The health, environmental, and economic impacts of changes towards sustainable diets

Dr Marco Springmann
Professor in Climate Change, Food Systems and Health

London School of Hygiene and Tropical Medicine
marco.springmann@lshtm.ac.uk

Climate Change
& Planetary
Health

Environmental impacts of the food system

The current food system is environmentally unsustainable:

- major driver of climate change (33% of GHG emissions, IPCC, 2019);
- major driver of land-use change and biodiversity loss (40% of the Earth's surface, Ramankutty et al, 2008; Houghton et al, 2012);
- major user of freshwater resources (70% of global freshwater withdrawals (WWAP, 2012);
- major polluter of terrestrial and aquatic systems through fertilizer runoff (Vitousek et al, 1997) ($\rightarrow$ dead zones in coastal oceans, Diaz and Rosenberg, 2008)

Environmental impacts of the food system

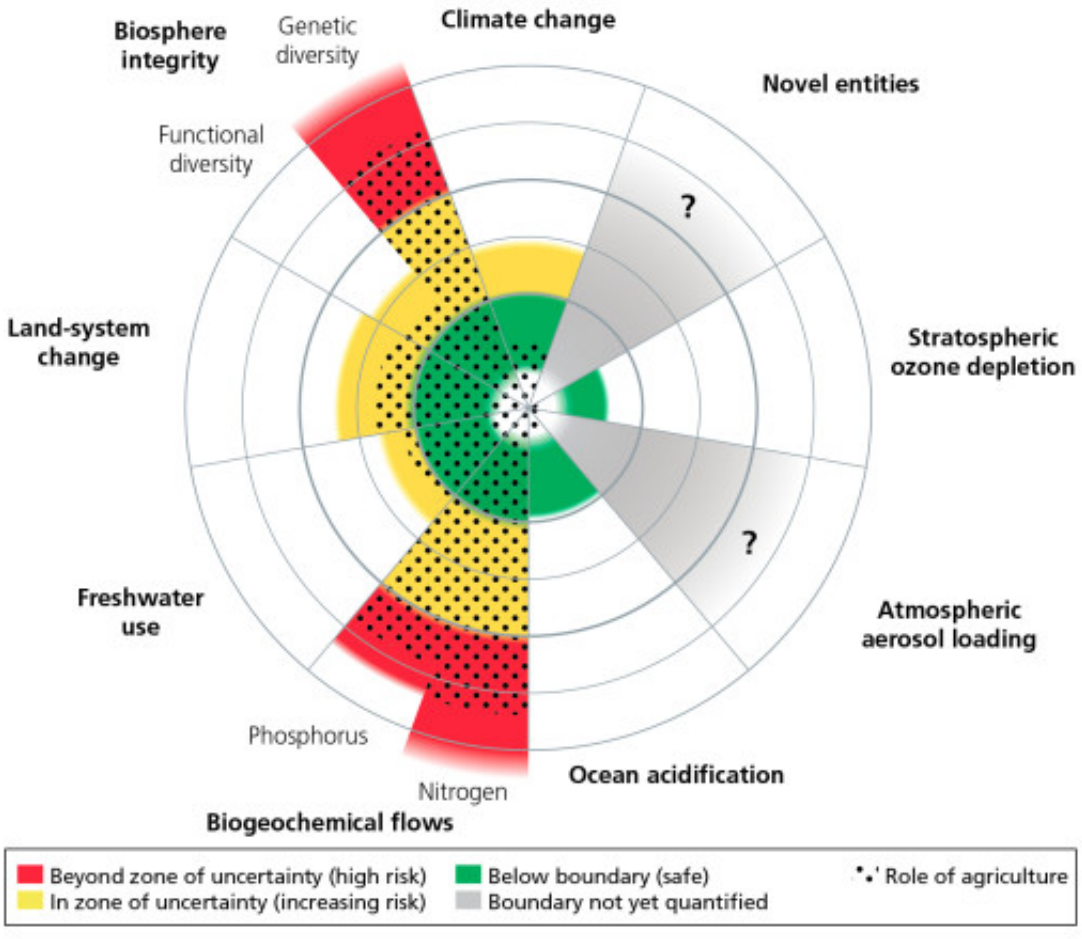
The current food system is environmentally unsustainable:

- major driver of climate change (33% of GHG emissions, IPCC, 2019);
- major driver of land-use change and biodiversity loss (40% of the Earth's surface, Ramankutty et al, 2008; Houghton et al, 2012);
- major user of freshwater resources (70% of global freshwater withdrawals (WWAP, 2012);
- major polluter of terrestrial and aquatic systems through fertilizer runoff (Vitousek et al, 1997) ($\rightarrow$ dead zones in coastal oceans, Diaz and Rosenberg, 2008)

$\rightarrow$ major driver of planetary impacts

Planetary boundaries

- Transgressing put ecosystems at risk of being destabilised and losing regulating functions on which populations depend



Steffan et al (2015), Campbell et al (2017)

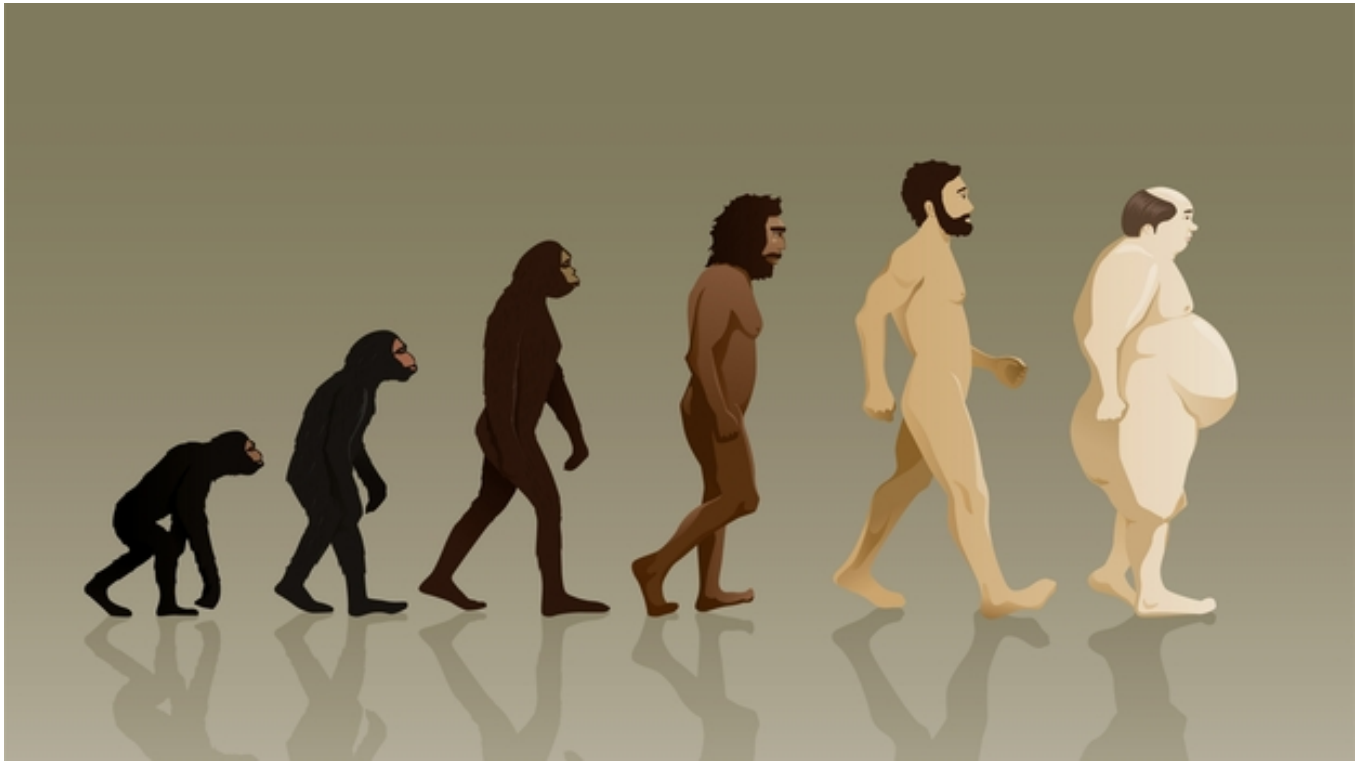
Health impacts of the food system

Current diets are not healthy:

- Less than half of all countries meet or are projected to meet dietary guidelines on red meat, fruits and vegetables, sugar, and total energy intake (Micha et al, 2015; Springmann et al, 2016).

Health impacts of the food system

- Global prevalence of overweight increased over a third, and obesity rates doubled over last 30 years (Stevens et al, 2012).



Health impacts of the food system

- Dietary risks are leading risk factors globally and in most regions (GBD, 2013):

	Global	High-income Asia Pacific	Western Europe	Australasia	High-income North America	Central Europe	Southern Latin America	Eastern Europe	East Asia	Tropical Latin America	Central Latin America	Southeast Asia	Central Asia	Andean Latin America	North Africa and Middle East	Caribbean	South Asia	Oceania	Southern Sub-Saharan Africa	Eastern Sub-Saharan Africa	Central Sub-Saharan Africa	Western Sub-Saharan Africa
Dietary risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	3	4	4
High blood pressure	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	5	1	1	3	3
Smoking	3	3	3	3	2	3	4	4	3	3	5	3	3	4	4	3	4	4	6	8	9	9
Household air pollution	4	23	24	24	24	10	14	13	5	11	9	4	9	8	13	7	3	6	8	2	2	2
High fasting plasma glucose	5	6	7	6	6	7	6	8	6	5	4	5	6	5	6	4	5	1	5	6	7	7
High body-mass index	6	7	4	4	4	4	3	5	9	4	3	9	4	3	3	5	12	3	3	10	15	10
Ambient PM pollution	7	5	8	11	8	8	11	9	4	12	10	7	7	13	7	11	6	16	15	12	12	8
Physical inactivity	8	4	5	5	5	5	5	6	7	7	7	6	5	7	5	6	7	7	7	9	8	11
Alcohol use	9	8	9	8	9	9	8	3	8	6	6	8	10	6	10	8	9	8	4	5	6	5
High total cholesterol	10	9	6	7	7	6	7	7	10	8	8	10	8	9	8	9	11	9	12	17	19	19
Childhood underweight	11	22	21	19	20	20	20	21	21	19	14	14	15	16	14	14	10	10	10	4	1	1
Occupational risks	12	11	11	10	12	12	10	12	11	10	12	11	12	11	11	15	8	11	13	13	17	15
Lead	13	10	10	9	11	11	9	10	12	9	11	12	11	10	9	10	14	13	11	16	18	18
Suboptimal breastfeeding	14	25	24	24	24	25	18	25	18	14	13	13	13	12	12	13	13	12	9	7	5	6
Sanitation	15	19	19	18	22	23	21	20	22	21	23	18	25	20	21	18	15	15	17	11	10	12
Low bone mineral density	16	12	12	12	13	13	13	17	13	15	17	15	22	19	18	16	18	22	22	21	23	20
Intimate partner violence	17	13	16	15	16	16	16	14	15	16	18	17	16	17	16	17	16	17	16	20	20	21
Drug use	18	14	14	13	10	15	12	11	17	13	16	16	14	14	15	19	24	19	14	22	21	22
Ozone	19	17	15	23	15	17	25	18	14	23	21	25	19	25	17	24	17	25	23	24	22	23
Vitamin A deficiency	20	24	23	22	23	24	24	24	25	25	25	22	23	22	24	22	19	21	18	14	13	13
Iron deficiency	21	18	18	16	18	19	15	19	20	17	15	21	21	15	22	12	20	14	19	19	16	14
Unimproved water	22	20	20	21	19	22	22	23	24	24	24	20	24	23	19	20	22	18	21	15	11	16
Zinc deficiency	23	21	22	20	21	21	23	22	23	22	20	19	17	18	23	21	23	20	20	18	14	17
Radon	24	16	13	17	14	14	17	15	16	18	19	23	18	24	20	25	25	24	25	25	25	25
Childhood sexual abuse	25	15	17	14	17	18	19	16	19	20	22	24	20	21	25	23	21	23	24	23	24	24

EAT-Lancet Commission

Goal of the **EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems**:

- Achieve a sustainable food system that can deliver healthy diets for a growing population.

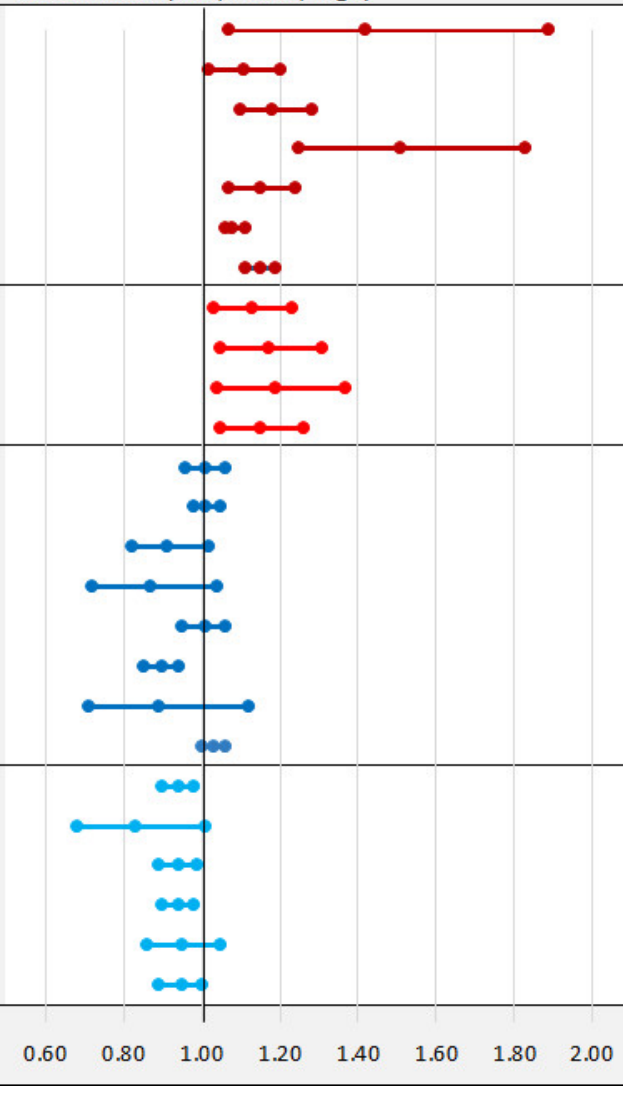
Approach:

- Group of 19 commissioners and 18 co-authors from 16 countries and various fields, including human health, agriculture, political science and environmental sustainability.
- Define a healthy reference diet
- Define planetary boundaries of the food system
- Analyse diets and food system changes to stay within planetary boundaries
- Outline strategies to achieve healthy diets from sustainable food systems by 2050.

Healthy diets

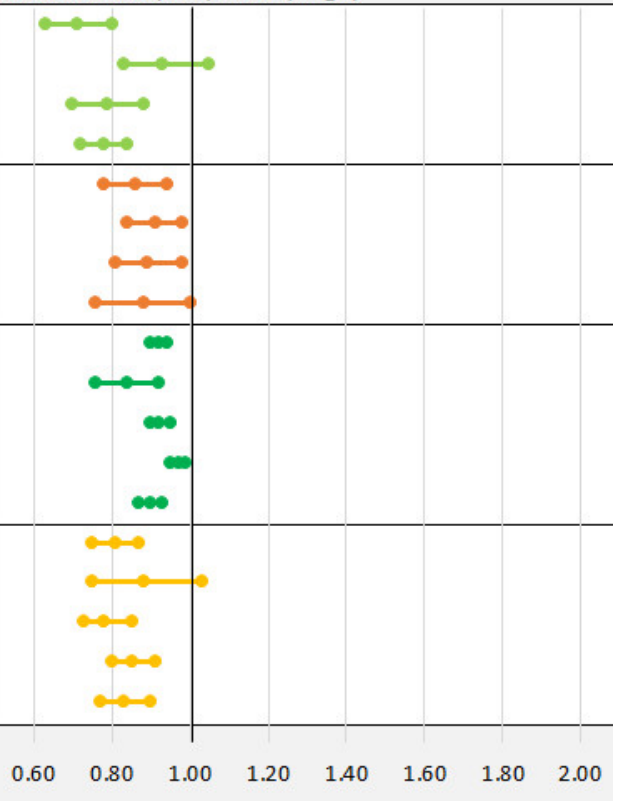
Evidence base for devising healthy diets: relative risks

Food group	Reference	Endpoint	Unit
Processed meat	Micha et al (2012)	CHD	50 g/d
	Chen et al (2013)	Stroke	50 g/d
	Chan et al (2011)	Colorectal cancer	50 g/d
	Feskens et al (2013)	Type 2 diabetes	50 g/d
	Wang et al (2016)	CVD mortality	50 g/d
	Wang et al (2016)	Cancer mortality	50 g/d
	Wang et al (2016)	All-cause mortality	50 g/d
Red meat	Chen et al (2013)	Stroke	100 g/d
	Chan et al (2011)	Colorectal cancer	100 g/d
	Feskens et al (2013)	Type 2 diabetes	100 g/d
	Abete et al (2014)	CVD mortality	100 g/d
Dairy	Mullie et al (2016)	All-cause mortality	200 mL/d
	Mullie et al (2016)	CHD	200 mL/d
	Mullie et al (2016)	Stroke	200 mL/d
	Aune et al (2013)	Type 2 diabetes	200 g/d
	Aune et al (2013)	Type 2 diabetes (adj, red meat intake)	200 g/d
	Aune et al (2012)	Colorectal cancer	200 g/d
	Aune et al (2012)	Colorectal cancer (adj, red meat intake)	200 g/d
	Aune et al (2015)	Prostate cancer	200 g/d
Seafood	Zheng et al (2012)	CHD mortality	15 g/d
	Zheng et al (2012)	CHD mortality	> 71 g/d
	Larsson and Orsini (2011)	Stroke	43 g/d
	Zhao et al (2016)	All-cause mortality	high vs low
	Zhao et al (2016)	All-cause mortality (adj, red meat intake)	high vs low
	Zhao et al (2016)	All-cause mortality (adj, fruit and veg intake	high vs low



Healthy diets

Food group	Reference	Endpoint	Unit	Relative risk (low, mean, high)
Nuts	Aune et al (2016)	CHD	28 g/d	
	Aune et al (2016)	Stroke	28 g/d	
	Aune et al (2016)	CVD	28 g/d	
	Aune et al (2016)	All-cause mortality	28 g/d	
Legumes	Afshin et al (2014)	CHD	57 g/d	
	Zhu et al (2015)	Colorectal cancer	high vs low	
	Zhu et al (2015)	Colorectal cancer (adj, red meat intake)	high vs low	
	Zhu et al (2015)	Colorectal cancer (adj, fruit and veg intake)	high vs low	
Fruit and vegetables	Aune et al (2017)	CHD	200g/d	
	Aune et al (2017)	Stroke	200g/d	
	Aune et al (2017)	CVD	200g/d	
	Aune et al (2017)	Cancer	200g/d	
	Aune et al (2017)	All-cause mortality	200g/d	
Whole grains	Aune et al (2016)	CHD	90 g/d	
	Aune et al (2016)	Stroke	90 g/d	
	Aune et al (2016)	CVD	90 g/d	
	Aune et al (2016)	Cancer mortality	90 g/d	
	Aune et al (2016)	All-cause mortality	90 g/d	

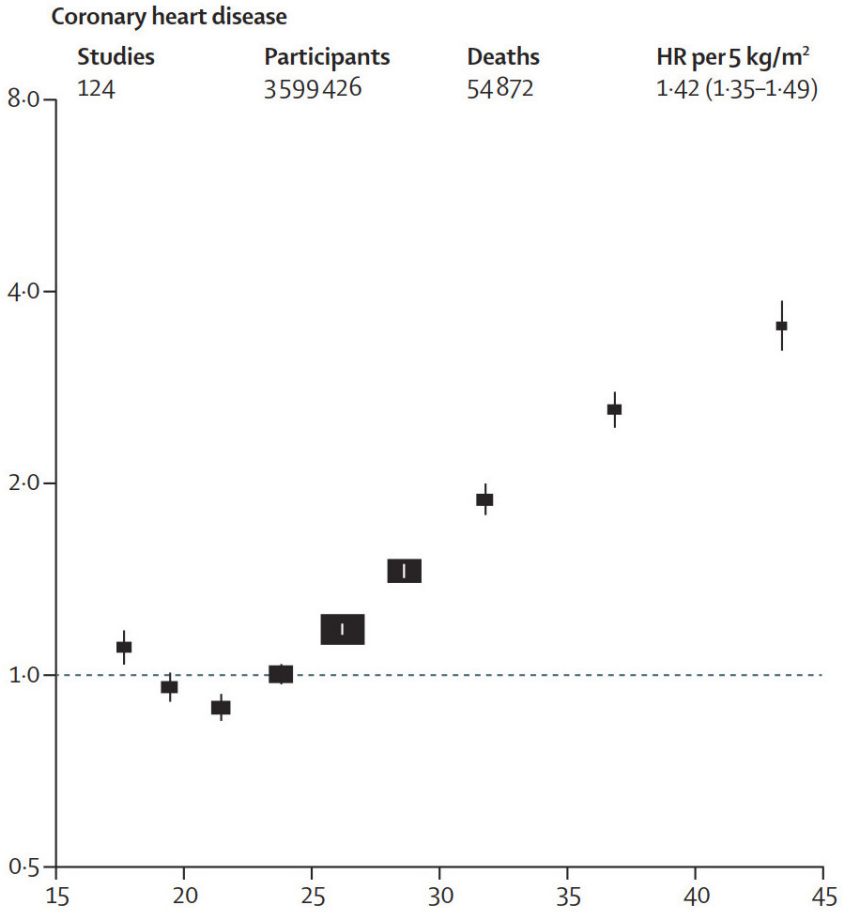


Springmann et al, 2019, *Environmental Nutrition, 1st Edition, Chapter 14*

Healthy diets

Healthy body weight:

The Global BMI Mortality Collaboration (2016), WHO (2004)



Age	Female	Male	Average
0-4	1200	1200	1200
5-9	1520	1600	1560
10-14	1920	2120	2020
15-19	2040	2760	2400
20-24	2200	2800	2500
25-29	2000	2600	2300
30-34	2000	2600	2300
35-39	2000	2600	2300
40-44	2000	2600	2300
45-49	2000	2400	2200
50-54	1800	2400	2100
55-59	1800	2400	2100
60-64	1800	2400	2000
65-69	1800	2200	2000
70-74	1800	2200	2000
75-79	1800	2200	2000
80-84	1800	2200	2000
85-89	1800	2200	2000
90-94	1800	2200	2000
95-99	1800	2200	2000
100+	1800	2200	2000

Healthy diets

Predominantly **plant-based** dietary patterns (flexitarian, pescatarian, vegetarian, vegan):

	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
Whole grains		
Rice, wheat, corn and other	232	811
Tubers or starchy vegetables		
Potatoes and cassava	50 (0–100)	39
Vegetables		
All vegetables	300 (200–600)	78
Fruits		
All fruits	200 (100–300)	126
Dairy foods		
Whole milk or equivalents	250 (0–500)	153
Protein sources		
Beef, lamb and pork	14 (0–28)	30
Chicken and other poultry	29 (0–58)	62
Eggs	13 (0–25)	19
Fish	28 (0–100)	40
Legumes	75 (0–100)	284
Nuts	50 (0–75)	291
Added fats		
Unsaturated oils	40 (20–80)	354
Saturated oils	11.8 (0-11.8)	96
Added sugars		
All sugars	31 (0–31)	120

Healthy diets

Consumption changes (%) to reach balanced flexitarian diets in 2030:

Food groups	World	HIC	UMC	LMC	LIC
red meat	-82	-90	-83	-78	-57
sugar	-48	-56	-68	-39	-15
white meat	-38	-59	-52	-6	-7
milk&eggs	-32	-55	-31	-17	-8
staples	-28	8	-16	-36	-33
fish	50	20	98	46	106
vegetables	55	50	92	35	247
fruits	59	24	24	72	117
legumes	249	485	198	240	187
nuts	280	336	294	248	335

Healthy diets

Analysis of diets:

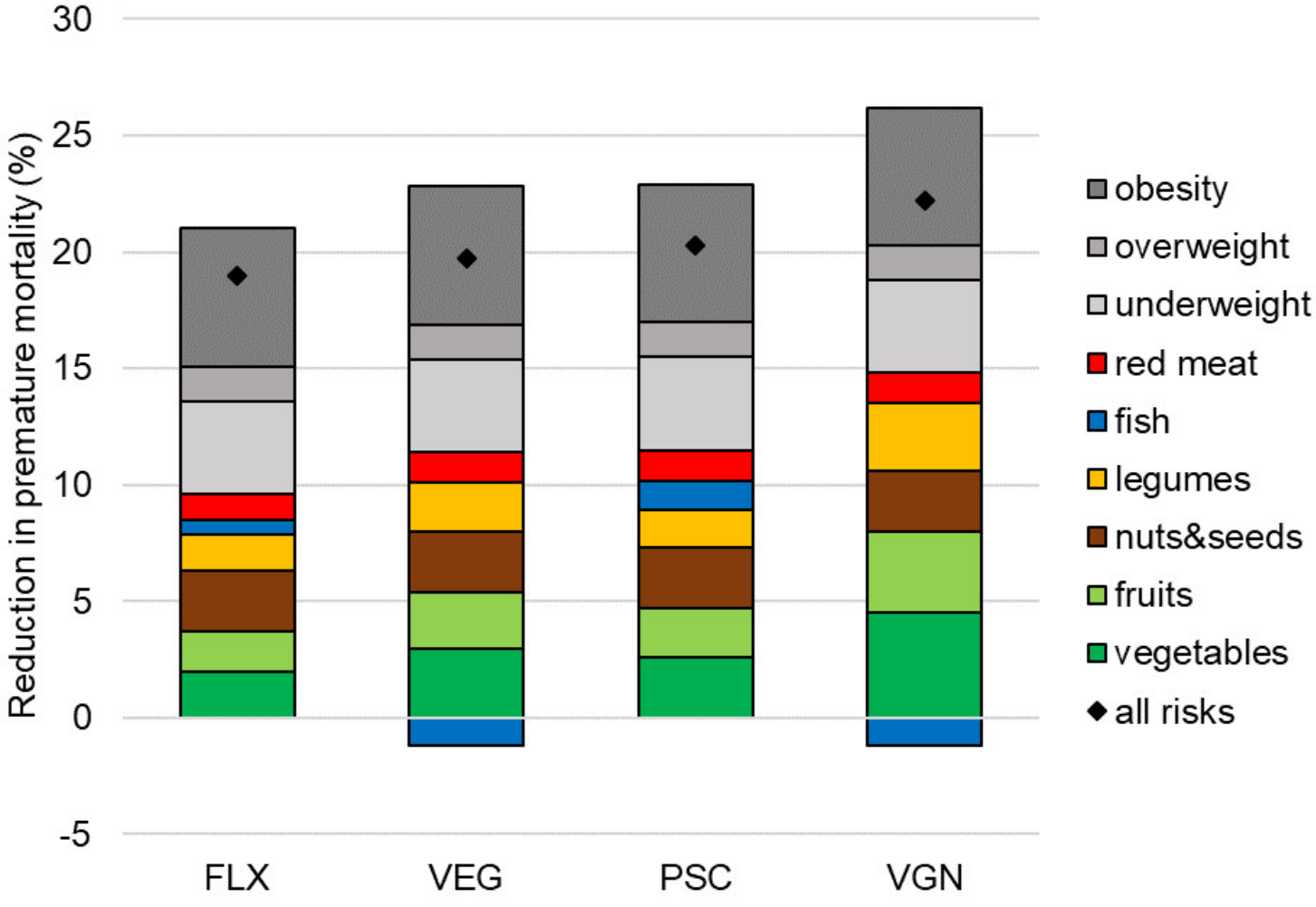
- Nutritional analysis: nutritional content of food groups for 24 nutrients based on GENuS dataset (Smith et al, 2016) and USDA (B5, B12); comparison to WHO recommendations;
- Mortality analysis: comparative risk assessment with 9 dietary and weight-related risk factors and 5 disease endpoints based on Oxford Global Health model (Springmann et al, 2016a,b);
- Environmental analysis: country-specific footprints for GHG emissions, cropland use, freshwater use, nitrogen application, phosphorus application (Springmann et al, 2018a).
- Food-systems analysis: combined analysis of improvements in technologies and management, reductions in food loss and waste, and dietary changes to more plant-based diets (Springmann et al, 2018b).

Nutritional analysis

Nutrient	unit	rec	Diet scenario				
			BMK	FLX	PSC	VEG	VGN
calories	kcal	2084	2146	2084	2084	2084	2084
protein	g	>52	68.4	70.6	72.5	65.0	64.7
carbohydrates	g	<391	324	274	278	289	304
fat	g		68.9	81.8	78.1	77.3	71.3
saturatedFA	g	<23	22.5	19.7	17.5	17.2	13.4
monounsatFA	g		26.7	31.4	28.1	27.7	26.1
polyunsatFA	g	>14	16.7	27.7	27.2	27.4	27.6
vitaminC	mg	>42	86.9	148	163	171	196
vitaminA	µg	>544	482	627	679	694	703
folate	µg	>364	280	553	577	644	733
calcium	mg	>520	556	621	660	630	489
iron	mg	>17	16.4	18.8	19.3	19.5	21.1
zinc	mg	>6.1	10.8	10.4	10.4	10.2	10.3
potassium	mg	>3247	2506	3383	3555	3634	3952
fiber	g	>29	26.0	35.5	36.6	39.9	44.6
copper	mg	>0.8	1.6	2.3	2.3	2.5	2.7
phosphorus	mg	>757	1312	1379	1429	1366	1337
thiamin	mg	>1.1	1.3	1.5	1.5	1.5	1.6
riboflavin	mg	>1.1	0.9	0.9	1.0	0.9	0.9
niacin	mg	>14	18.7	17.5	17.4	16.0	16.8
vitaminB6	mg	>1.2	6.1	6.1	6.2	6.1	2.3
magnesium	mg	>205	436	527	543	561	596
pantothenate	mg	>4.7	5.7	5.4	5.4	5.3	4.9
vitaminB12	µg	>2.2	3.0	2.4	3.7	0.8	0.0

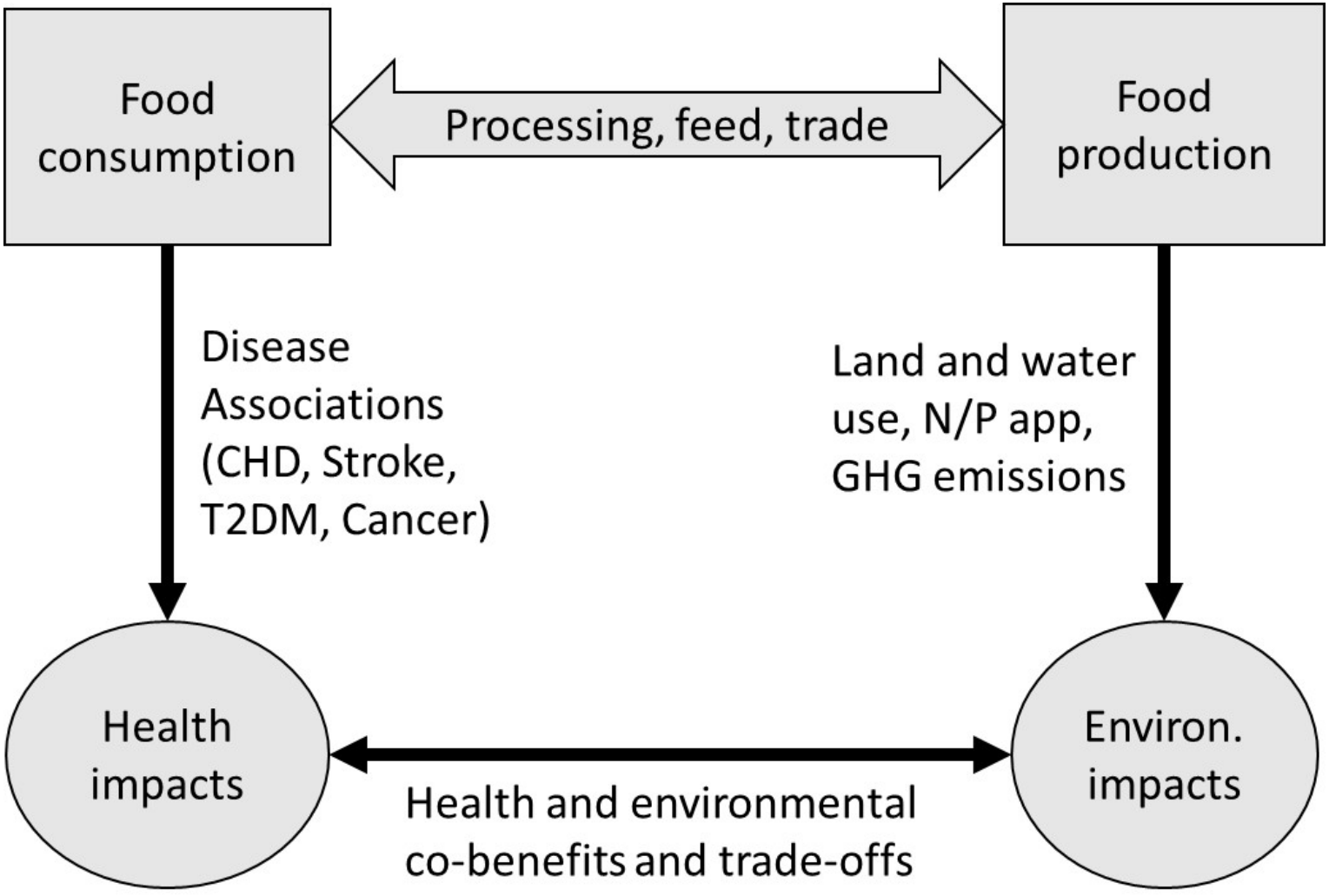
Springmann et al, *Lancet Planetary Health* 2018

Chronic-disease analysis



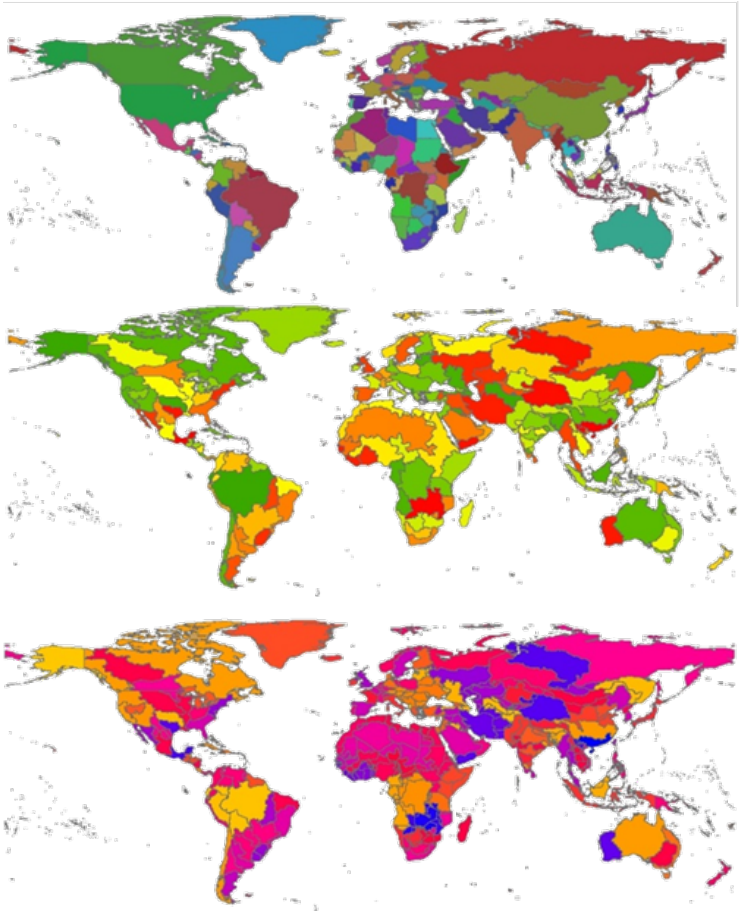
Springmann et al, *Lancet Planetary Health* 2018

Environmental and food-systems analysis



Level of detail

Analysis based on future food projections for 159 regions and 62 agricultural commodities from IFPRI-IMPACT model:



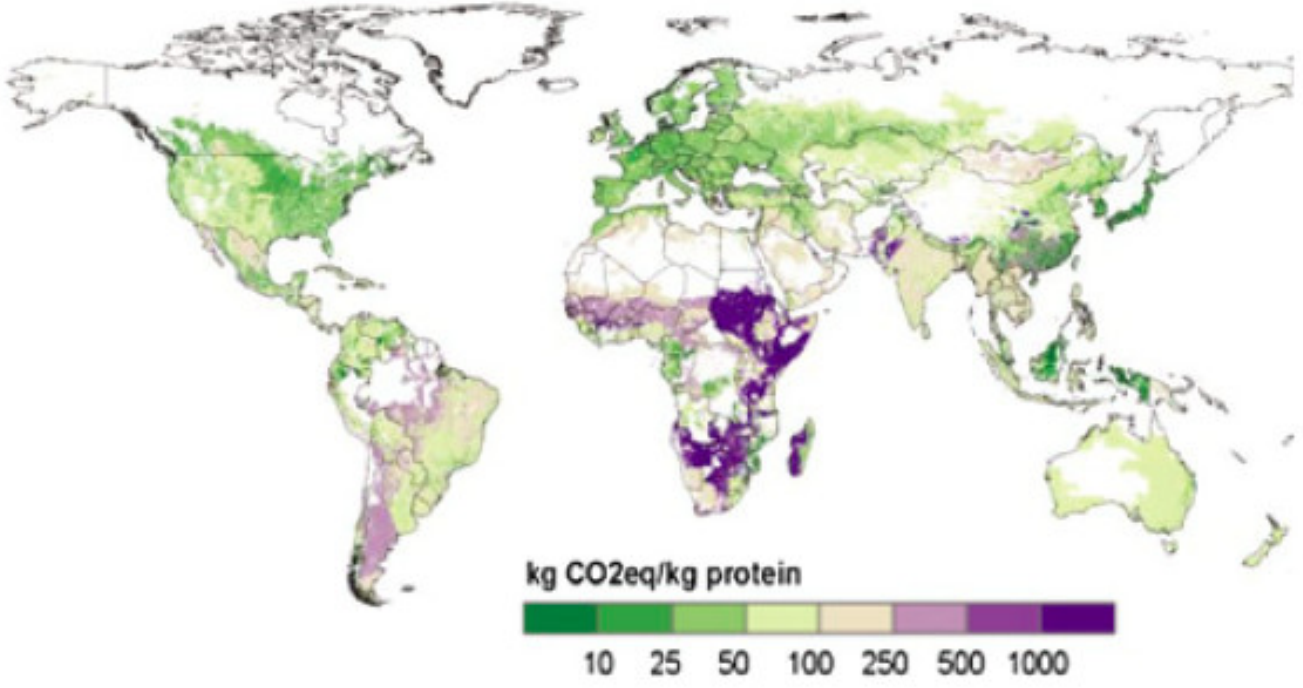
159
- Countries

154
- Water Basins

320
- Food Production Unit

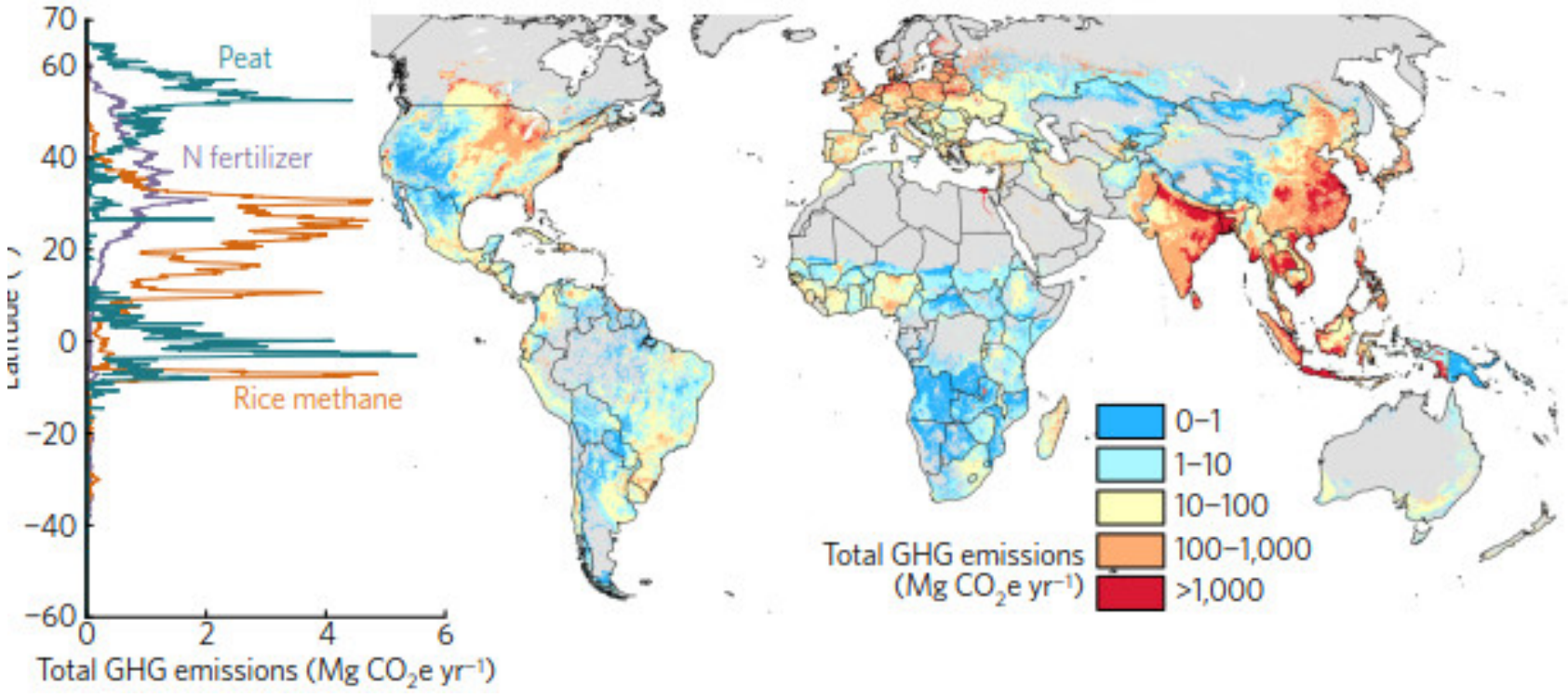
Add to that (1)

GHG emissions of livestock (Herrero et al 2013; FAOSTAT):



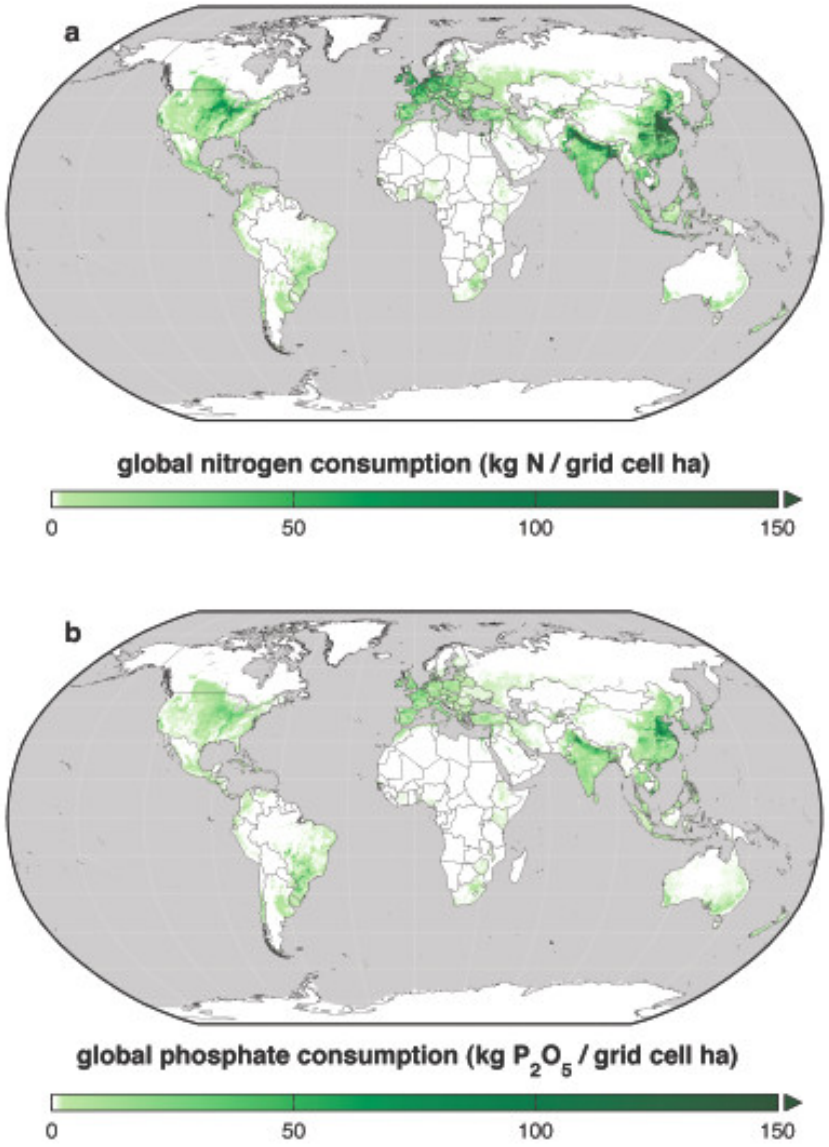
Add to that (2)

GHG emissions of crops (Carlson et al 2016):



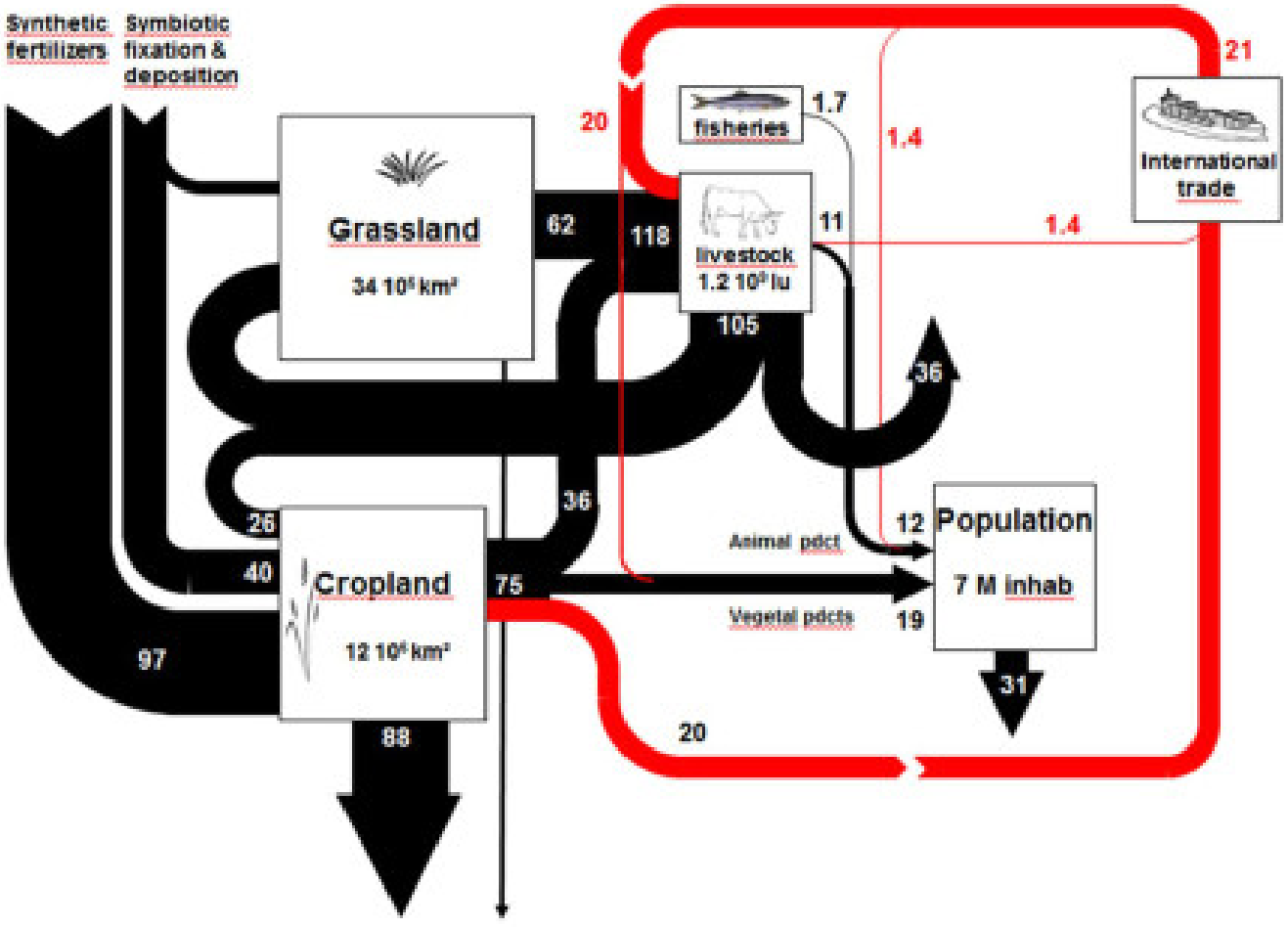
Add to that (3)

Fertilizer application (Mueller et al, 2012):



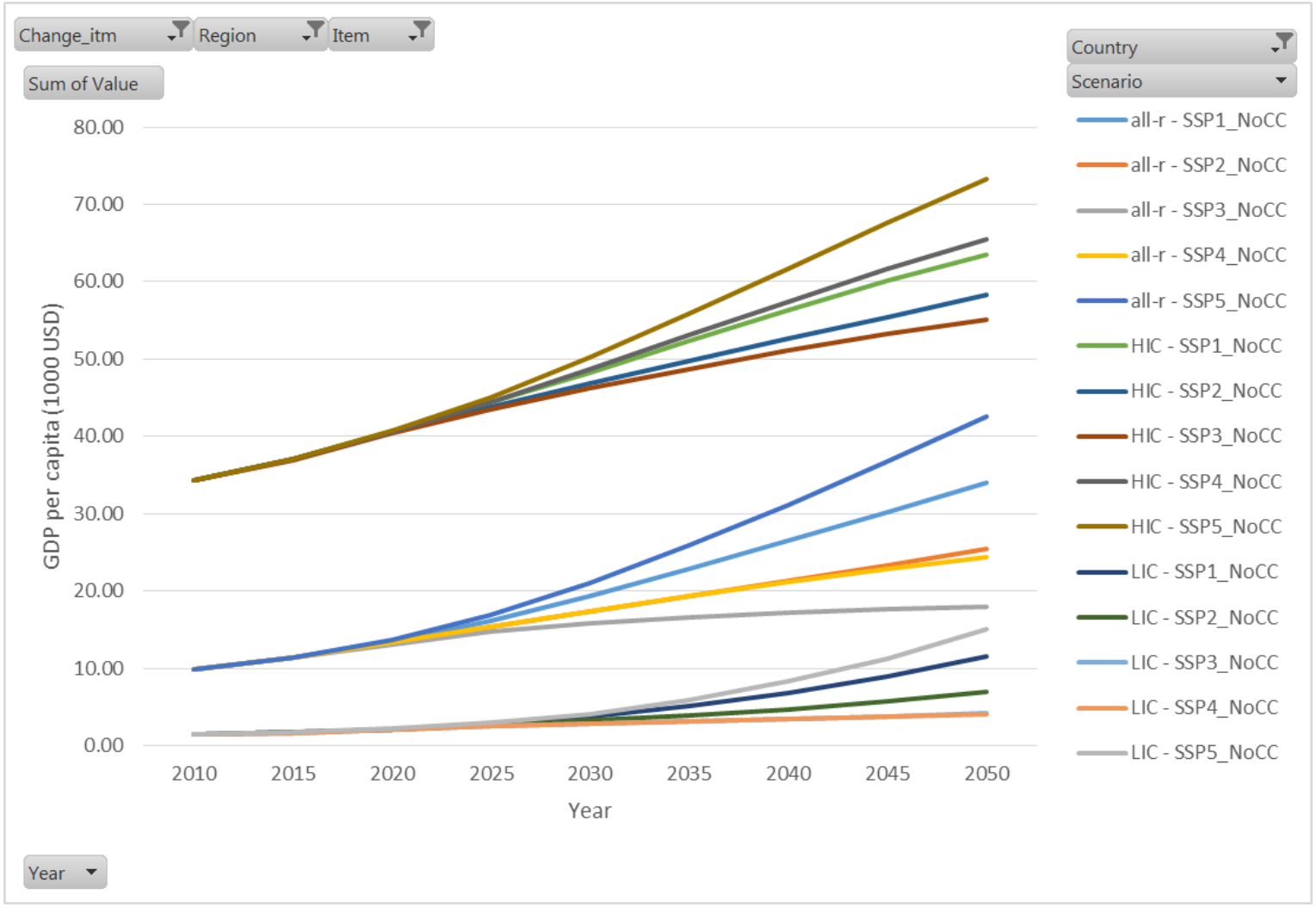
Add to that (4)

Nitrogen balance model (Lassaletta et al, 2016):



Add to that (5)

Drivers of future food demand (population and income, SSPs):



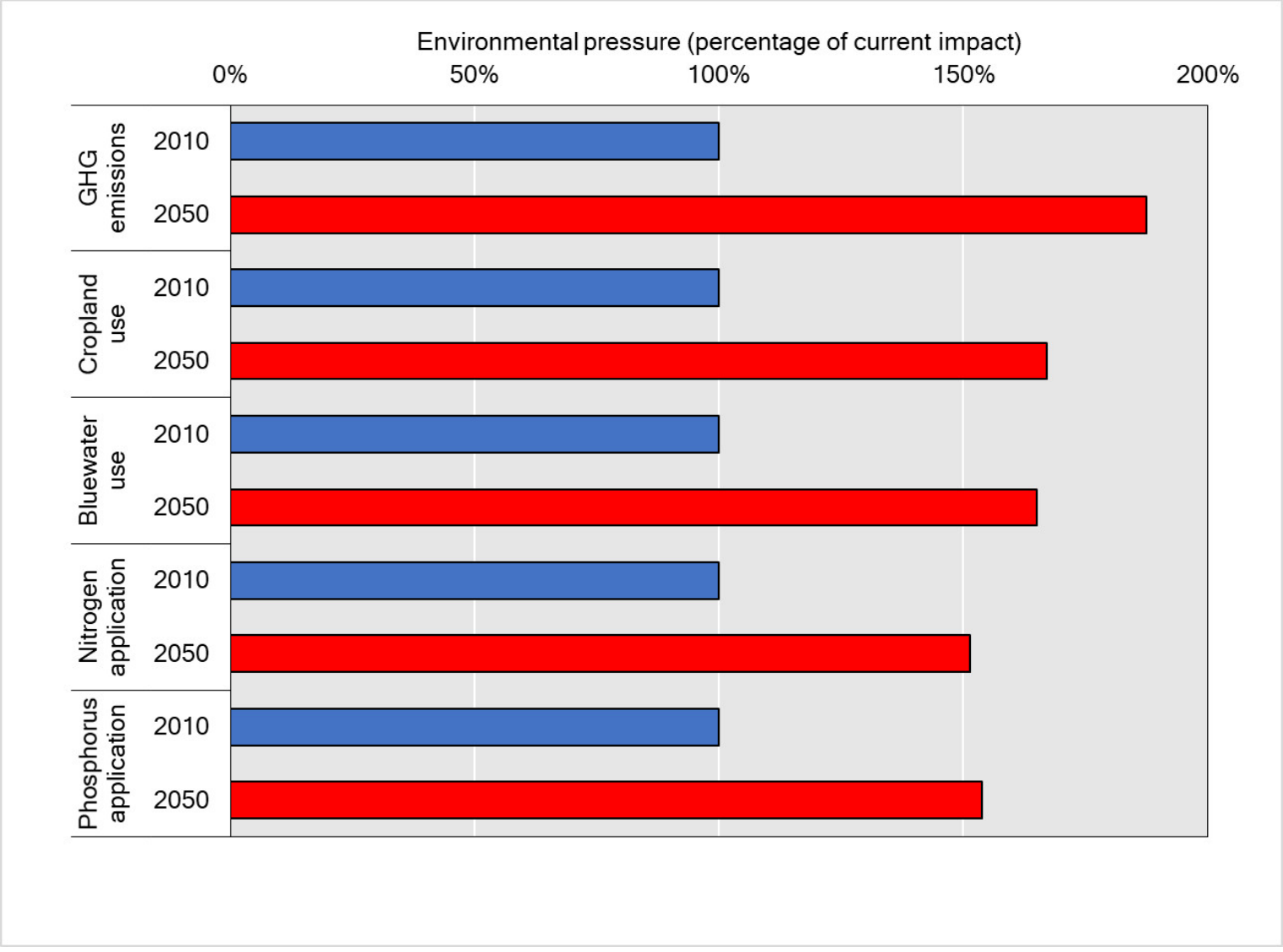
Add to that (6)

Scenario assumptions:

Waste/2	Food losses and waste are reduced by half, in line with pledges made as part of the Sustainable Development Goals.
Waste/4	Food losses and waste are reduced by three quarters, %, a value likely close to the maximum value that can be theoretical avoided (Parfitt et al., 2010).
TECH	Closing of yield gaps between attained and attainable yields to about 75% (Mueller et al., 2012; Robinson et al., 2015); Rebalancing nitrogen and phosphorus fertilizer application between over and under-applying regions (Mueller et al, 2012); improving water management, including increasing basin efficiency, storage capacity, and better utilization of rainwater (Robinson et al., 2015); and implementation of agricultural mitigation options that are economic at the projected social cost of carbon in 2050, including changes in irrigation, cropping and fertilization that reduce methane and nitrous oxide emissions for rice and other crops, as well as changes in manure management, feed conversion and feed additives that reduce enteric fermentation in livestock (Beach et al., 2015).
TECH+	Additional measures on top of TECH scenario, including additional increases in agricultural yields that close yield gaps to 90% (Mueller et al, 2012); a 30% increase in nitrogen use efficiency in line with suggested targets (Sutton et al., 2013), and 50% recycling rates of phosphorus; implementation of all available bottom-up options for mitigating food-related GHG emissions (Beach et al, 2015).
HGD	Dietary shifts towards global dietary guidelines (WHO, 2004, 2003), including maximum intakes for red meat (three 100g servings per week) and sugar (5% of energy intake), minimum intakes of fruits and vegetables (five servings a day), and energy intakes in line with recommendations on healthy body weight and physical activity (2100-2200 kcal per day on average)
FLX	Dietary shifts towards flexitarian dietary patterns based on recent evidence on healthy eating (Willett and Stampfer, 2013) that include, in addition to HGD requirements, more stringent limits for red meat (one serving a week), limits for white meat (half a portion a day) and dairy (one portion a day), and greater minimum amounts of legumes, nuts, and vegetables.
VEG VGN	Dietary shifts towards nutritionally-balanced vegetarian and vegan diets that are based on FLX diets, but substitute meat (vegetarian) or all animal products (vegan) to two thirds with legumes and to one third with vegetables, in line with observed dietary changes in those groups.

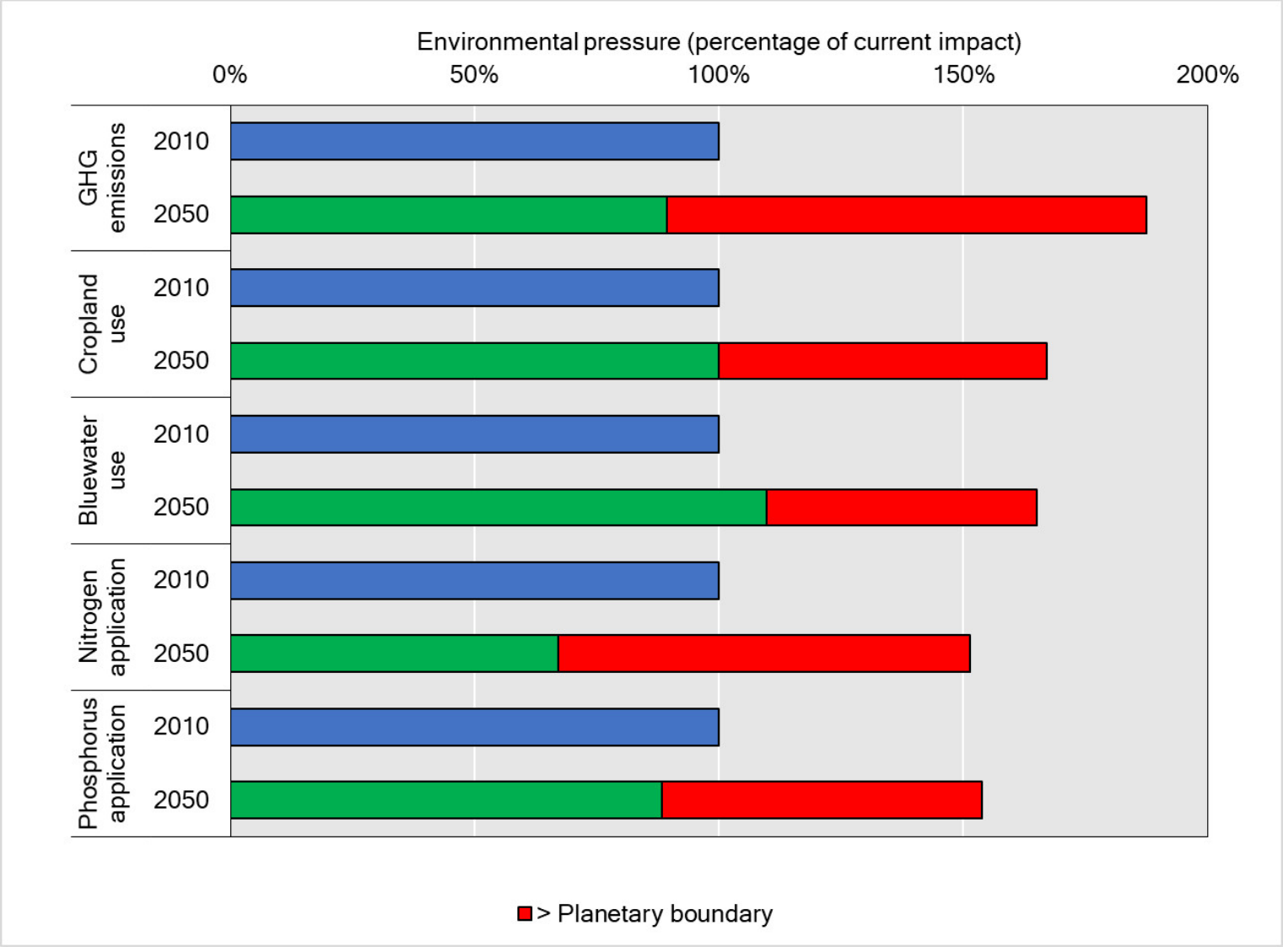
Results

Increase in resource demand by 2050: 50-90%



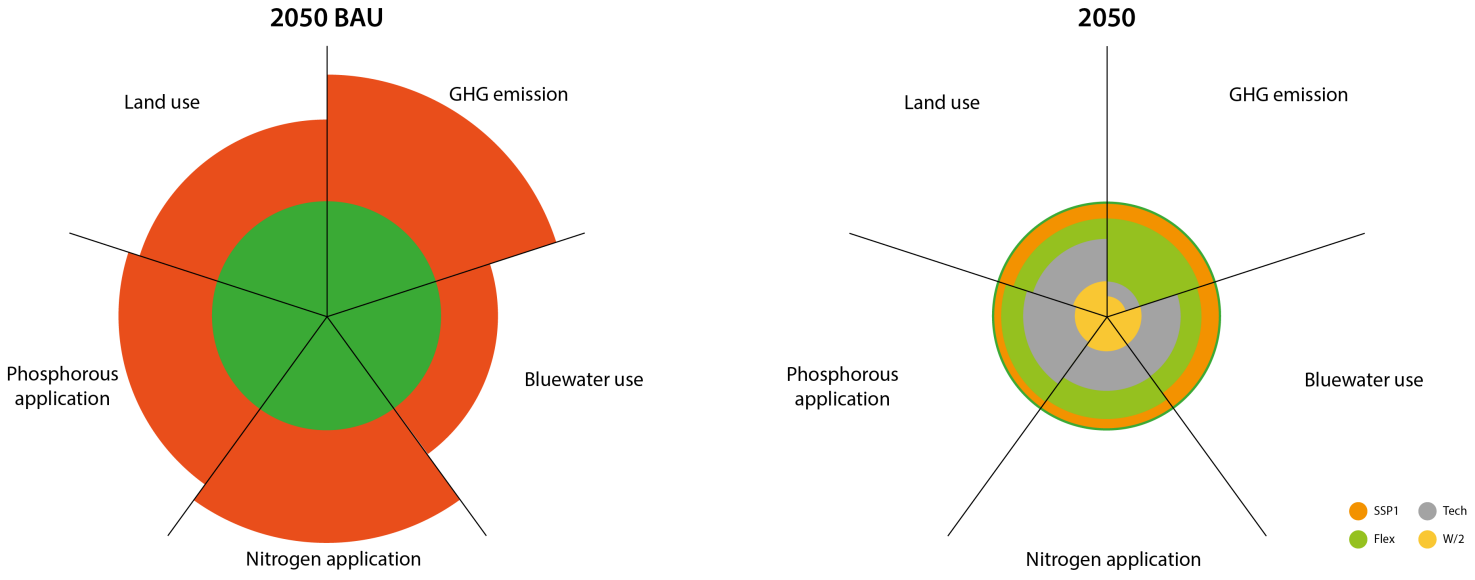
Results

All planetary boundaries could be exceeded by 2050:



Food-systems analysis

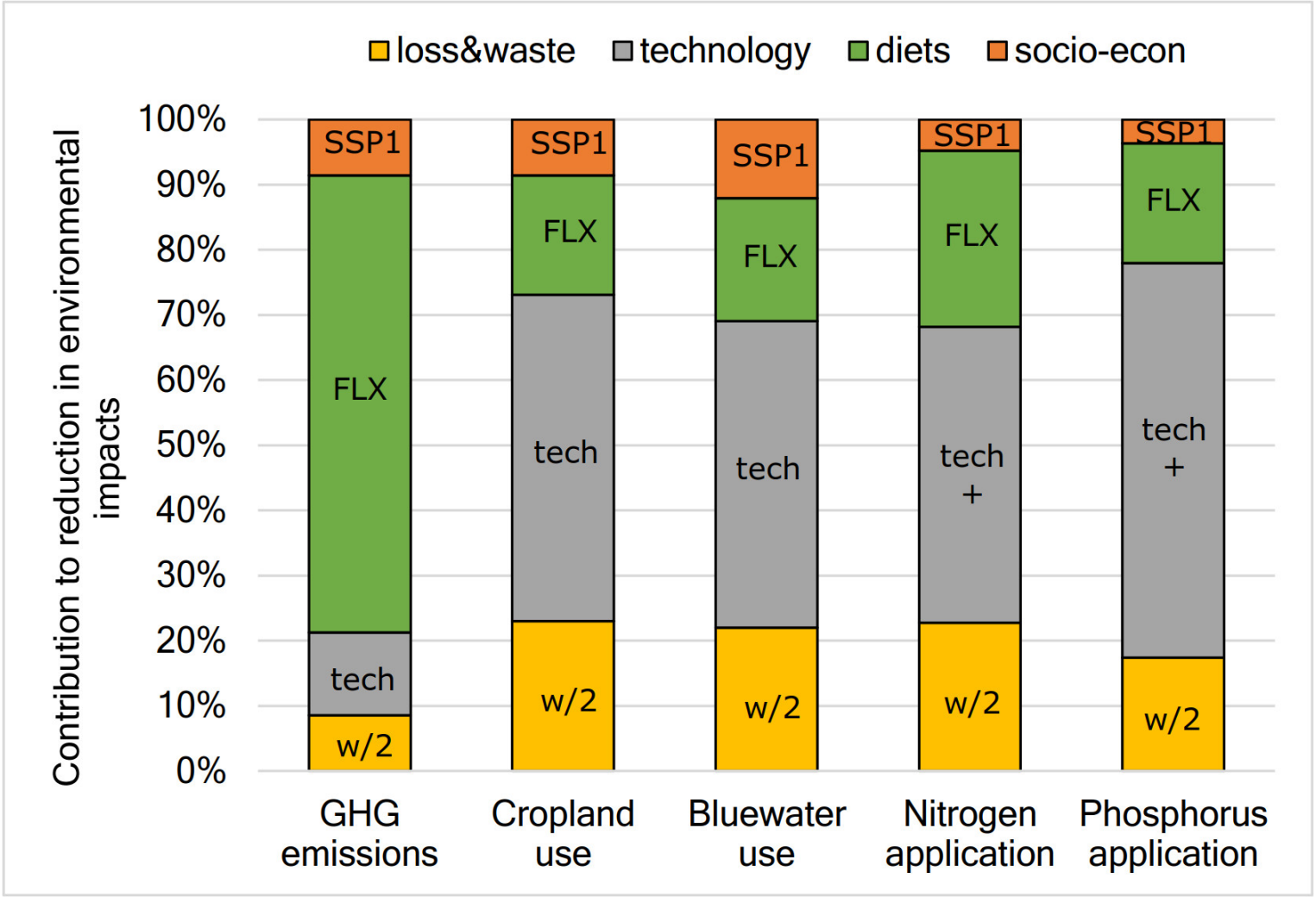
Combination of measures needed to stay within **planetary boundaries** of the food system:



Springmann et al, *Nature* 2018

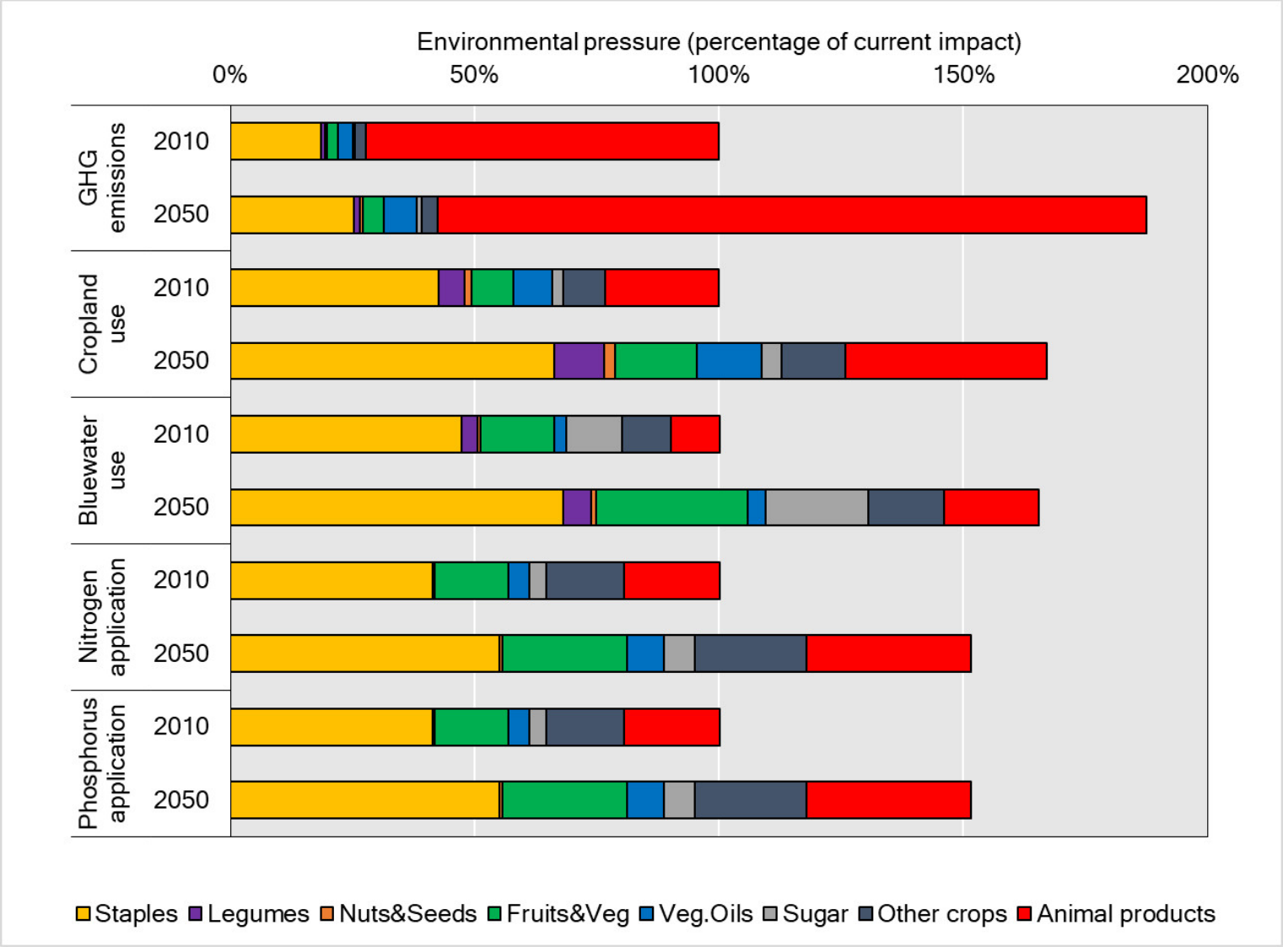
Food-systems analysis

Combination of measures to stay within environmental limits:



Results

Domains: livestock-dominated or staple-crop-dominated

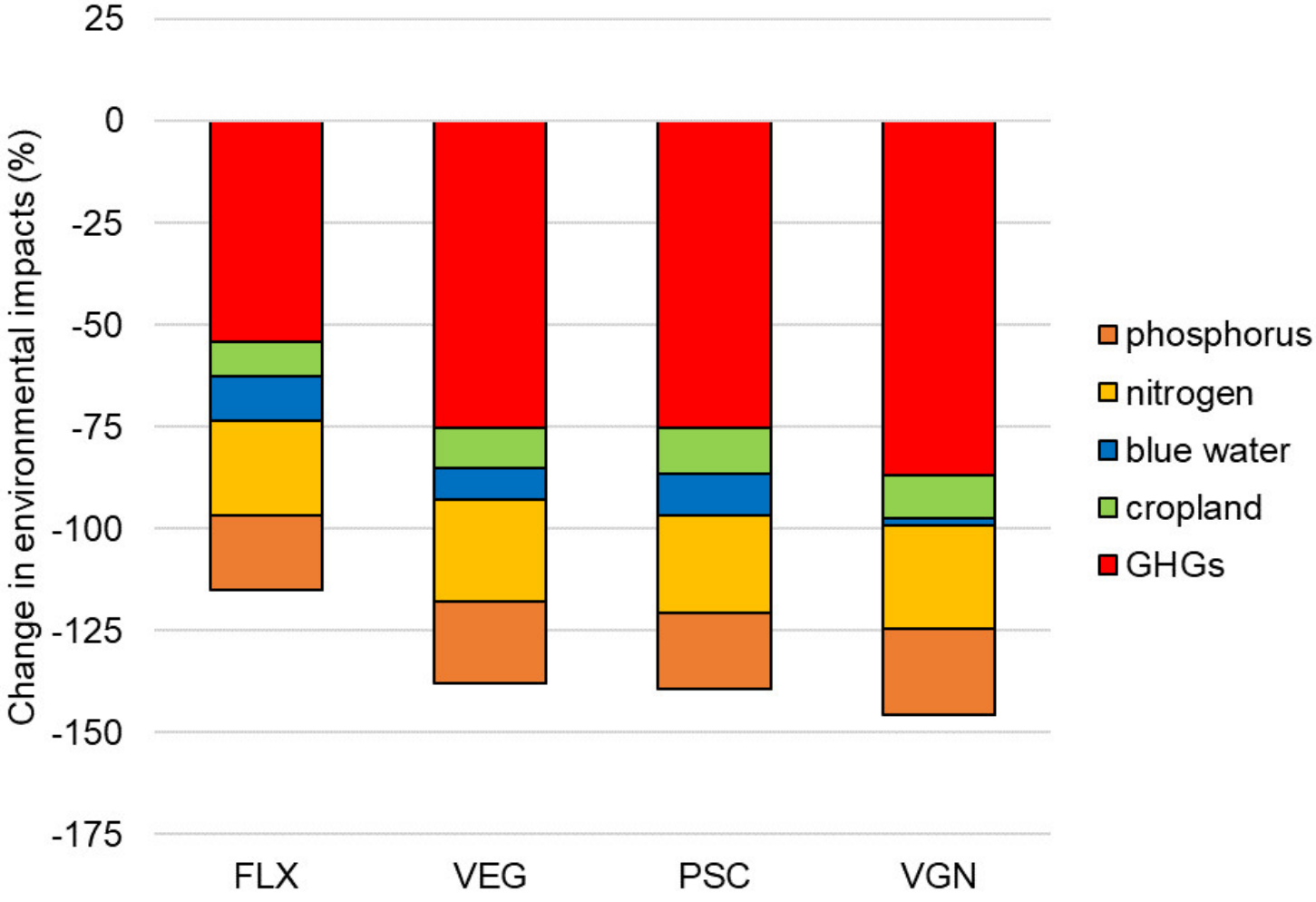


Results

Environmental **footprints** per serving of food:

Food item	GHG emissions ($10kgCO_2$/serving)	Cropland use ($10m^2$/serving)	Freshwater use ($10m^3$/serving)	Nitrogen use (10gN/serving)	Phosphorus use (10gP/serving)
wheat	0.10	1.51	0.22	12.93	1.98
rice	0.53	1.58	0.48	16.49	2.34
maize	0.08	0.89	0.07	10.25	1.60
other grains	0.13	2.76	0.07	7.36	1.22
roots	0.08	0.76	0.05	3.99	0.78
legumes	0.08	3.86	0.33	0.00	0.00
soybeans	0.04	1.38	0.05	0.96	2.06
nuts & seeds	0.21	1.92	0.13	4.28	0.63
vegetables	0.05	0.41	0.07	8.12	1.42
fruits (temperate)	0.11	1.65	0.47	17.82	2.67
fruits (tropical)	0.13	1.32	0.45	14.38	2.21
fruits (starchy)	0.15	1.18	0.16	8.76	1.50
sugar	0.01	0.07	0.05	0.89	0.15
palm oil	0.26	0.43	0.00	3.13	0.50
vegetable oil	0.09	1.44	0.07	5.98	1.61
beef	35.74	4.64	0.24	30.01	5.89
lamb	36.33	6.86	0.54	30.27	5.43
pork	3.21	6.69	0.38	56.68	9.75
poultry	1.55	7.25	0.44	55.22	9.92
eggs	0.79	3.43	0.22	25.61	4.40
milk	2.93	3.21	0.19	15.18	3.79
shellfish	0.08	0.40	0.04	3.69	0.89
fish (freshwater)	0.33	1.66	0.11	18.46	3.98
fish (demersal)	0.02	0.14	0.01	1.32	0.32
fish (pelagic)	0.00	0.00	0.00	0.00	0.00

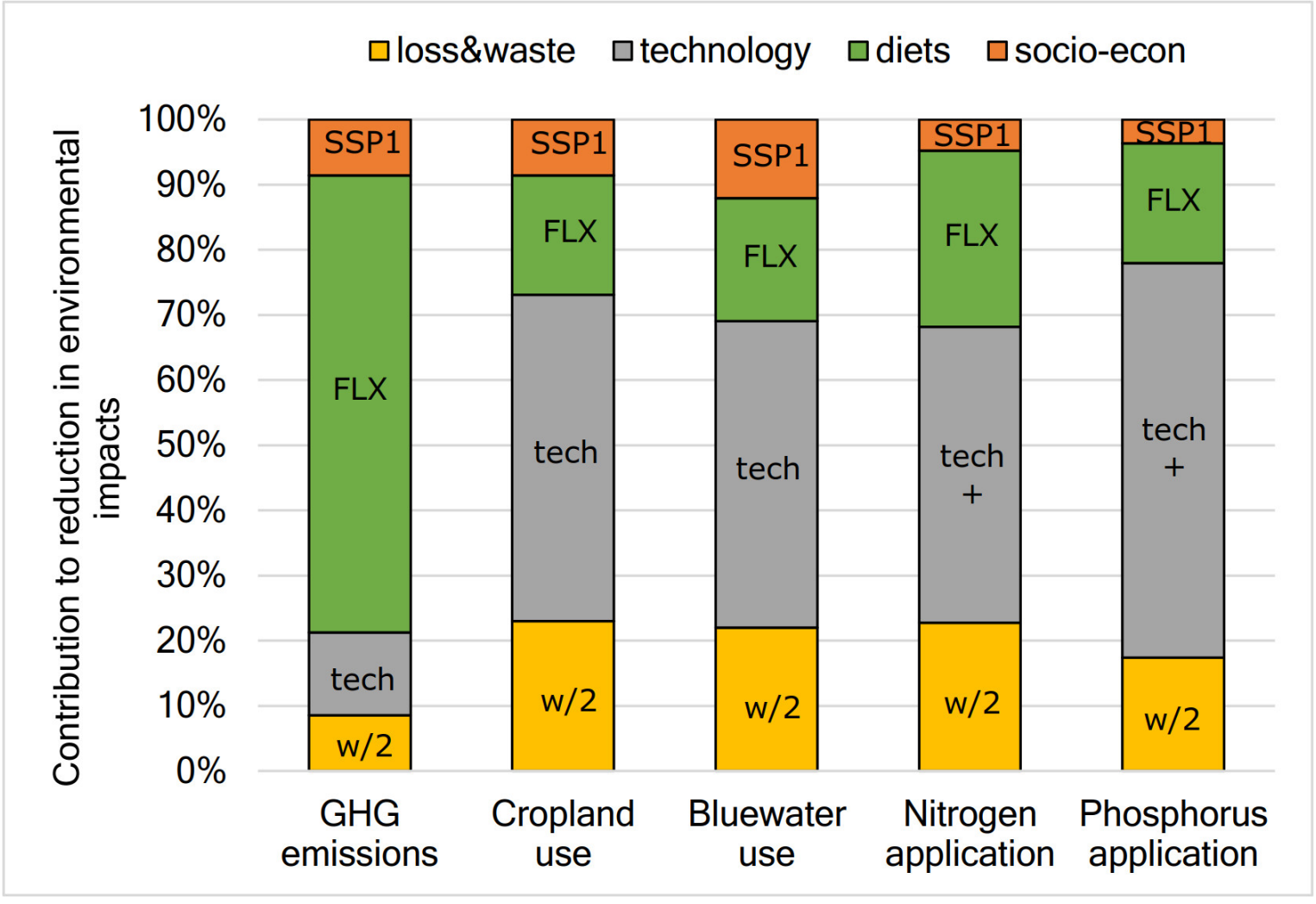
Environmental analysis



Springmann et al, *Lancet Planetary Health* 2018

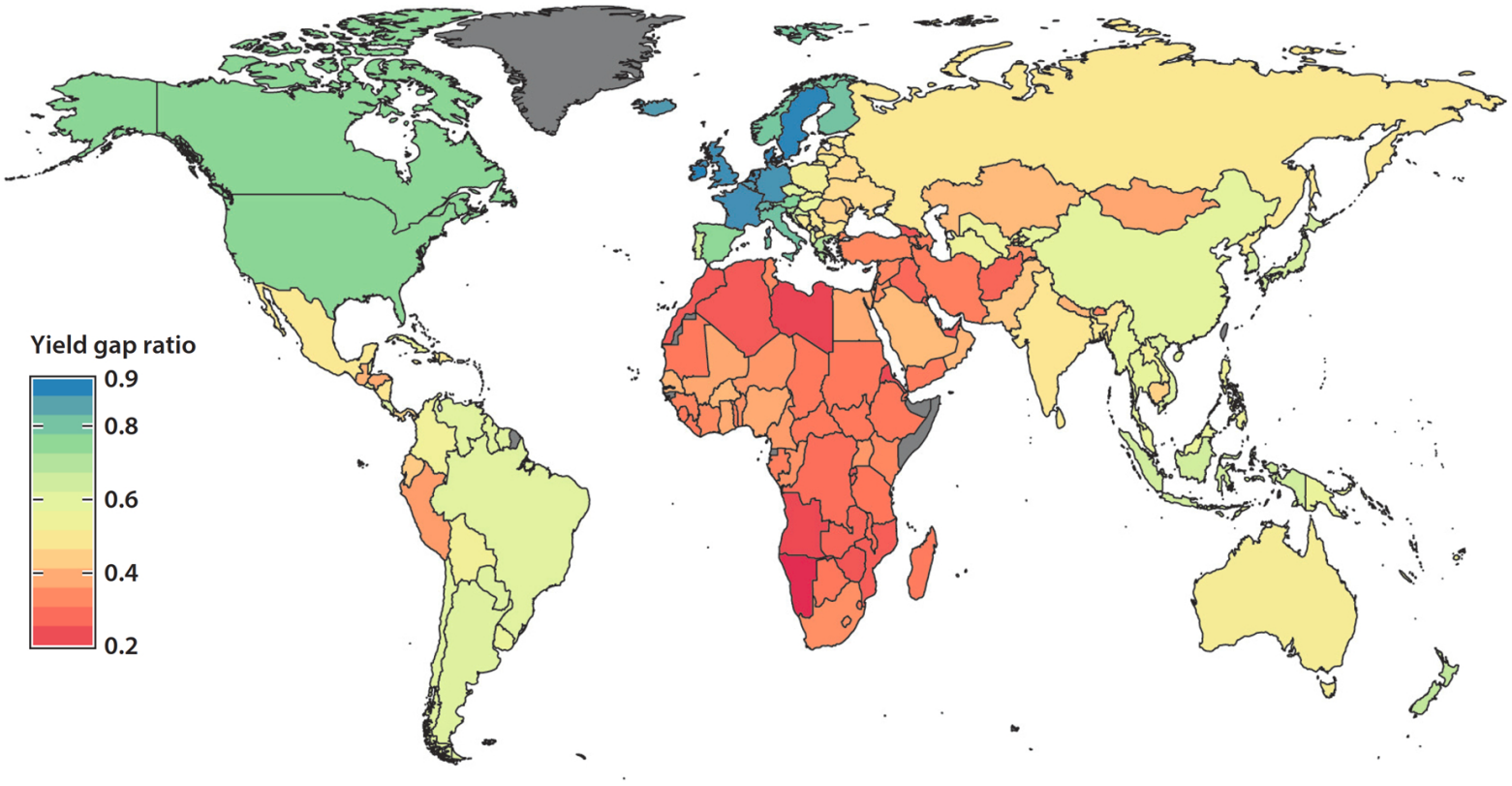
Food-systems analysis

Combination of measures to stay within environmental limits:



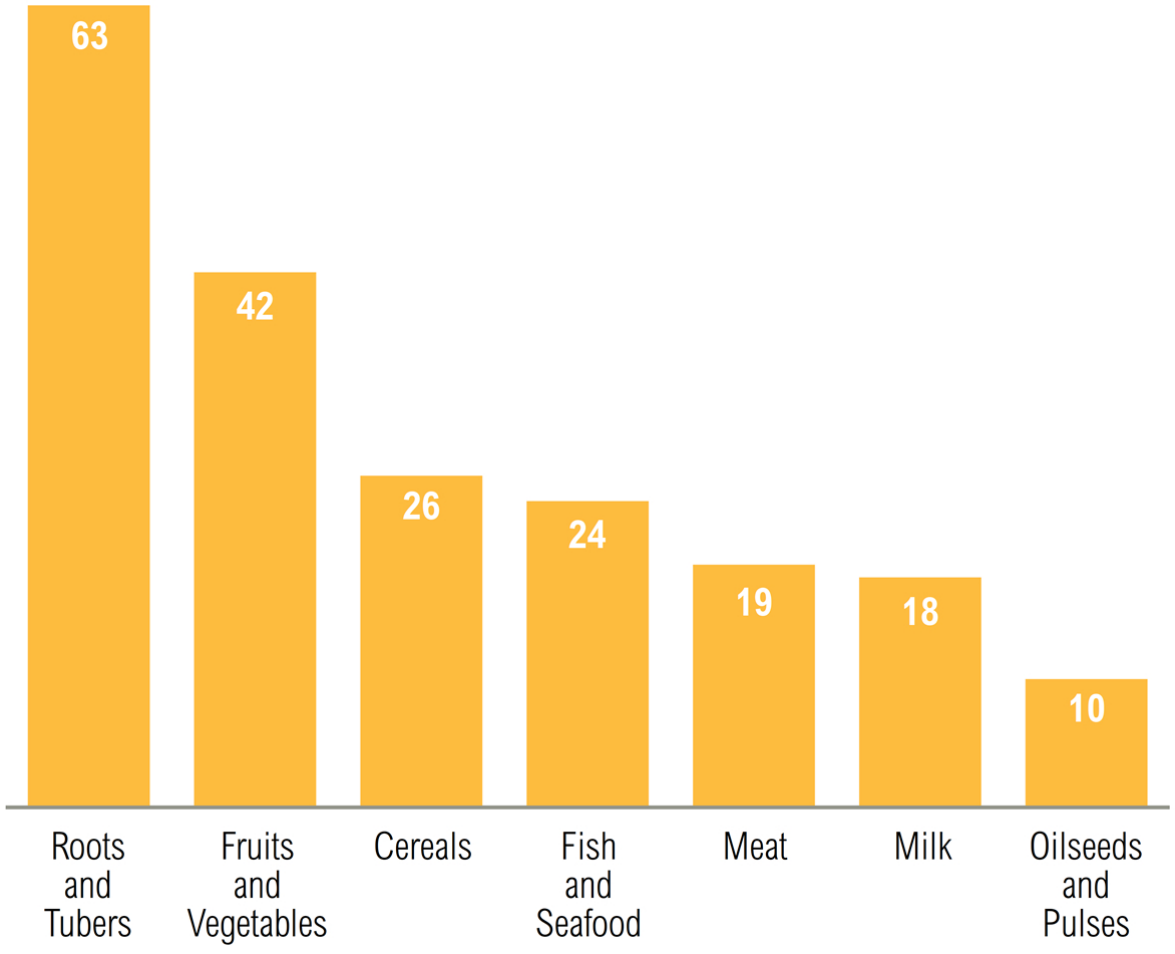
Food-systems analysis

Unequal **distribution** of technology and capital (Mueller et al, 2012):



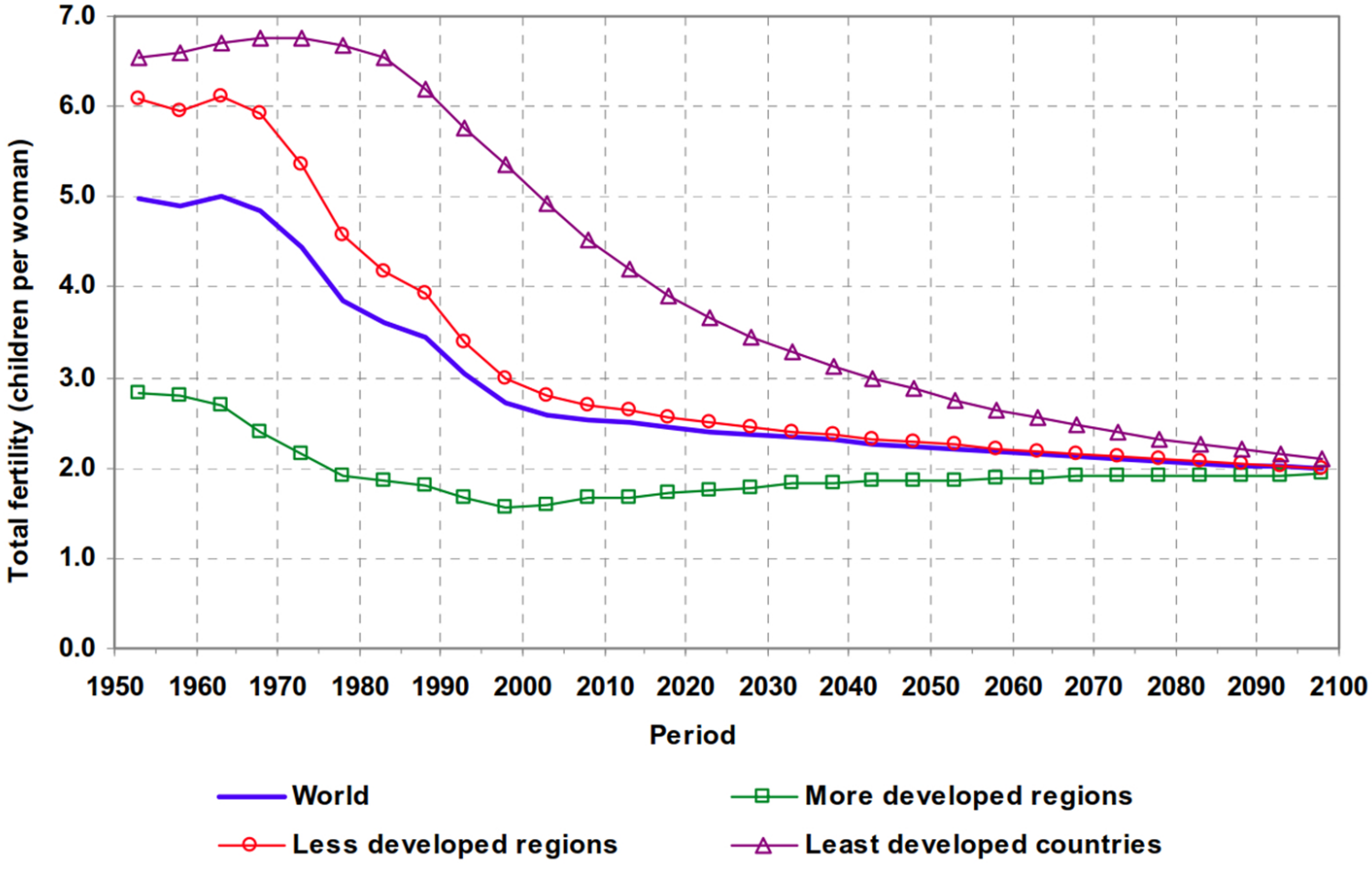
Food-systems analysis

Food **waste** by food group (FAO, 2012; WRI, 2013):



Food-systems analysis

Fertility by region (UN Population Division, 2013):



Policy implications

Improvements in technologies and management:

- Investments in public infrastructure
- Farm-level incentives/support to adopt best available technologies
- Better environmental regulation (eg water use and quality)

Reductions in food loss and waste:

- *Loss*: investments in agricultural infrastructure, technological skills, storage, transport and distribution
- *Waste*: Closed-loop supply chains, packaging, labelling and awareness campaigns

Improvements in socio-economic development:

- Investments in education, especially for women
- Improved access to general and reproductive health services

Dietary change

How to incentivise healthy and sustainable diets?

- Providing information without additional economic or environmental changes has limited influence on behaviour;
- Integrated, multicomponent approaches that include clear policy measures are best suited for changing diets (Mozaffarian et al, 2012, 2016):

1. Media and education campaigns; labelling and consumer information; update national dietary guidelines
2. Fiscal measures, such as taxation, subsidies, and other economic incentives, including for producers
3. School and workplace approaches; local environmental changes;
4. Direct restriction and mandates

Dietary change

How to incentivise healthy and sustainable diets?

- Providing information without additional economic or environmental changes has limited influence on behaviour;
- Integrated, multicomponent approaches that include clear policy measures are best suited for changing diets (Mozaffarian et al, 2012, 2016):

1. Media and education campaigns; labelling and consumer information; update national dietary guidelines
2. Fiscal measures, such as taxation, subsidies, and other economic incentives, including for producers
3. School and workplace approaches; local environmental changes;
4. Direct restriction and mandates

Dietary guidelines

National food-based dietary guidelines (FBDGs) are:

- political, government endorsed documents intended to provide context-specific recommendations and advice on healthy diets and lifestyles (WHO, 1998);
- form basis for educational programmes and national food and nutrition policies (FAO, 2016);

$\Rightarrow$ FBDGs are important starting point for food-system regulation, in addition to being a communication tool

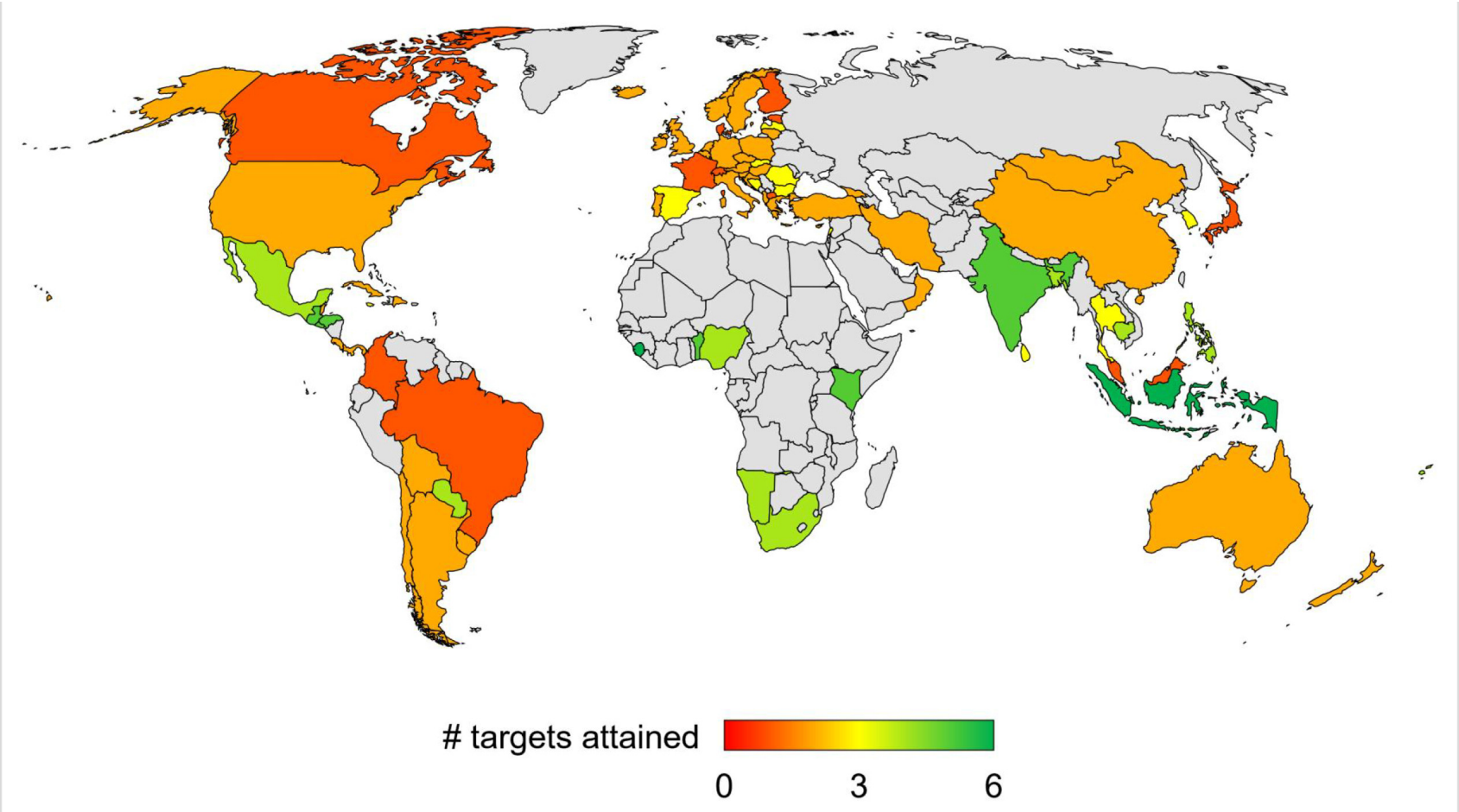
Difference between recommendations and current intake

Food group	Percentage difference between recommended intake and current intake								
	Average	Europe	North America	Near East	Asia and Pacific	Latin America	Africa	WHO	EAT-Lancet
Legumes	+166	+197	+90	+309	+128	+279	+240		+247
Whole grains	+122	+119	-16	+194	+144	+160	+113	+241	+362
Milk	+60	+16	+21	+534	+103	+53	+32		+9
Fish	+36	+56	+21	-0	+32	+53	+55		+5
Nuts&seeds	+22	+56	+18	+1	+7	+132	+29		+428
Fruits&veg	+18	+17	+62	-43	+14	+29	+54	-8	+15
◦ Fruits	+34	+16	+57	-18	+43	+13	+50	+7	+28
◦ Vegetables	+9	+18	+67	-60	+2	+64	+58	-17	+7
Eggs	+17	+5	-57	+9	+25	+45	+20		-51
Sugar	-6	-15	-47	-23	+23	-41	-2	+9	-33
Meat	-28	-36	-48	-5	-29	-1	-19	-9	-49
◦ Poultry	-13	-19	-48	-3	-13	+29	-18		+5
◦ Red meat	-34	-38	-46	-8	-39	-4	-15		-68
◦ Processed meat	-44	-51	-50	-11	-13	-73	-46	-56	-100
Energy intake	-6	-14	-18	-8	-3	-11	+7	-6	-6

Uncertainty score by food group and region

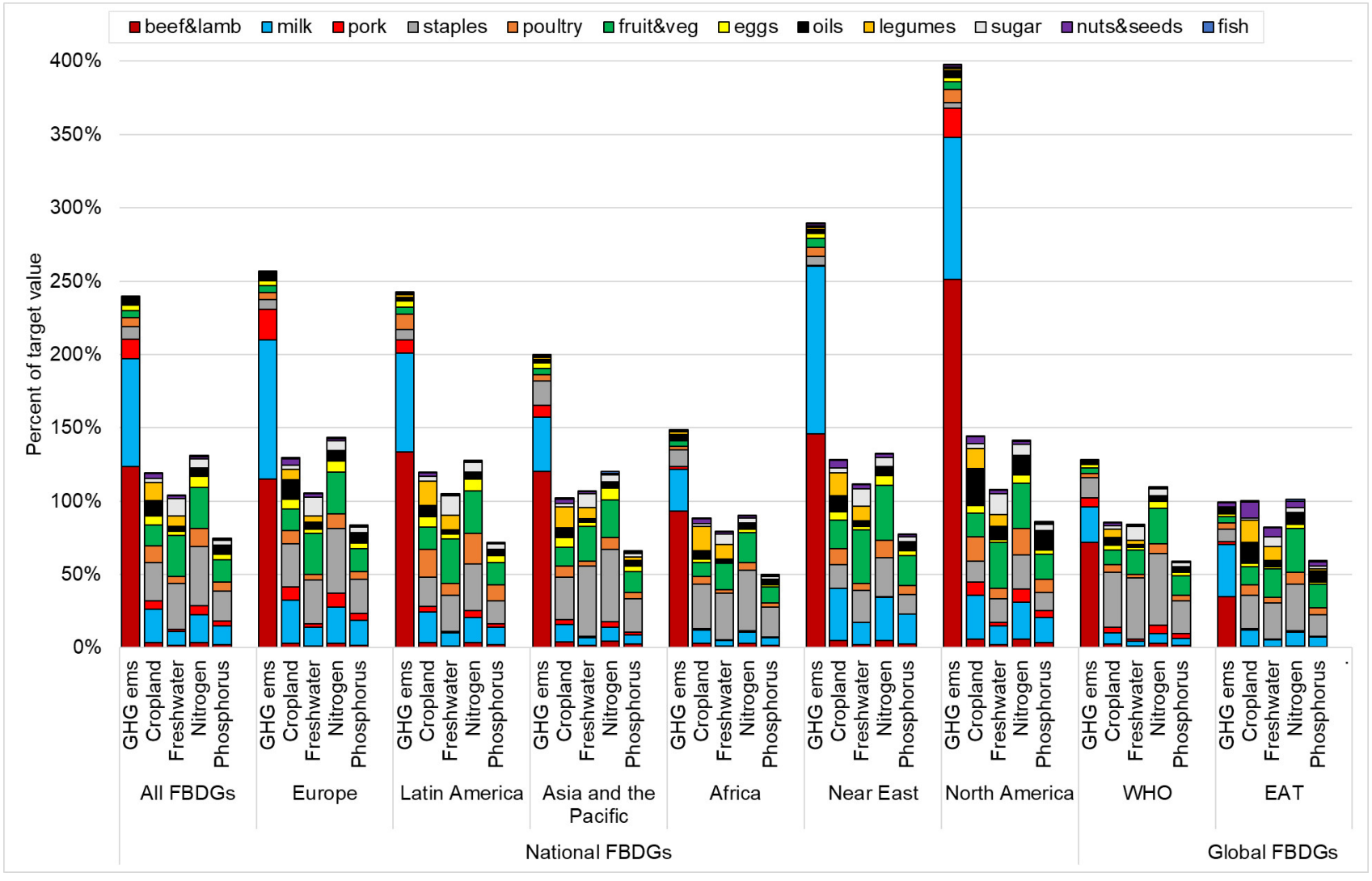
Food group	Regions of national FBDGs							Global FBDGs	
	Average	Europe	North America	Near East	Asia and Pacific	Latin America	Africa	WHO	EAT-Lancet
Total	3.2	2.9	3.0	3.0	3.3	3.4	3.8	4.0	1.0
Fruits&veg	1.9	1.6	3.0	2.0	1.7	2.1	2.5	1.0	1.0
Milk	2.3	1.6	3.0	2.0	2.3	2.8	3.7	5.0	1.0
Sugar	2.8	2.9	1.0	2.0	2.9	2.7	3.8	1.0	1.0
Fish	2.9	2.1	3.0	2.3	3.4	3.7	3.7	5.0	1.0
Legumes	3.2	3.5	2.5	2.0	3.1	3.0	3.5	5.0	1.0
Eggs	3.3	3.1	3.0	4.3	2.9	3.5	4.2	5.0	1.0
Red meat	3.4	2.9	4.5	4.0	3.8	3.7	3.8	5.0	1.0
Nuts&seeds	3.8	3.2	2.5	4.7	4.4	4.0	4.5	5.0	1.0
Whole grains	3.9	3.7	2.5	3.0	3.9	4.3	4.2	4.0	1.0
Processed meat	4.2	4.6	5.0	3.3	4.5	3.8	3.8	4.0	1.0
Energy balance	0.8	0.7	1.0	1.0	0.9	0.9	0.7	1.0	1.0

Number of global targets attained

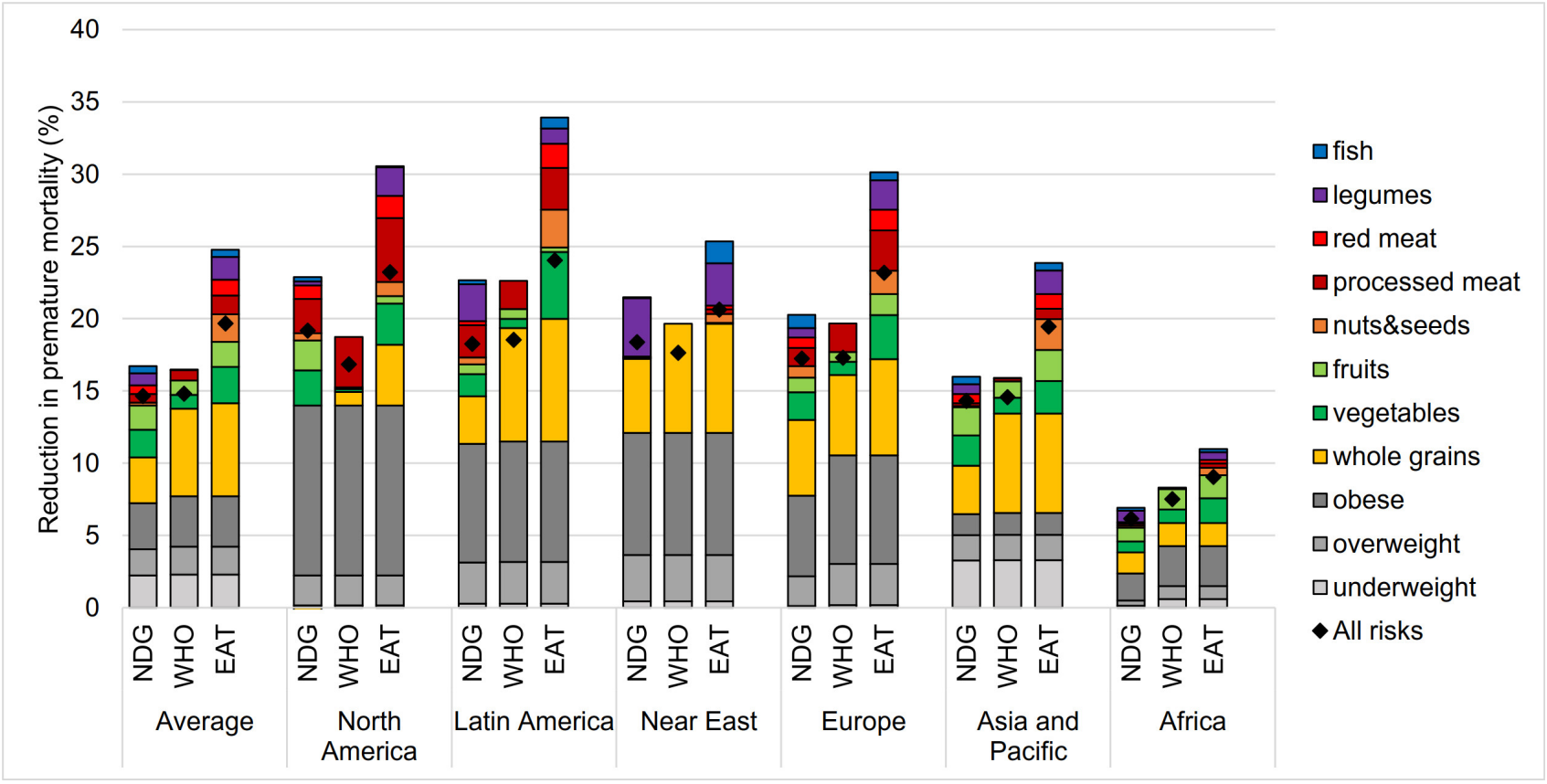


- 98% of FBDGs did not meet at least one target
- 67% of FBDGs only fulfilled 1-2 targets

Target attainment by region and food group



Health impacts

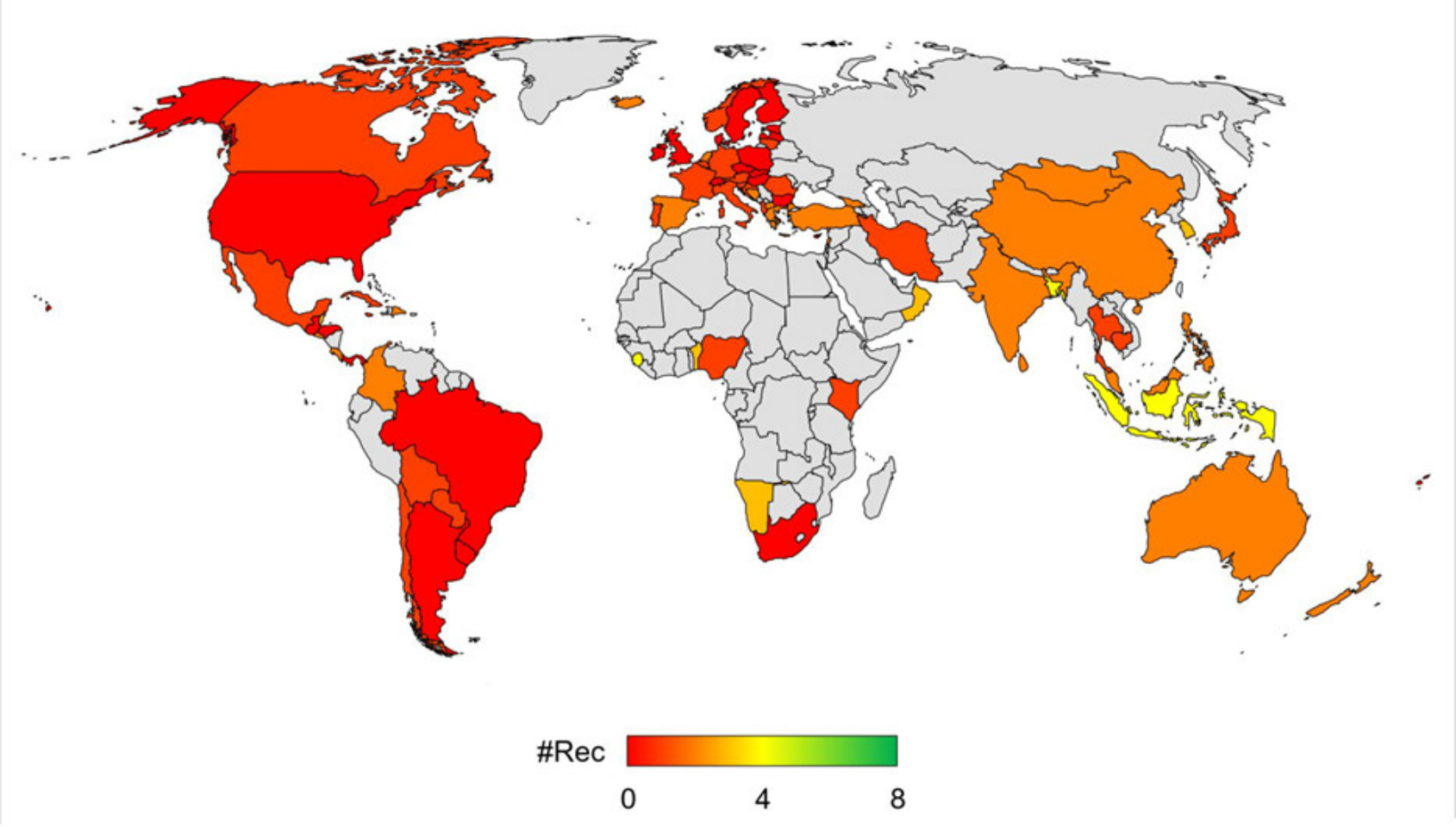


Discussion

Take-away messages:

- Dietary guidelines inform national policies (health programmes, procurement, etc).
- Many dietary guidelines are not sustainable when adopted globally (and could also be healthier).
- Reason is lack of limits for animal products.
- Updating guidelines in light of sustainability concerns is essential first step for progressive food-policy reforms.

Number of recommendations achieved

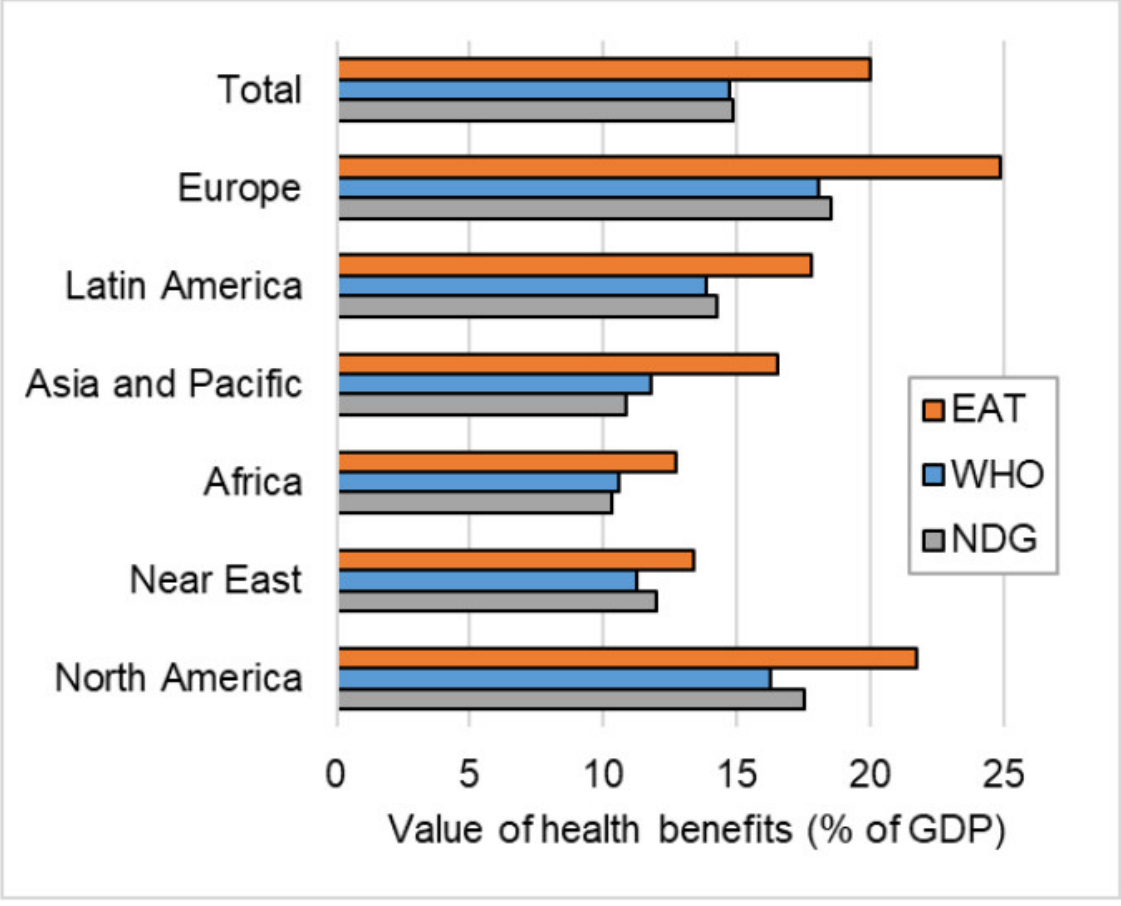


Discussion

Take-away messages:

- Even with progressive FBDGs, poor adherence is a problem

⇒ Need for investment in health promotion programmes and policy coherence



Dietary change

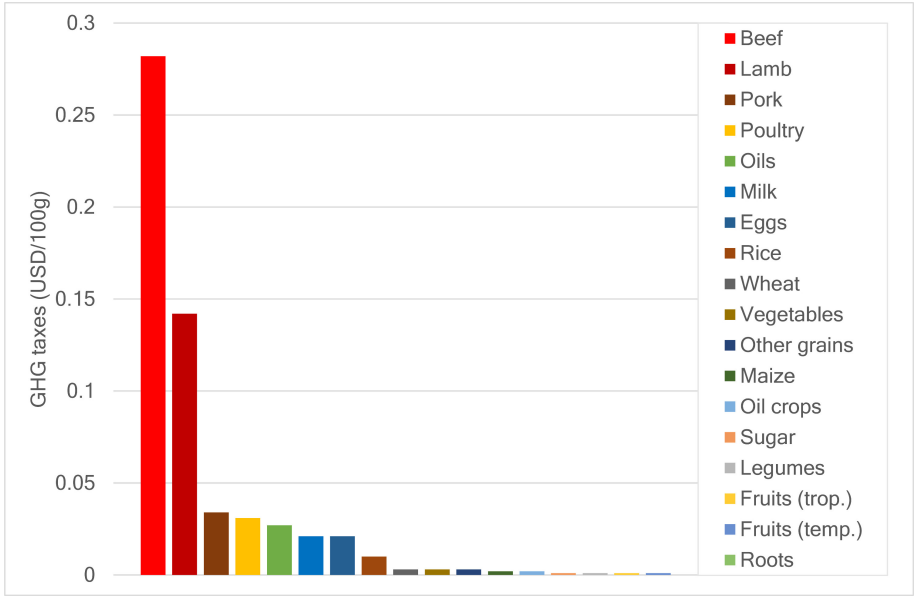
How to incentivise healthy and sustainable diets?

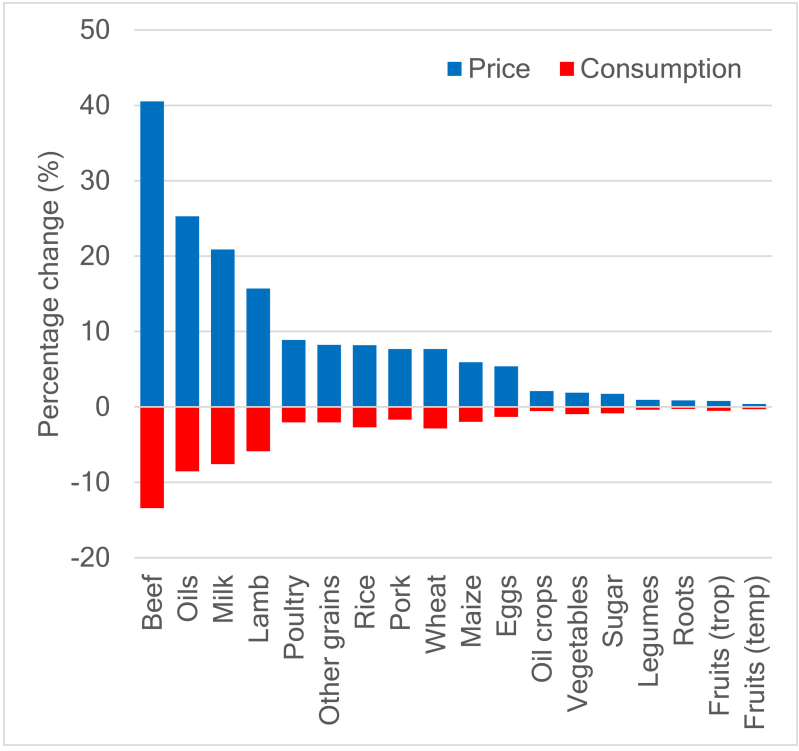
- Providing information without additional economic or environmental changes has limited influence on behaviour;
- Integrated, multicomponent approaches that include clear policy measures are best suited for changing diets (Mozaffarian et al, 2012, 2016):

1. Media and education campaigns; labelling and consumer information; update national dietary guidelines
2. Fiscal measures, such as taxation, subsidies, and other economic incentives, including for producers
3. School and workplace approaches; local environmental changes;
4. Direct restriction and mandates

Fiscal incentives

Adjust food prices for climate damages
(Springmann et al, 2017, *Nature Climate Change*):





Design of emissions taxes on foods

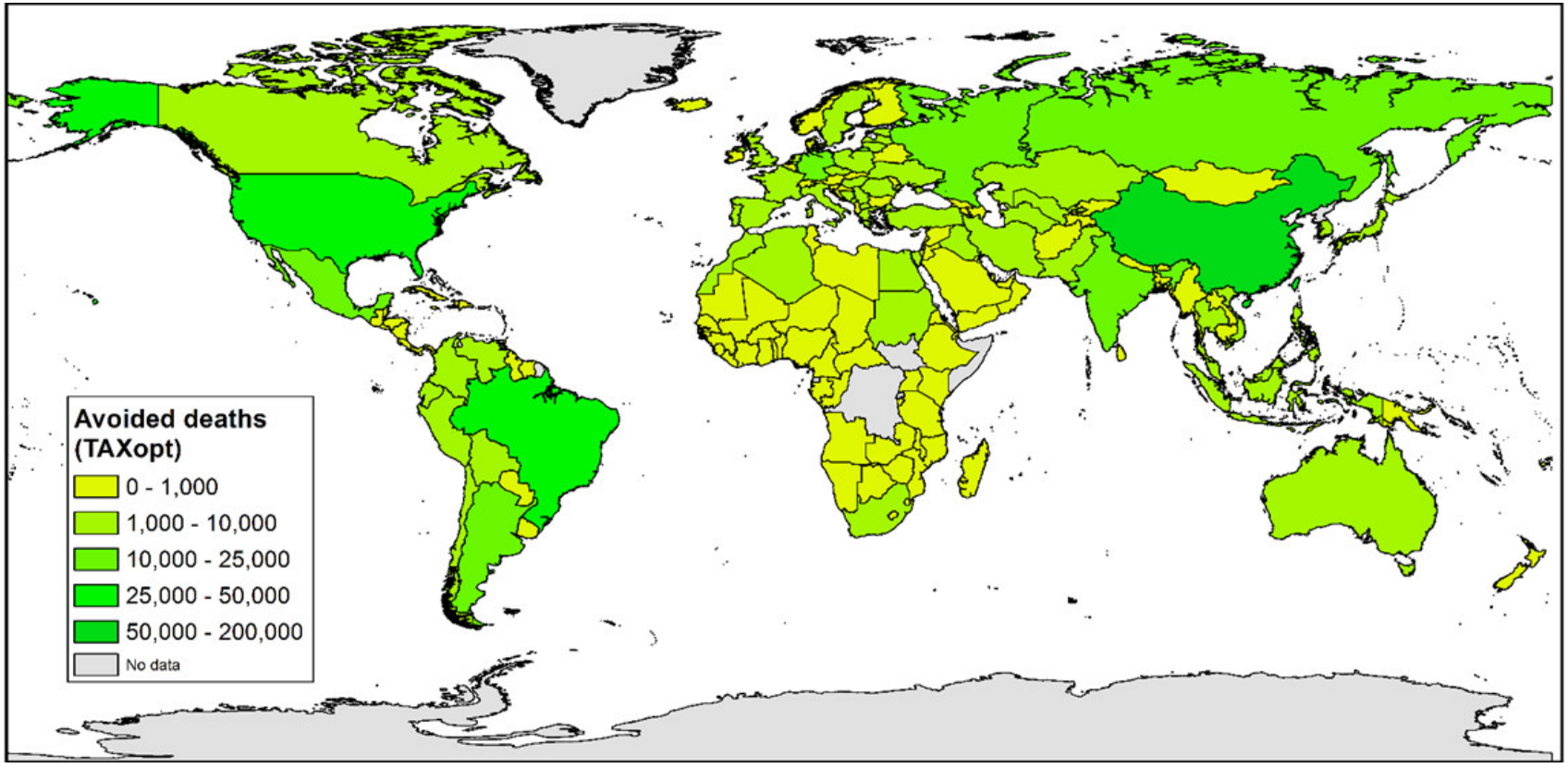
Model scenarios:

- *TAX*: GHG taxes on all food commodities
- *TAXadj*: Tax exemptions for health-critical food groups in dev countries (fruits&veg and staples)
- *TAXani*: GHG taxes only on animal products (meat, dairy, eggs)
- *TAXrem*: GHG taxes only on red meat (beef, lamb, pork)
- *TAXbef*: GHG taxes only on beef
- Income-compensated variants ($_r$)
- Variants in which half of tax revenues are used to subsidize fruits&veg ($_s$)

$\Rightarrow$ **15** different tax scenarios

Optimal tax scenario

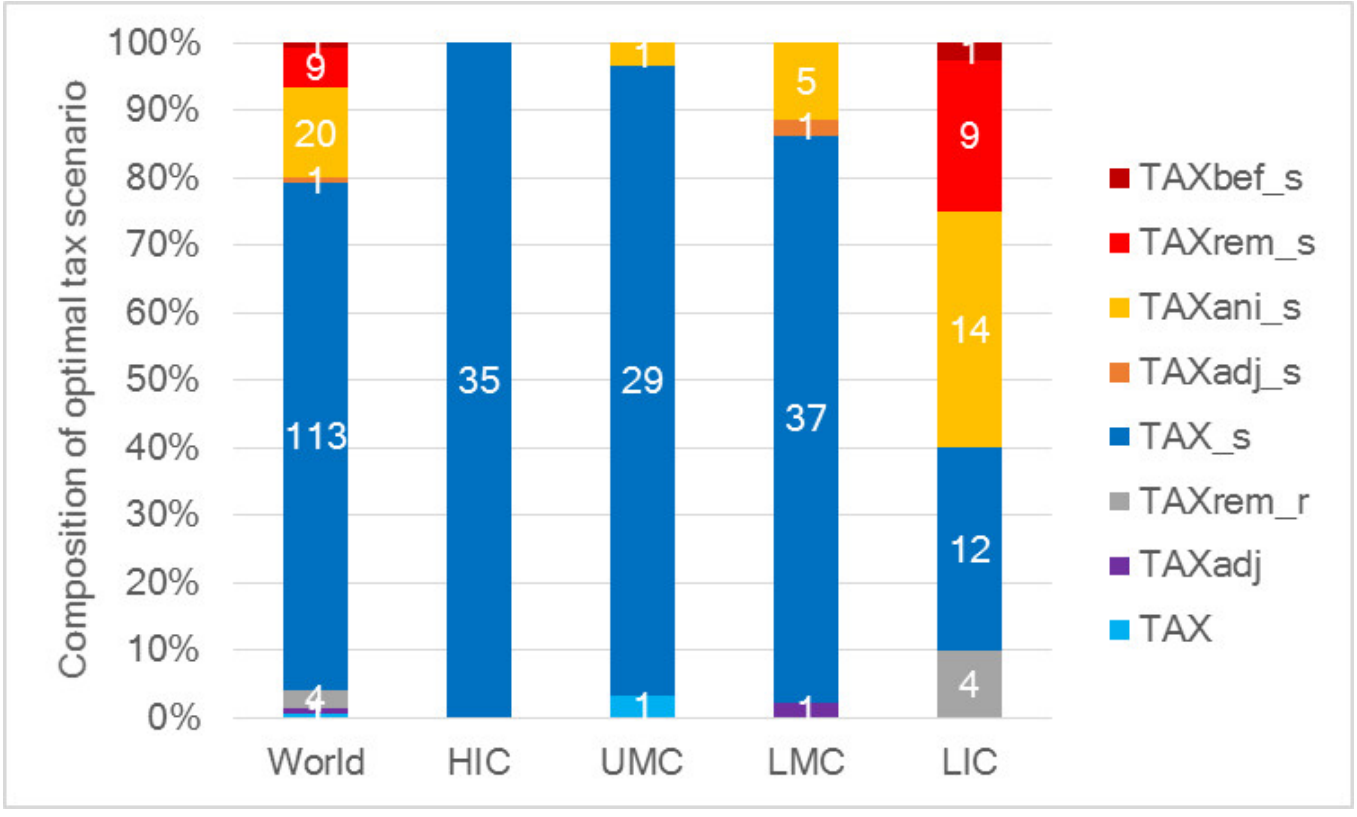
Health-sensitive taxing scheme



Optimal tax scenarios

Health-maximising tax scenario for each region:

- Optimization across all 15 tax scenarios:



Fiscal incentives

Adjust food prices for health costs
(Springmann et al, 2018, *PLOS One*):

International Agency for Research on Cancer

World Health Organization

PRESS RELEASE
N° 240

26 October 2015

IARC Monographs evaluate consumption of red meat and processed meat

Lyon, France, 26 October 2015 – The International Agency for Research on Cancer (IARC), the cancer agency of the World Health Organization, has evaluated the carcinogenicity of the consumption of red meat and processed meat.

Red meat

After thoroughly reviewing the accumulated scientific literature, a Working Group of 22 experts from 10 countries convened by the IARC Monographs Programme classified the consumption of red meat as *probably carcinogenic to humans* (Group 2A), based on *limited evidence* that the consumption of red meat causes cancer in humans and *strong* mechanistic evidence supporting a carcinogenic effect.

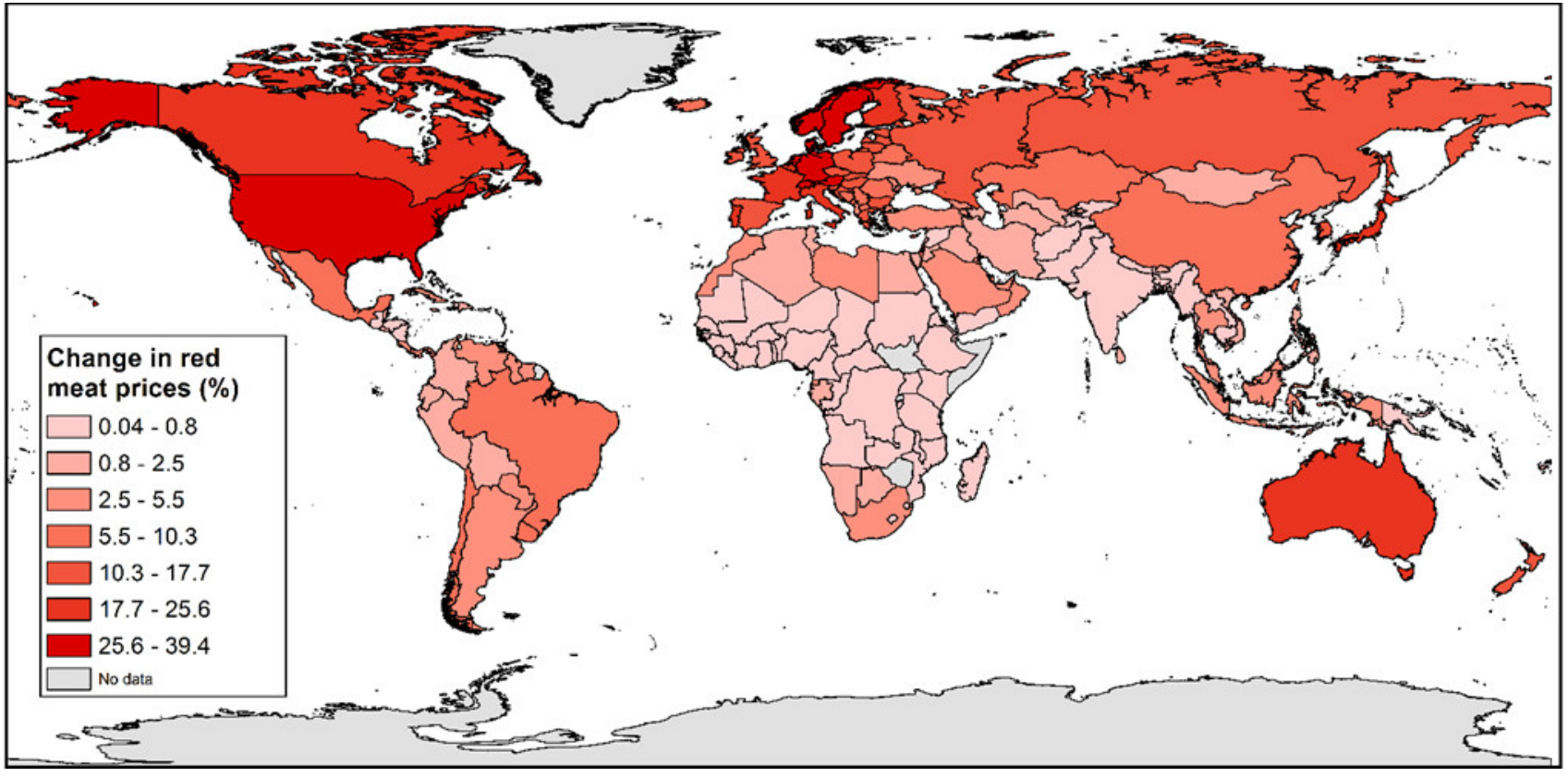
This association was observed mainly for colorectal cancer, but associations were also seen for pancreatic cancer and prostate cancer.

Processed meat

Processed meat was classified as *carcinogenic to humans* (Group 1), based on *sufficient evidence* in humans that the consumption of processed meat causes colorectal cancer.

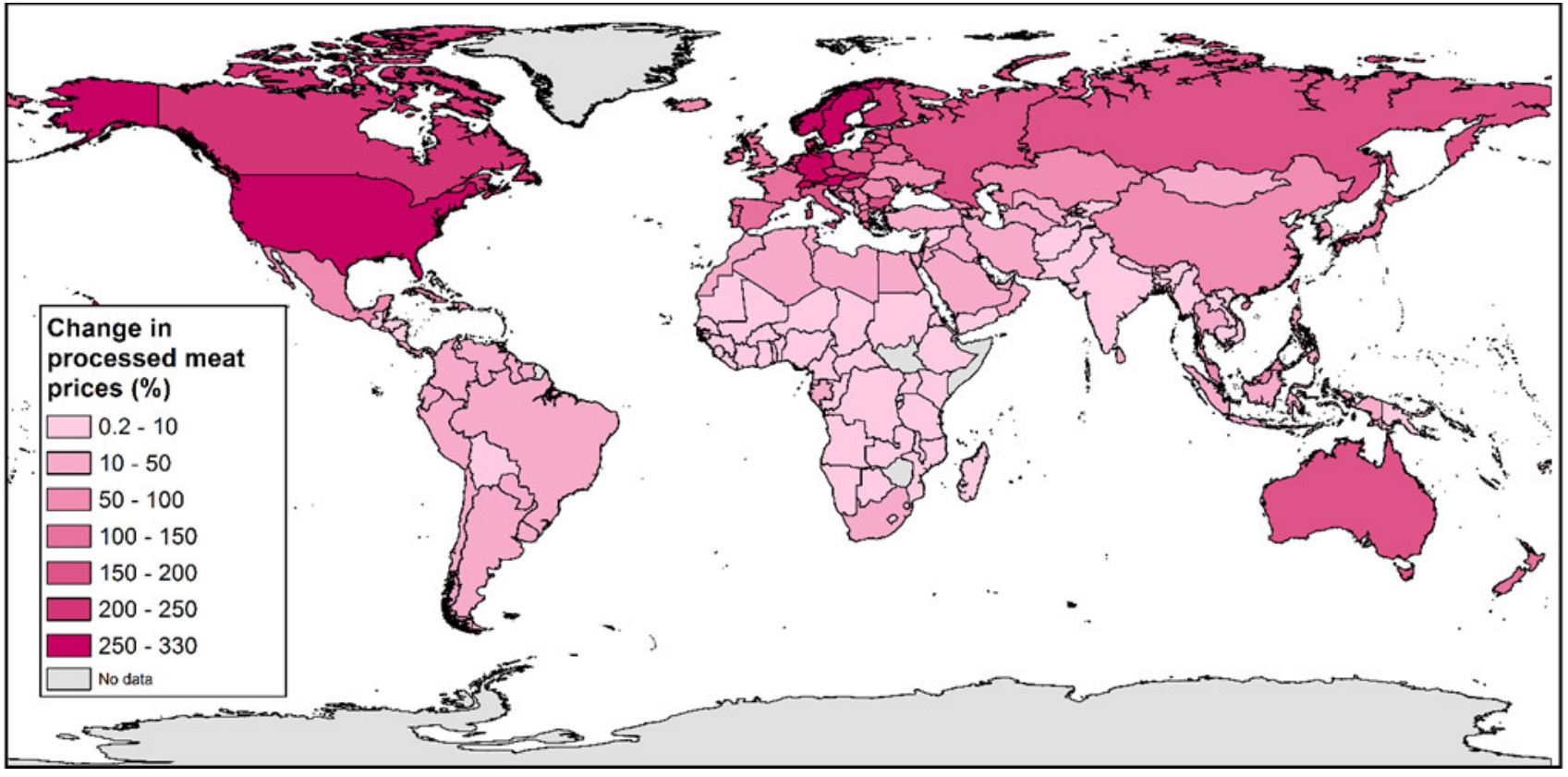
Health taxes on red meat

Prices changes needed to pay for health care-related costs in equilibrium (**red meat**):



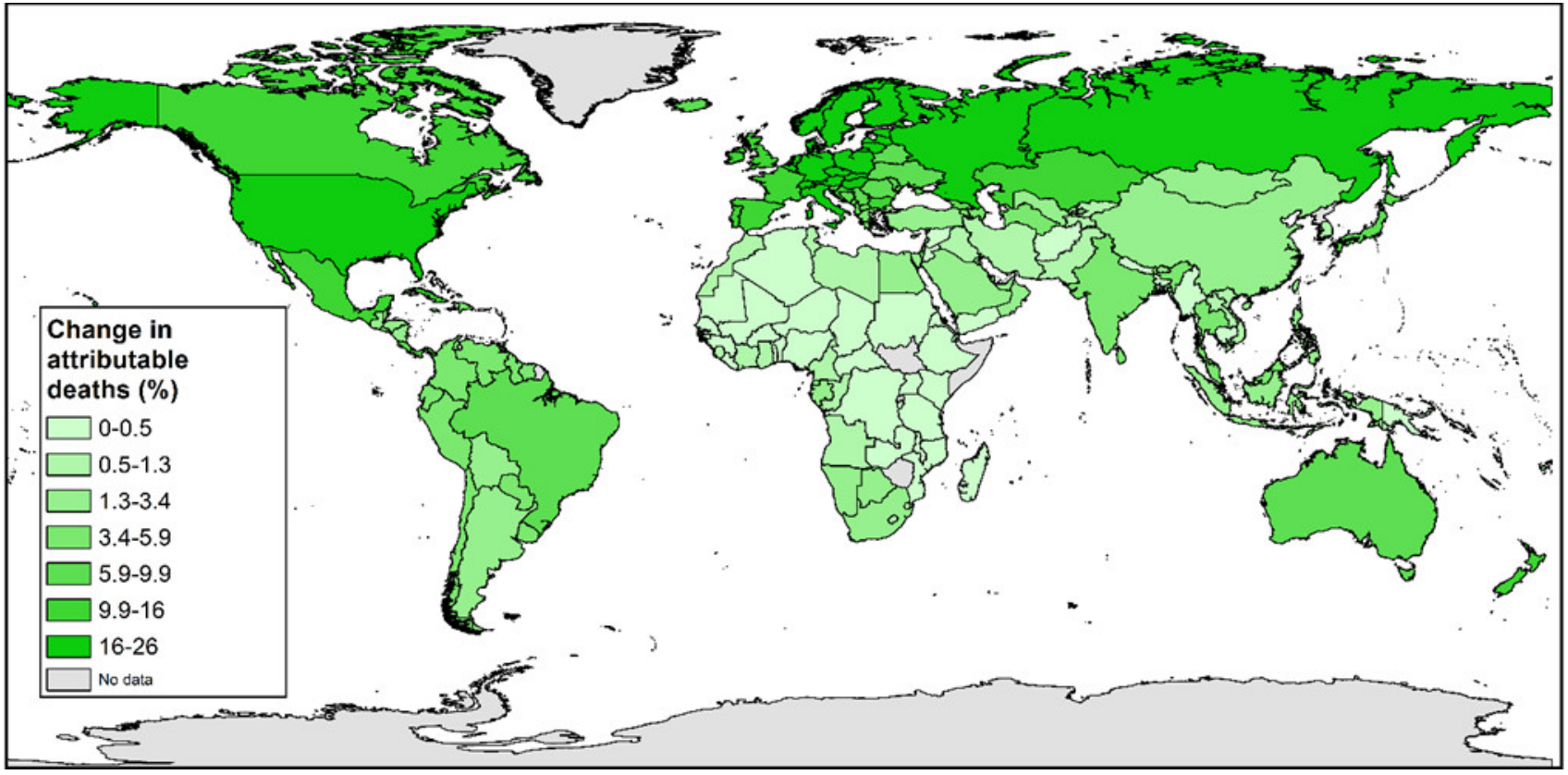
Health taxes on processed meat

Prices changes needed to pay for health care-related costs in equilibrium (**processed meat**):



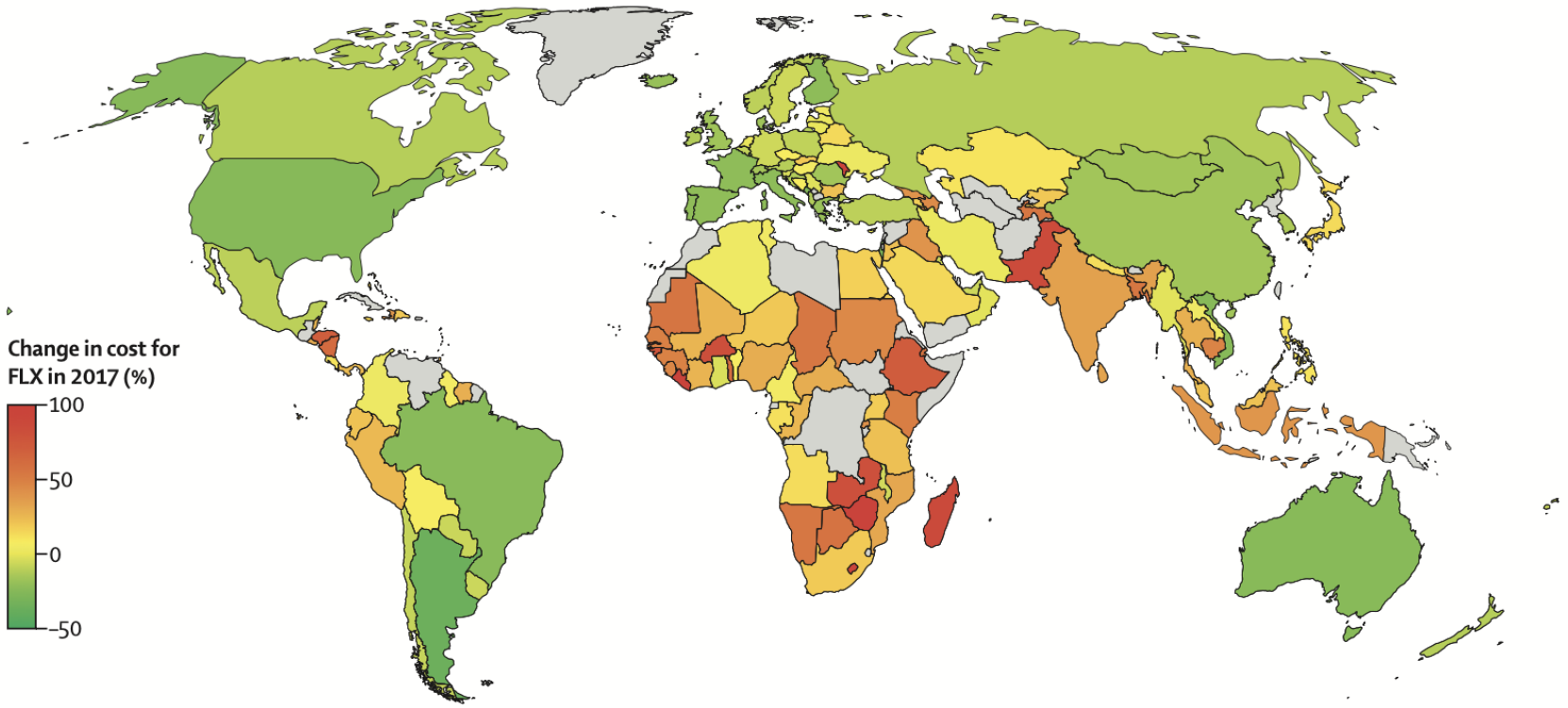
Health taxes on processed meat

Reductions in **mortality** attributed to red and processed meat:



Cost of diets

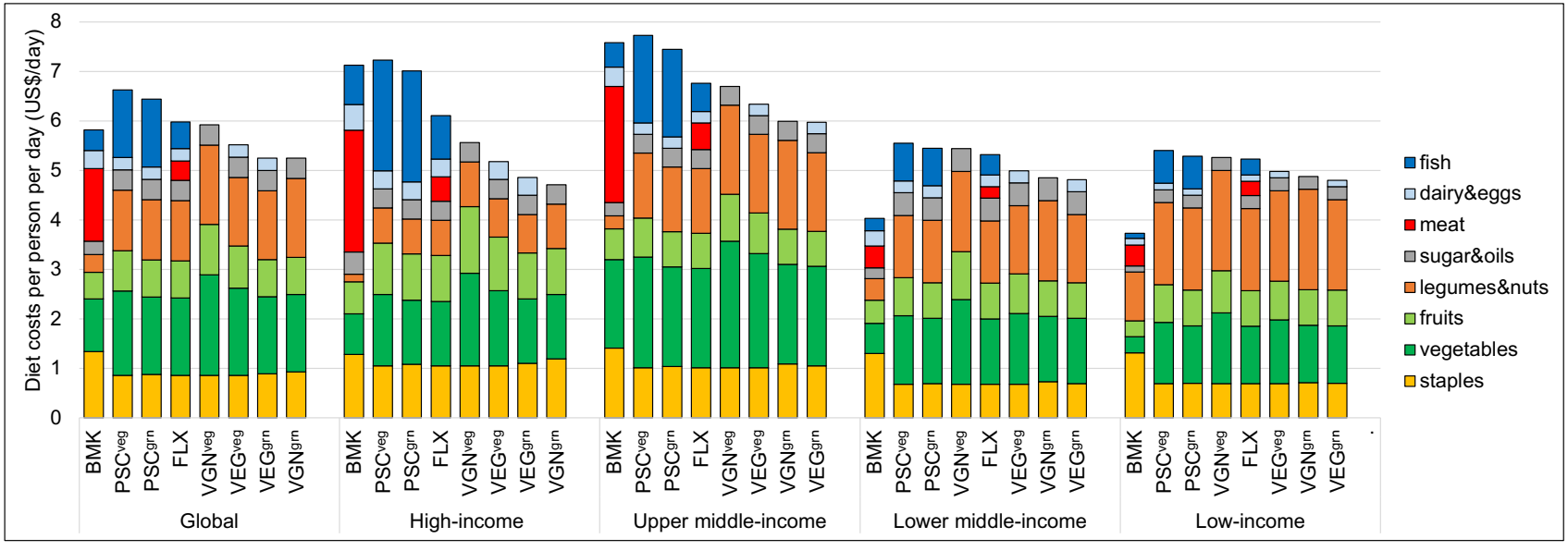
Affordability of diets
(Springmann et al, 2021, *Lancet Planetary Health*):



Cost of diets

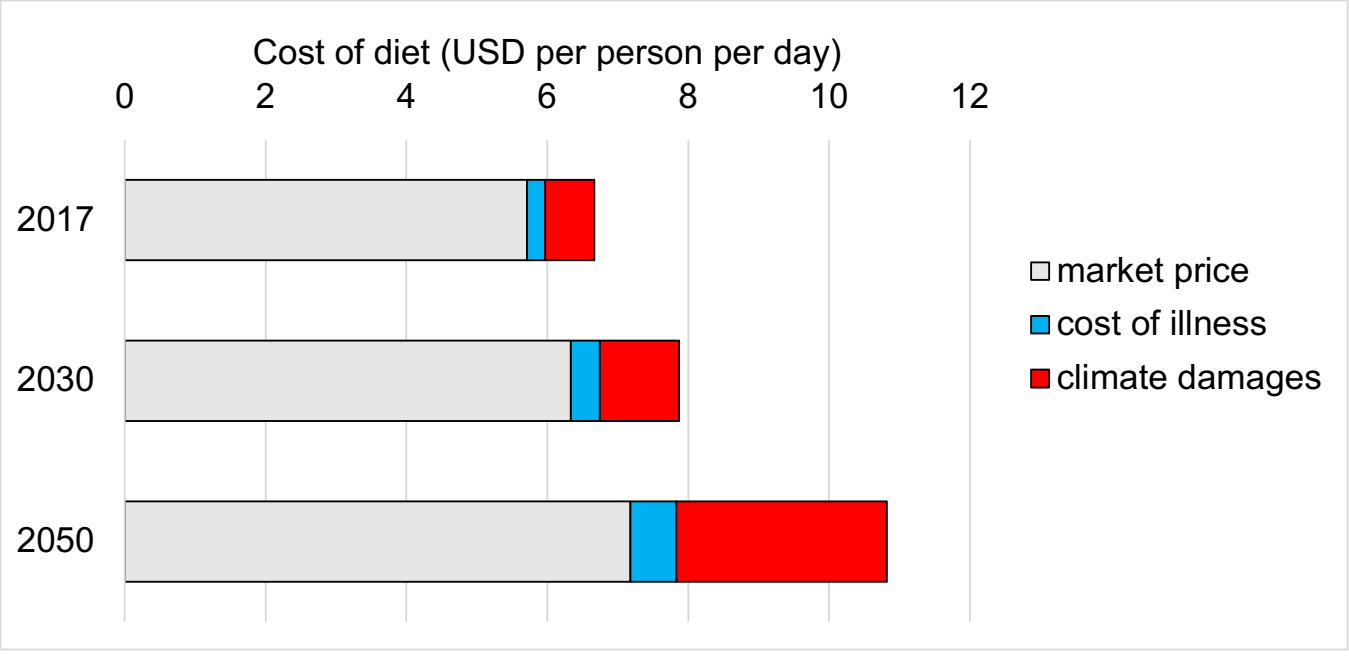
Affordability of diets

(Springmann et al, 2021, *Lancet Planetary Health*):



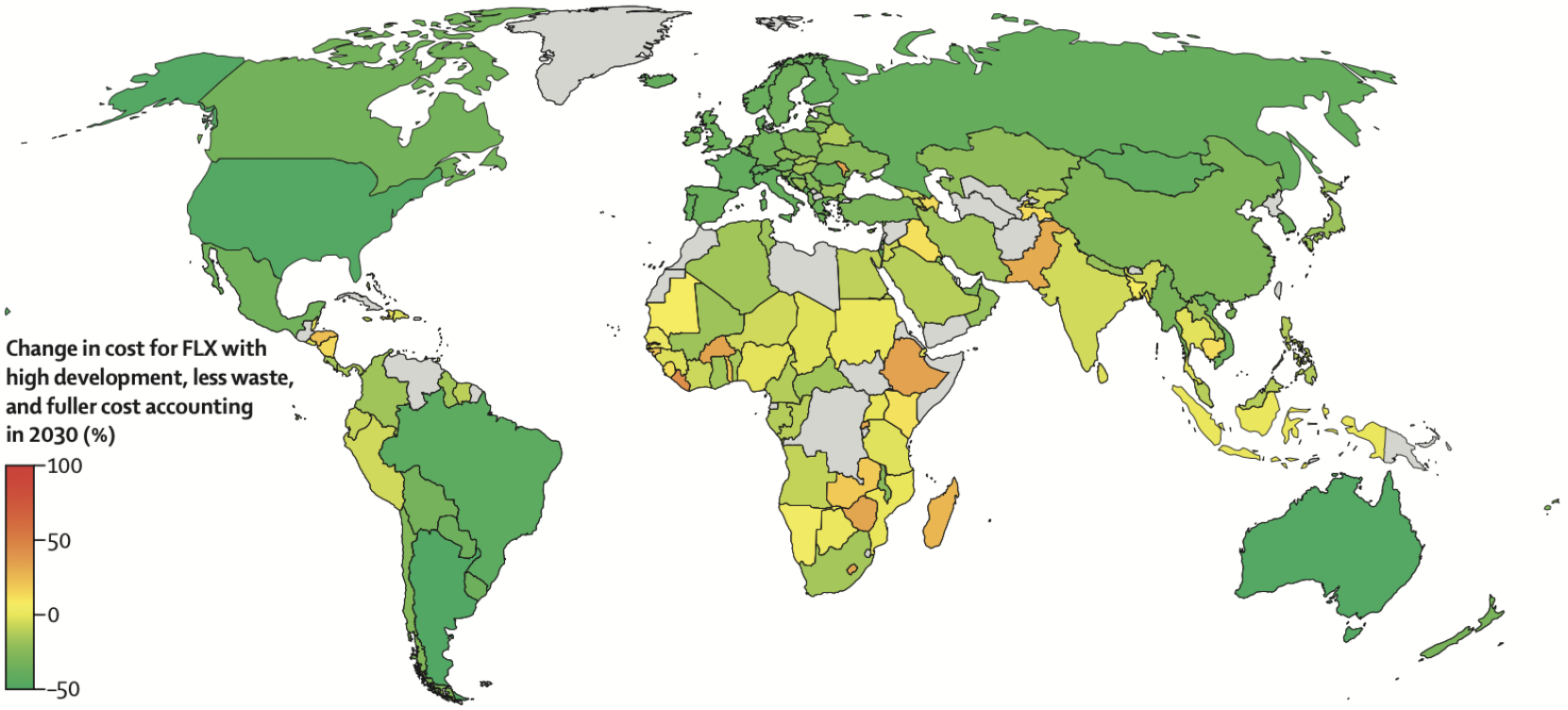
Cost of diets

Full costing makes sustainable diets relatively more affordable (Springmann et al, 2021, *Lancet Planetary Health*):



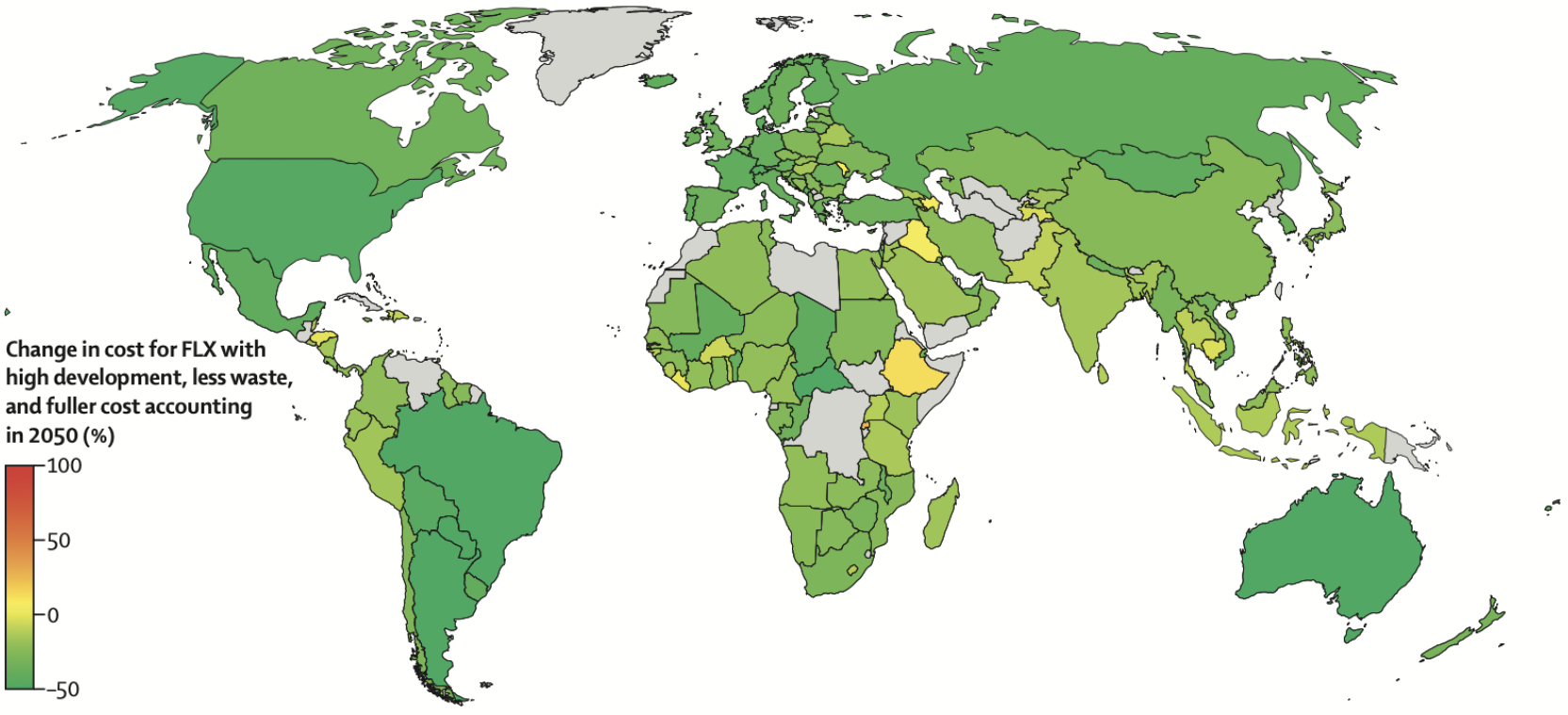
Cost of diets

Full costing at the country level
(Springmann et al, 2021, *Lancet Planetary Health*):



Cost of diets

Full costing at the country level
(Springmann et al, 2021, *Lancet Planetary Health*):



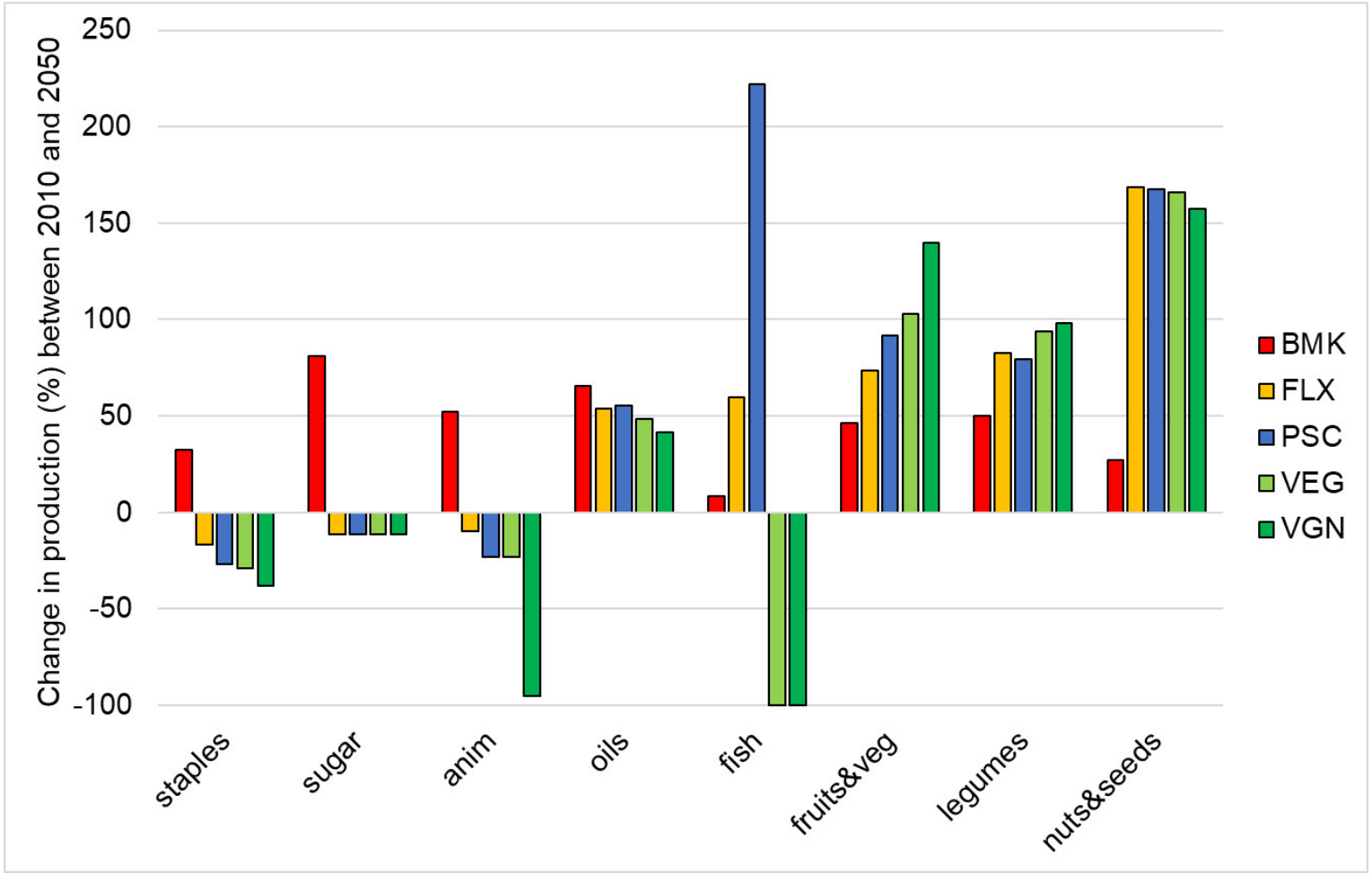
Food prices

Implications:

- Consumption decisions are influenced, in part, by food prices.
- Current prices do not reflect the full health and environmental costs of diets and foods.
- Pricing in food-system externalities (e.g. via taxes) can help consumers make healthier and more environmentally friendly choices.
- Tax revenues (and avoided healthcare costs and climate damages) can be used to compensate low-income households.

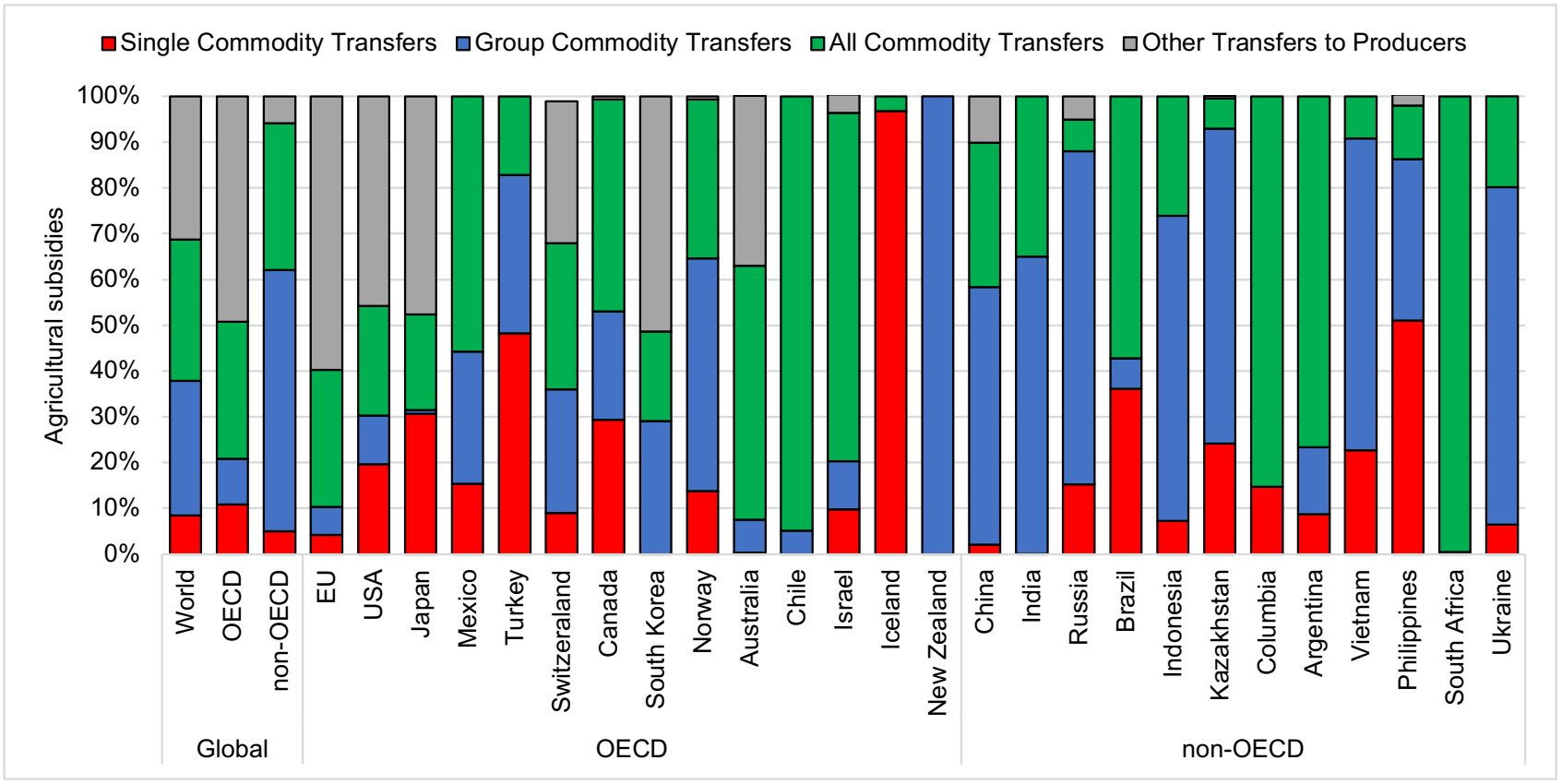
Agricultural subsidies

Align agricultural subsidies with public health objectives (Springmann and Freund, 2022, *Nature Communications*):



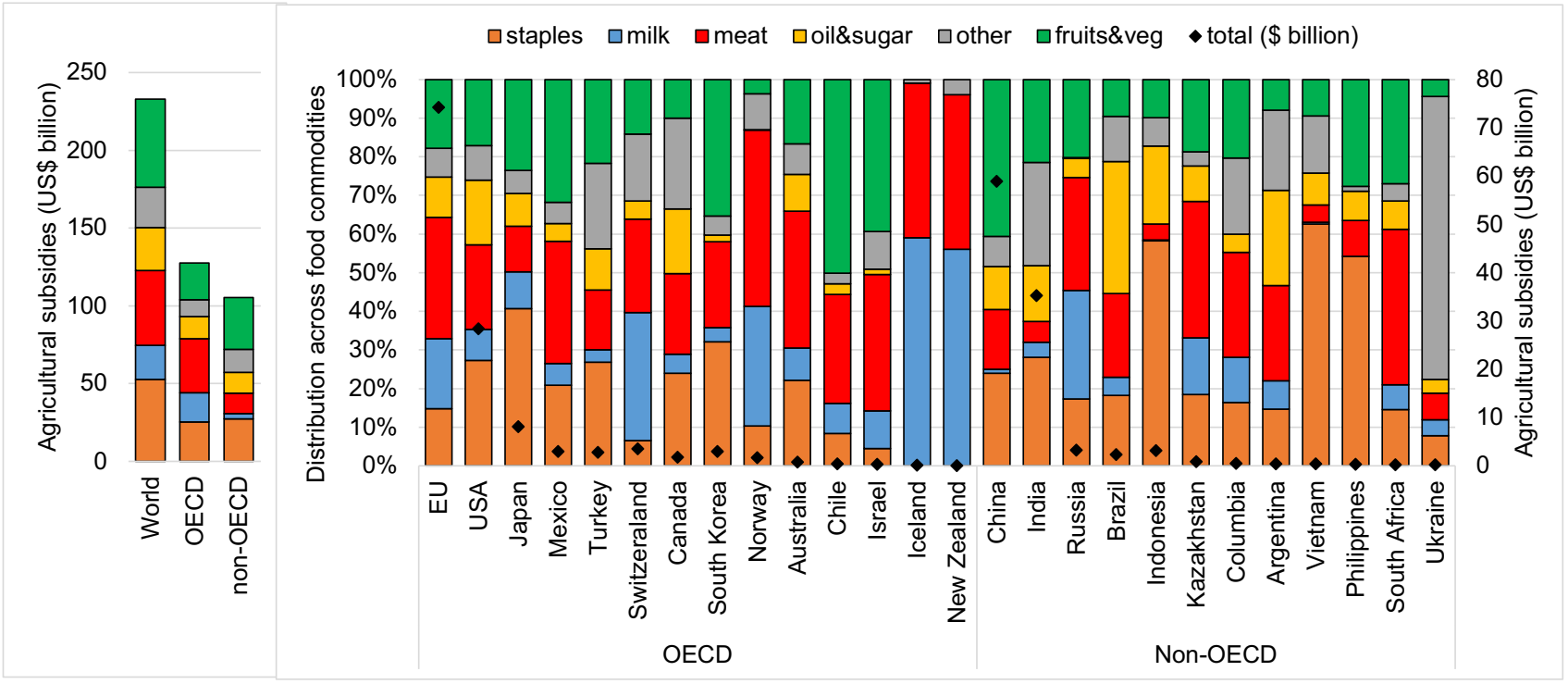
Agricultural subsidies

Agricultural support measures by **type**:



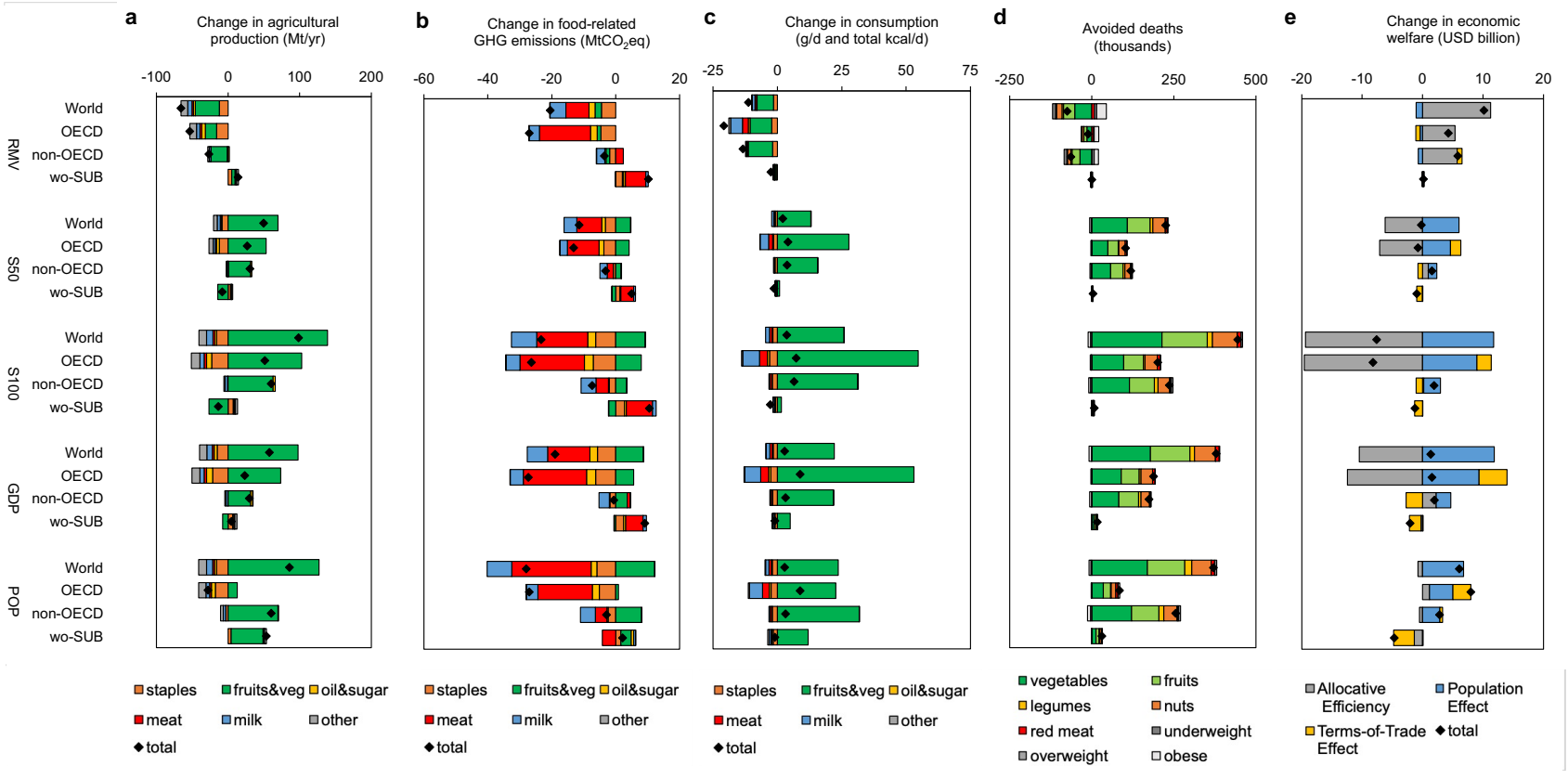
Agricultural subsidies

Agricultural support measures by **final use**:



Agricultural subsidies

Impacts of **subsidy reform**:



Discussion

Policy implications:

- Results suggest health and environmentally sensitive approaches to subsidy reform could make meaningful contribution to transition towards healthier and more sustainable food systems
- Potential policy trajectory including, in the short term, introducing conditioning of subsidies to healthy and sustainable food commodities, and restructuring global subsidy payments in the long term
- In OECD, subsidies are increasingly decoupled, but a "public money for public goods" approach stresses importance of healthiness and sustainability of food production (EU Farm to Fork, UK Ag Bill)

Conclusion

Healthy diets and sustainable food systems are achievable, but it will require:

- Strong regulation and right incentives are required;
- Combining measures with attention to local contexts important for defining region-specific sustainable-development pathways;
- The country-specific data and suite of scenarios produced for the report and associated studies can be a starting point.

Inaction is not an option:

- Food-system demand for environmental resources could increase by 50-90% without targeted mitigation measures;
- Key planetary boundaries could be exceeded by 2050, risking destabilization of ecosystems;

Bibliography

- Springmann et al, 2018, Options for keeping the food system within environmental limits, *Nature*, doi:10.1038/s41586-018-0594-0.
- Springmann et al, 2018, Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail, *Lancet Planetary Health* 2, e451-e461.
- Willett et al, 2019, Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems, *The Lancet* 392:10270, 447-492.
- Springmann et al, 2020, The healthiness and sustainability of national and global food based dietary guidelines: modelling study, *BMJ* 2020, `http://dx.doi.org/10.1136bmj.m2322`

Bibliography

- Springmann et al, 2017, Mitigation potential and global health impacts from emissions pricing of food commodities, *Nature Climate Change*, 7, 69-74.
- Springmann et al, 2018, Health-motivated taxes on red and processed meat: a modelling study on optimal tax levels and associated health impacts, *Plos One*, 13, e0204139.
- Springmann et al, 2021, The global and regional costs of healthy and sustainable dietary patterns: a modelling study, *Lancet Planetary Health*, 5:e797-807.
- Springmann and Freund, 2022, Options for reforming agricultural subsidies from health, climate, and economic perspectives *Nature Communications*, 13, 82.

Thank you

Contact, comments and suggestions:

- at LSHTM: marco.springmann@lshtm.ac.uk
- at Oxford: marco.springmann@ouce.ox.ac.uk