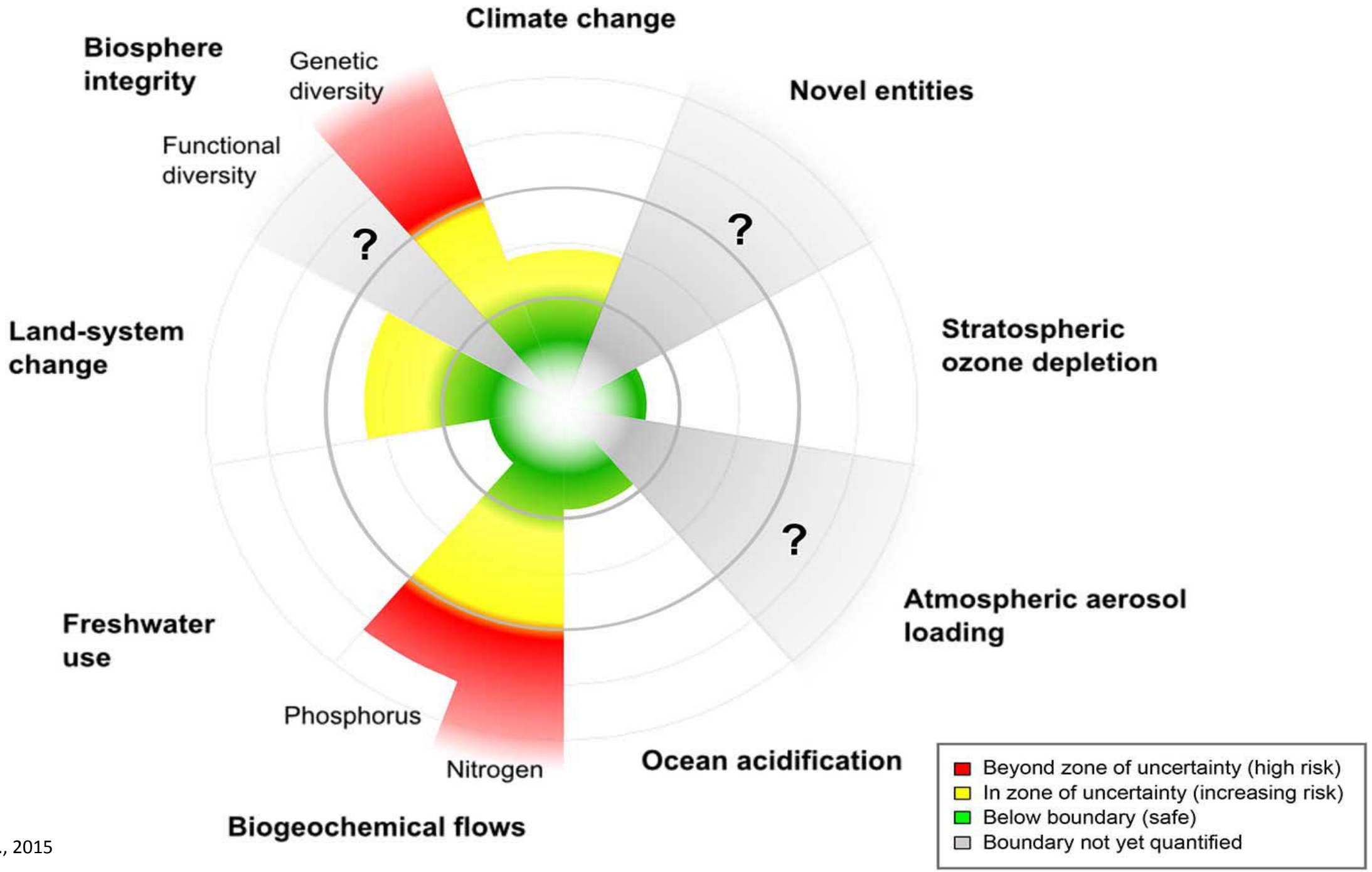
- Reliance on finite natural resources
- Reduced availability of natural resources due to contamination
- Population rise ⟶ more demand for finite resources
- Increased wealth ⟶ more demand for finite resources

Increased affluence: shifting consumption patterns…

- 7.9 billion acres of arable land in the world
- Takes 3.25 acres to feed one person the typical western diet
- ~7 billion people would require over 21 billion acres, or the equivalent of almost three planet Earths…

Lapp 1982, FAO.

We are exceeding Earth's biophysical capacity…



Steffen et al., 2015

Environmental degradation

- land use change
- chemical pollution
- biodiversity loss
- greenhouse gas emissions

Greenhouse gas emissions are relevant because…

- They retain heat in the atmosphere causing the ‘greenhouse’ effect
- More gas = more heat

The world's top climate body, the Intergovernmental Panel on Climate Change has stated that continued emissions of greenhouse gases…

"***will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts***."

and

"we have a very limited window of opportunity, the global community must look at these numbers and show the resolve by which we can bring about change."

IPCC, 2014.

Some of those impacts are already occurring and include:

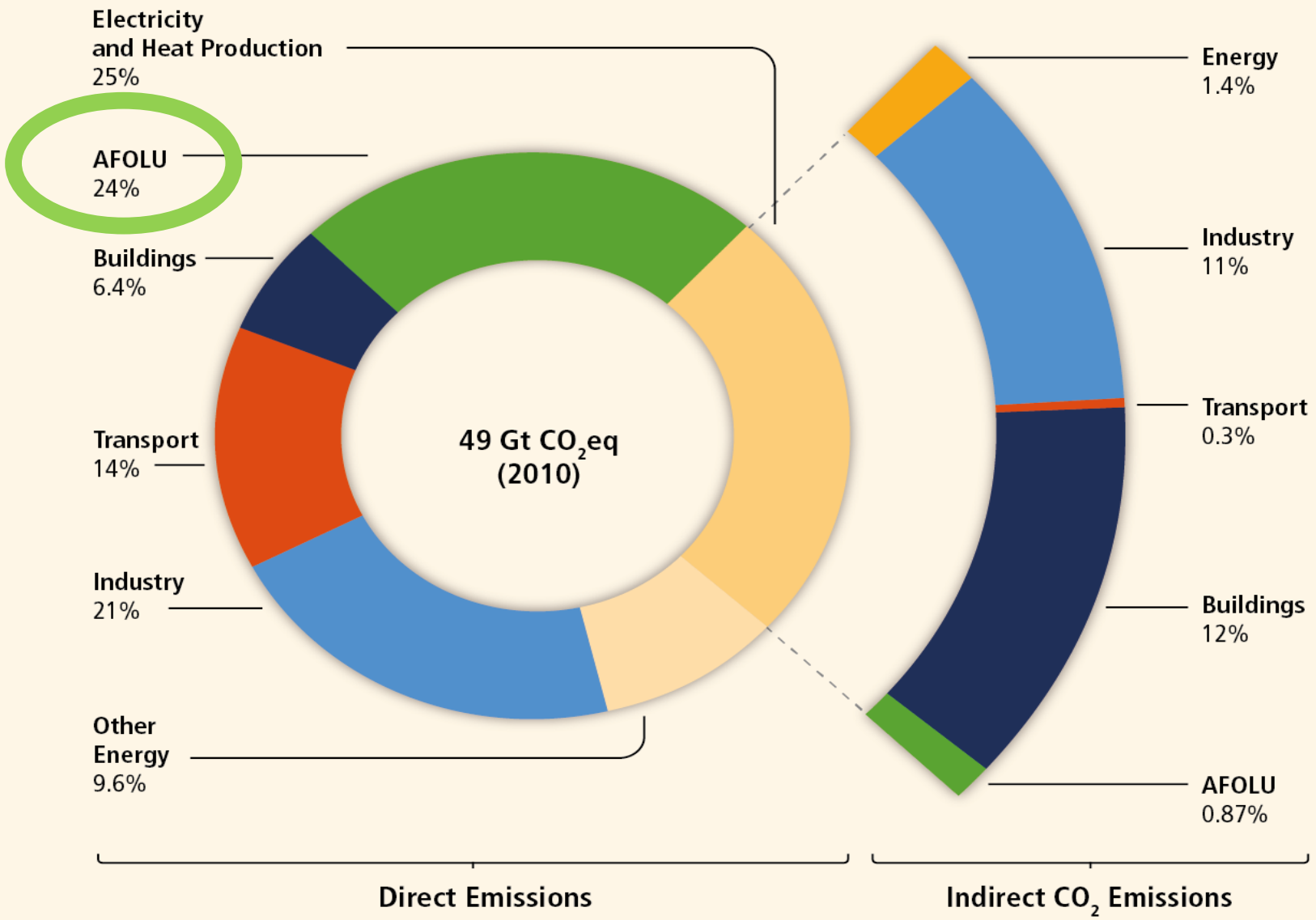
- Flooding
- Drought
- Warmer temperatures
- Storms
- Hurricanes
- Crop disruption/reduced yield
- Ocean acidification
- Sea level rise

"It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century"

IPCC, 2014

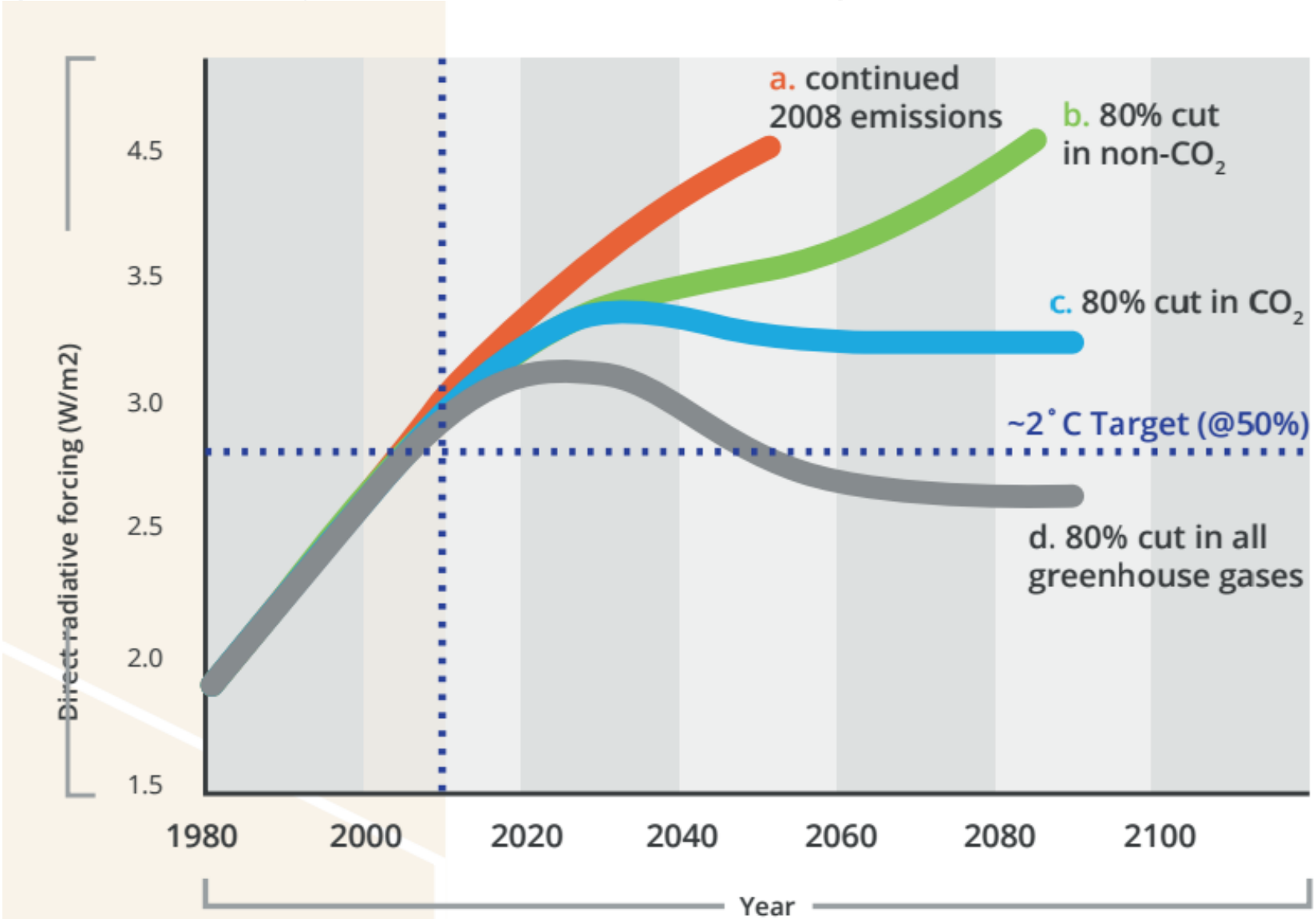
Greenhouse Gas Emissions by Economic Sectors

Livestock = ~15% of total



IPCC, 2014

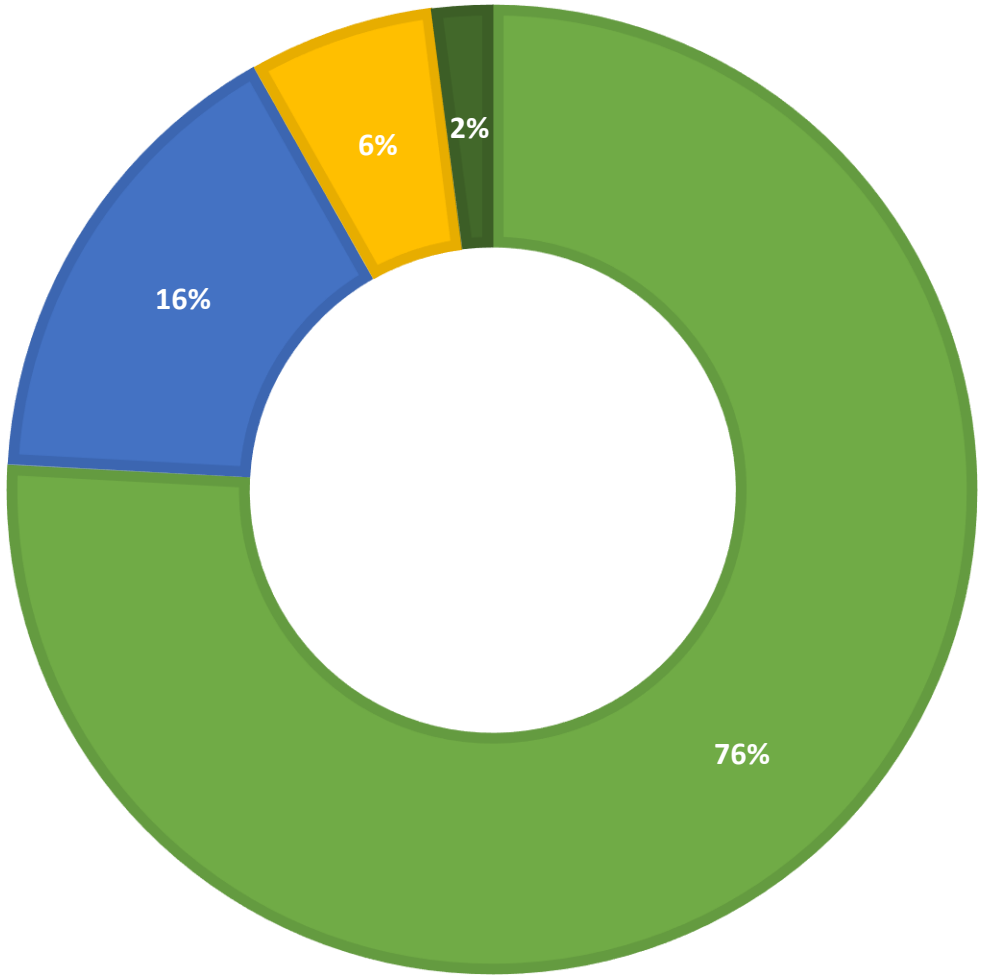
Significant reductions in non-CO_2 emissions are essential to avoiding catastrophic climate change



Major cuts are required from ALL sectors, including FOOD

Graphics: Food Choice Taskforce

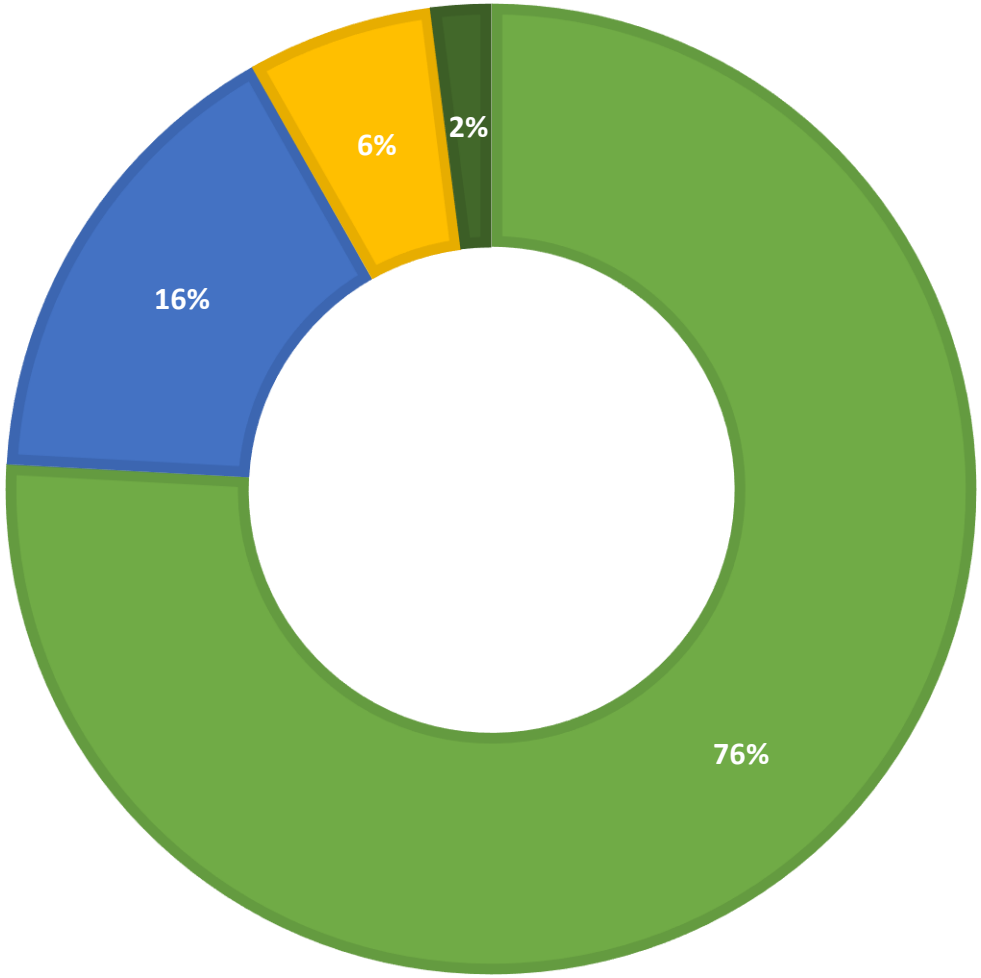
Global greenhouse gas emissions



"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."

Ripple *et al.*, 2014.

Global greenhouse gas emissions

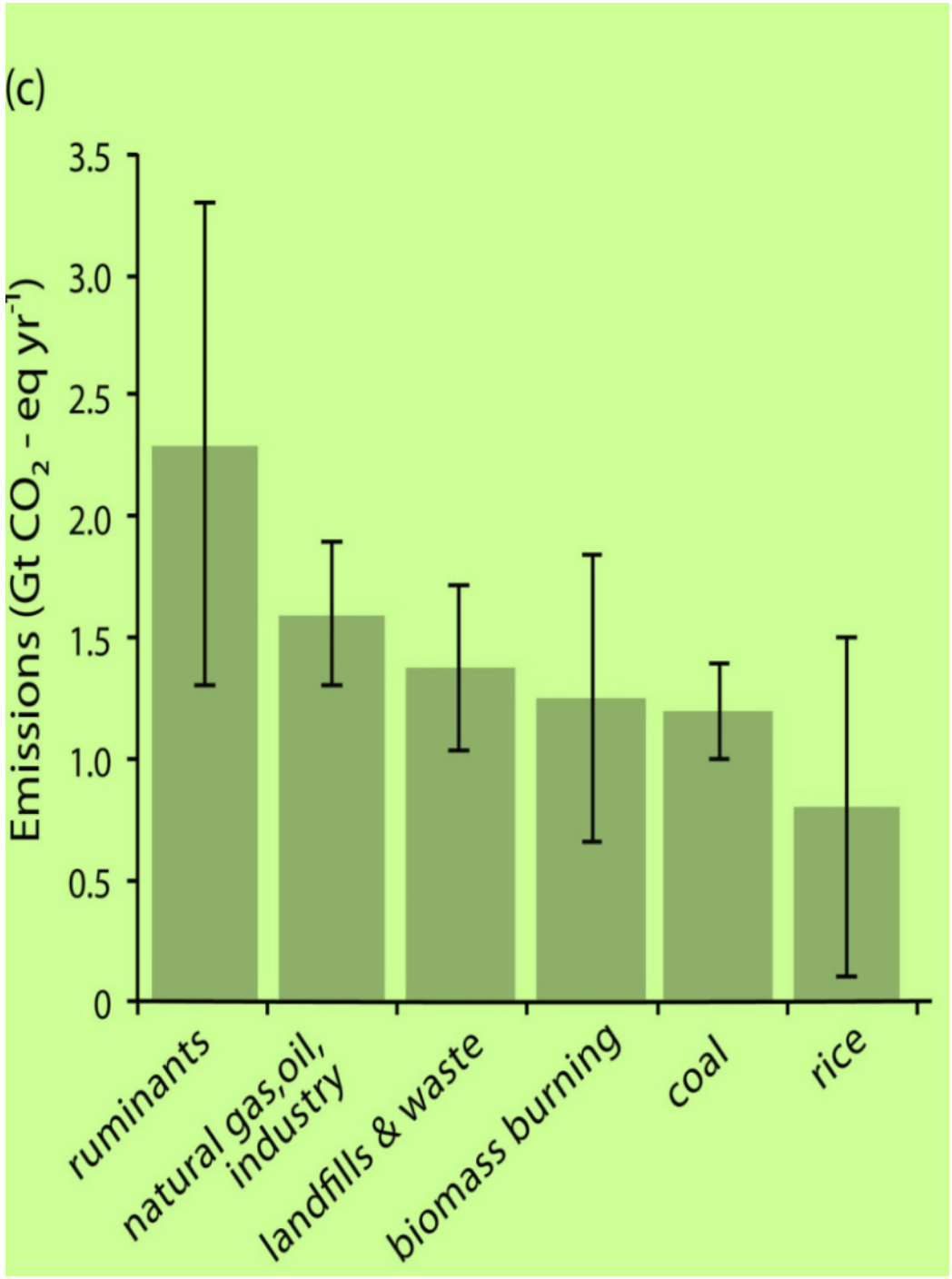


Livestock are the biggest source of methane (44%) and nitrous oxide (53%)

FAO, 2013.

Methane emissions

Much shorter atmospheric lifetime (~9 years) than CO_2 and holds the potential for more rapid reductions.



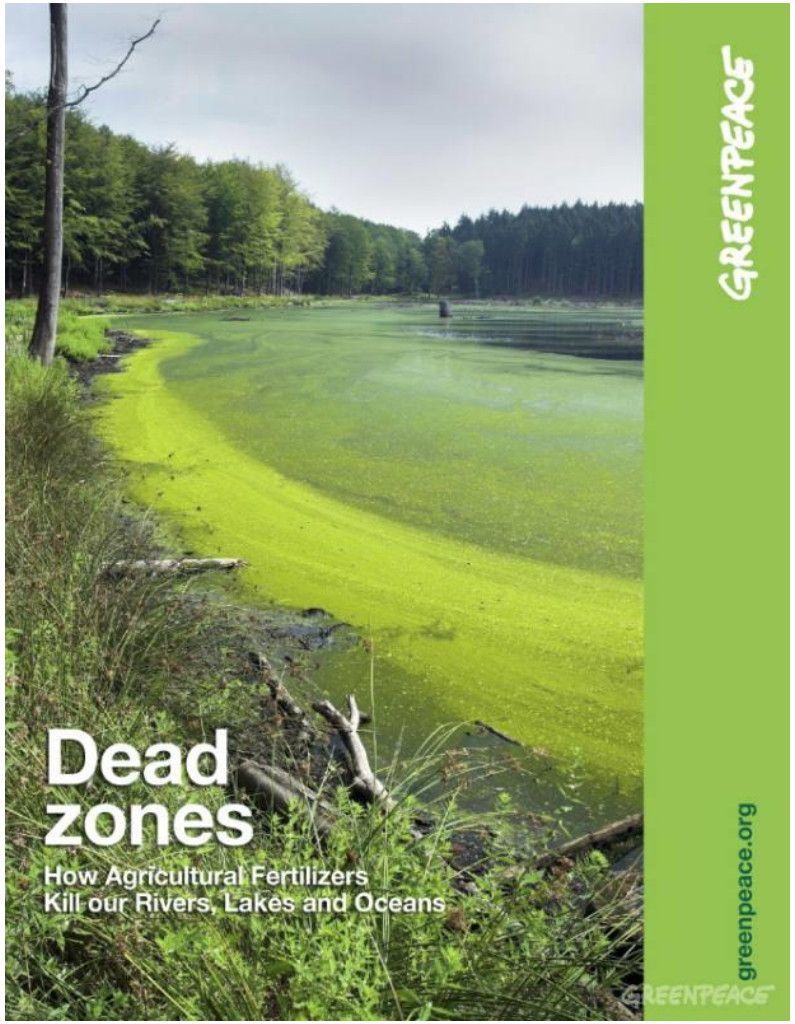
Ripple *et al.* 2014.

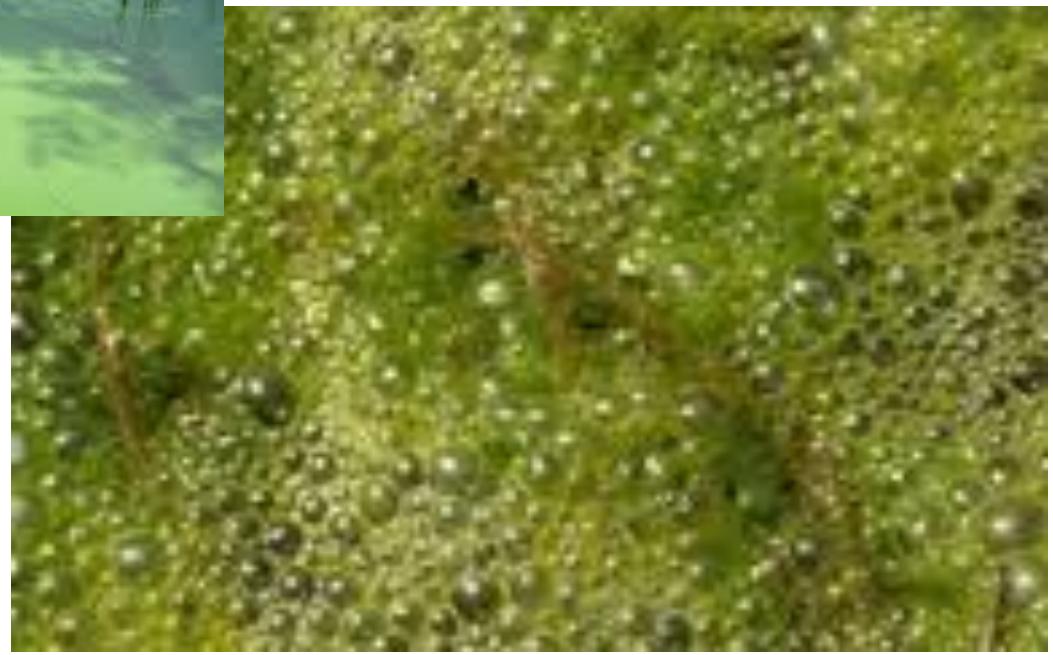
Nitrogen and phosphorus

- Food production is the leading cause of nitrogen and phosphorus pollution.
- 70% of phosphorus footprint related to diet is linked to animal products.
- Of all the nitrogen released into the environment, livestock production is linked to ~60%.
- Excessive amounts of these chemicals in the environment disrupts natural biochemical flows.
- Range of adverse environmental impacts.

Metson et al 2012; Pelletier & Tyedmers, 2012

Excess nutrients cause algal blooms which reduce light and oxygen availability for all other fauna and flora

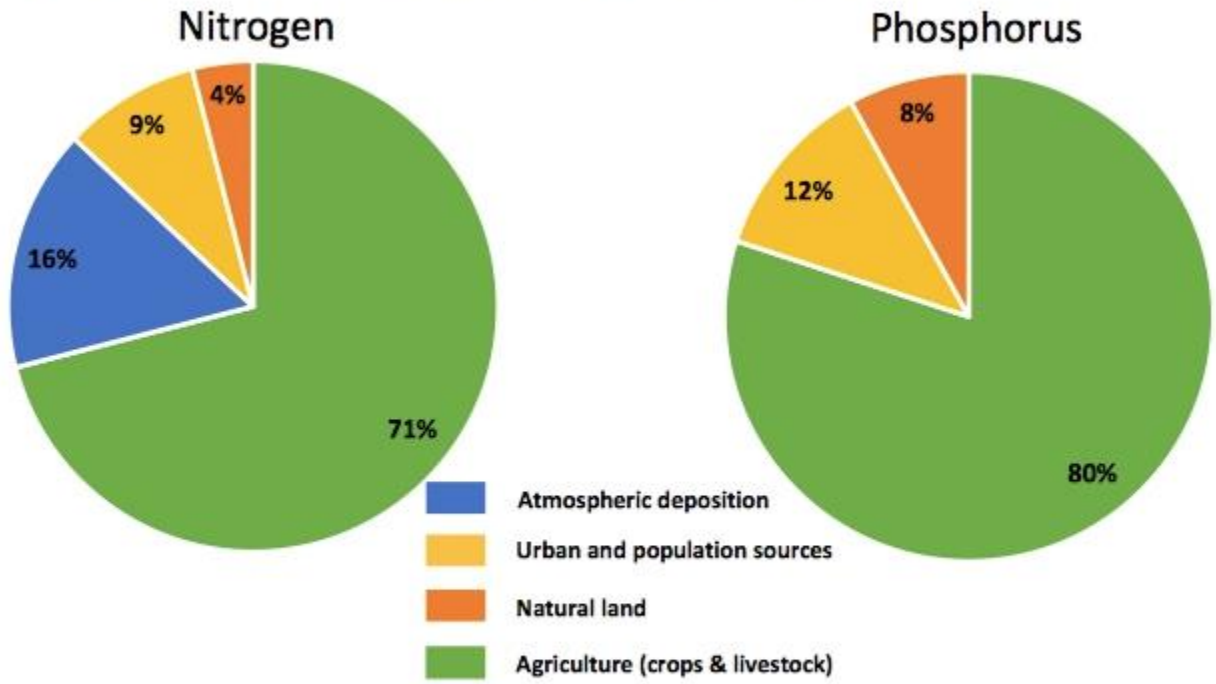




Excess nutrients also cause oceanic ‘dead zones’

Case study: agriculture = main cause

Figure 3: Sources of nutrients released into the Gulf of Mexico



Source: OIG analysis of USGS data:
http://water.usgs.gov/nawqa/sparrow/gulf_findings/primary_sources.html.

Deforestation- land use change and biodiversity loss

Food production is a major contributor to deforestation

- Agriculture is estimated to be the direct driver for around 80% of deforestation worldwide
- Livestock production is linked to ~70% of deforestation in the Brazilian Amazon
- Forests are among the most important repositories of terrestrial biological diversity
- Forests are a natural carbon sink, when removed this causes atmospheric imbalance

Wageningen University and Research Centre; Nepstad et al., 2014; FAO, 2015.

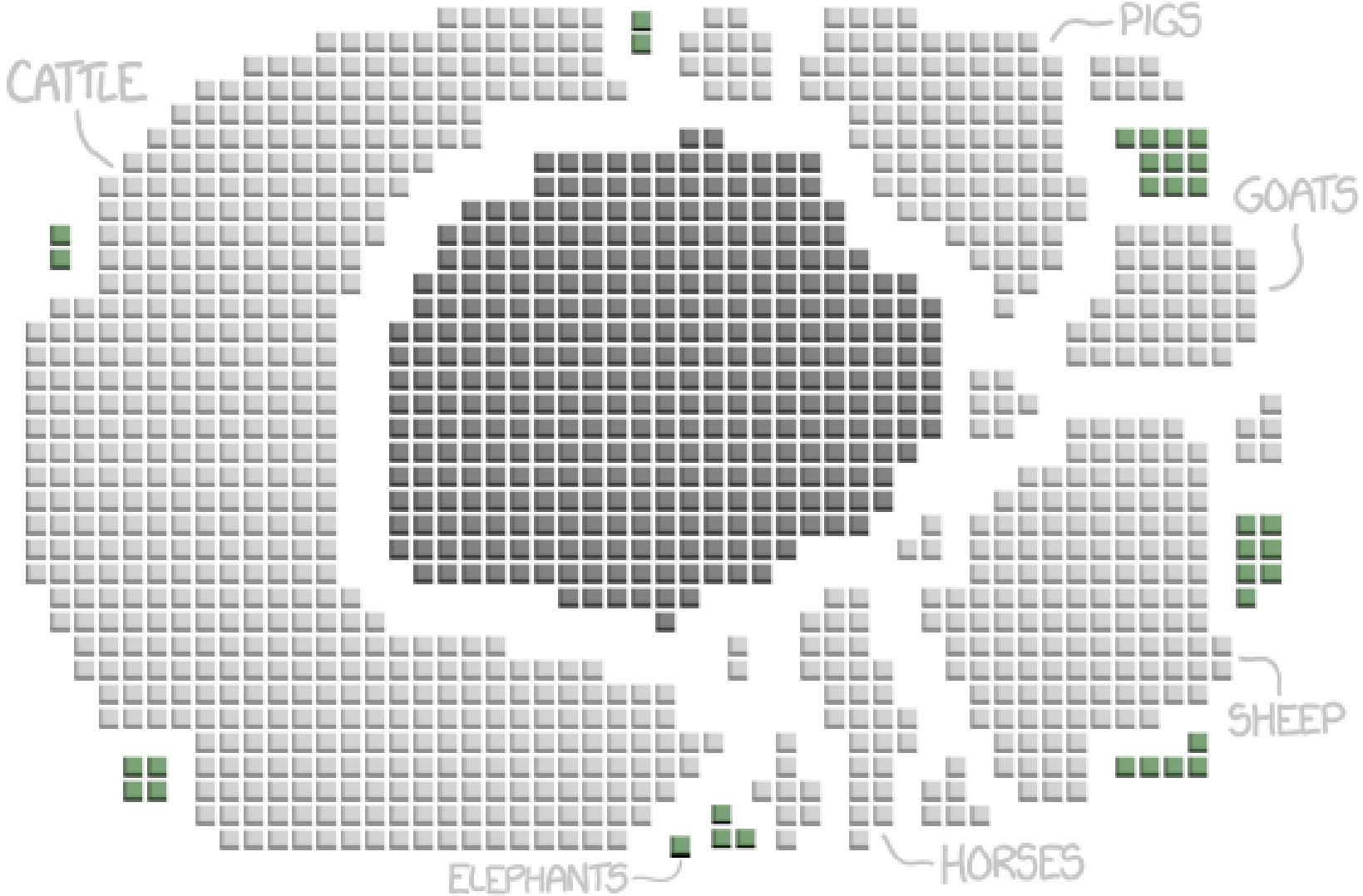
Biodiversity loss

- Food production is a leading cause of biodiversity loss
- 30% of global biodiversity loss is linked to livestock production
- Also a huge imbalance in biomass…

EARTH'S LAND MAMMALS BY WEIGHT

= 1,000,000 TONS

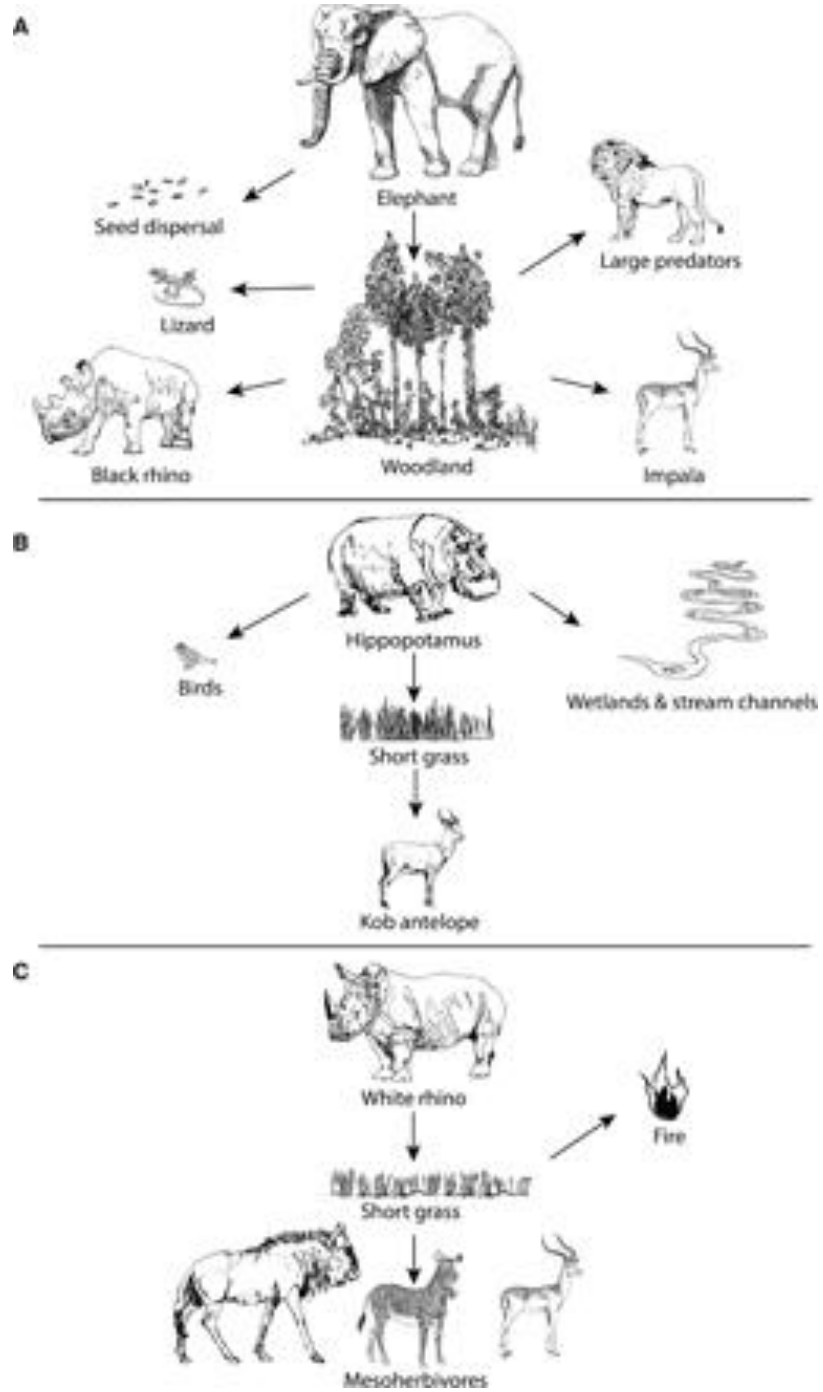
HUMANS | OUR PETS AND LIVESTOCK | WILD ANIMALS



DATA FROM VACLAV SMIL'S *THE EARTH'S BIOSPHERE: EVOLUTION, DYNAMICS, AND CHANGE*, PLUS A FEW OTHER SOURCES.

Why is biodiversity important?

- Trophic cascades
- Complex dependencies



Ripple et al., 2015

Species loss

44 of the 74 largest terrestrial herbivores (~60%) are listed as threatened with extinction

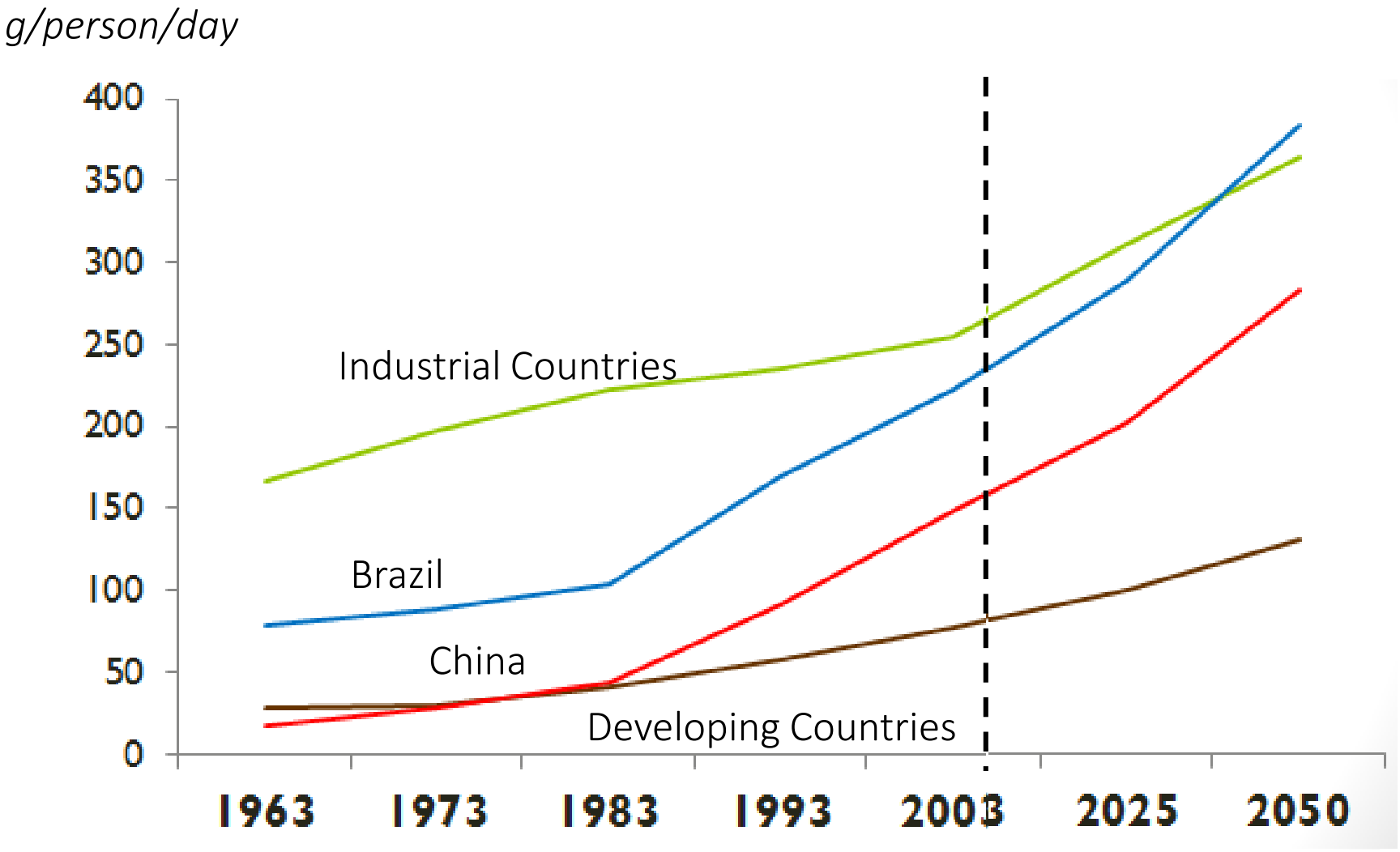
(including 12 critically endangered or extinct in the wild)

The biggest threat is human consumption of animal products…

- Hunting for meat
- Competition with livestock
- Habitat loss

Ripple et al., 2015

Meat Consumption Patterns By Region



Source: *FAO Food balance sheets*, 2009

Our food choices are using finite resources and exceeding Earth's biophysical capacity

What's the solution?

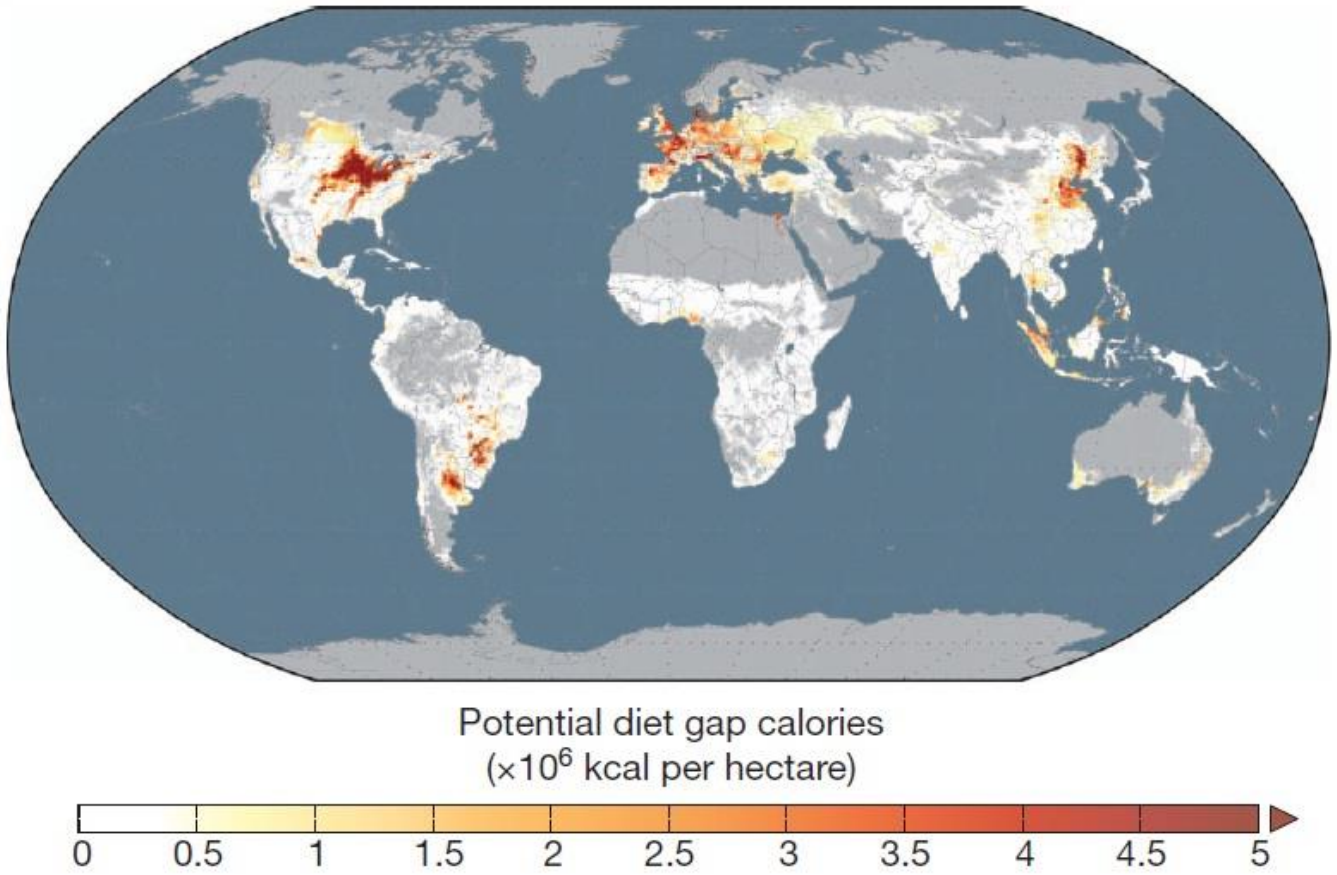
We need to use less resources to produce more food, and avoid dangerous tipping points…

- Sounds impossible – but….

Let’s first look at the variation in resource use…

SHIFTING MAJOR CROPS TO 100% HUMAN FOOD

- ~1/3 of global crops are fed to animals
- On average, 4 calories of crop-based feed roughly equals 1 calorie of animal products



28% increase of food supply and 45% increase of dietary energy by shifting crop use to human consumption

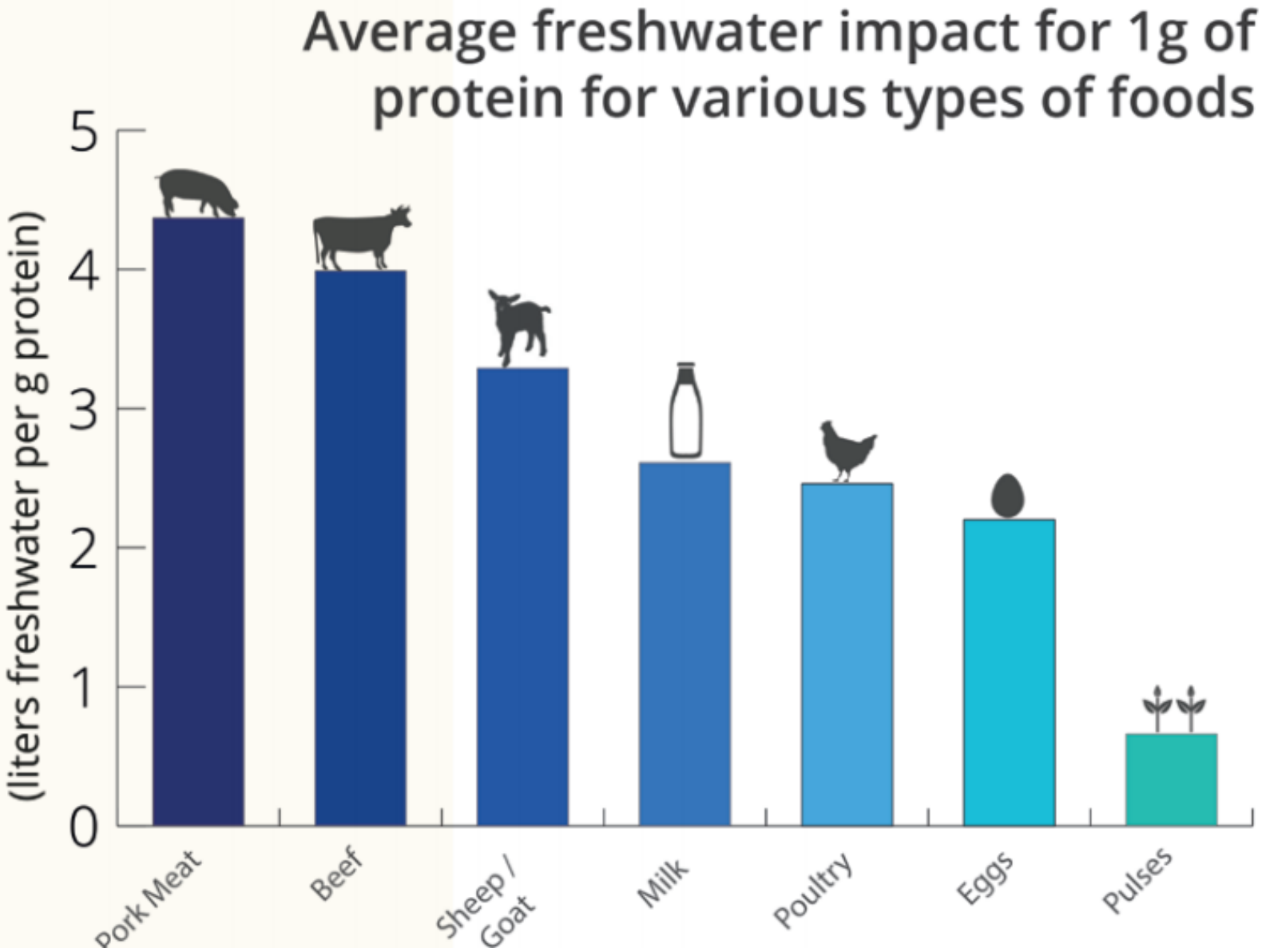
Pradhan et al., 2013; Cassidey et al, 2013; Foley, et al., 2011

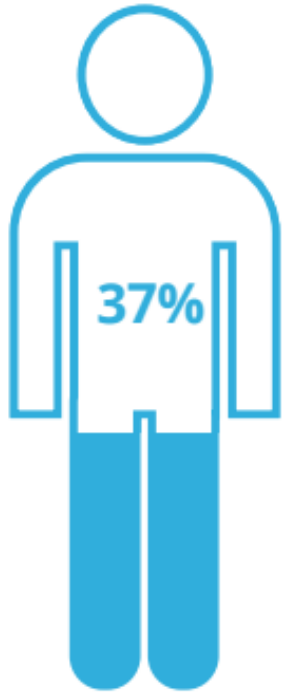
Water use

- Water required to produce 1kg:
- Apples 700 liters
- Soybean 2,145 liters
- Beef 15,400 liters
- Per serving ~375 liters for soybeans and 2,700 liters for beef.

- Average American family of 4 uses ~1,500 liters of water/day.
- Standard shower head uses ~9 liters of water/minute.

‘Climate change is projected to reduce renewable surface water and groundwater resources in most dry subtropical regions’. IPCC, 2014





Meat contributes 37%* to the food-related water footprint of an average American Citizen

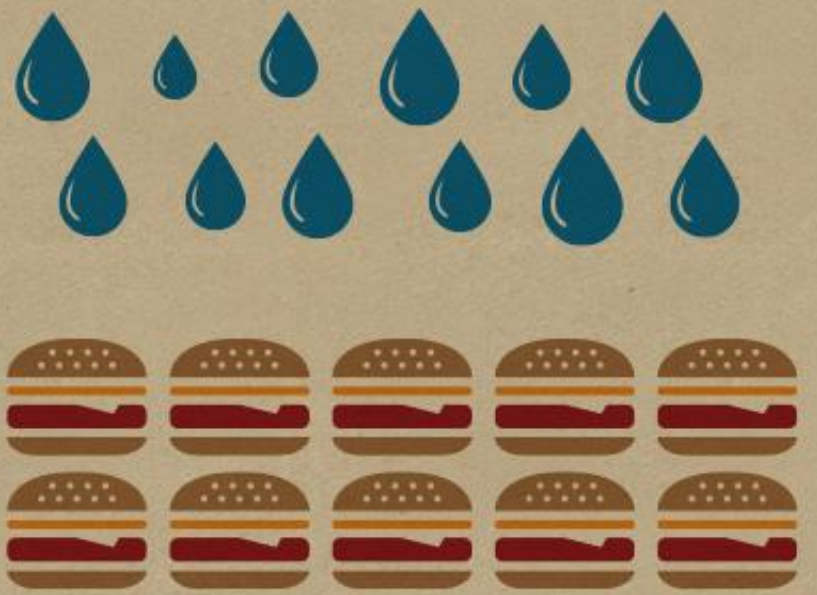
(Mekonnen & Hoekstra, 2012)

Graphics: Food Choice Taskforce

The Plantrician Project

Planting the seeds of change

12,000 GALLONS OF WATER
is enough *water for a family of four* for a year



12,000 GALLONS OF WATER
is the amount required to produce *10 pounds of beef*

http://plantricianproject.org

Land use

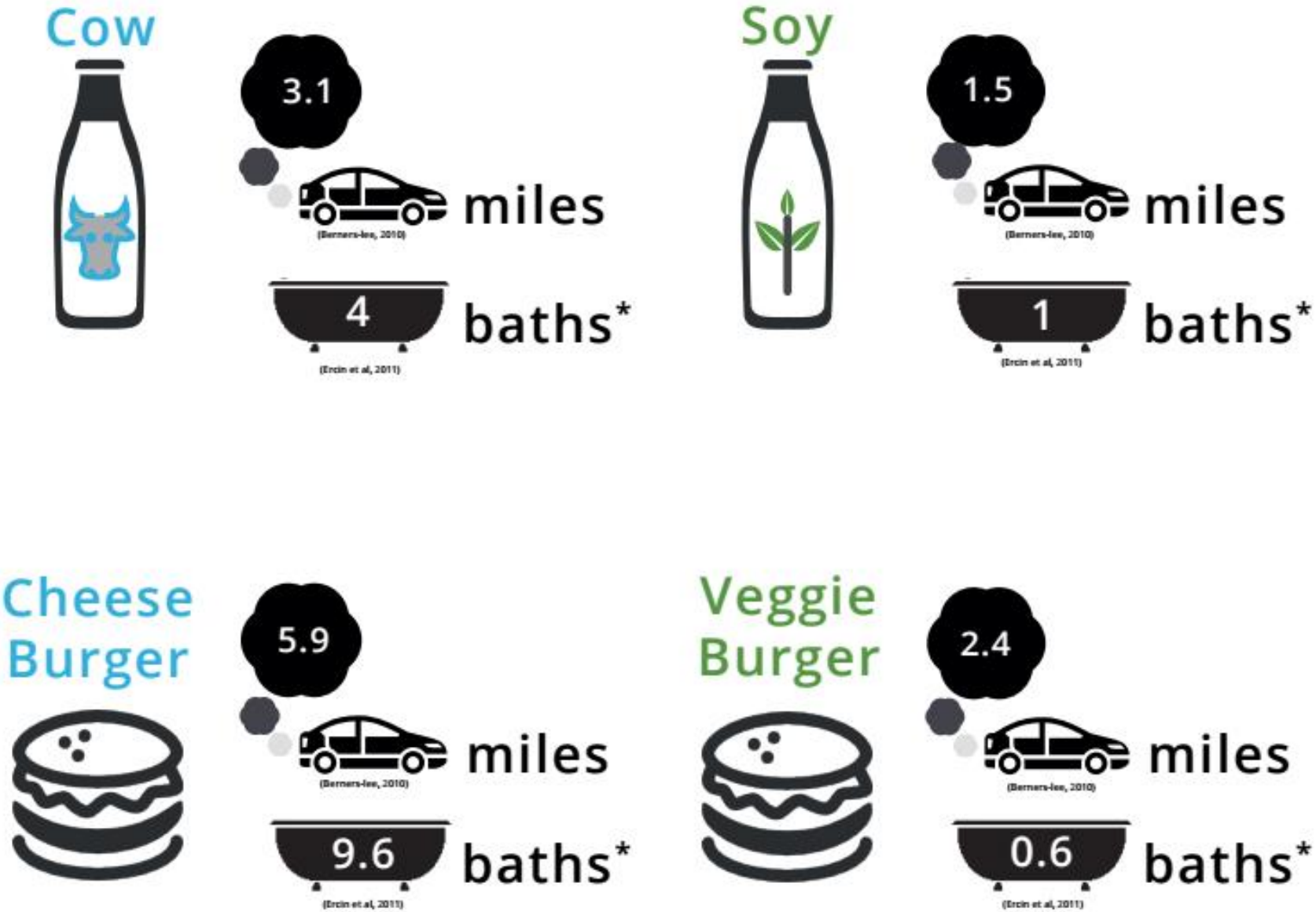
- In comparison to tofu:
  - ➢Beef requires 32-900 times more land
  - ➢Lamb requires 73 times more land
  - ➢Chicken requires 10-16 times more land

- ○In comparison to staples like potatoes, wheat, and rice, beef requires 160 times more land
- ○Currently around 75% of agricultural land is used for livestock production
- ○Beef production uses ~60% of agricultural land, but produces <2% of the calories that feed the global population

Boucher et al., 2012

Lappe 1982. Graphics: http://plantricianproject.org

Lappe, 1982, FAO, J. Morris Hicks. http://plantricianproject.org



Graphics: Food Choice Taskforce

Energy use

- Energy used to produce 1kg:
  - Peaches 344 kJ
  - Beans 2,861 kJ
  - Almonds 4,646 kJ
  - Beef 7,880 kJ

- Average American home uses 104,400 kJ electricity per day
- **'Energy use can be substantially lowered through** changes in consumption patterns, adoption of energy savings measures, **dietary change and reduction in food wastes**.' IPCC, 2014.

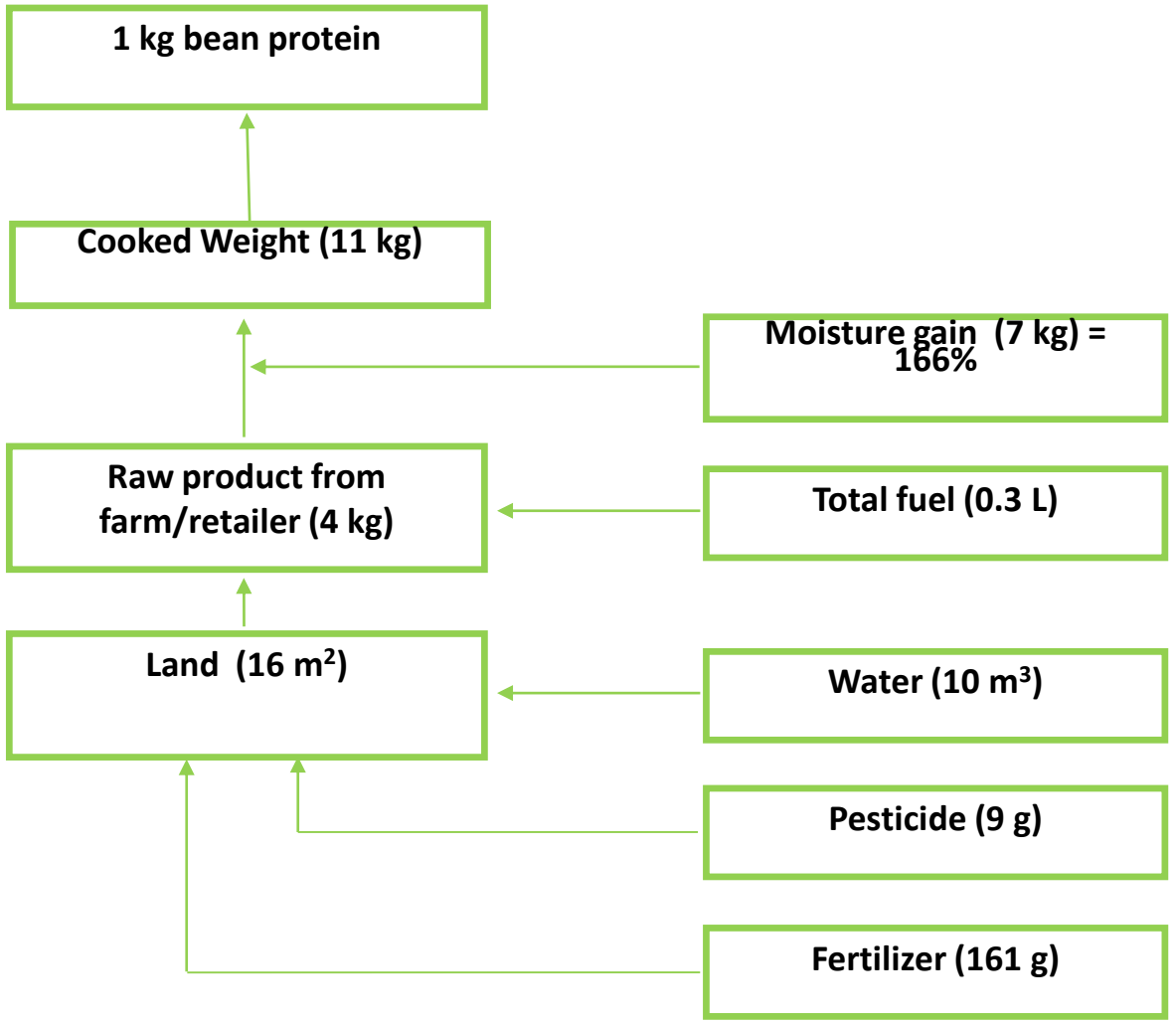
Public Health Nutrition

The environmental cost of protein food choices

Joan Sabaté[1,*], Kitti Sranacharoenpong[1], Helen Harwatt[1], Michelle Wien[2] and Samuel Soret[3]

[1]Department of Nutrition, Loma Linda University, Nichol Hall 1102, Loma Linda, CA 92350, USA: [2]Human Nutrition and Food Science Department, School of Agriculture, California State Polytechnic University, Pomona, CA, USA: [3]Department of Occupational and Environmental Health, Loma Linda University, Loma Linda, CA, USA

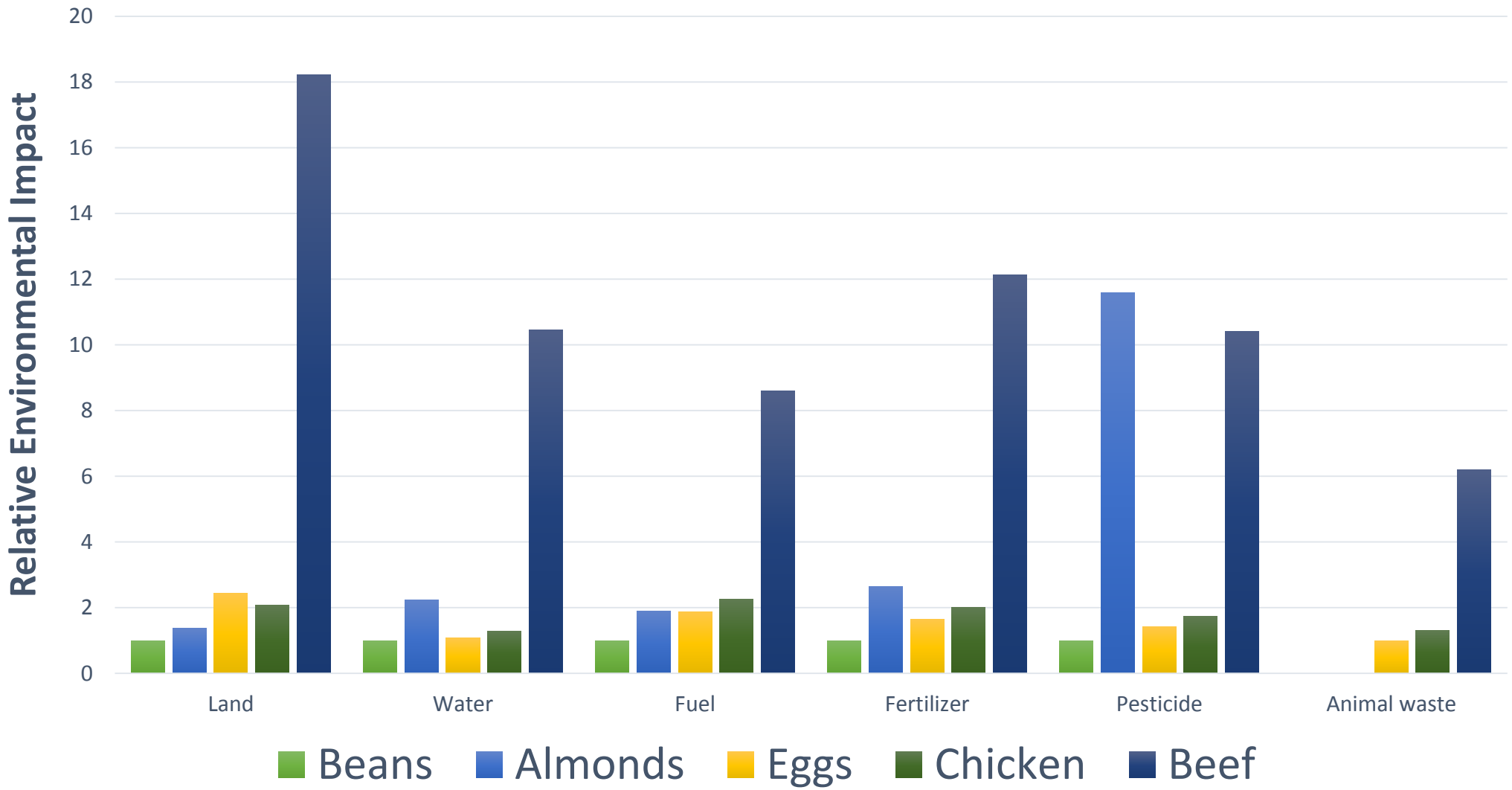
Inputs To Produce 1 Kg Of Protein From Beans



Inputs And Animal Waste Generated To Produce 1 Kg Of Protein From Each Commodity

	Kidney beans	Almonds	Eggs	Chicken	Beef
Food Yields (kg)					
Raw weight from farms	4	5	8	10	13
Raw weight from retailers	4	5	8	6	5
Cooked weight	11	5	8	4	3
Protein	1	1	1	1	1
Environmental Factors					
Land (m^2)	16	21	38[a]	32[a]	283[a]
Water (m^3)	10	23	11[b]	14[b]	109[b]
Fuel[c] (L)	0.3	1	1	1	3
Fertilizer[d] (g)	161	426	264	320	1945
Pesticide (g)	9	104	13	16	93
Animal waste (kg)	-	-	17	22	105

Relative Environmental Impacts To Produce Protein From Plant And Animal Sources

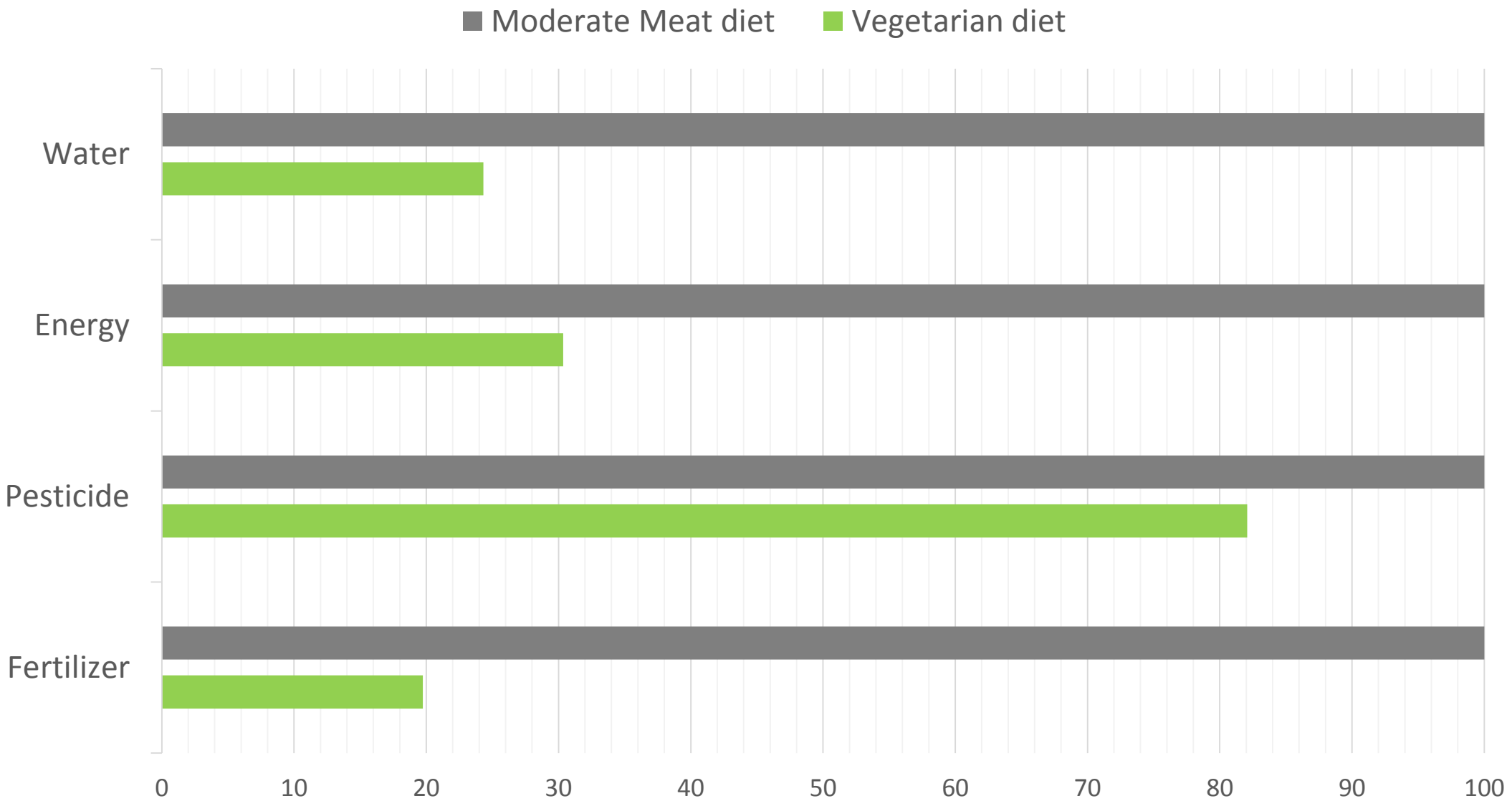


Public Health Nutrition

Comparing the water, energy, pesticide and fertilizer usage for the production of foods consumed by different dietary types in California

Harold J Marlow[1,†], Helen Harwatt[1,*], Samuel Soret[2] and Joan Sabaté[1]
[1]Department of Nutrition, Loma Linda University, 24951 North Circle Drive, Loma Linda, CA 92350, USA:
[2]Department of Environmental Health and Geoinformatics Sciences, Loma Linda University, Loma Linda, CA, USA

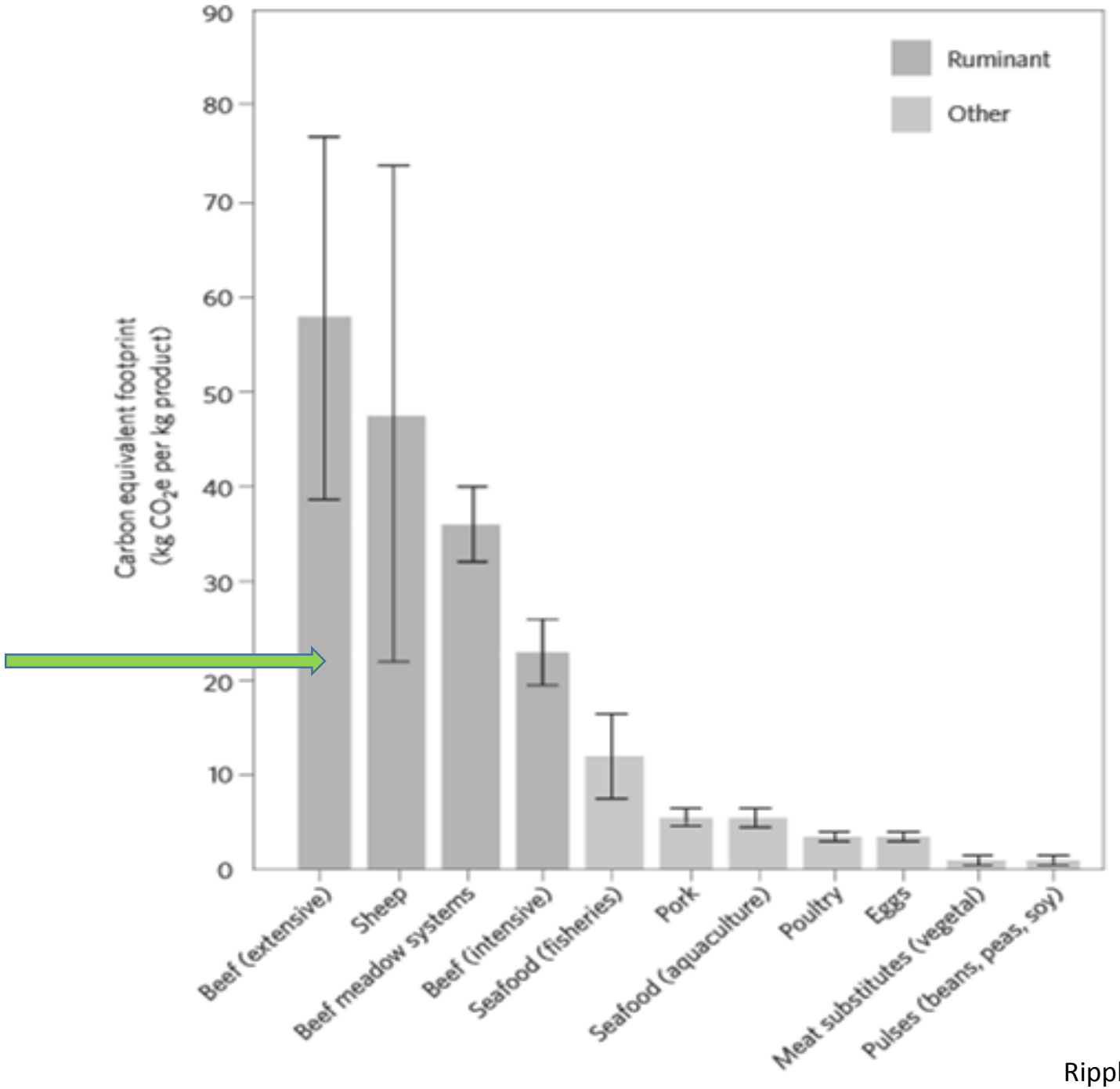
Resources Used:
Vegetarian Vs Moderate Meat Diets



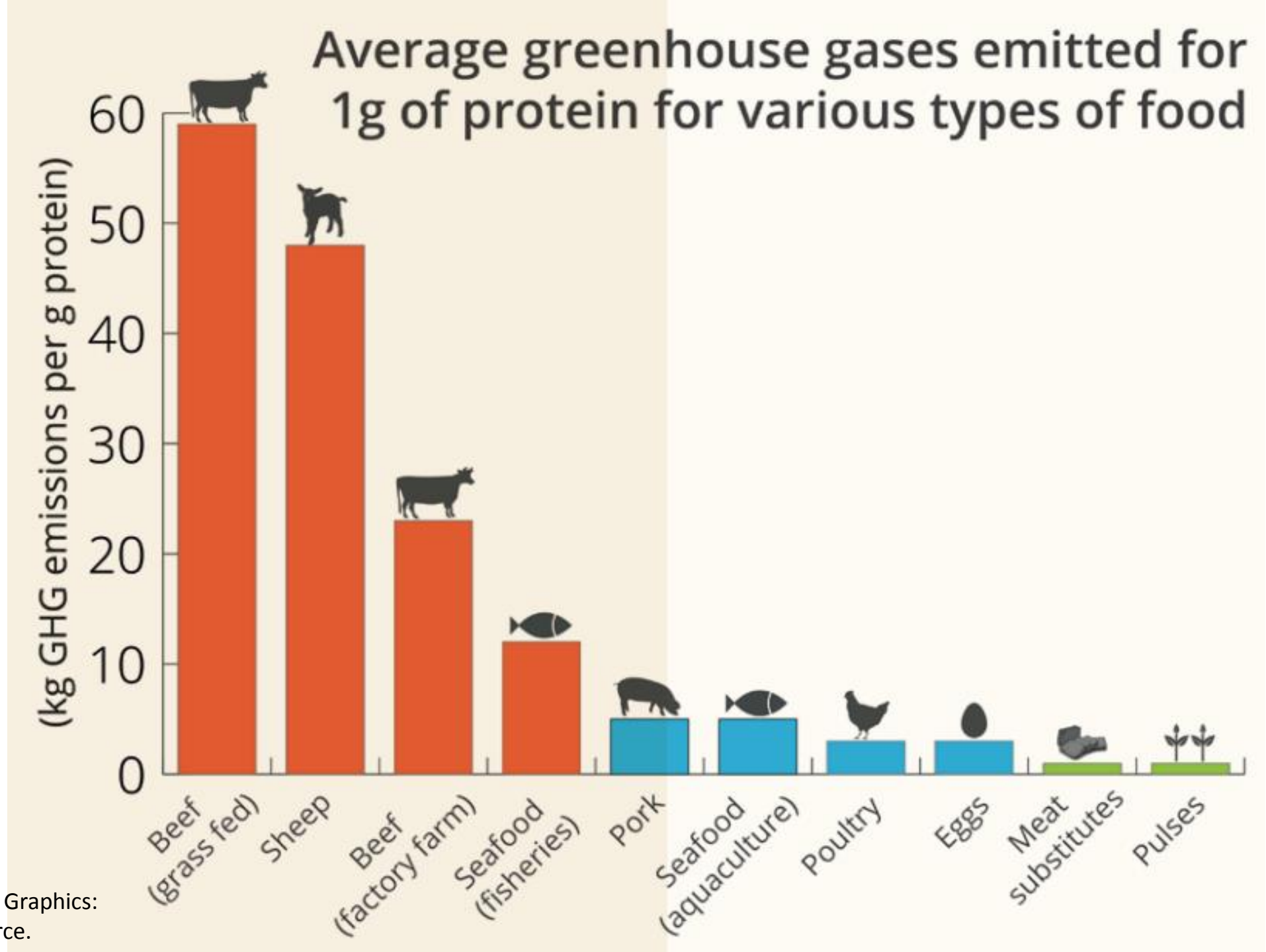
Environmental degradation aspects of foods and dietary patterns

Greenhouse Gas Emissions From Protein-rich Foods

‘Grass fed/free range’ is not the answer

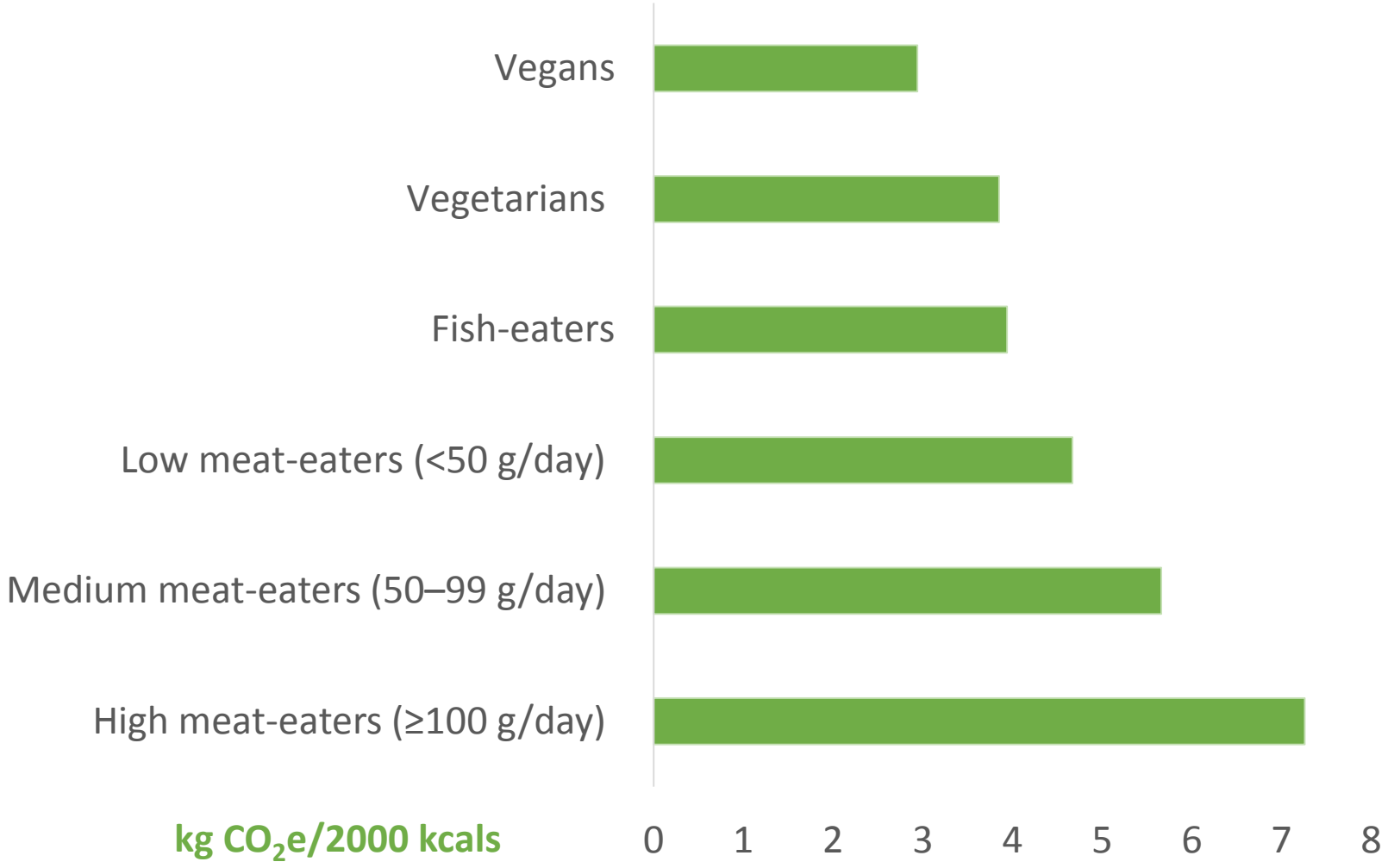


Ripple *et al.* 2014.



Nijdam *et al.,* 2012. Graphics: Food Choice Taskforce.

Greenhouse Gas Emissions by Diet Pattern



GHG emissions in meat-eaters are twice as high as those in vegans

Scarborough et al., 2014.

The American Journal of Clinical Nutrition

Climate change mitigation and health effects of varied dietary patterns in real-life settings throughout North America[1–4]

Samuel Soret, Alfredo Mejia, Michael Batech, Karen Jaceldo-Siegl, Helen Harwatt, and Joan Sabaté

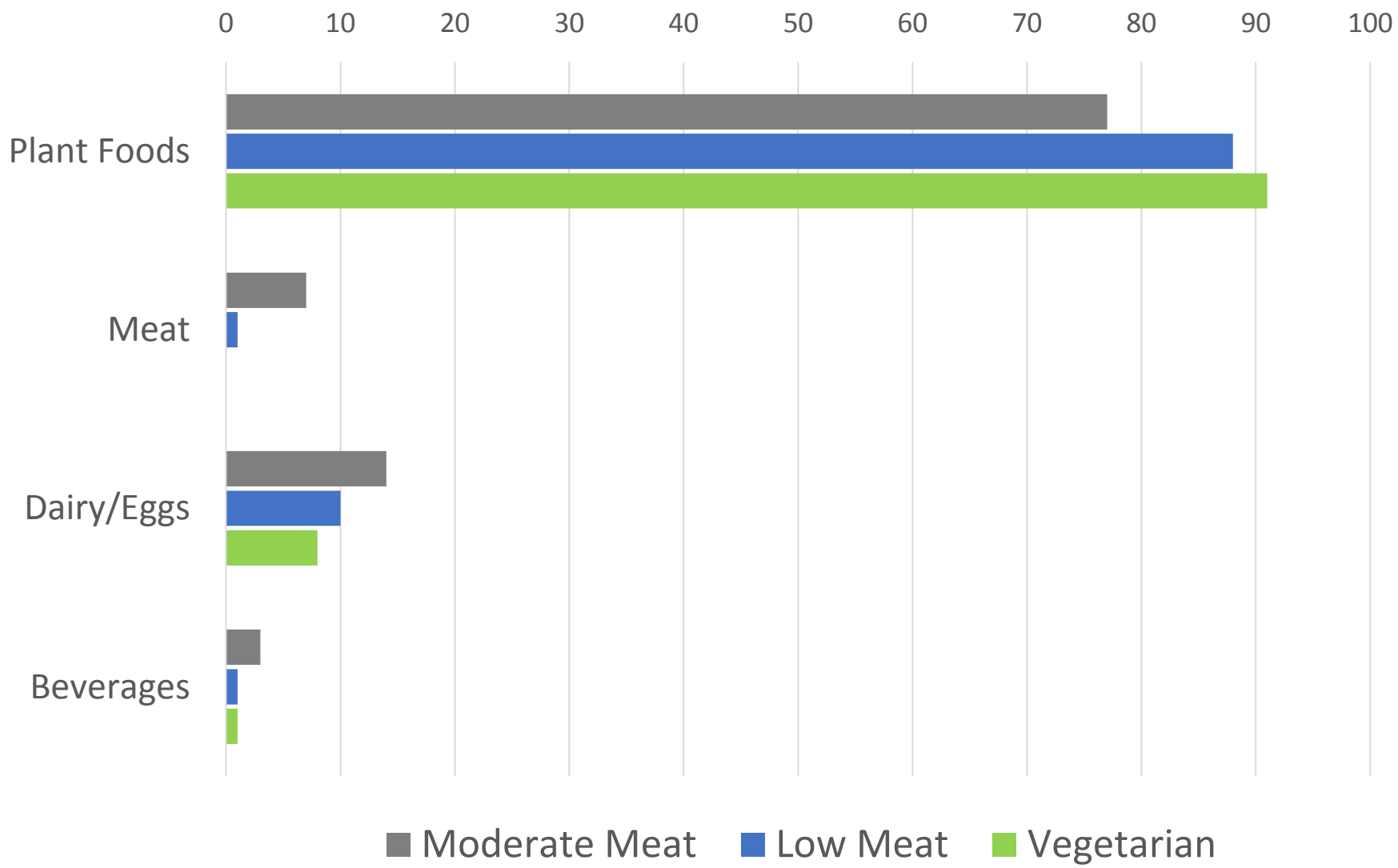
ABSTRACT

Background: Greenhouse gas emissions (GHGEs) are a major consequence of our dietary choices. Assessments of plant-based compared with meat-based diets are emerging at the intersection of public health, environment, and nutrition.

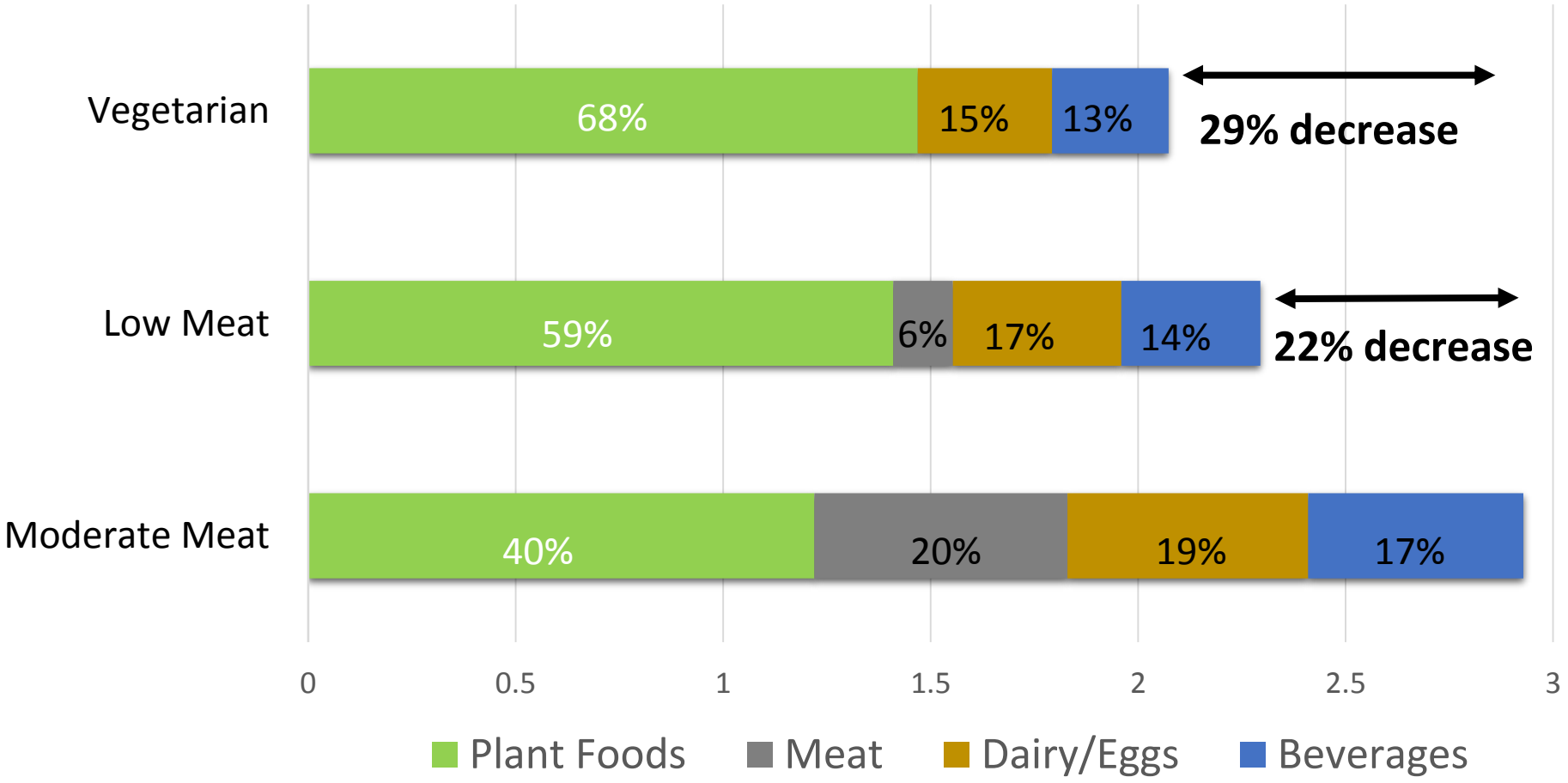
GHGEs based on a range of conservative and more inclusive assessments (11, 12).

To alleviate the environmental pressure imposed by the modern food system, both the average worldwide consumption of animal products and the intensity of emissions from livestock production

% Energy From Each Food Group According To Diet Pattern



Greenhouse Gas Emissions By Dietary Pattern And Food Groups (With % Contribution)



Example of ecosystem restoration when livestock are removed

Batchelor *et al.* Environmental Management 2014.

More birds
and other wildlife

Batchelor et al. 2015

3007.4.167.1990
Barnhardy Meadow
Oct 1990

Batchelor et al. 2015

Can technology save the day?

- 32% reduction through technology and ambitious farming techniques, BUT

Reducing the consumption of animal products is unavoidable

No longer a ‘fringe’ interest

- Growth in ‘Meat free Monday’ campaigns
- USDA dietary guidelines – considering sustainability
- 1st food campaign from environmental NGO ‘take extinction off your plate’
- Rise in meat analogs
- Impossible Foods vegan burgers that ‘bleed’
- Growing public concern

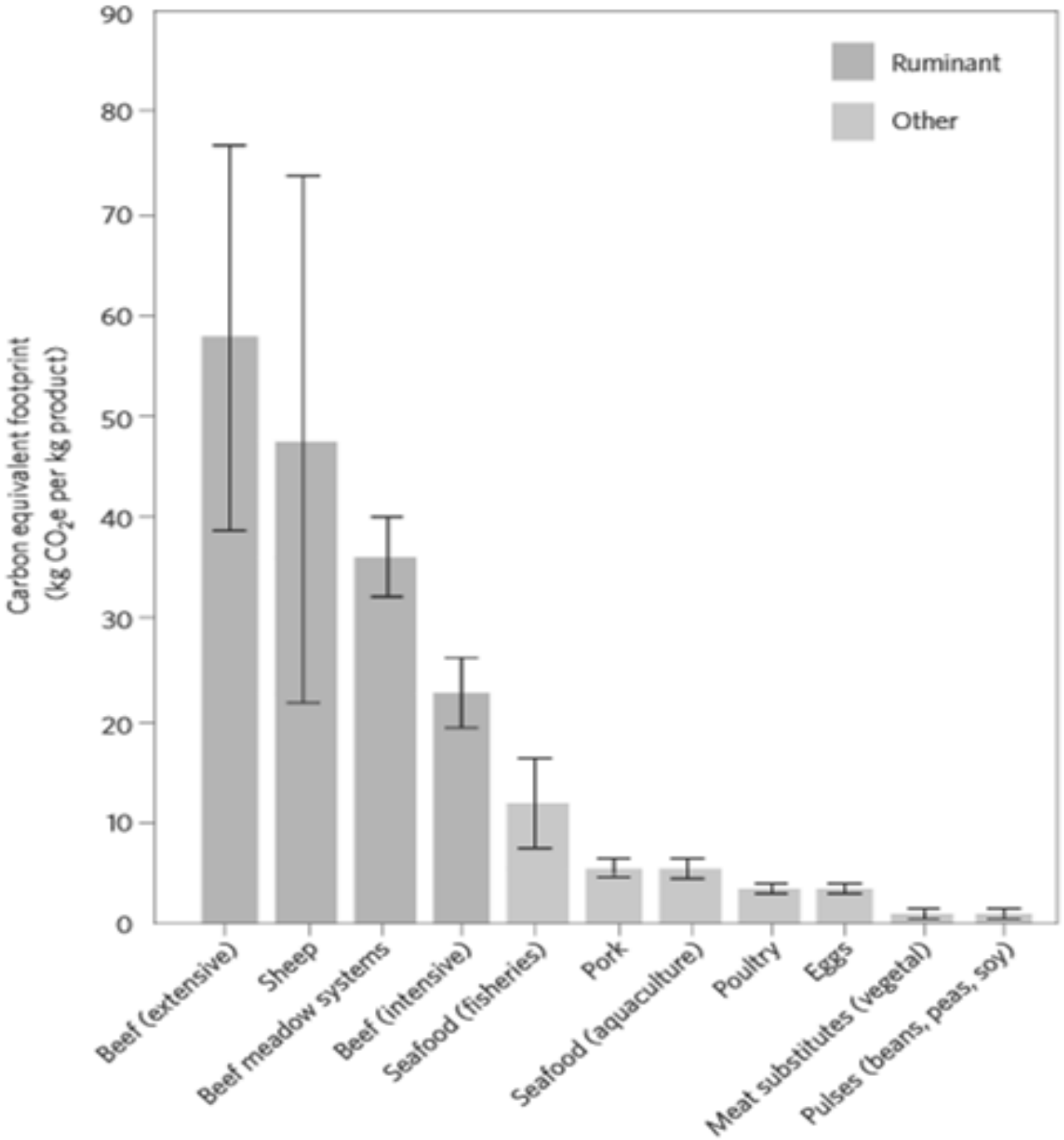
IMPOSSIBLE™

Why we are working on this topic@Loma Linda University?

- Dominated by industry bias
- Need clear, factual database
- Public respect expert opinion

Figure 9: Actors perceived as helpful sources of information on climate and livestock issues

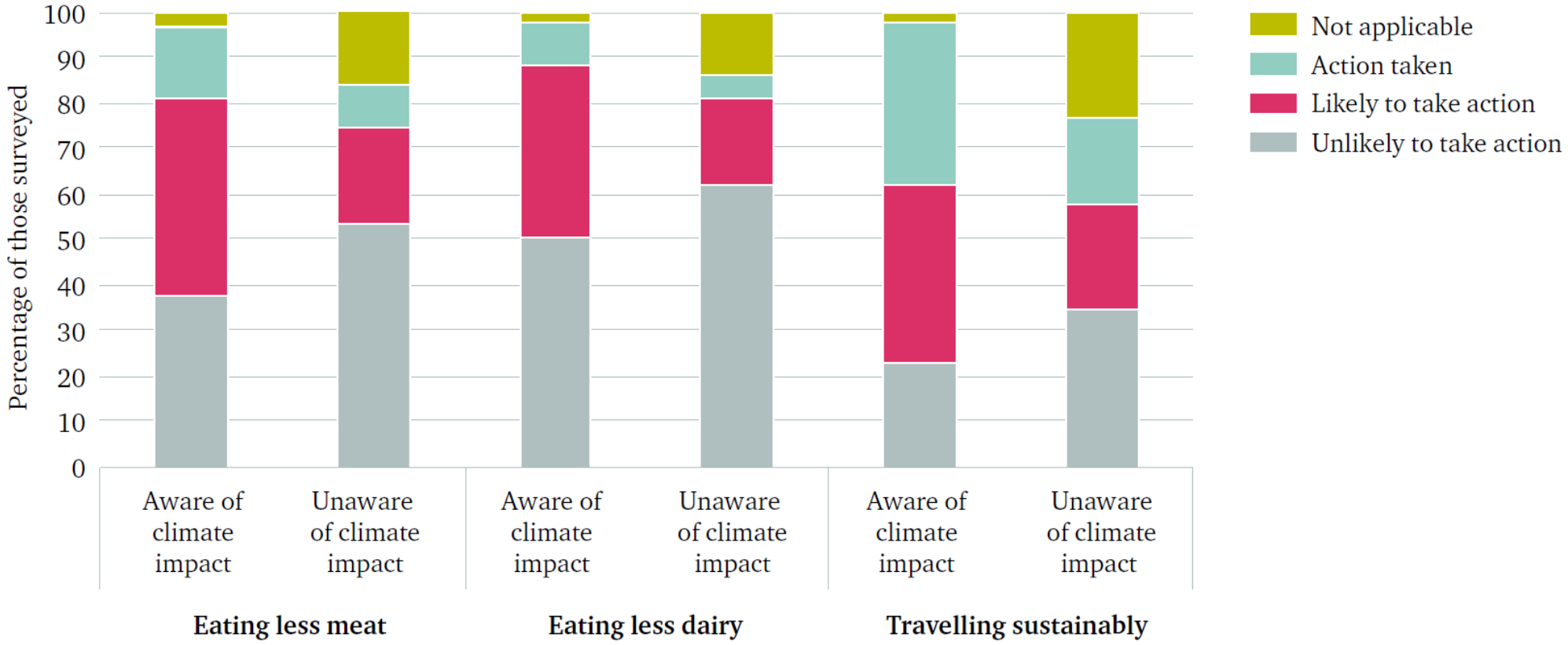
Source: Ipsos MORI/Chatham House (2014).



Ripple et al., 2014

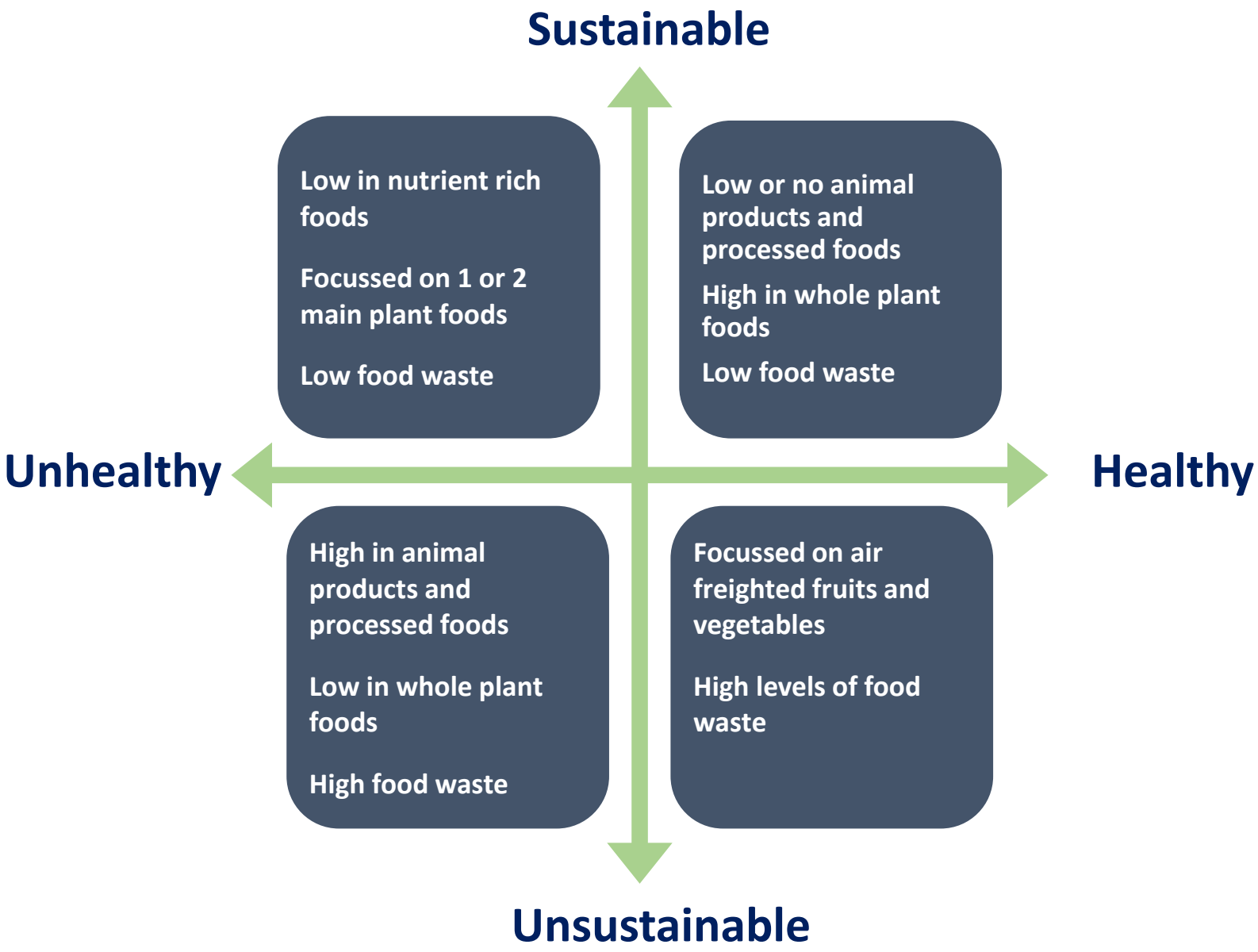
Higher level of awareness = higher likelihood of taking action

Figure 8: Comparison of the impact of awareness on willingness to take individual action on transport habits and on meat and dairy consumption

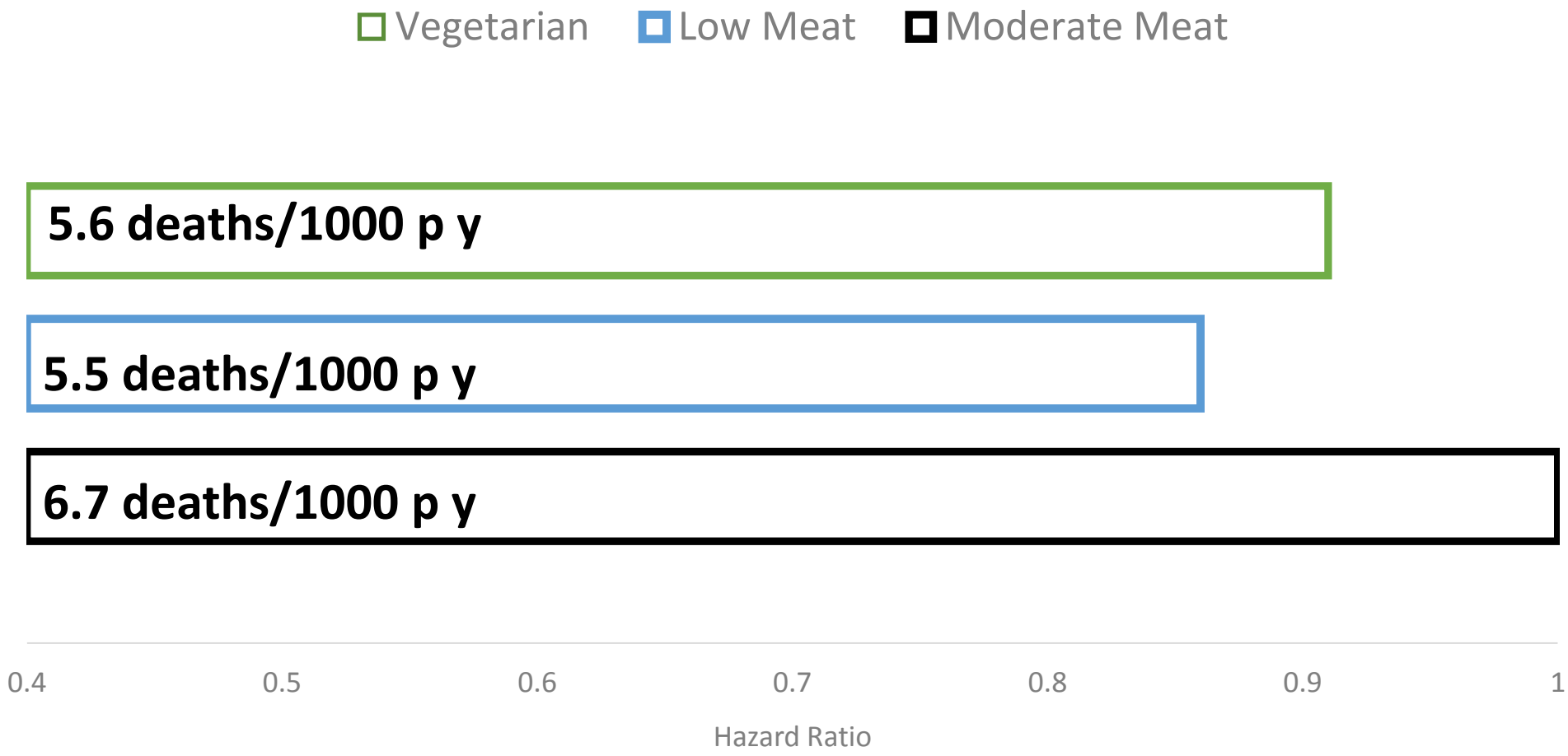


Source: Ipsos MORI/Chatham House (2014).

Health & Environment: Relationships



All Cause Mortality HRs by Dietary Pattern (Death Rate)



Soret et al., 2014

Conclusions

What we eat matters, a lot

Food production has a significant environmental ‘cost’

- Livestock uses the majority of agricultural land and water, and is a leading cause of climate change, chemical pollution, deforestation and biodiversity loss
- In exchange for <2% of global calorie provision!
- Increasing pressure from population and affluence growth…

To stay within Earth’s biophysical capacity