Health Protection & Health Behaviours: Agriculture & Health

Kristin Bash MPH FFPH

Public Health Consultant (Health & Wellbeing), OHID Yorkshire & Humber

Chair, Food Special Interest Group, Faculty of Public Health

Honorary Lecturer in Public Health and PhD Candidate, School of Health & Related Research, University of Sheffield

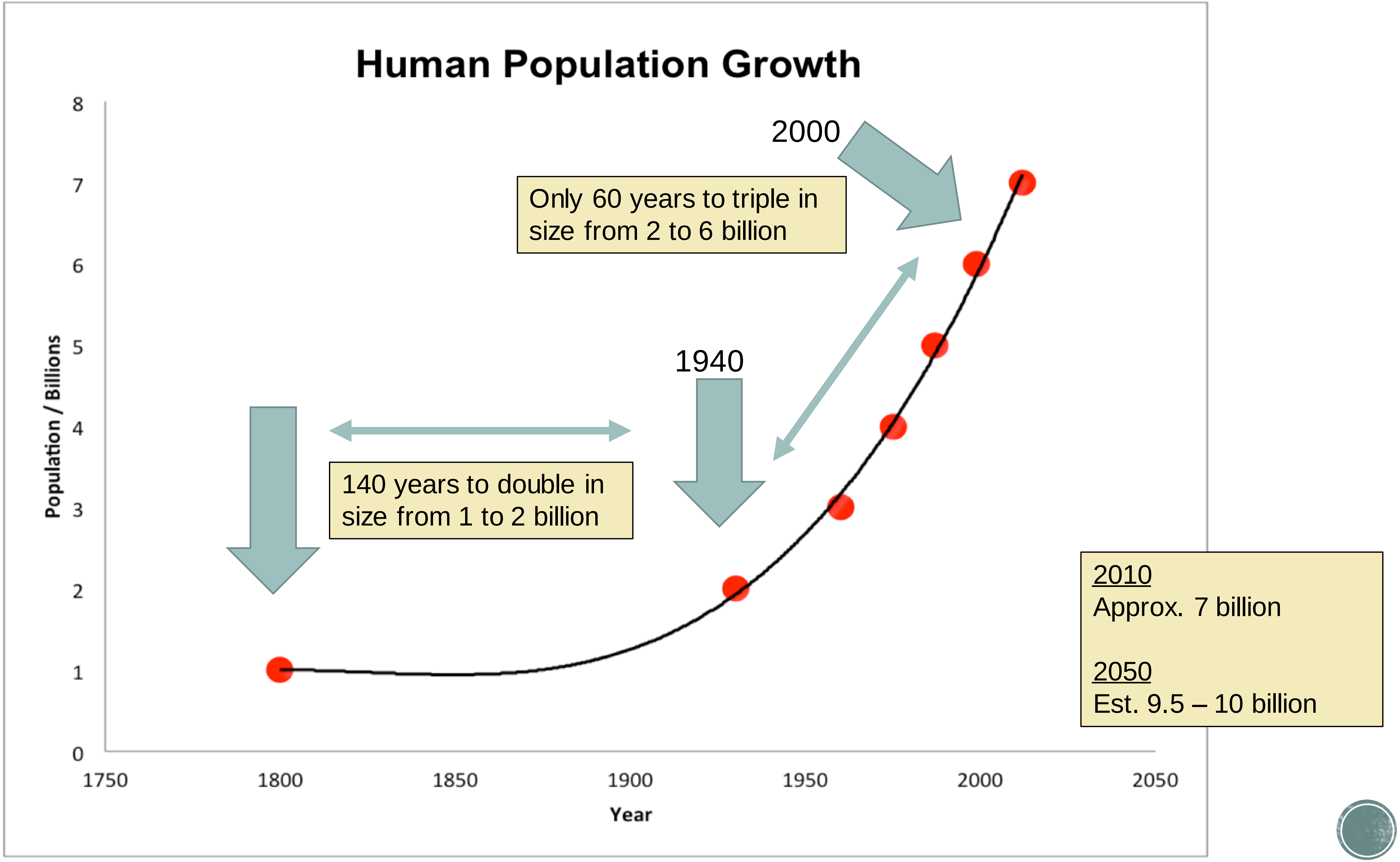
Today’s talk:

- Our food system – overview & sustainability
- What are the impacts on population health?
- Impacts outside of nutrition?
- Three key areas to cover
- What can we do about them?

Public health and food - what comes to mind?

- Nutrition – obesity, HFSS foods, Type 2 diabetes, CVD
- Food safety – food borne illness, safe handling and food hygiene

  - Food insecurity?
  - Environmental damage?
  - High use of non-renewable resources?
  - Other impacts on population health?


Human Population Growth
Population / Billions
0
1
2
3
4
5
6
7
8
1750
1800
1850
1900
1950
2000
2050
Year
2000
Only 60 years to triple in size from 2 to 6 billion
1940
140 years to double in size from 1 to 2 billion
2010
Approx. 7 billion
2050
Est. 9.5 – 10 billion

2011 Foresight Report – Outlined environmental impacts of global food system.

Concluded that without change, it will:

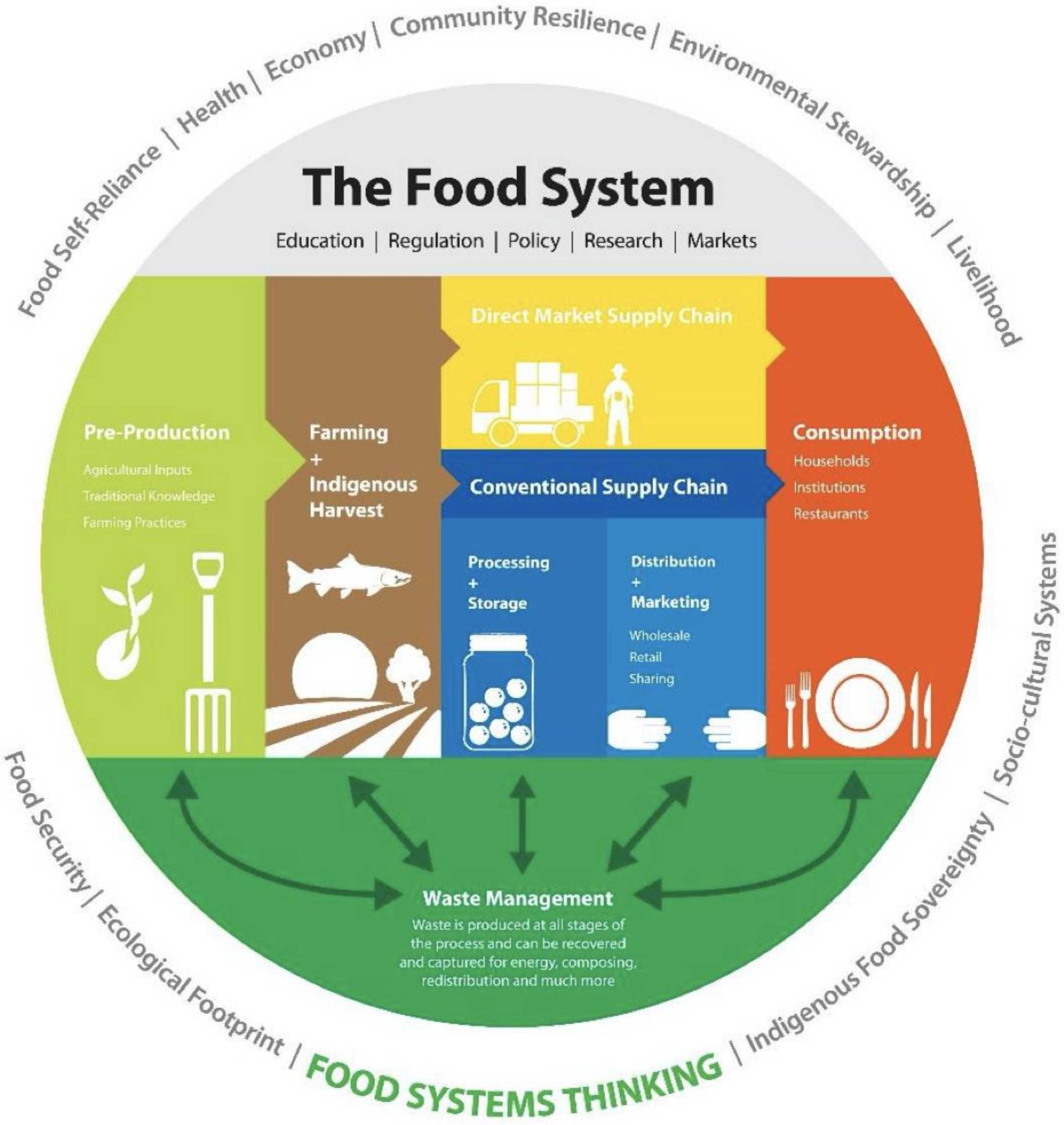
CONTINUE TO CONTRIBUTE TO CLIMATE CHANGE

CONTINUE TO DEGRADE THE ENVIRONMENT

CONTRIBUTE TO BIODIVERSITY DESTRUCTION

COMPROMISE THE WORLD'S CAPACITY TO PRODUCE FOOD IN THE FUTURE

Foresight (2011). The Future of Food and Farming, Executive Summary. London: The Government Office for Science (p.10)



SOURCE: SOUTHWEST BC BIO-REGION FOOD SYSTEM DESIGN PROJECT

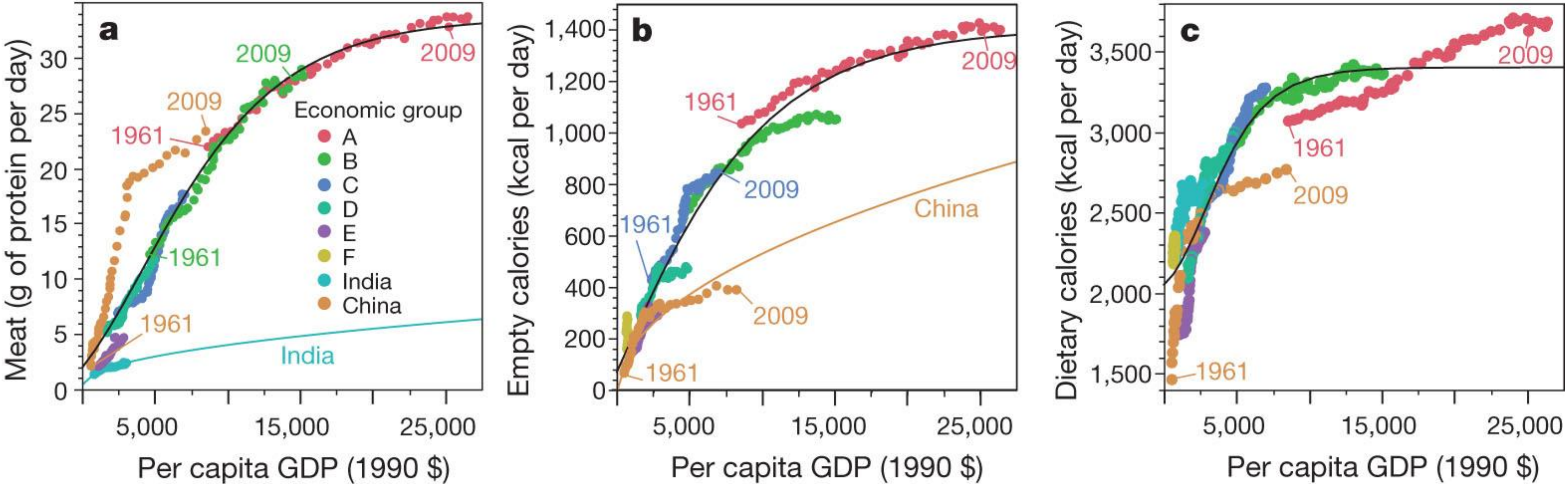
The food system

Circular relationships:

- Production & Environment
- Consumption & Production
- Consumption & Environment

DIETARY TRENDS & INCOME

Meat protein | **Refined sugars, animal fats, oils & alcohol** | **Calories**

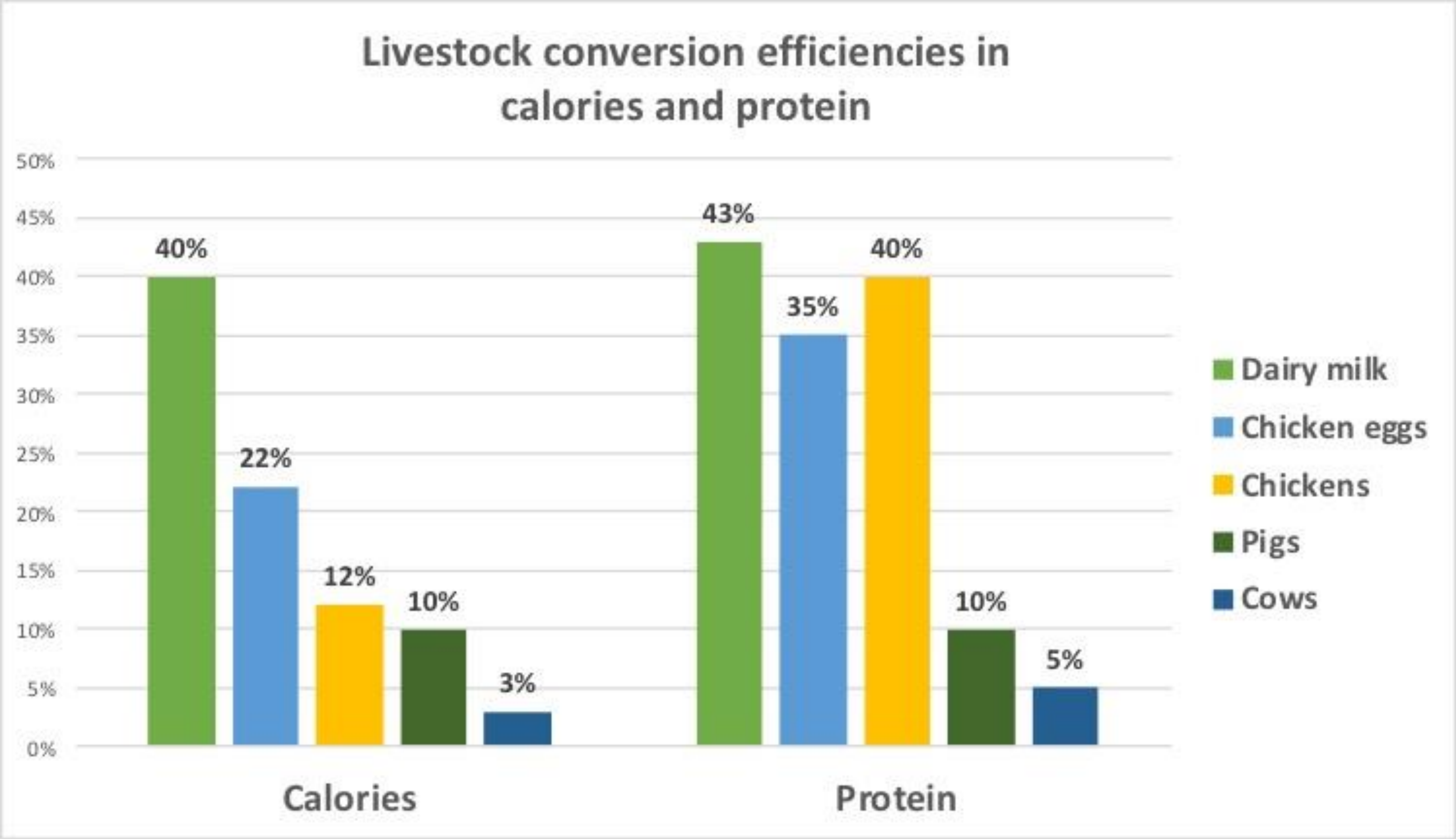


Dependence of per capita daily dietary demand for: **a**, meat protein; **b**, refined sugars+refined animal fats+oils+alcohol; and **c**, calories on per capita gross domestic product

D Tilman & M Clark *Nature* **000**, 1-5 (2014) doi:10.1038/nature13959

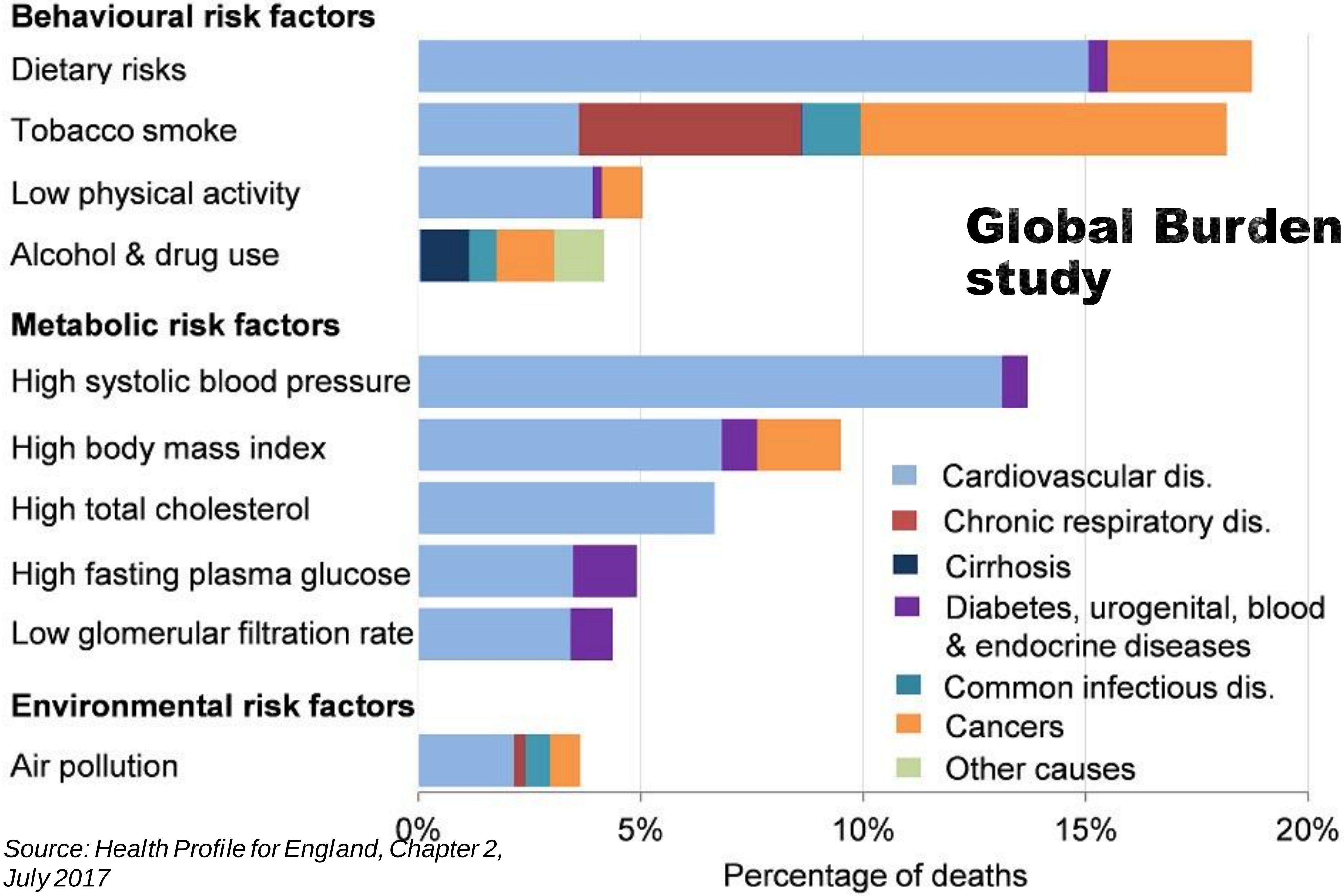
nature

So what?
(Or: Why is this a problem?)



Cassidy, E.M et al, 2013. Redefining agricultural yields: from tonnes to people nourished per hectare. University of Minnesota. Environ. Res. Lett. 8 (2013) 034015

Global Burden of Disease study



Source: Health Profile for England, Chapter 2, July 2017

Environmental Impacts

Breakout session 1

What are the impacts of agriculture on our health that are not related to nutrition?

What are the biggest risks?

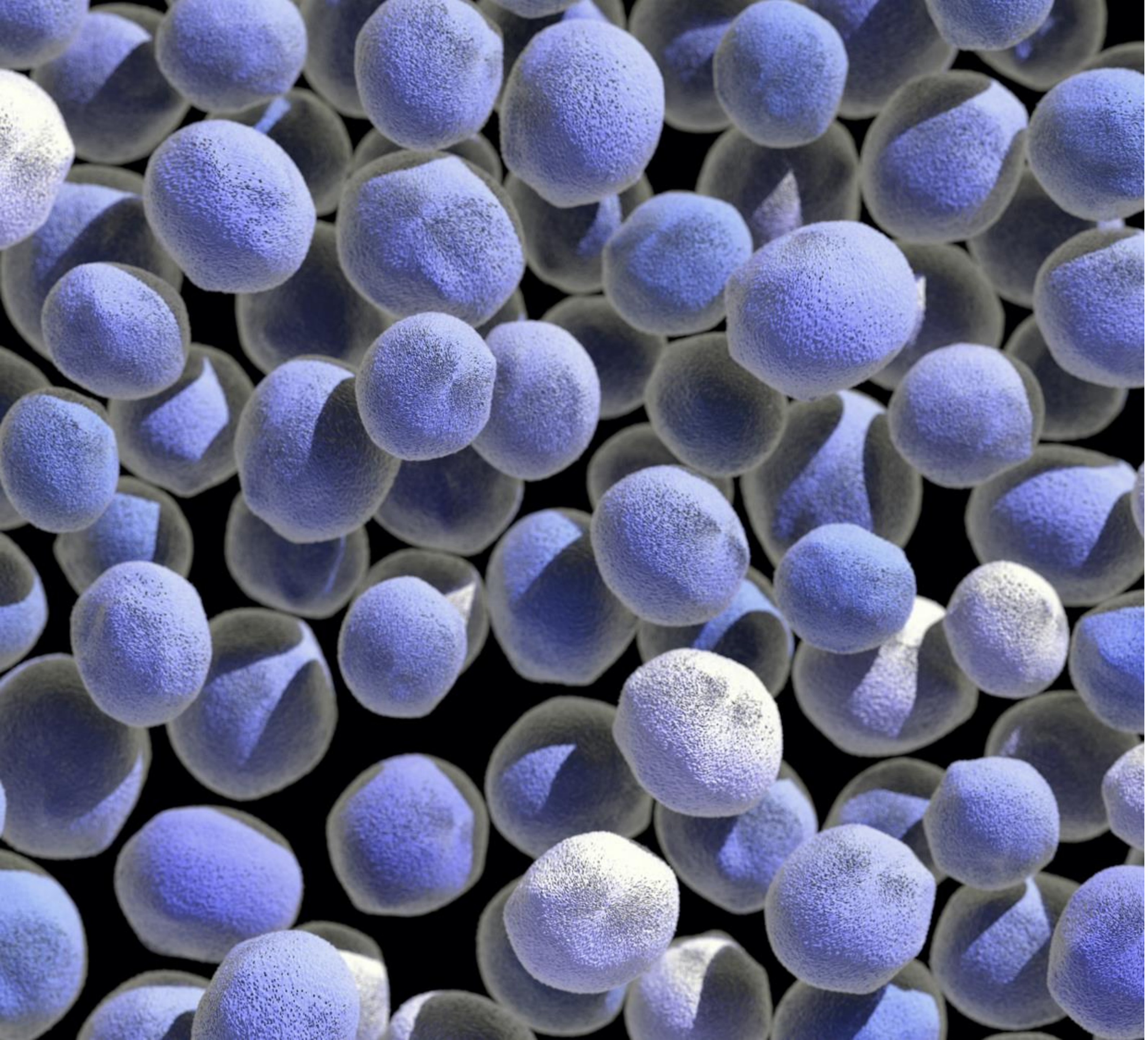
Locally? Globally?

What did we think?

What are the impacts of agriculture on our health?

What are the biggest risks? Locally? Globally?

AMR



Antimicrobial resistance (AMR)

‘As is now quite well known, we suggested that without policies to stop the worrying spread of AMR, today's already large 700,000 deaths every year would become an extremely disturbing 10 million every year, more people than currently die from cancer. ‘

Jim O’Neill, Forward to ‘Tackling Drug-Resistant Infections Globally: Final Report and Recommendations” May 2016

Antimicrobial Resistance (AMR)

Resistant pathogens of interest

- Campylobacter spp
- non-typhoidal Salmonella spp
- Escherichia coli
- livestock-associated methicillin-resistant Staphylococcus aureus (LA-MRSA).

Key antibiotics of interest – Critically Important Antibiotics (MIAs) (WHO classification)

- Colistin
- fluoroquinolones
- 3rd and 4th generation cephalosporins

Critically Important Antibiotics (CIAs)

- Essential to maintaining human health
- Defined in current regulation by the European Medicines Agency (EMA)
- Veterinary Medicines Directorate (VMD) recommend use only after positive diagnostic test indicates use is necessary
- 2016 – European Parliament voted to restrict or ban veterinary use of CIAs – not yet ratified

ANTIMICROBIAL USE & LIVESTOCK

Worldwide, approximately 73% of current antibiotic production is used in agriculture, most of which is to promote growth and prevent disease. (van Boekel et al 2019)

Reliance on antimicrobials in intensive livestock farming is a significant contributor to the emergence of antimicrobial-resistant bacteria that affect human health. (WHO, 2012)

A Scientific Opinion by the European Food Safety Authority (EFSA) concludes that it is "**of high priority to decrease the total antimicrobial use in animal production in the EU**". (EFSA, 2011)

Antibiotic use in Livestock

Treat disease

Prevent disease
(Prophylaxis and Metaphylaxis)

Growth promotion

Growth promotion in livestock animals

Antibiotics mediate growth enhancement

Sub-clinical levels added to feed

Affects the gut microbiota – density & diversity

- Optimizes nutrient utilization
- Reduces energy waste
- Increases growth in animal.

Banned in EU countries since 2006

ECONOMIC IMPACT – 2015 ANALYSIS BY US DEPARTMENT OF AGRICULTURE (USDA)

- Production costs estimated 2% higher when antibiotics not used for either growth promotion or prophylaxis disease prevention
- Increased growth = less time to feed broiler chickens
- Each 1% reduction in feed use worth $27.5 million for integrators

https://www.ers.usda.gov/amber-waves/2015/november/restrictions-on-antibiotic-use-for-production-purposes-in-us-livestock-industries-likely-to-have-small-effects-on-prices-and-quantities/

Aquaculture

Raised stressors on fish

Sanitation - high population densities, crowding of farming sites, lack of sanitary barriers or ability to isolate infected fish

Increased AMR in environment and in fish pathogens – leading to use of more/different antibiotics

Aquaculture products (e.g. fish, shellfish, and shrimp) at retail can carry bacteria that are resistant to medically important antimicrobials

FAO/WHO 2018

Caballo, 2006; Rohr et al. 2019

Citrus Greening & Streptomycin Oxytetracycline

- **Citrus greening** - caused by the bacterium Candidatus Liberibacter asiaticus
- Devastated Florida's citrus industry – **estimated 90% of state's citrus trees are infected**
- **"The level of desperation is high,"** says Rick Dantzler, chief operating officer of Florida's Citrus Research and Development Foundation (CRDF) in Lake Alfred.

Does this matter to human health?

ARBs of animal origin can be transmitted to humans through various mechanisms, including:

- the environment (Graham et al 2009)
- food products (Price et al., 2005)
- agricultural workers by direct contact (Smith et al., 2013)

Is antimicrobial administration to food animals a direct threat to human health? A rapid systematic review (Scott et al., 2018)

- Out of 93 studies identified - 89 studies showed (3 directly, 86 indirectly) limiting antimicrobials given to animals reduces antimicrobial resistance in animals.

- 4 studies indicated (1 directly, 3 indirectly) withdrawing antimicrobials in food animals results in decreased antimicrobial resistance in humans.

- Authors' conclusions:
    - Limiting antimicrobial use in food animals reduces antimicrobial resistance in food animals
    - Also probably reduces antimicrobial resistance in humans.
    - The magnitude of the effect cannot be quantified.

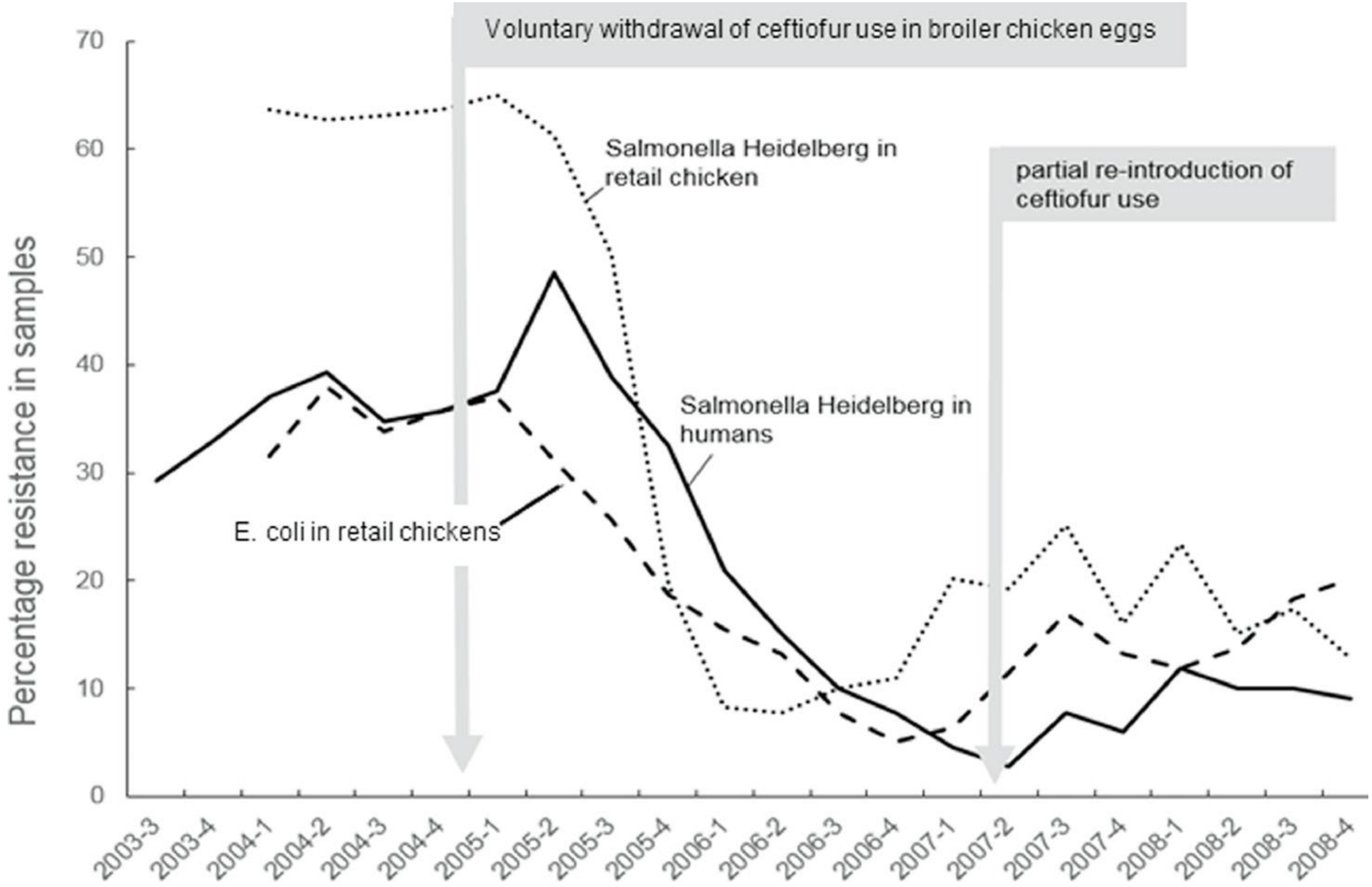
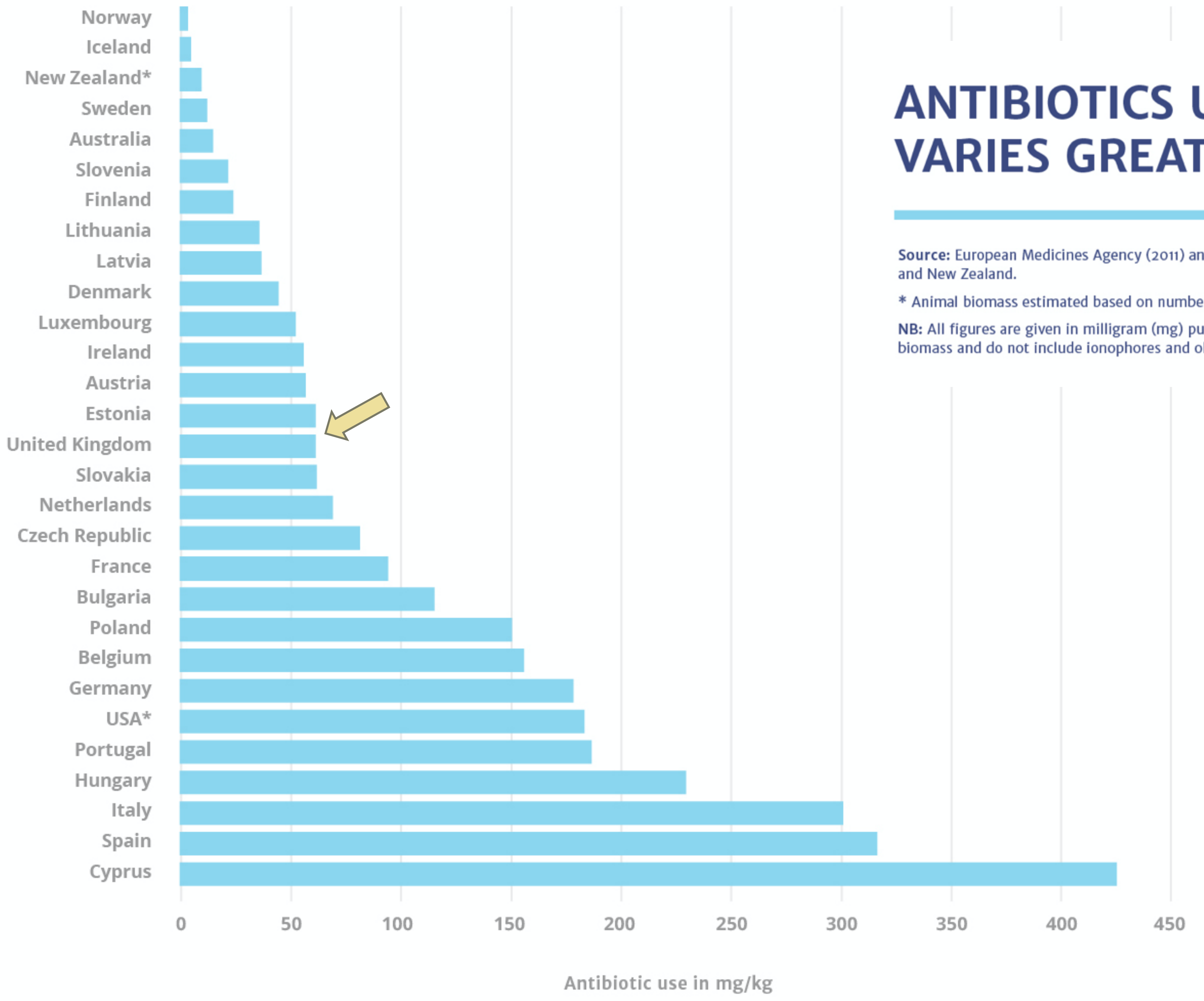


Fig. A.3. Resistance to ceftiofur over time in Quebec, Canada (Scott et al., 2018 - redrawn from data in Dutil 2010 [15])



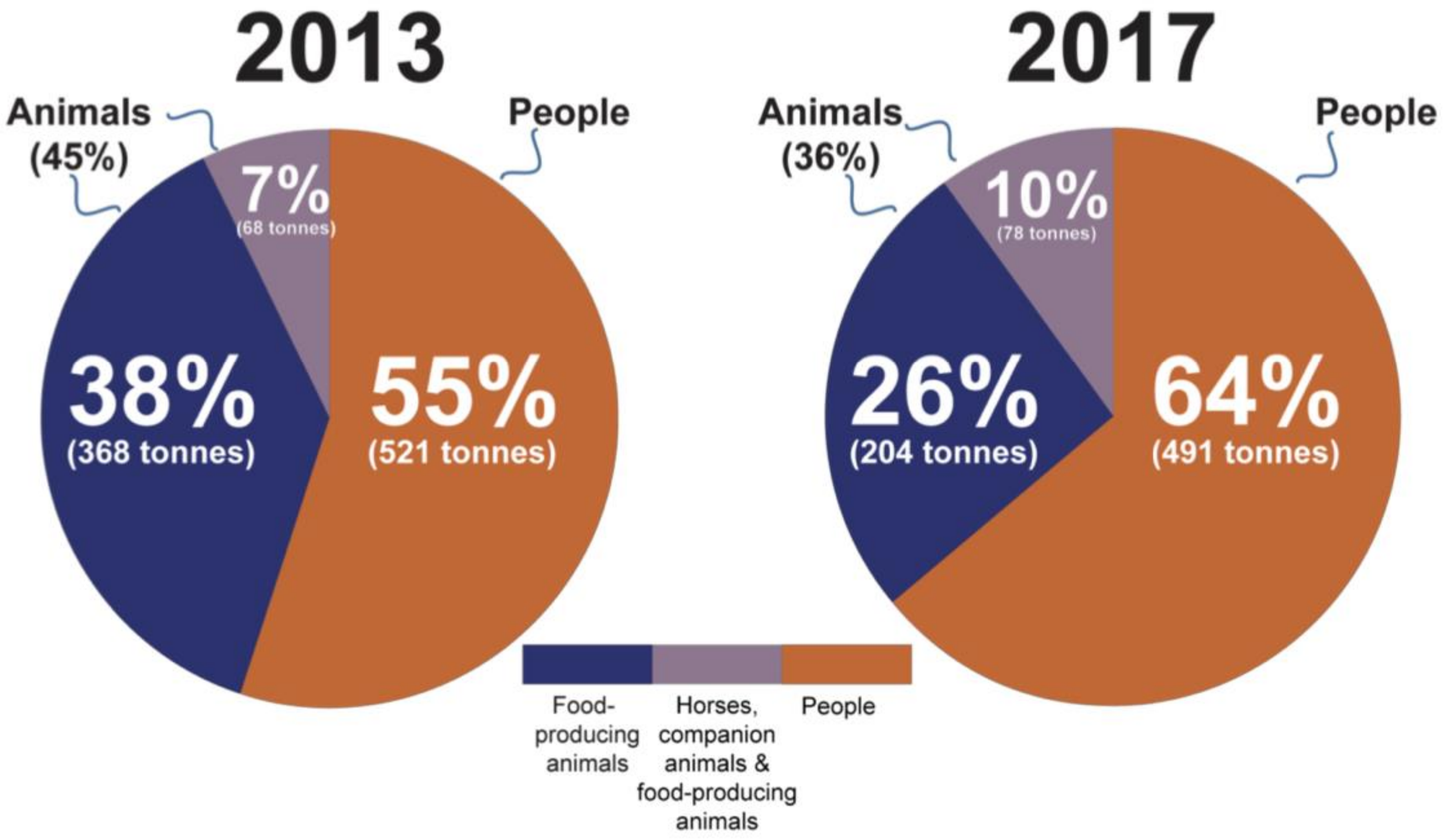
ANTIBIOTICS USE IN AGRICULTURE VARIES GREATLY BY COUNTRY

Source: European Medicines Agency (2011) and the national governments of the US, Australia and New Zealand.

* Animal biomass estimated based on number of animals.

NB: All figures are given in milligram (mg) purchased for every kilogram (kg) of livestock biomass and do not include ionophores and oligosaccharides.

Review on Antimicrobial Resistance



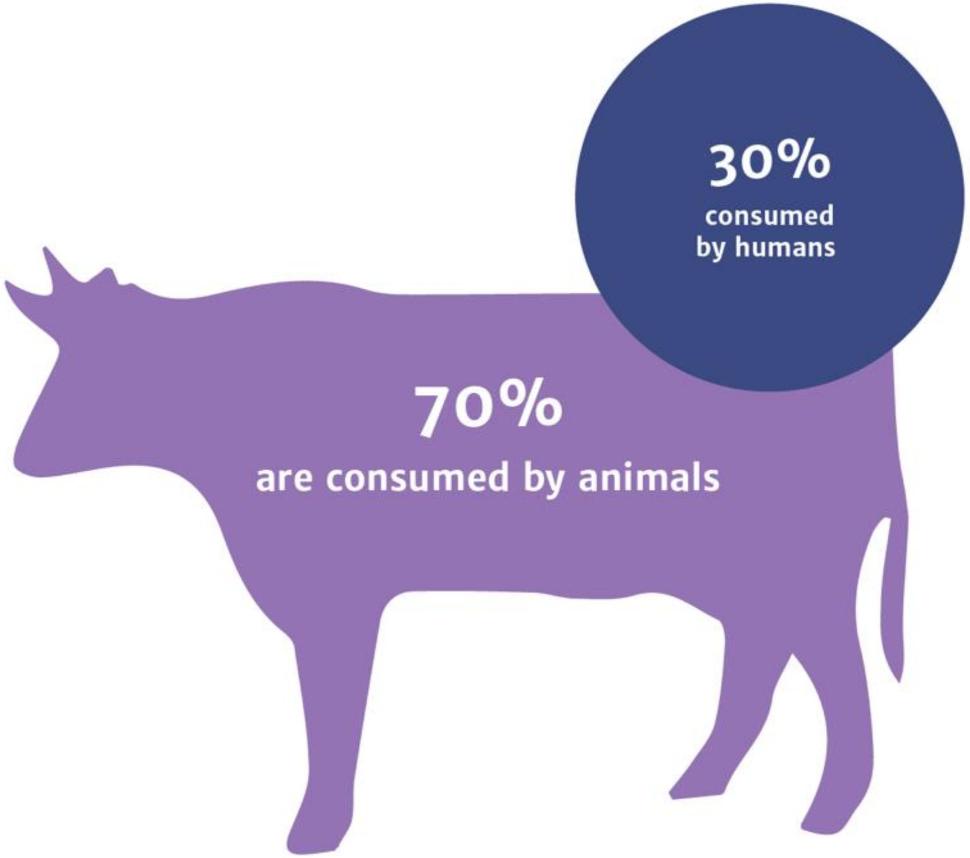
Veterinary Medicines Directorate (2019). UK One Health Report – Joint report on antibiotic use and antibiotic resistance, 2013-2017. New Haw, Addlestone: Veterinary Medicines Directorate, p.3

UK Reductions in total tonnes between 2013 and 2017

In the UK reductions in farm antibiotic use have been achieved in recent years, Directorate 2019)

As one example, a 2010/11 survey undertaken by the Department for Environmental and Rural Affairs (DEFRA) found 85% of non-organic dairy farms in the UK used routine antibiotic therapy during the non-lactating phase (Brunton et al, 2012).

ANIMALS IN THE USA CONSUME MORE THAN TWICE AS MANY MEDICALLY IMPORTANT ANTIBIOTICS AS HUMANS

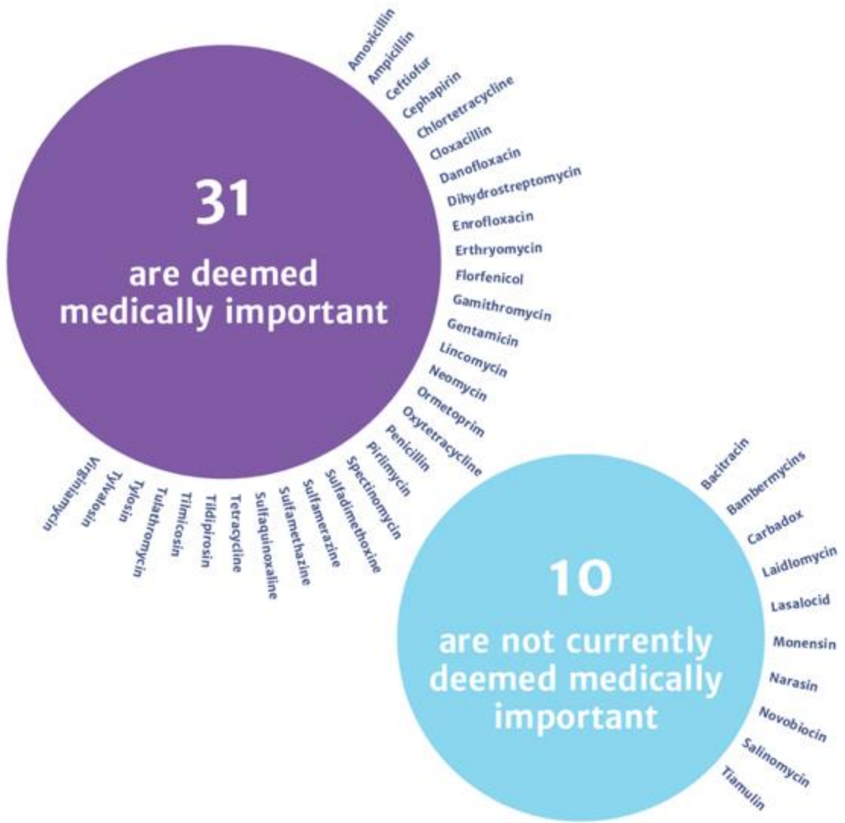


Source: Animal consumption figure of 8,893,103kg from FDA, 2012. Human consumption of 3,379,226kg in 2012 based on calculations by IMS Health. The figures are rounded from 72.5% used in animals and 27.5% used in humans.

Review on Antimicrobial Resistance

MOST ANTIBIOTICS USED IN ANIMALS ARE MEDICALLY IMPORTANT FOR HUMANS

Of the 41 antibiotics* that are approved for used in food producing animals by the FDA, 31 are categorised as being medically important for human use.

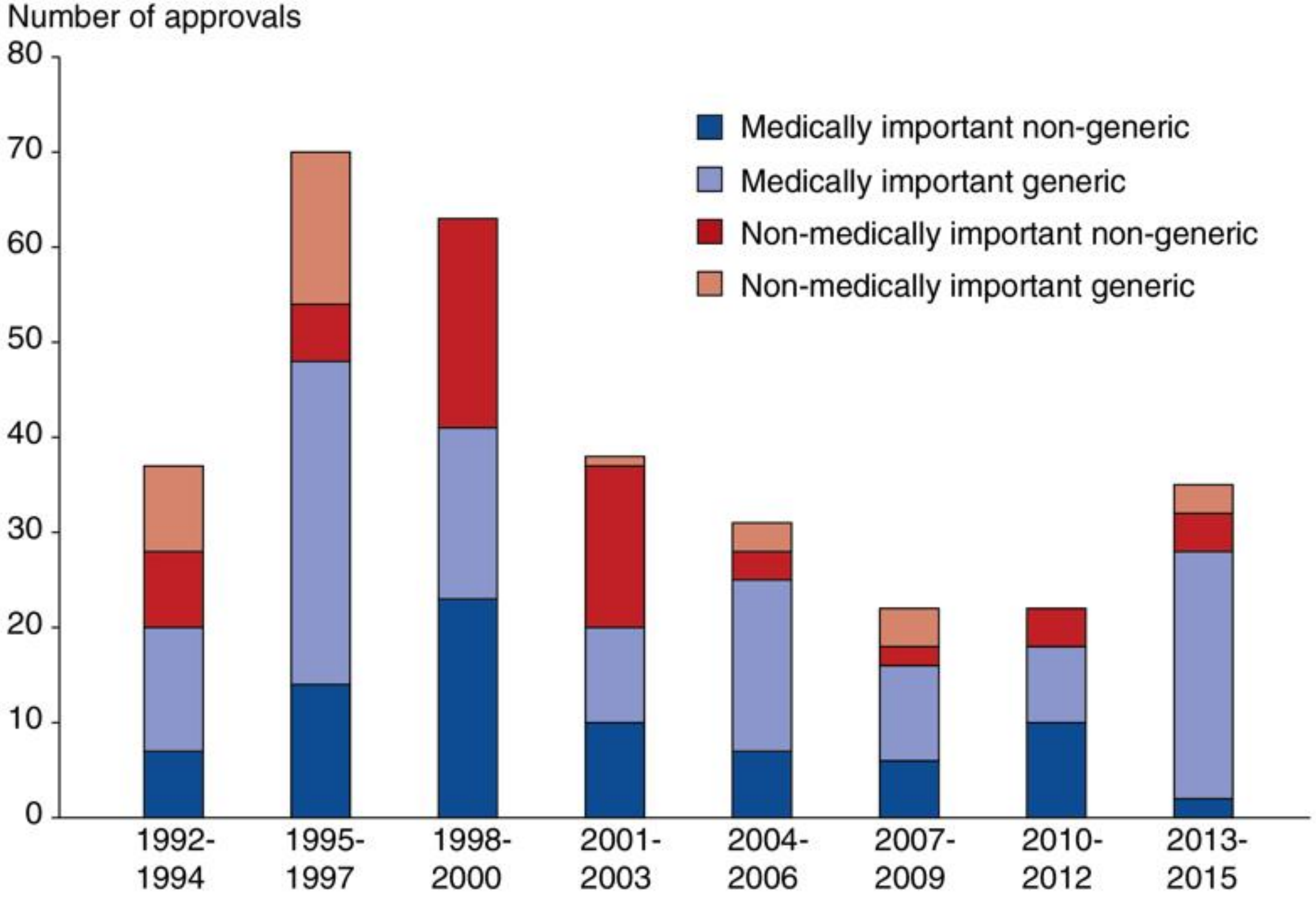


Source: FDA, 2012 Summary report on Antimicrobials sold or distributed for use in Food-producing animals.

* Includes ionophores

Review on Antimicrobial Resistance

Between 1992 and 2015, most new antibiotic approvals for use in food animals have been generic drugs that are also used in human medicine



Note: Medically important antibiotics are those important for human-disease treatment.
Source: USDA, Economic Research Service analysis of Food and Drug Administration Center for Veterinary Medicine Green Book (FDA-CVM Green Book) reports of animal pharmaceutical product approvals.

Breakout Session 2

How can we reduce use of antimicrobials in agriculture?

What would be the most effective?

What level is acceptable?

5-minute comfort break

What did we think?

How can we reduce use of antimicrobials in agriculture?

What would be the most effective?

What level is acceptable?

Agriculture sector

To prevent and control the spread of antibiotic resistance, the agriculture sector can:

- Only give antibiotics to animals under veterinary supervision.
- Not use antibiotics for growth promotion or to prevent diseases in healthy animals.
- Vaccinate animals to reduce the need for antibiotics and use alternatives to antibiotics when available.
- Promote and apply good practices at all steps of production and processing of foods from animal and plant sources.
- Improve biosecurity on farms and prevent infections through improved hygiene and animal welfare.

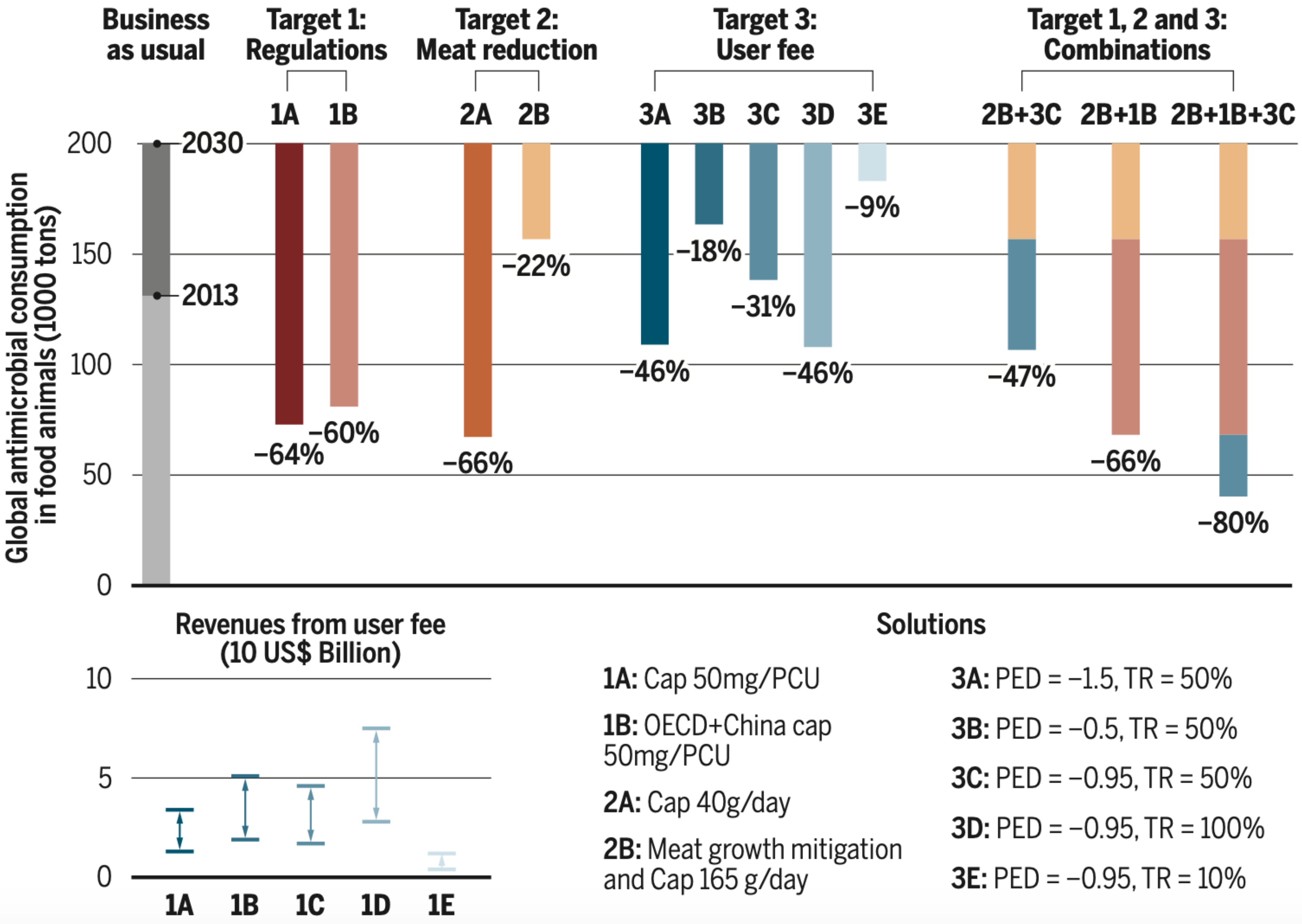
WHO Guidance

WHO Antibiotic Resistance Fact Sheet (2020)

https://www.who.int/en/news-room/fact-sheets/detail/antibiotic-resistance

Antimicrobial consumption in food animals by 2030

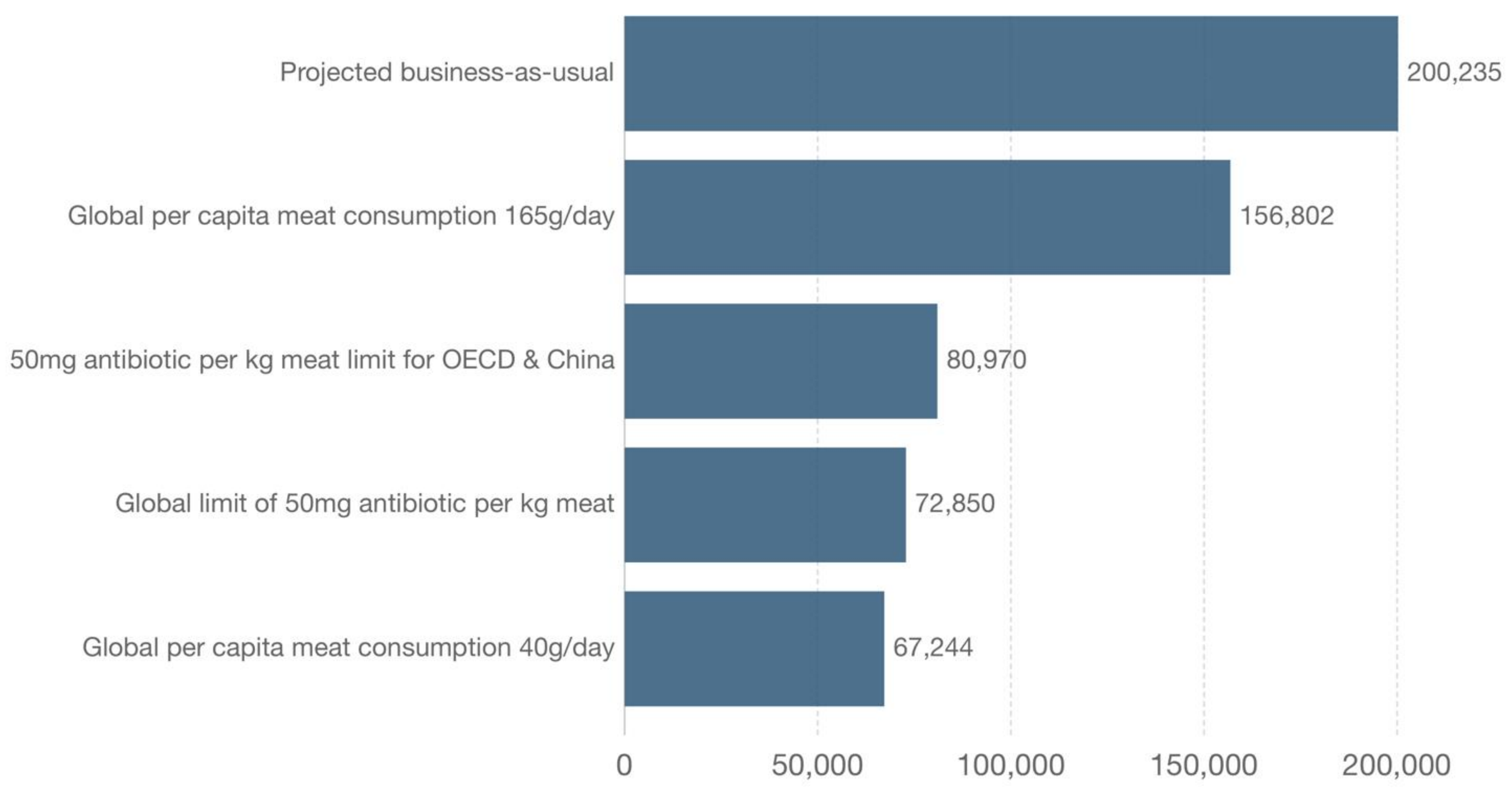
Business as usual and intervention policies are shown. Revenue ranges are estimated for different fee rates (TR) and price elasticities of demand (PED). For 3C, 3D, and 3E, PEDs are derived from time series of imports of veterinary antimicrobials in each country (Protocol S4); the global average PED was -0.95. See supplementary materials for discussions of uncertainty in all estimates shown in figures. PCU, population correction unit.



(Van Boeckel et al., 2017)

Global antibiotic use in livestock under reduction scenarios, 2030

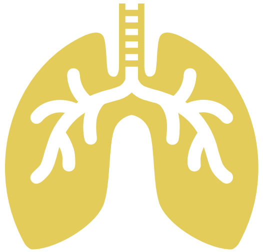
Projected global antibiotic use in livestock under expected meat consumption levels in 2030, and a range of modeled reduction scenarios based on antibiotic use limits, reductions in meat consumption, and a fee on antibiotic sales. Further details on each scenario are given in the sources tab. Global antibiotic use is measured in tonnes per year.



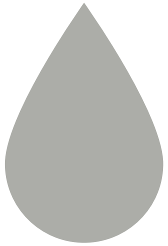
Source: Van Boeckel, T. P., Glennon, E. E., Chen, D., Gilbert, M., Robinson, T. P., Grenfell, B. T.,Laxminarayan, R. (2017). Reducing antimicrobial use in food animals. Science, 357, 1350-1352.

Nitrogen

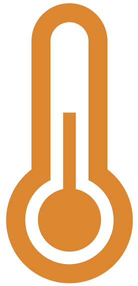
How does nitrogen impact on population health?



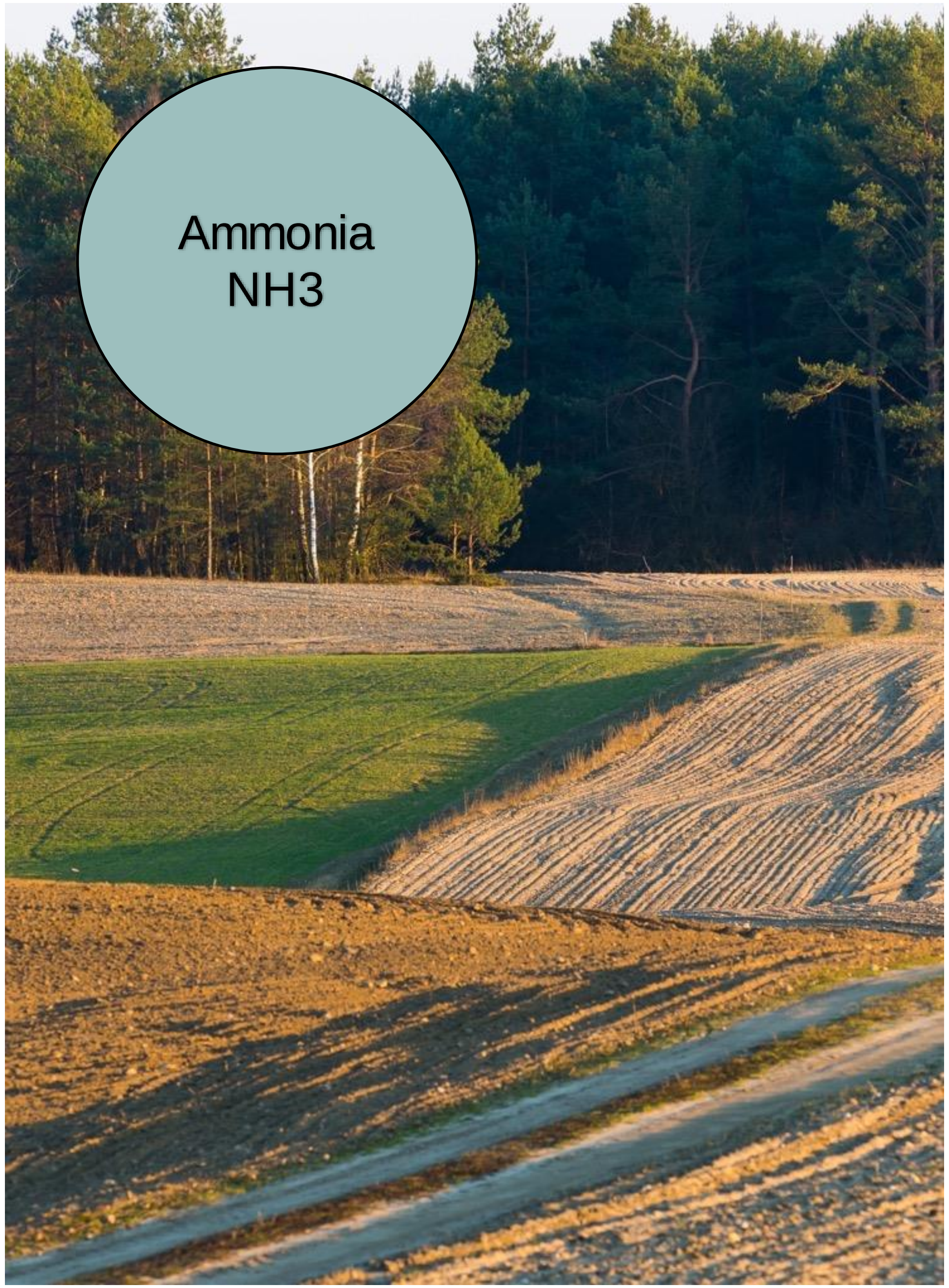
Air Quality



Water Quality



Climate



Nitrogen and Air Pollution

Deaths attributable to ambient air pollution, 2016

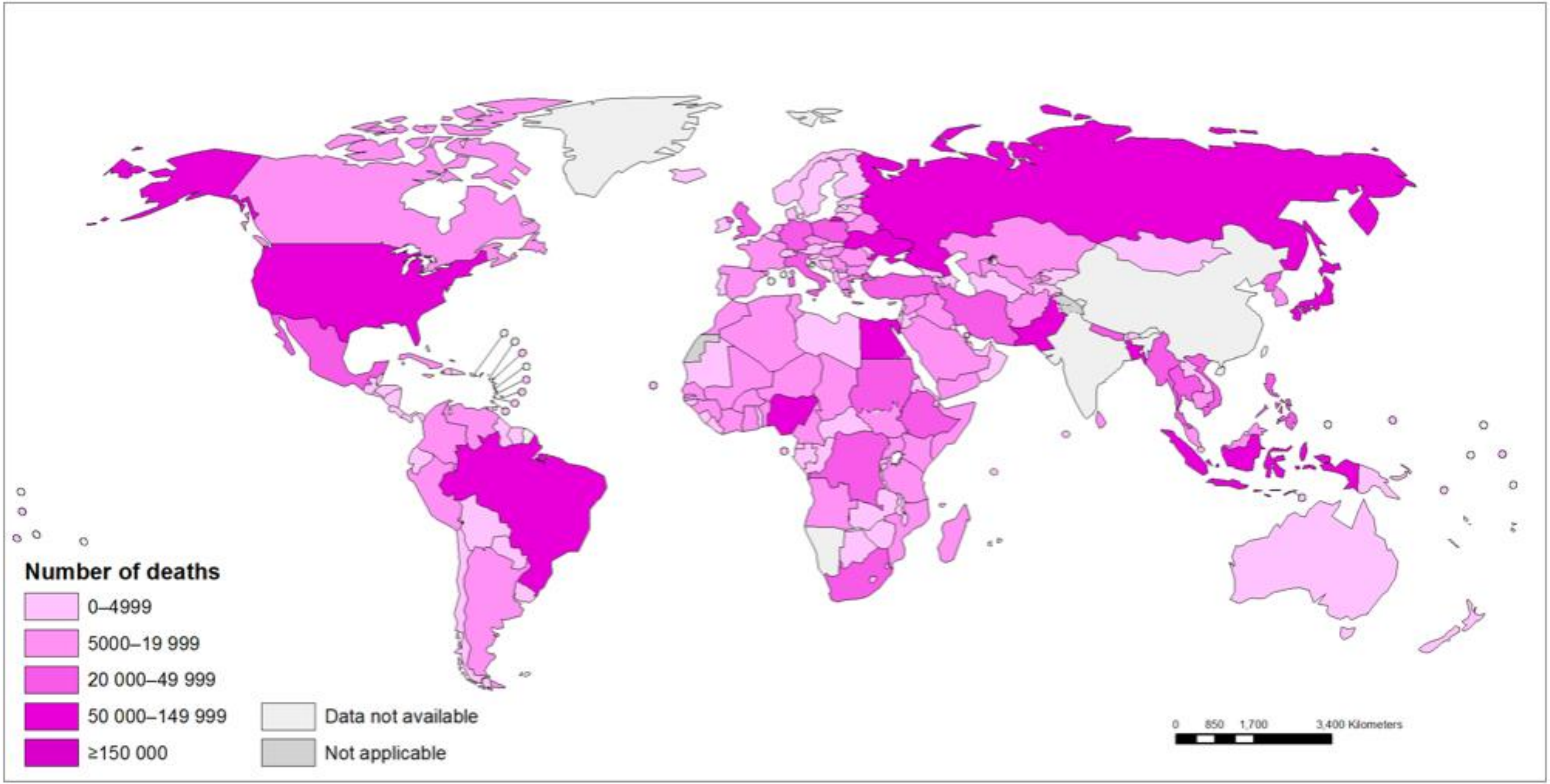
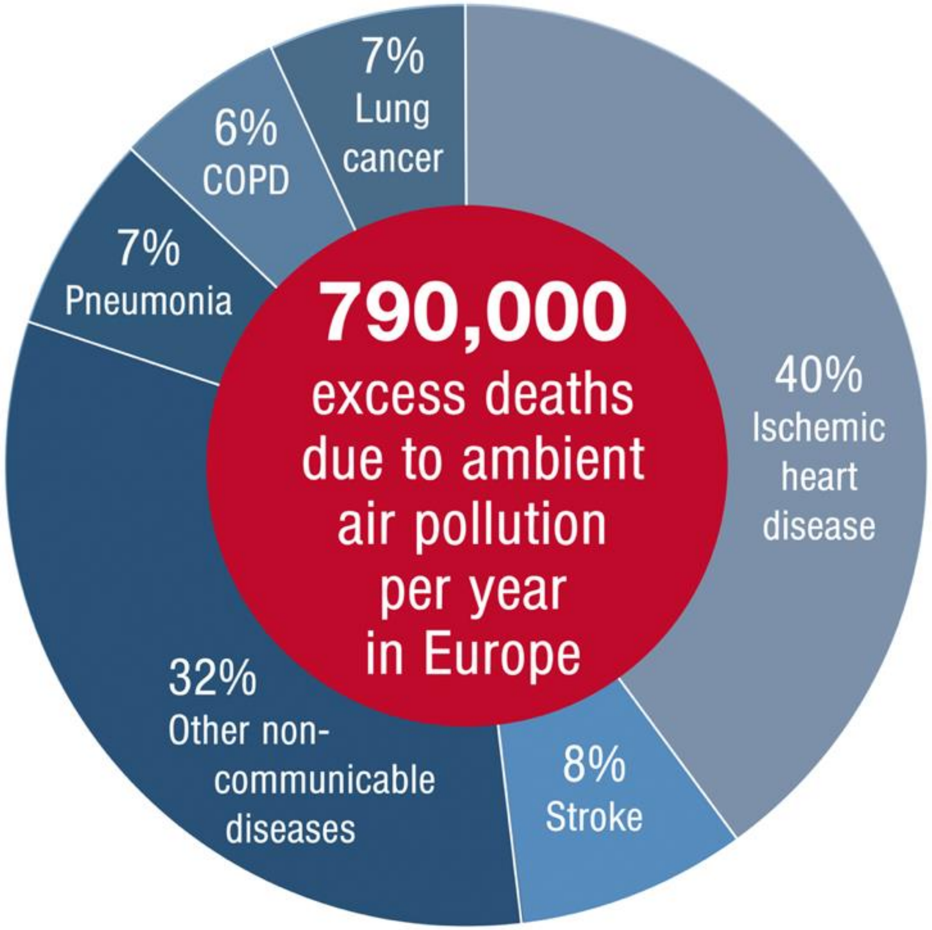


Figure 4 Estimated excess mortality attributed to air pollution in Europe, and the contributing disease categories. At ...



Eur Heart J, Volume 40, Issue 20, 21 May 2019, Pages 1590–1596, https://doi.org/10.1093/eurheartj/ehz135

Air pollution affects people throughout their lifetime

Pregnancy

low birth weight

Children

asthma

slower development of lung function

development problems

more wheezing and coughs

start of atherosclerosis

Adults

asthma

coronary heart disease

stroke

lung cancer

chronic obstructive pulmonary disease (as chronic bronchitis)

diabetes

Elderly

asthma

accelerated decline lung function

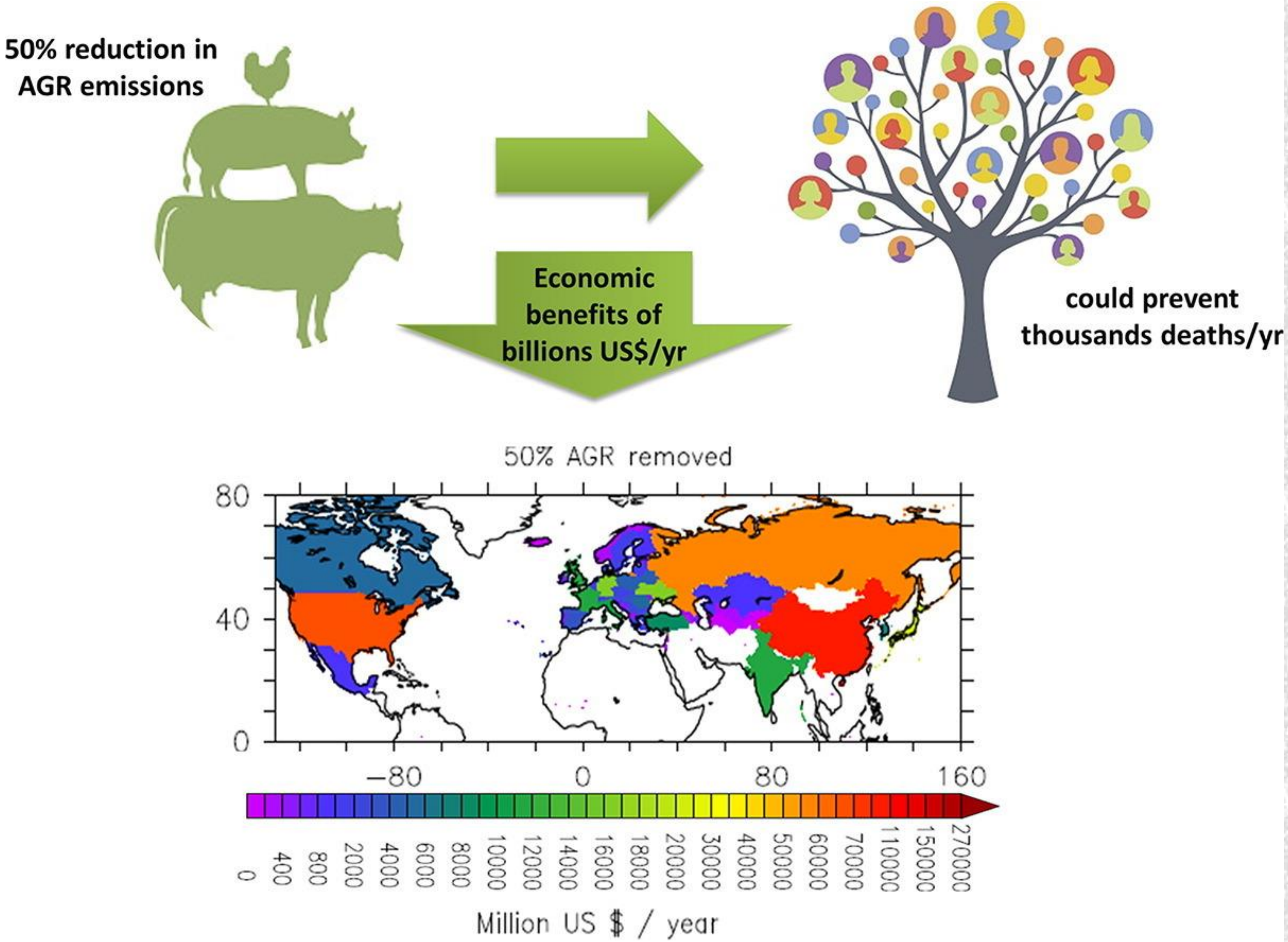
lung cancer

diabetes

dementia

heart attack, heart failure and strokes

Air Pollution – a local issue?



Agriculture impact - UK

Modelling estimates for UK of a 50% reduction in agricultural emissions

- 21% reduction in mortality attributed to $PM_{2.5}$ (approximately 3,300 fewer deaths annually)
- 22% reduction in associated costs (approximately US$11.8 million reduced annual spend)

(Giannadaki et al., 2018; Pozzer et al.,2017)

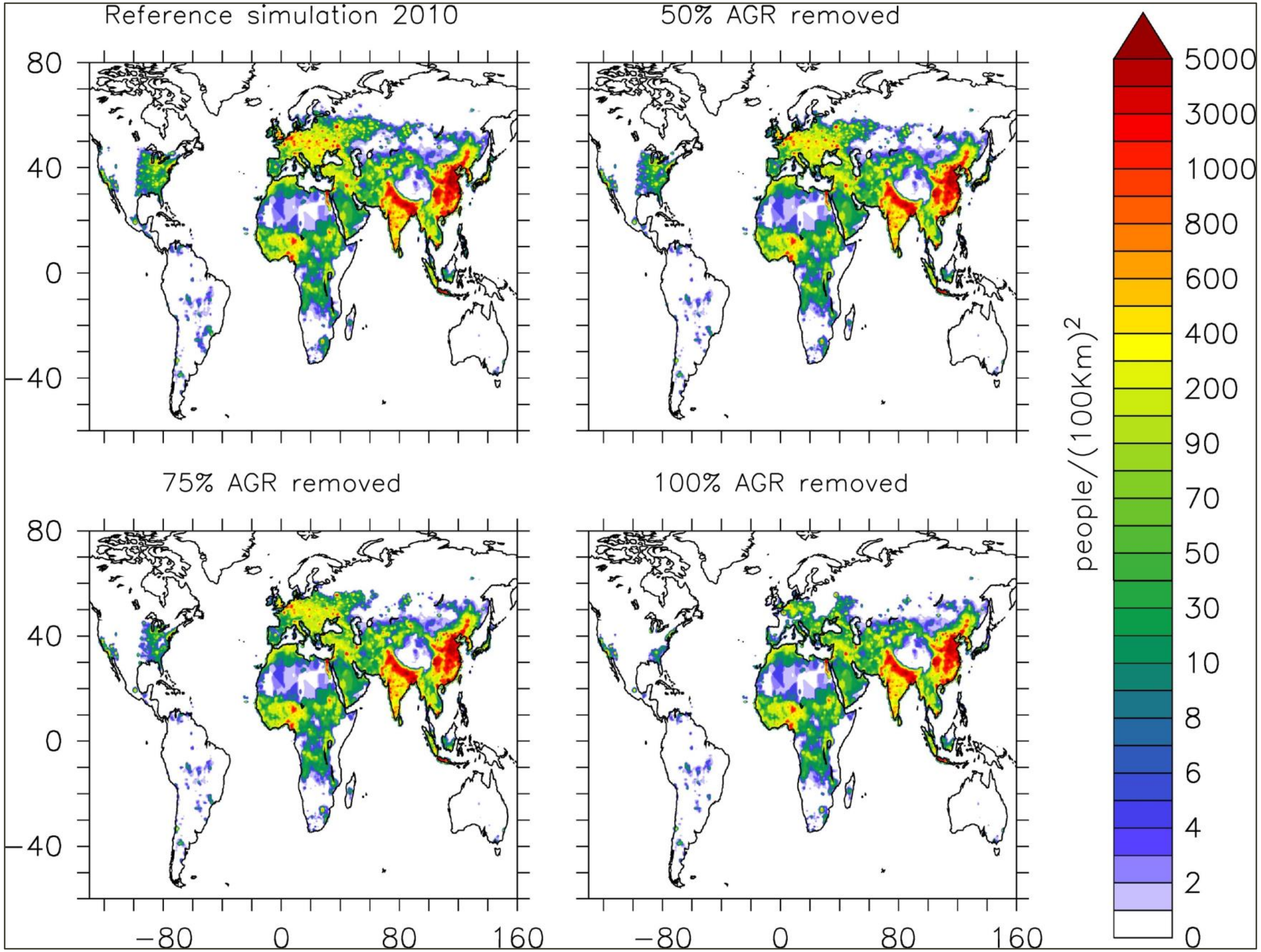


Fig. 1. PM2.5 related mortality (in deaths/area of 100 × 100 km2) for the year 2010 (top left, reference case) and the three sensitivity scenarios.

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Article | Published: 16 December 2021

Dietary shifts can reduce premature deaths related to particulate matter pollution in China

Xueying Liu, Amos P. K. Tai, Youfan Chen, Lin Zhang, Gavin Shaddick, Xiaoyu Yan & Hon-Ming Lam

Nature Food **2**, 997–1004 (2021) | Cite this article

A Publisher Correction to this article was published on 07 January 2022

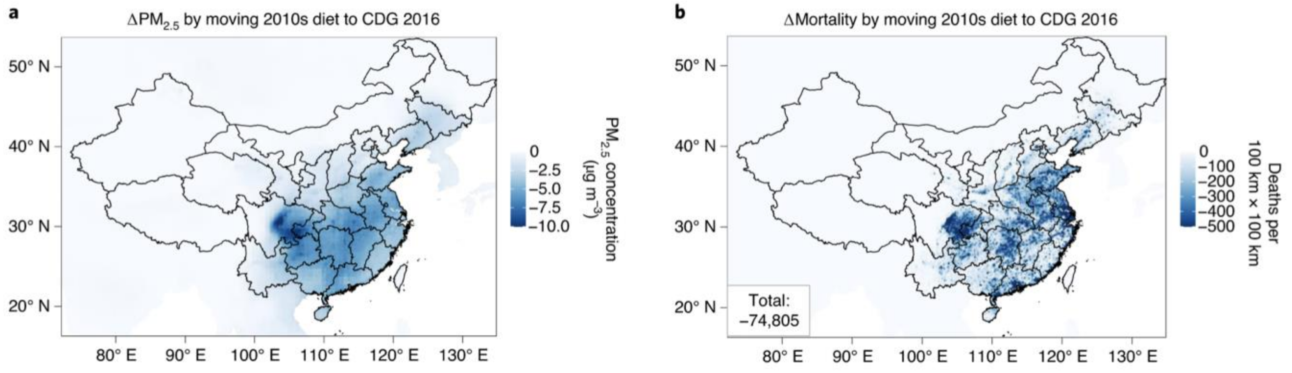
This article has been updated

Abstract

Shifting towards more meat-intensive diets may have indirect health consequences through environmental degradation. Here we examine how trends in dietary patterns in

Fig. 5: Environmental and indirect health benefits of less meat-intensive diets.

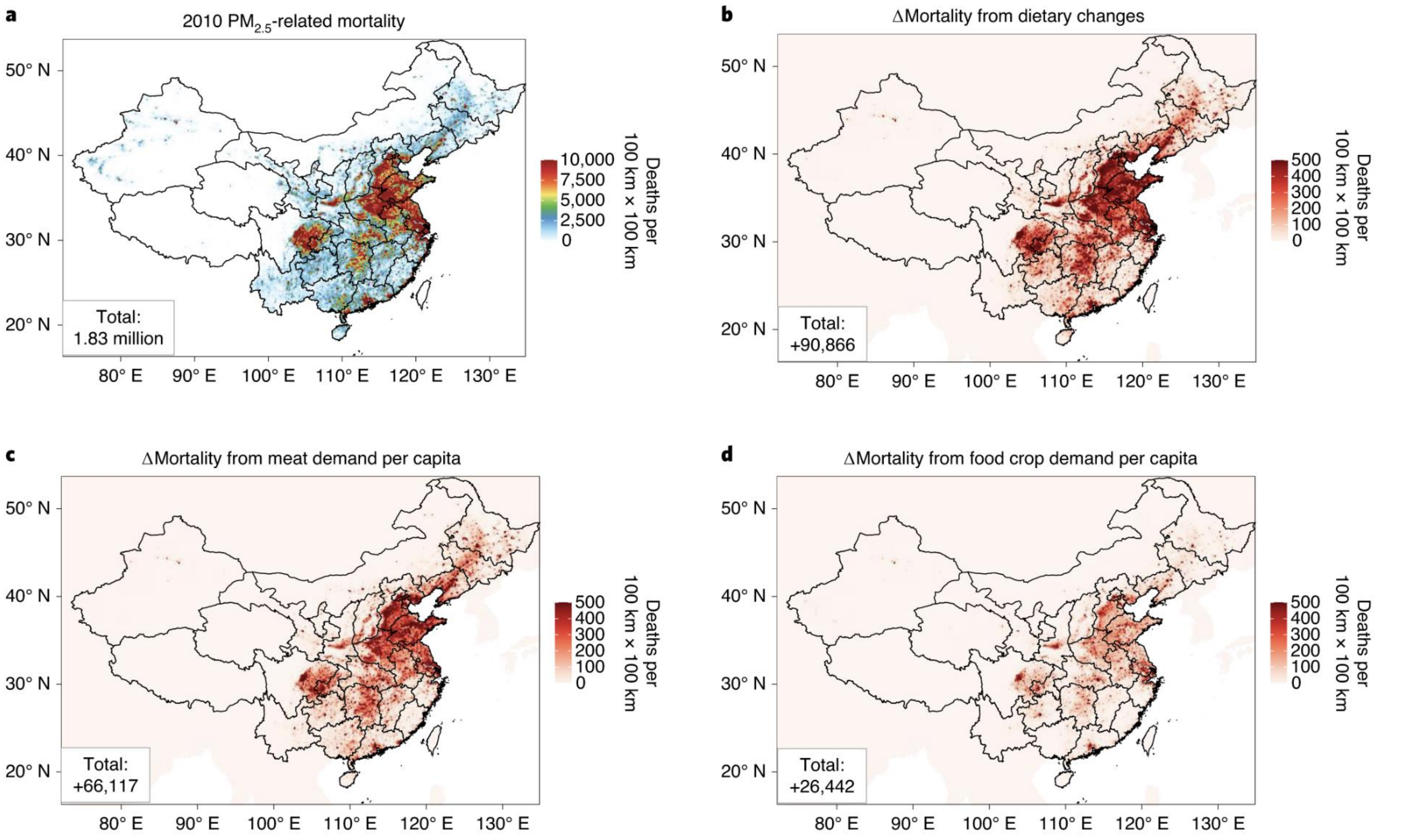
From: Dietary shifts can reduce premature deaths related to particulate matter pollution in China



a,**b**, Potential benefits of moving from the current 2010s diet to the healthier, less meat-intensive direct recommended by CDG 2016 in terms of changes in annual mean $PM_{2.5}$ concentrations (**a**) and $PM_{2.5}$-related premature mortalities (**b**). These plots correspond to [HEAL–2010] in Methods.

Fig. 4: Indirect health cost of dietary changes related to $PM_{2.5}$ pollution.

From: Dietary shifts can reduce premature deaths related to particulate matter pollution in China



a, Chinese $PM_{2.5}$-related premature mortalities in 2010. **b**–**d**, The portions of those mortalities that could be attributable to 1980–2010 changes in dietary pattern as a whole (**b**), demand for meat (including animal feed crops) (**c**) and demand for food crops for direct human consumption (**d**). These plots correspond to [2010] (**a**), [2010–POP] (**b**), [MEAT–POP] (**c**) and [CROP–POP] (**d**) in Methods.

Water & Nitrogen

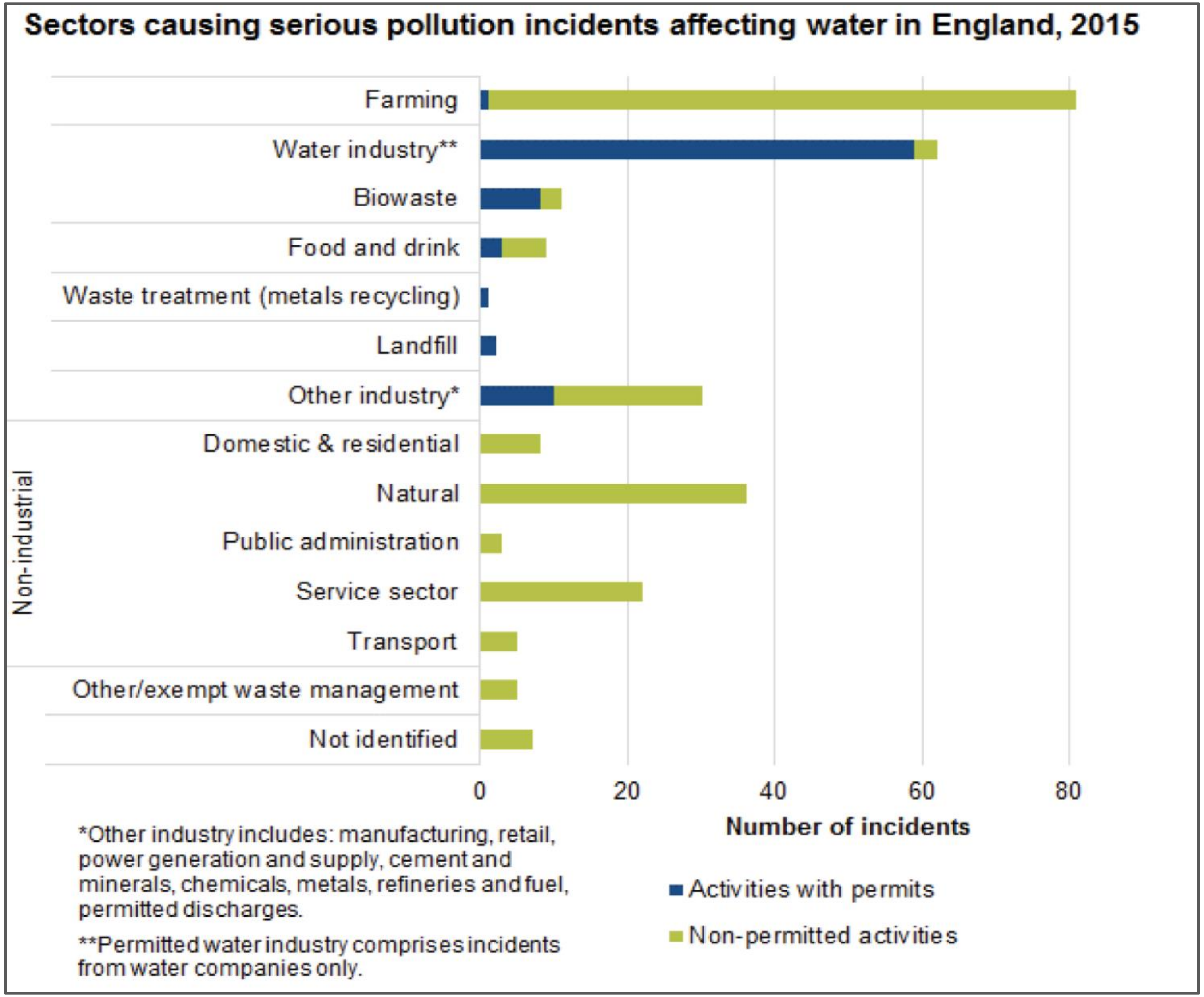
Drinking Water and Excess Nitrogen and Human Health

- Blue Baby Syndrome

- Pregnancy risks – increased risk of miscarriage
- Low functioning thyroid – iodine blocking effects
- Some evidence of association with certain cancers – but this may be due to interaction with other compoputs?

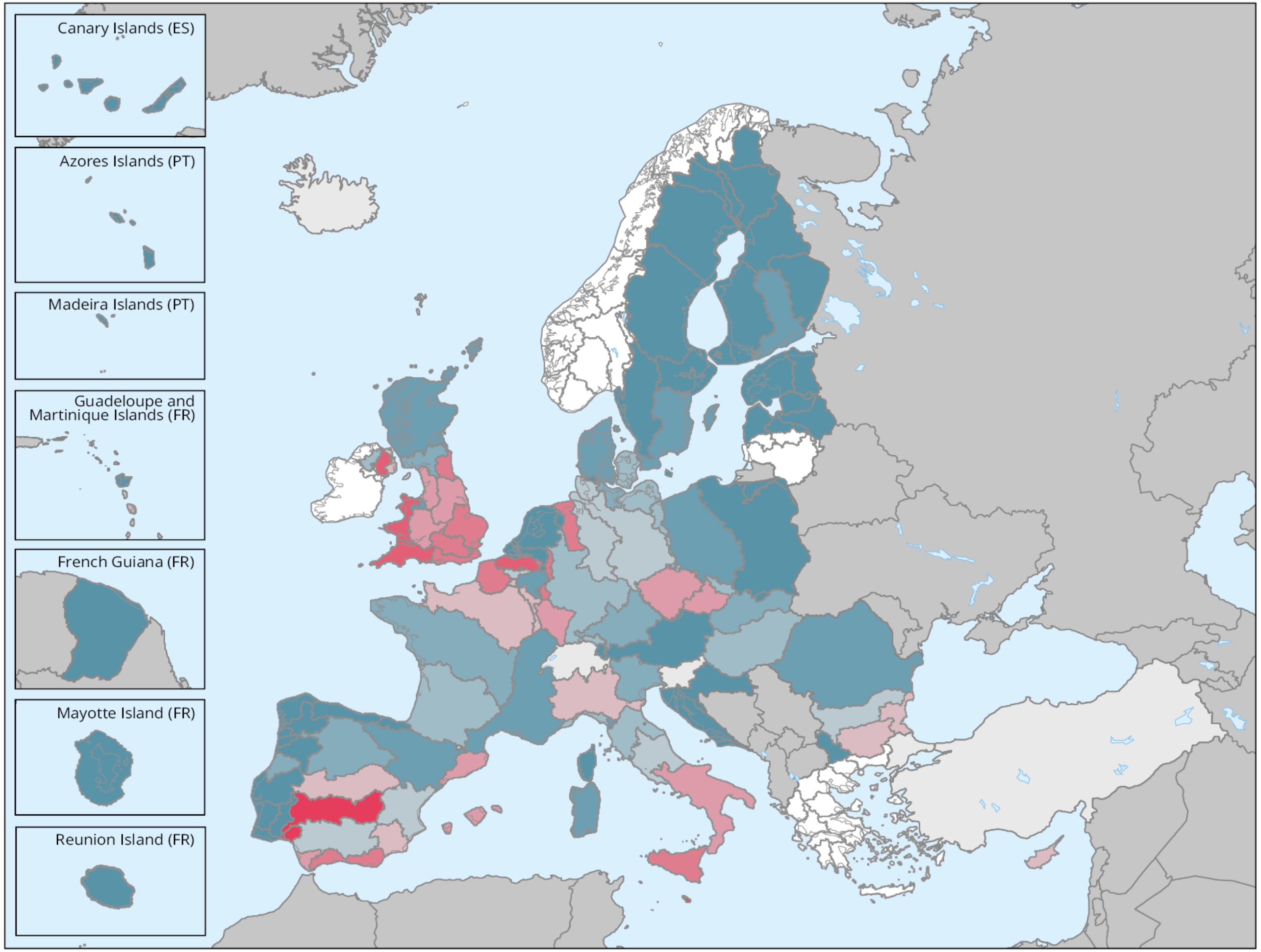
- Other more minor issues:
  - Gastric problems
  - Headache
  - Fatigue

Serious water pollution incidents - UK



https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/656/65605.htm

Map 4.1 **River basin groundwater chemical status**



Percentage of area of groundwater bodies not in good chemical status per river basin district (RBD) in second RBMPs

0% 100% RBD areas without data No data Outside coverage

Groundwater report 2017 UK Parliament

Groundwater – supply nearly 1/3 drinking water in UK

Nitrates - main cause for groundwater not reaching good chemical status

High levels of nitrate pollution in some groundwater sources in UK

Nitrate levels in groundwater not expected to peak for another 60 years

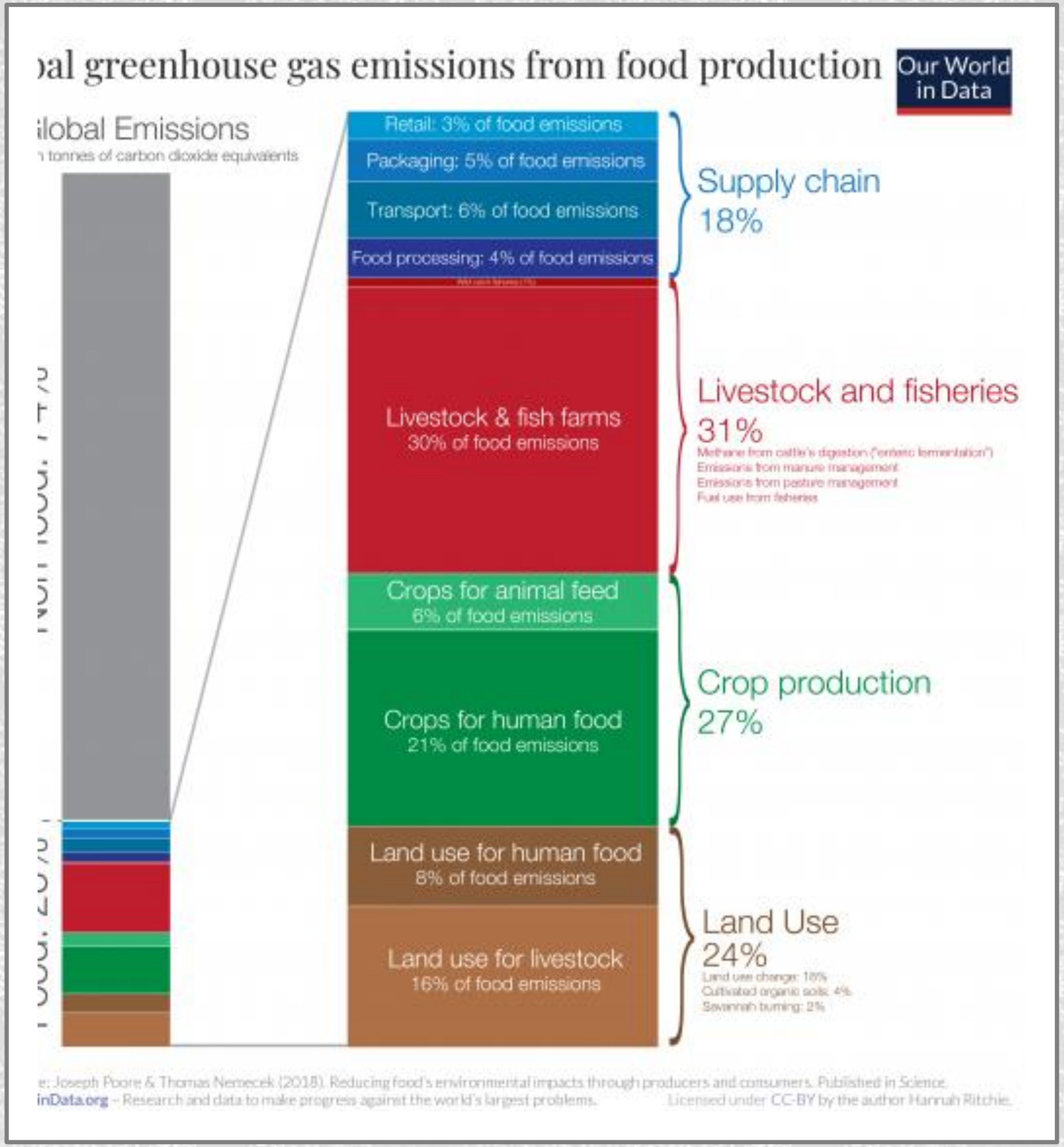
Drinking Water and Excess Nitrogen and Financial Cost

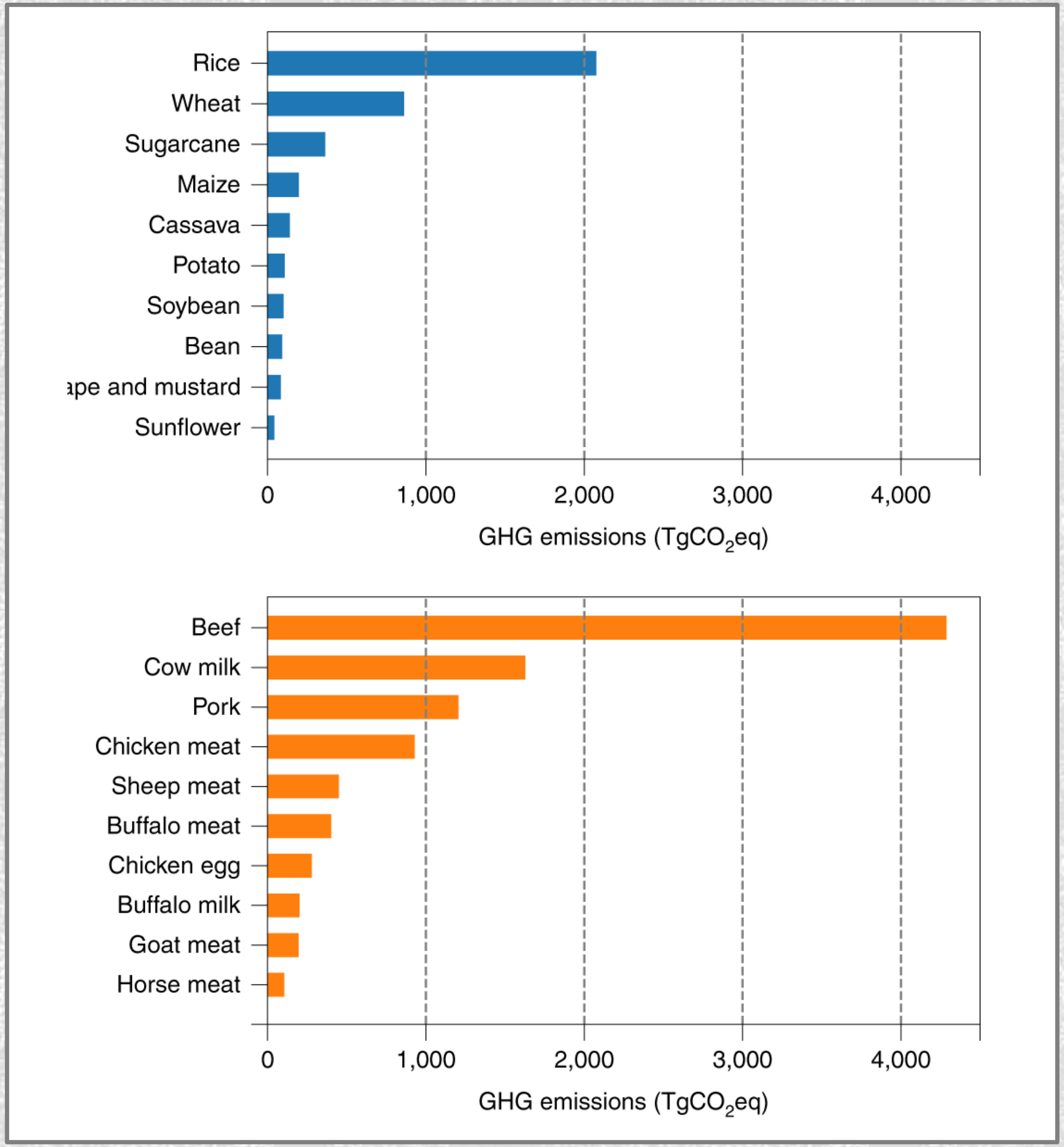
- Water companies invest significantly in facilities to ‘blend’ polluted water with water from a low nitrate source or in processing plants to remove nitrate

- **High levels of compliance - regulators report high levels of drinking water quality.**

- **Cost of delivering this in terms of mitigating nitrate pollution, especially in groundwater sources, are high. Such costs are ultimately passed on to the consumer.**

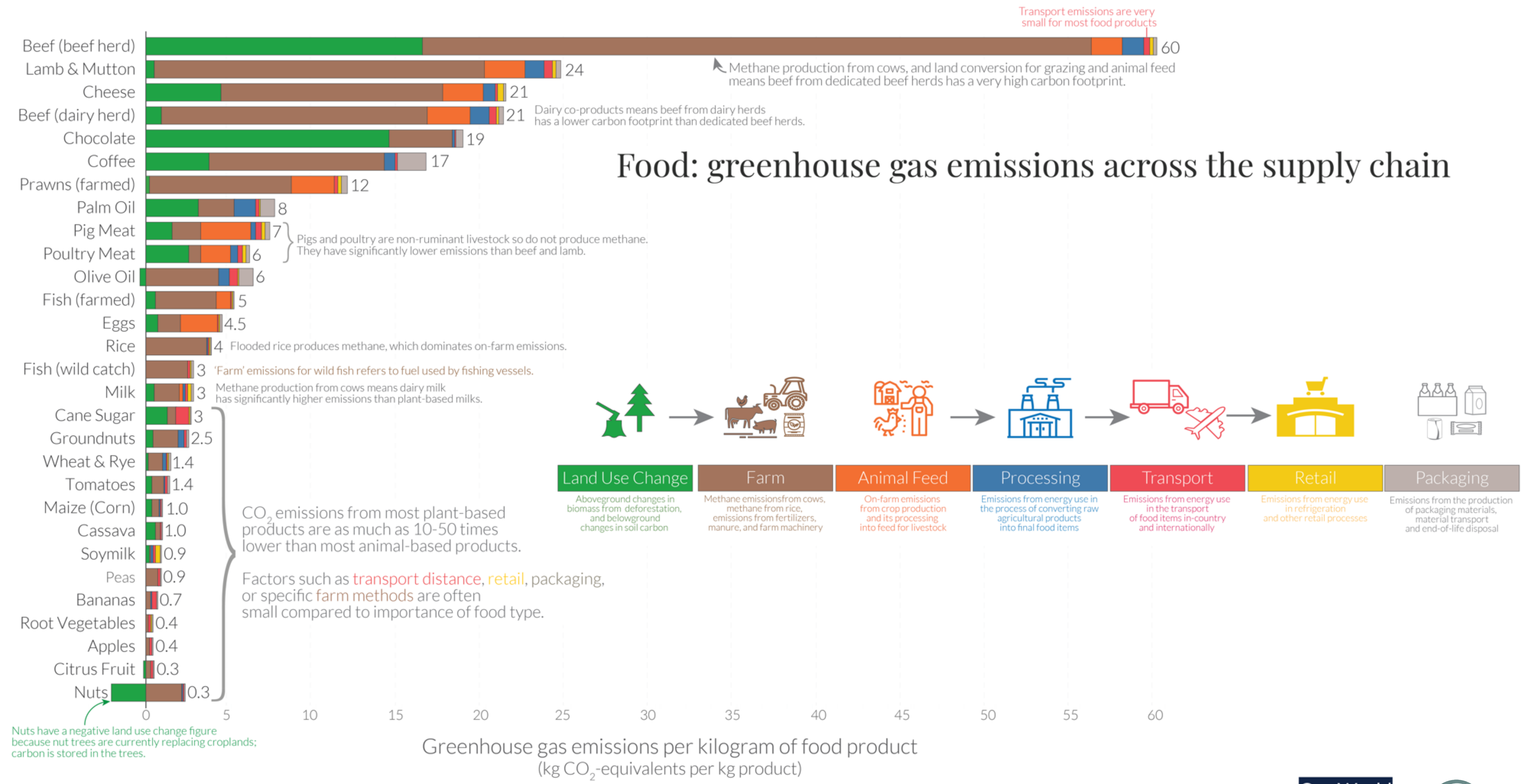
Climate change





https://ourworldindata.org/food-ghg-emissions

https://www.nature.com/articles/s43016-021-00358-x



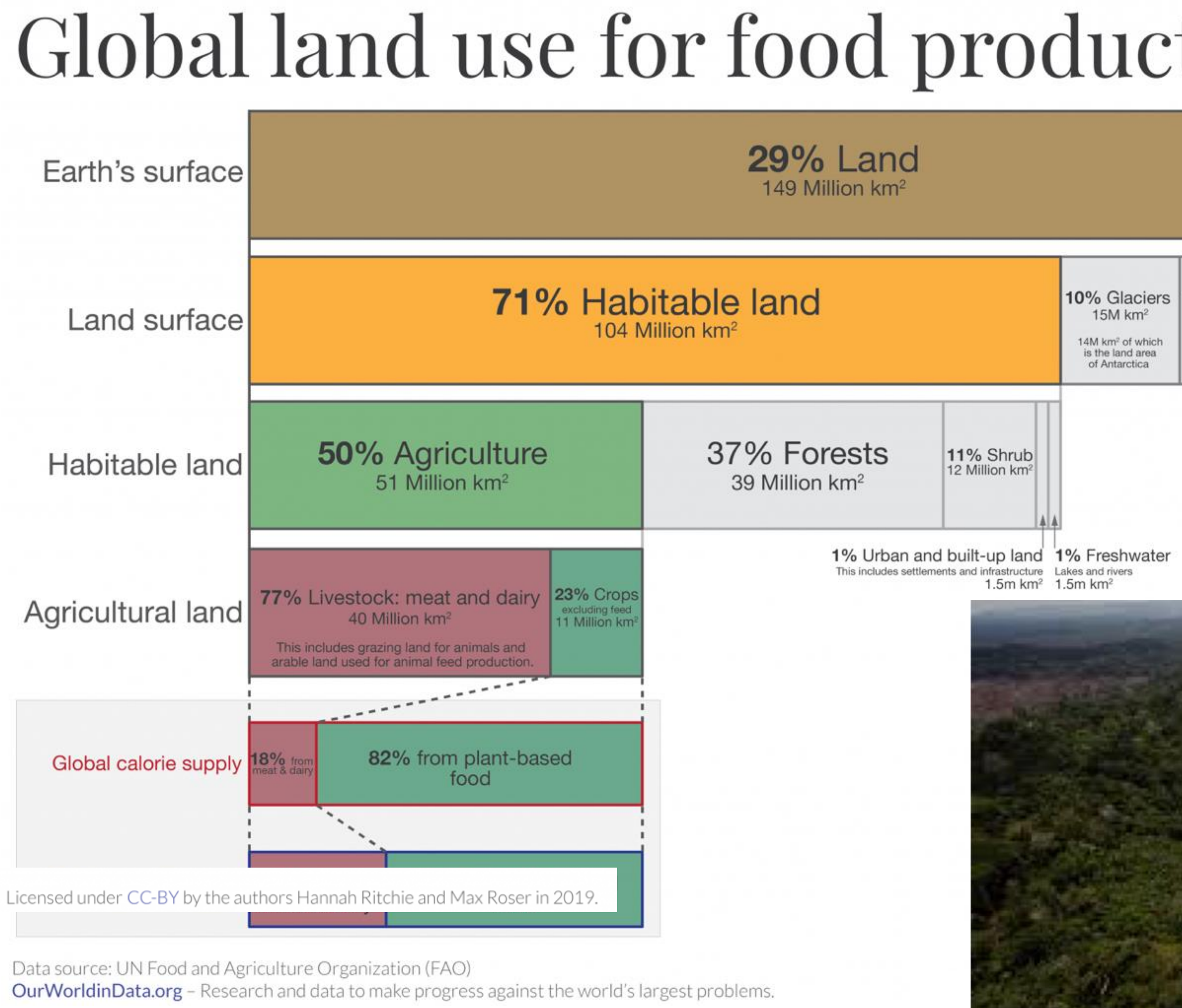
Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries.

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.

Our World in Data

Land Use & Deforestation



Food Waste

Globally - 1/3 of all food produced is wasted

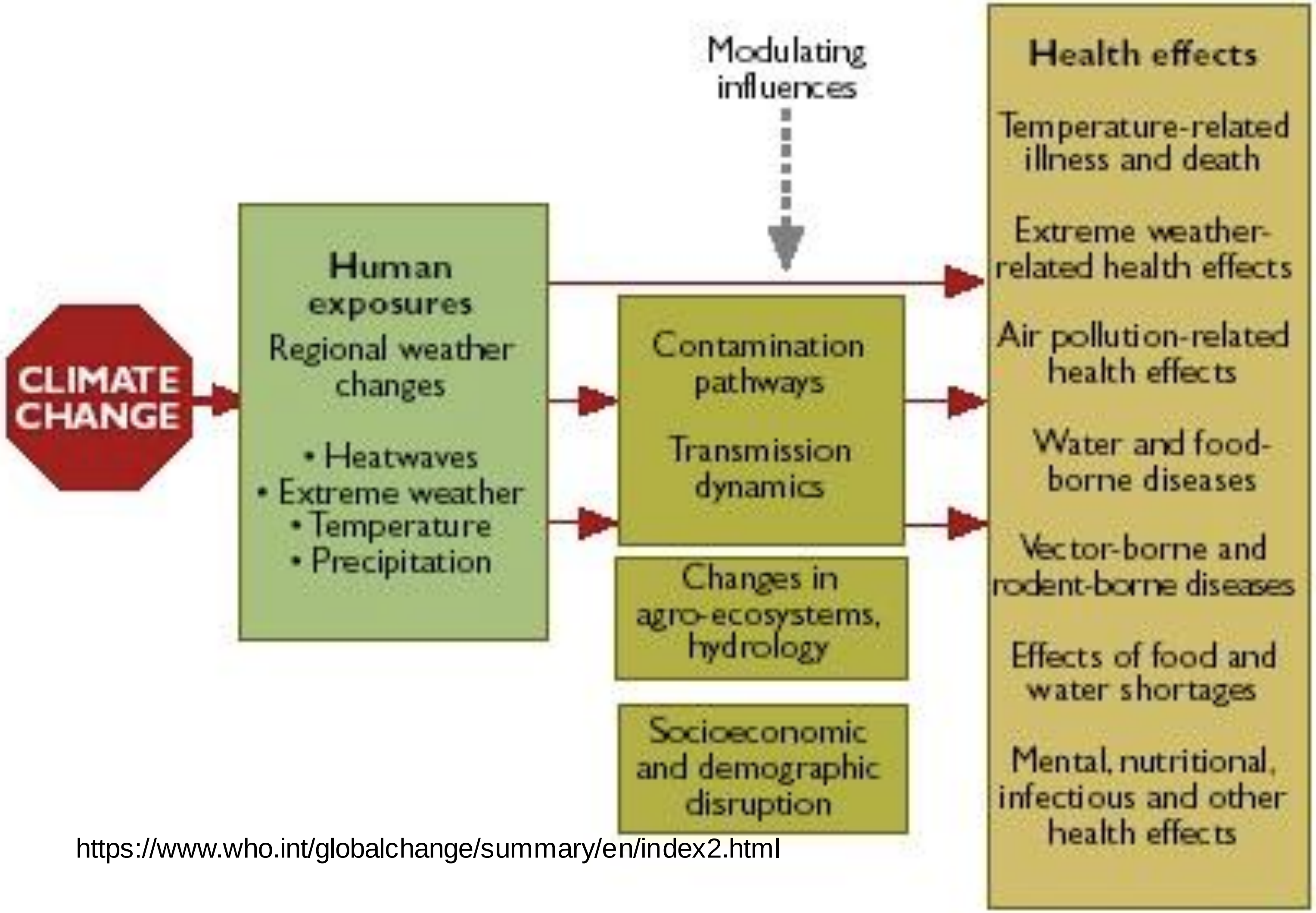
7 million tonnes of food wasted every year in the UK alone

Wasted food costs the average UK household £470 per year.

Source: Food Standards Agency

These several pathways are illustrated in Figure 3.1.

Figure 3.1. Pathways by which climate change affects human health (modified from reference 2)



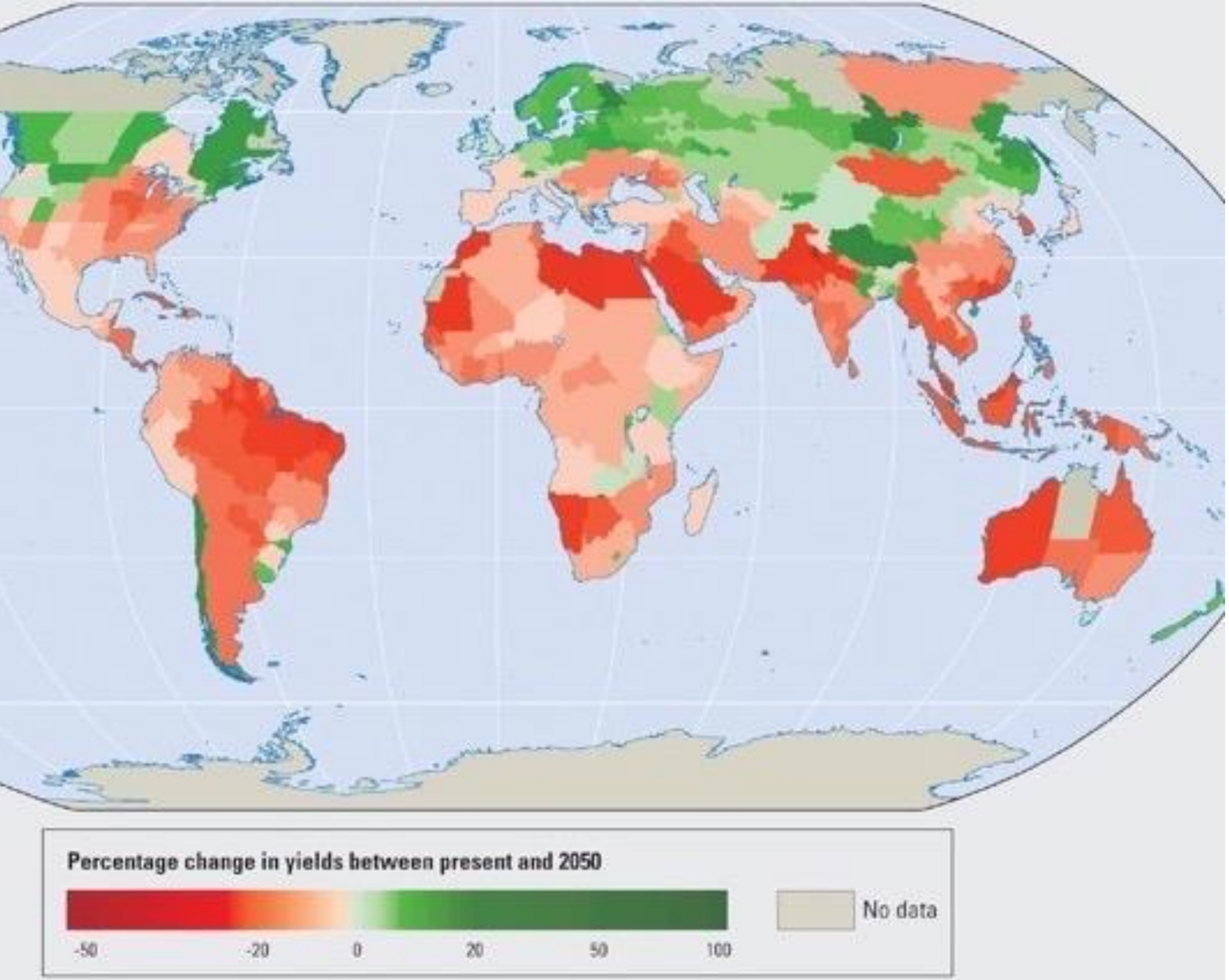
https://www.who.int/globalchange/summary/en/index2.html

How does climate change affect our health?

Climate change impacts related to agriculture

- WATER resources – shifting precipitation patterns, loss of glacier and early snow melt
  - Rainfall events – more unpredictable and extreme, leads to crop loss
  - Crop yields sensitive to temperature and water availability
  - Crop water stress
- PESTS – insects, pathogens, fungi and weeds – extended growing seasons, habitat creep (latitudinal range), lack of natural predators
- POLLINATORS – decrease pollinator populations, affect food production of flowering species of food plants
- AGRICULTURAL LABOUR – Physical human labour dependent on temperature and humidity levels within physically tolerable levels. Estimates that (if 540 ppm by 2100, a moderate projection) outdoor labour would be restricted to 50% of workday during hottest month of the year in India, sub-Saharan Africa and Australia.
- CONFLICT – potential for political unrest and conflict arising from stresses on natural resources and food supply
- World Bank estimates potential for 143 million climate migrants by 2050 (https://www.worldbank.org/en/topic/climatechange/overview)

Myers, S., Smith, M., Guth, S., Golden, C., Vaitla, B., Mueller, N., Dangour, A. and Huybers, P. (2017). Climate Change and Global Food Systems: Potential Impacts on Food Security and Undernutrition. *Annual Review of Public Health*, 38(1), pp.259-277.



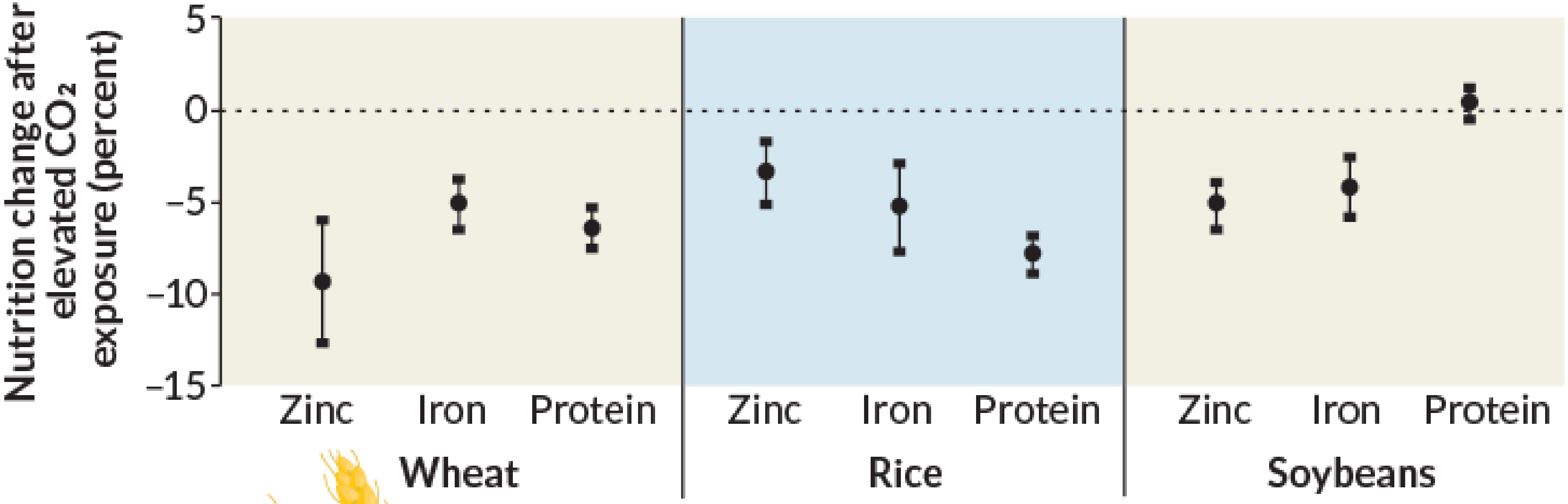
Tim Wheeler, and Joachim von Braun Science 2013;341:508-513

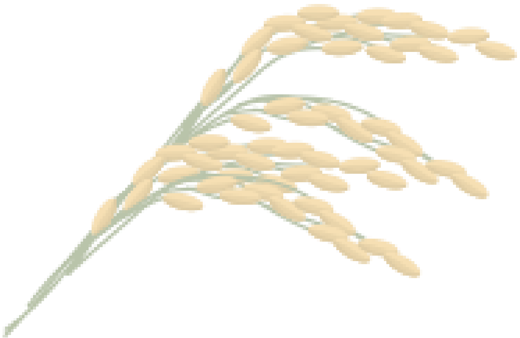
Published by AAAS

Simulated global impacts of climate change on crop productivity

- 2010 World Bank study
- Simulates changes in yields of 11 crops for the year 2050
- Depicts averages across 3 greenhouse emission scenarios and 5 GCMs

Major crops grown in experimental plots with extra carbon dioxide blown over plants (ranging from 546 to 584 parts per million).





Data source: Myers et al., [Nature.](#) 2014 Jun 5;510(7503):139-42
Graphic source: https://www.sciencenews.org/article/nutrition-climate-change-top-science-stories-2017-

WHAT LINKS CLIMATE AND FOOD BORNE ILLNESSES?

The climate variables with most potential influence on foodborne illness:

- **increased air temperature**
- **water temperature and**
- **precipitation**

These variables affect foodborne illness through three mechanisms:

- **abundance, growth, range and survival of pathogens in crops, livestock and the environment**
- **human exposure factors, including cooking practices, food handling and food preferences that are influenced by a longer period of warm temperatures; and**
- **transmission factors, such as wildlife vectors, that transfer pathogens to food.**

Two examples: Salmonella & Campylobacter

Salmonella

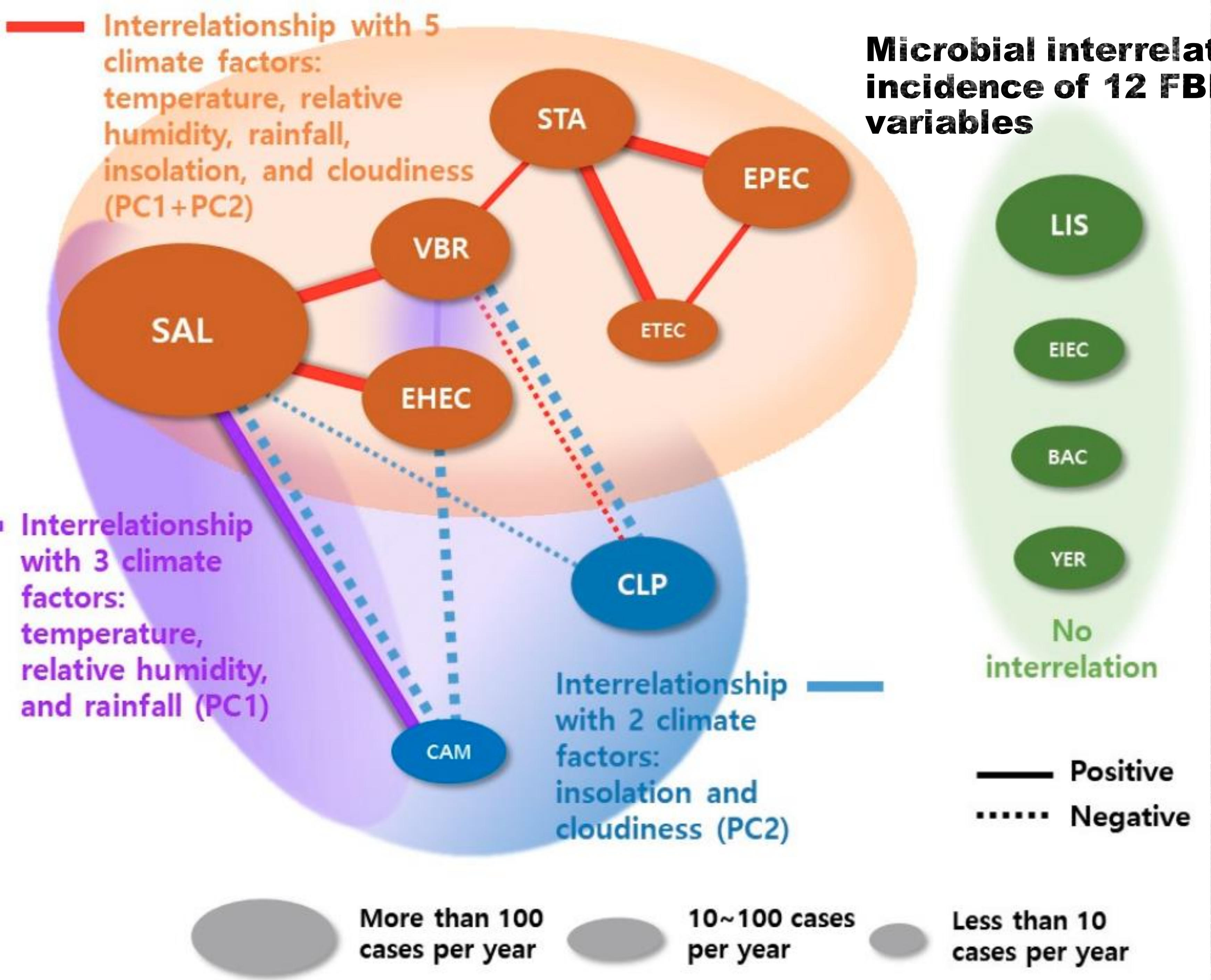
- Strong links between *Salmonella* and environment, esp ambient temperature
- At elevated ambient temperatures, *Salmonella* reproduction is enhanced
- Even so – UK experts don't consider that climate change will affect Salmonella
  - Current control measures and substantial decrease since 1990s
  - Note that over ¼ cases associated with foreign travel

Campylobacter

- Most common bacterial cause of diarrheal disease in high income countries
- Strong seasonal variability, positive association with temperature – suggest potential impact of climate change
- Ambiguity due to uncertainty over exact pathways by which weather affects incidence
  - Montreal study estimates 23% increase in incidence by 2055;
  - Study in Ireland estimated 2-3% increase
  - Other modelling suggests climate-related increase in *Campylobacter* incidence related to poultry consumption, but decrease in drinking water pathway

Source: Lake, 2017

Microbial interrelation networks inferred from incidence of 12 FBDs according to climactic variables



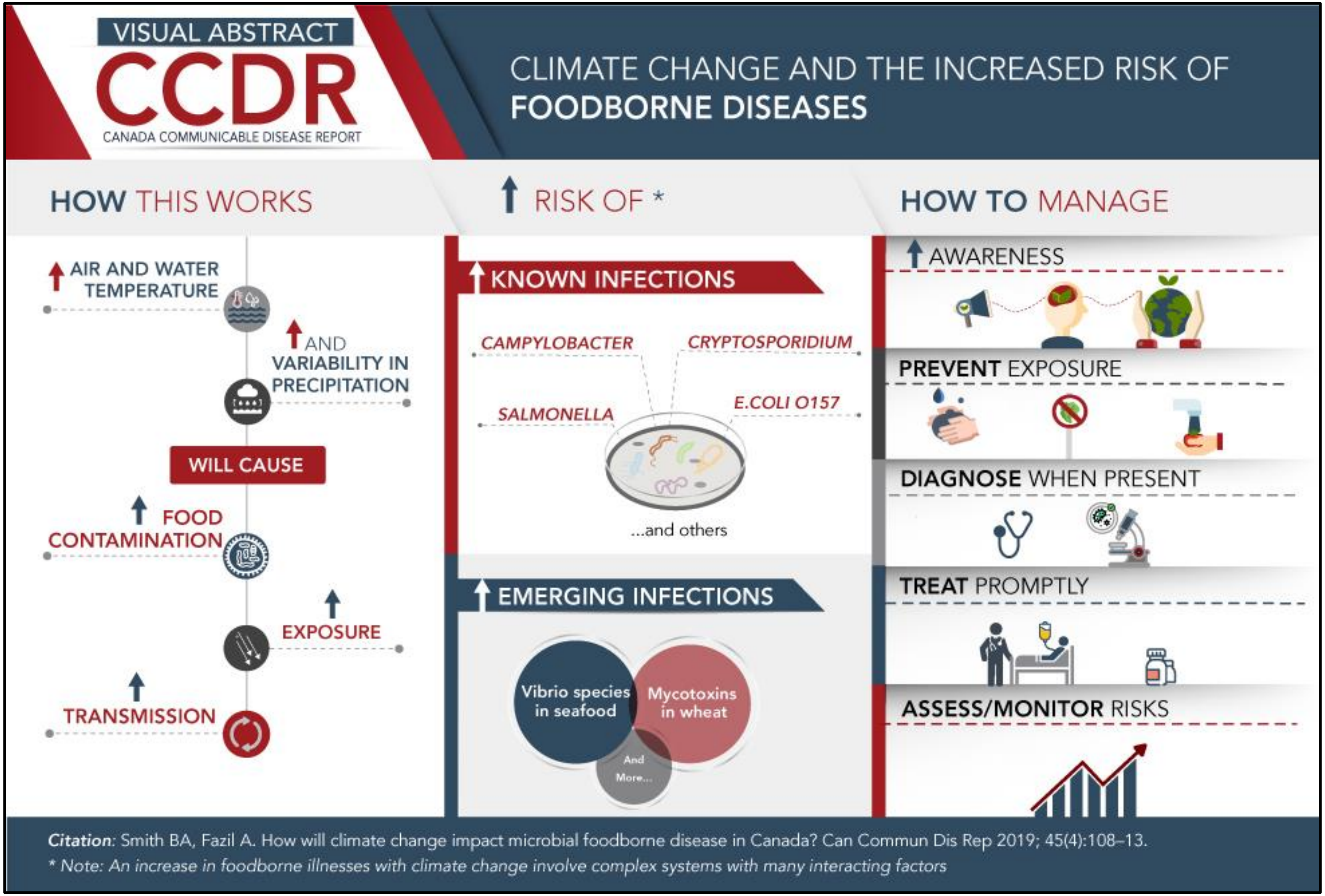
Nodes – incidence of bacterial FBD with size indicating number of cases/year

Lines represent significant pairwise associations between pathogens (thick p<0.01, thin p<0.05)

Red, blue and purple – 3 conditional climactic variables

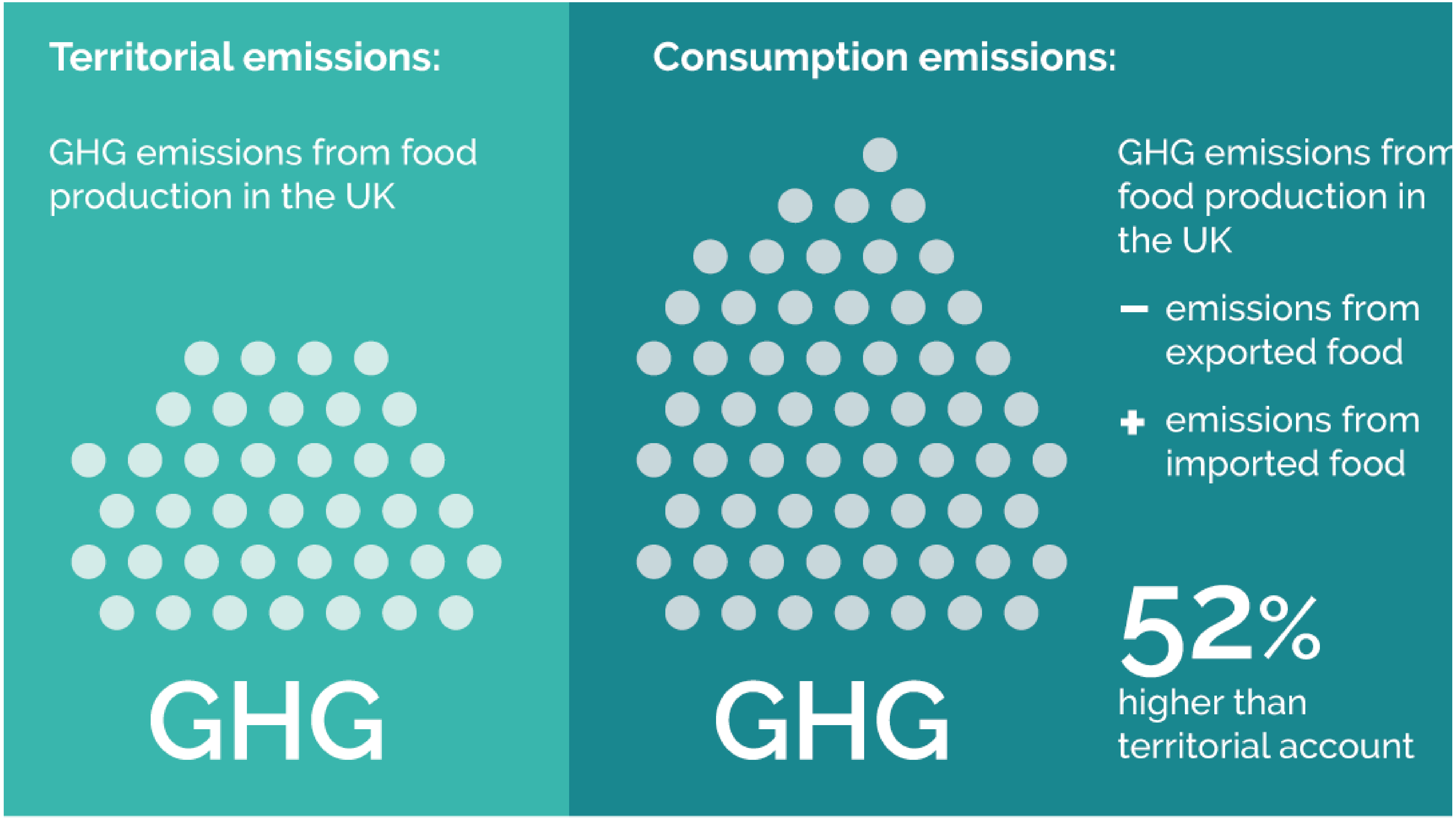
Salmonella – strongest evidence of links to climactic conditions

Park MS, Park KH, Bahk GJ. Interrelationships between Multiple Climatic Factors and Incidence of Foodborne Diseases. *Int J Environ Res Public Health* 2018; **15**(11).



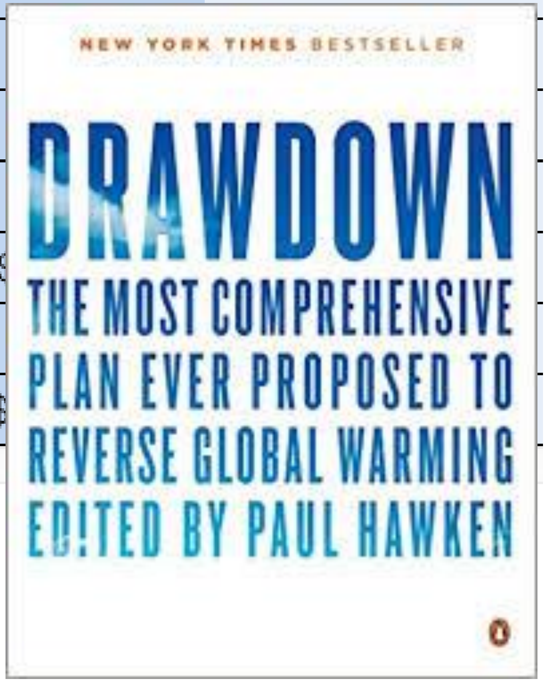
VISUAL ABSTRACT
CCDR
CANADA COMMUNICABLE DISEASE REPORT
CLIMATE CHANGE AND THE INCREASED RISK OF
FOODBORNE DISEASES
HOW THIS WORKS
AIR AND WATER TEMPERATURE
AND VARIABILITY IN PRECIPITATION
WILL CAUSE
FOOD CONTAMINATION
EXPOSURE
TRANSMISSION
RISK OF *
KNOWN INFECTIONS
CAMPYLOBACTER
CRYPTOSPORIDIUM
SALMONELLA
E.COLI O157
...and others
EMERGING INFECTIONS
Vibrio species in seafood
Mycotoxins in wheat
And More...
HOW TO MANAGE
AWARENESS
PREVENT EXPOSURE
DIAGNOSE WHEN PRESENT
TREAT PROMPTLY
ASSESS/MONITOR RISKS
Citation: Smith BA, Fazil A. How will climate change impact microbial foodborne disease in Canada? Can Commun Dis Rep 2019; 45(4):108–13.
* Note: An increase in foodborne illnesses with climate change involve complex systems with many interacting factors

Reducing the UK's food footprint: Demand-side action for more palatable food emissions (CREDS 2021

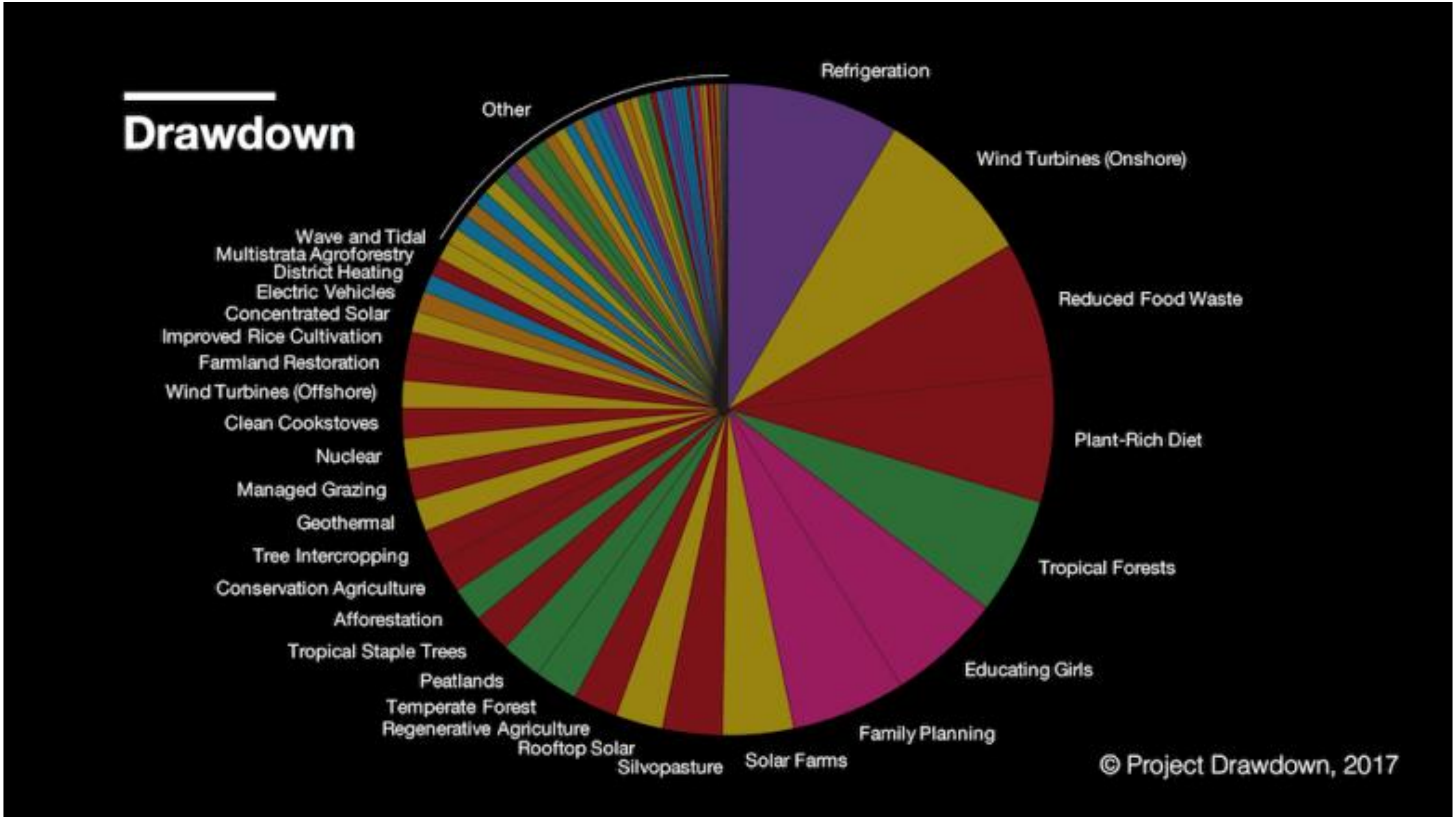


Solutions by Rank

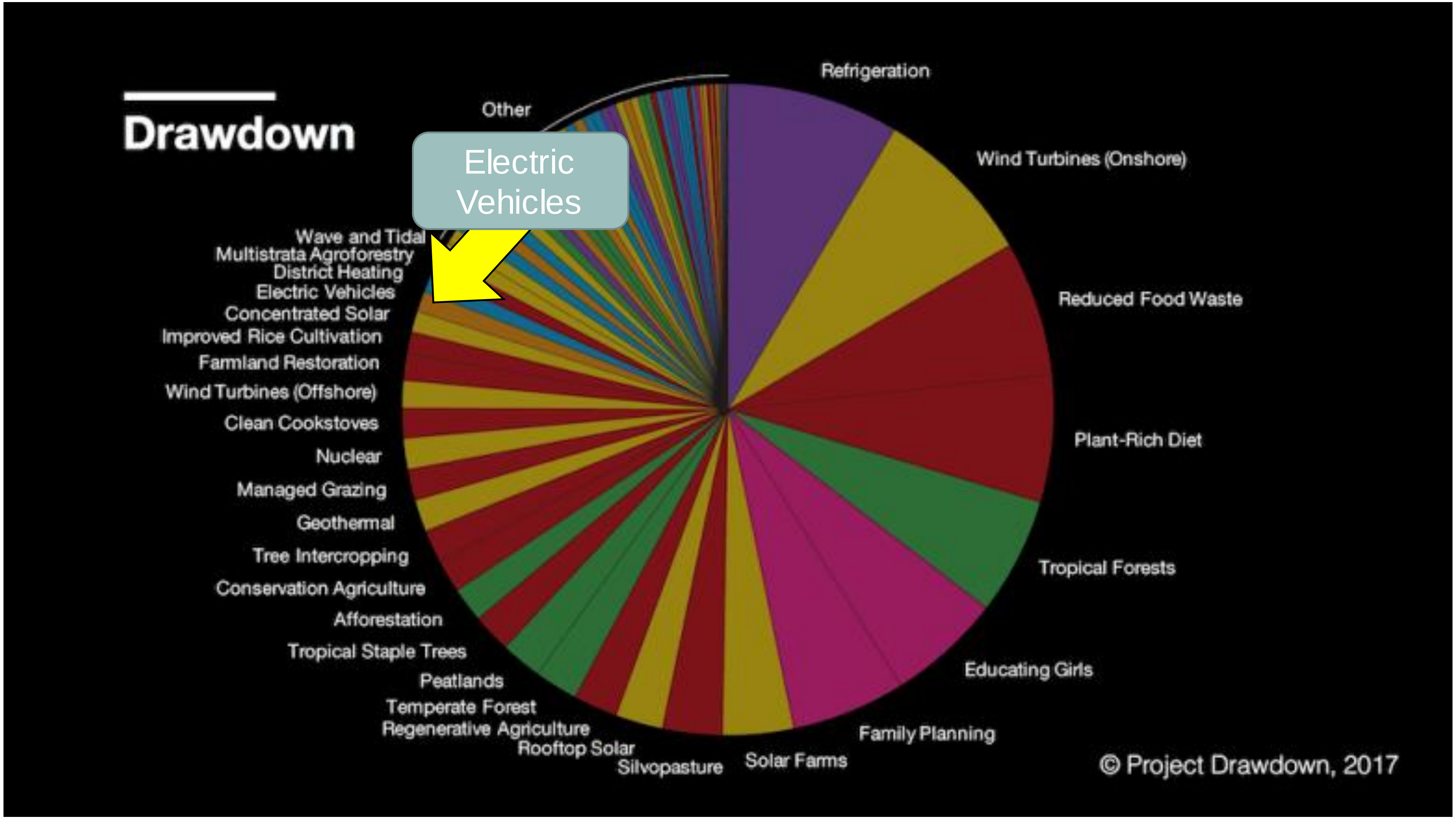
Rank	Solution	Sector	TOTAL ATMOSPHERIC CO2-EQ REDUCTION (GT)	NET COST (BILLIONS US $)	SAVINGS (BILLIONS US $)
1	**Refrigerant Management**	Materials	89.74	N/A	$-902.77
2	**Wind Turbines (Onshore)**	Electricity Generation	84.60	$1,225.37	$7,425.00
3	**Reduced Food Waste**	Food	70.53	N/A	N/A
4	**Plant-Rich Diet**	Food	66.11	N/A	N/A
5	**Tropical Forests**	Land Use	61.23		
6	**Educating Girls**	Women and Girls	59.60		
7	**Family Planning**	Women and Girls	59.60		
8	**Solar Farms**	Electricity Generation	36.90	$	
9	**Silvopasture**	Food	31.19		
10	**Rooftop Solar**	Electricity Generation	24.60	$	



https://www.drawdown.org/solutions



https://www.drawdown.org



https://www.drawdown.org

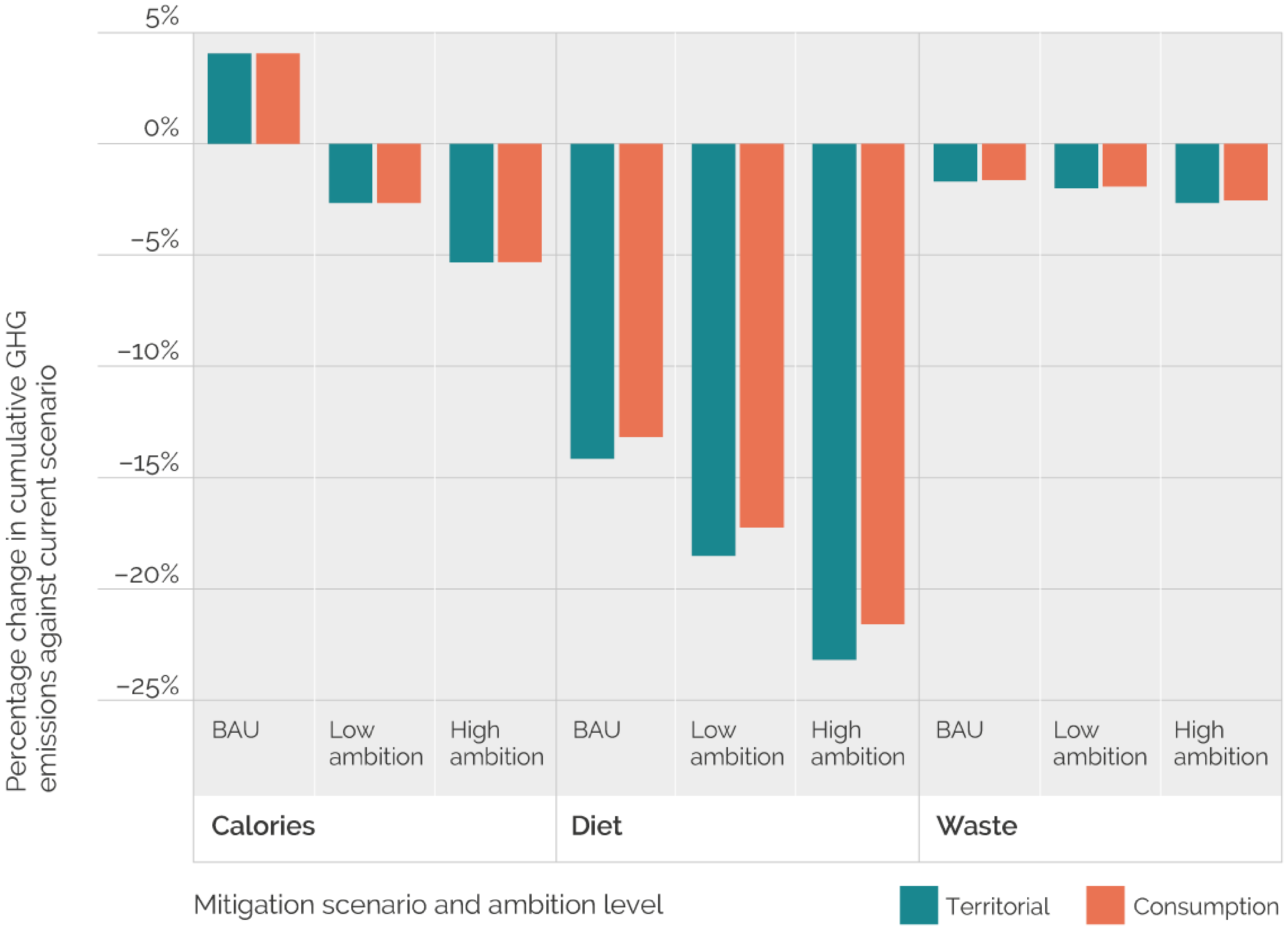


Figure 3: Cumulative GHG emissions (2017-2050; territorial and consumption) according to each mitigation option and ambition case. BAU: Business-as-usual scenario, extrapolating historic trends.

https://www.creds.ac.uk/publications/reducing-the-uks-food-footprint-demand-side-action-for-more-palatable-food-emissions/

Demand-side Mitigation Scenarios

Researchers used hybrid physical input-output food system model, namely:

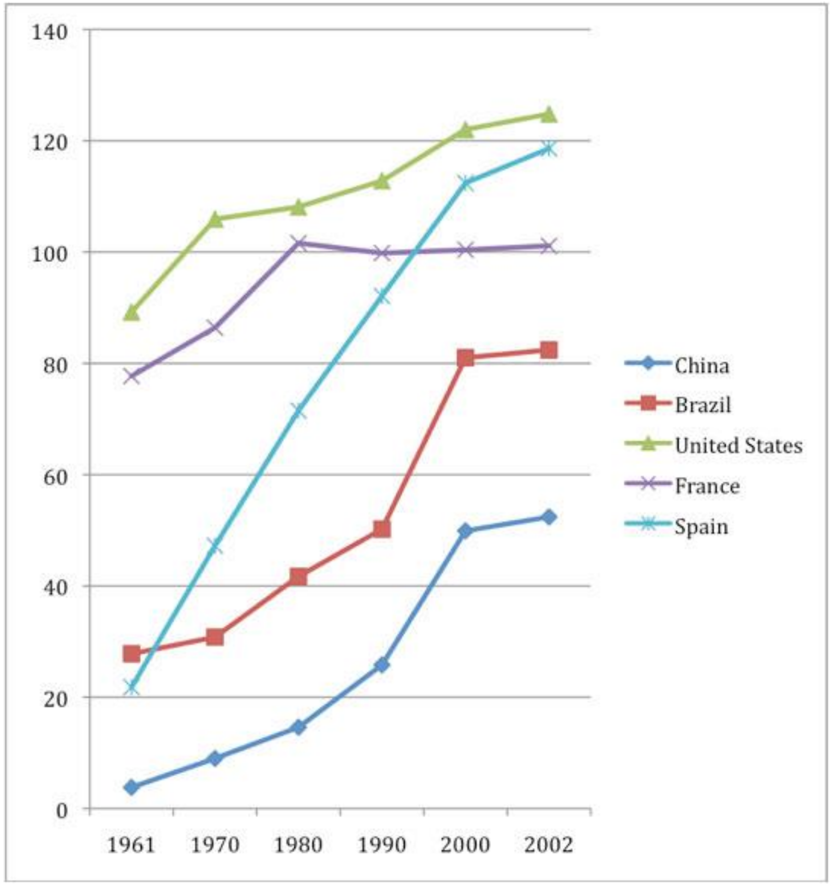
1. following government dietary recommendations on calorific intake
2. dietary transitions towards plant-based consumption
3. reducing food waste (Garvey et al., 2021

FINDINGS:

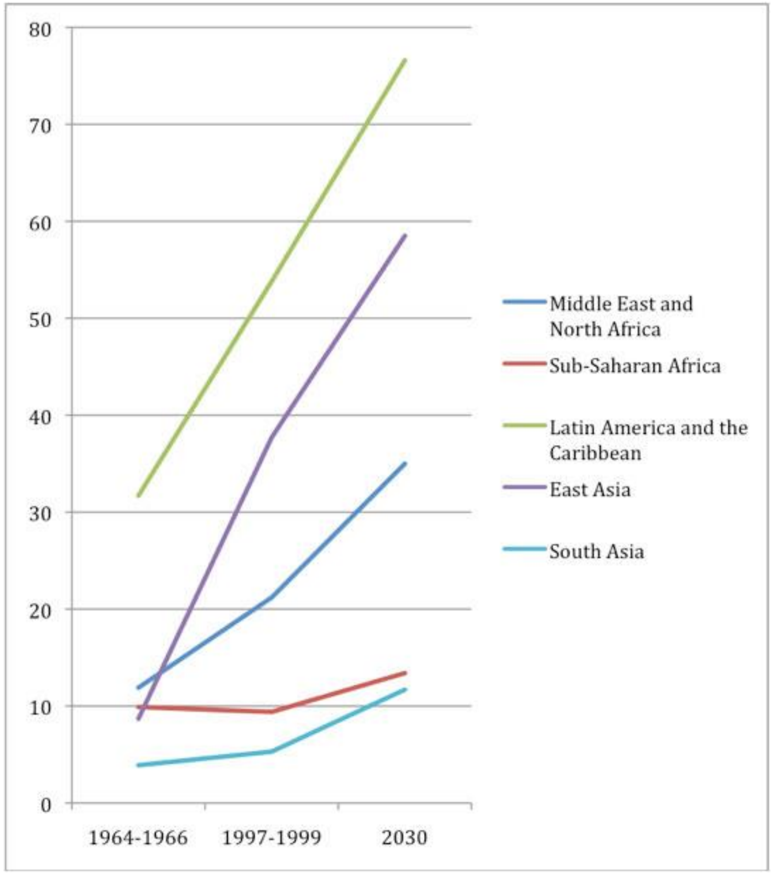
Demand-side scenarios of the UK food system could reduce absolute annual territorial GHG emissions by 52% (2017–2050),

dietary transitions being the single most effective measure, achieving reductions of 22–44% (see Figure 3).

Trends in meat consumption over time (kg/per capita/per year) – selected countries. (Source: FAO)



Trends in meat consumption over time (kg/per capita/per year) – by region (Source: WHO)



Intensive farming & increased risk of epidemics?

2020 – researchers studied genetic evolution of Campylobacter

Found cattle-specific strains emerged at same time as steep increase in number of cattle in 20th Century

Changes in cattle diet, anatomy and physiology triggered gene transfer between general and cattle-specific strains – significant gene gain and loss

Bacteria able to cross species barrier

Intensive farming practices – and increased global movement of cattle = ideal setting for global spread via trade networks

University of Bath, 2020; Mourkas et al 2020

Final points from today

- The food system influences our health in a wide variety of ways
- Critically Important Antibiotics are being used in agriculture and are affecting the resistance levels of pathogens for animals, in the environment and in the human population.
- Industrial agriculture is affecting our environment at local levels, e.g., air pollution and water contamination.
- Agricultural production, particularly of meat and dairy, is a major contributor to GHGE and affecting climate change.
- The climate crisis and AMR – these are global issues: regardless of where they are being used, the potential for medicine to become less effective is one that affects everyone. Reducing this risk is an ethical imperative.
- Solutions need to come from all parts of the system: regulators, producers and consumers.

Thank you

kristin.bash@dhsc.gov.uk
@kristinbash