Healthy diets from sustainable food systems

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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)

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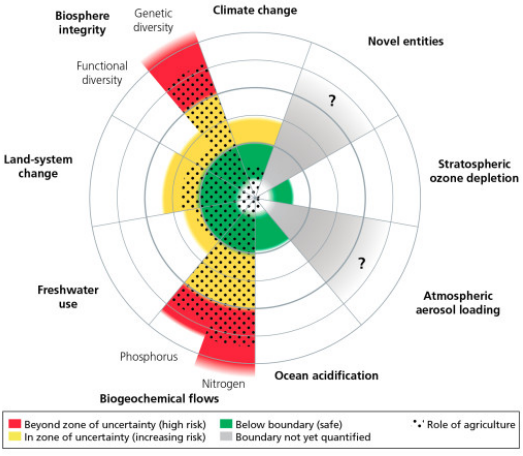
$\rightarrow$ major driver of planetary impacts

Planetary boundaries

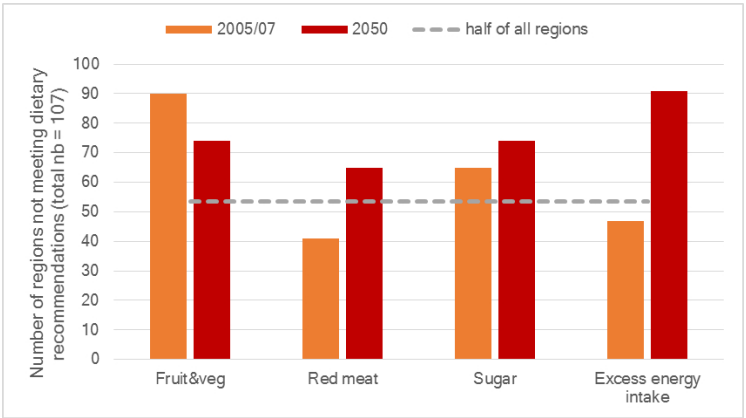
- Transgressing put ecosystems at risk of being destabilised and losing regulating functions on which populations depend (Steffen et al, 2015; Campbell et al, 2017):



Health impacts of the food system

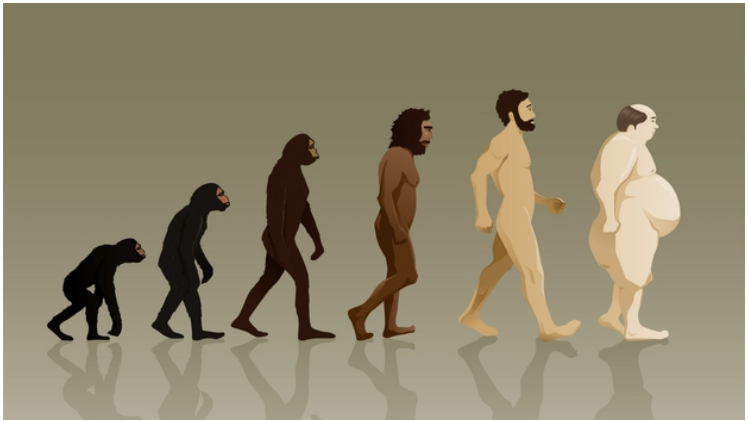
Current diets are not healthy:

- Less than half of all countries meet or are projected to meet basic dietary recommendations (Micha et al, 2015; Springmann et al, 2016).



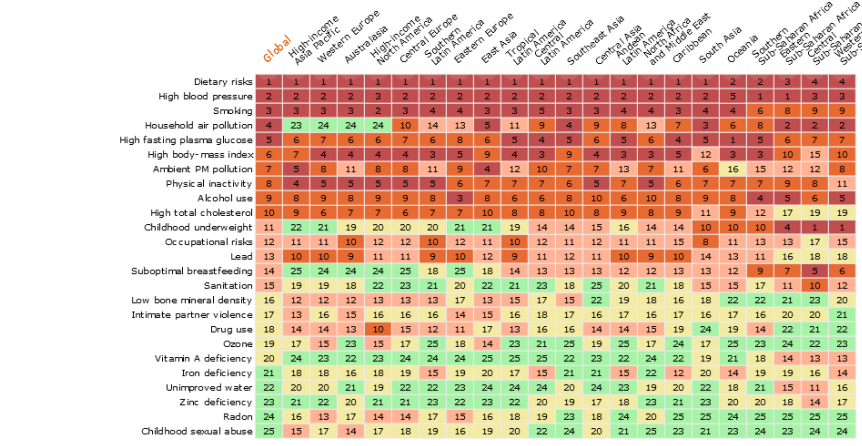
Health impacts of the food system

- Global prevalence of overweight increased over a third, and obesity rates doubled over last 30 years (Stevens et al, 2012; NCD-RisC 2019).



Health impacts of the food system

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



EAT-Lancet Commission

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

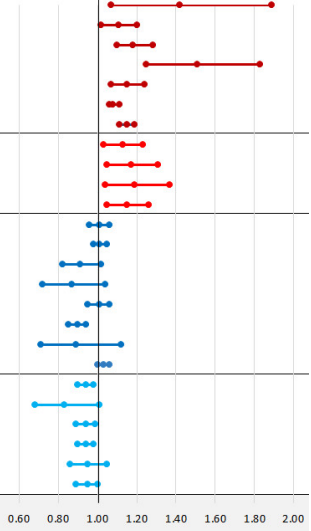
- Achieve a sustainable food system that can deliver healthy diets for a growing population.

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.

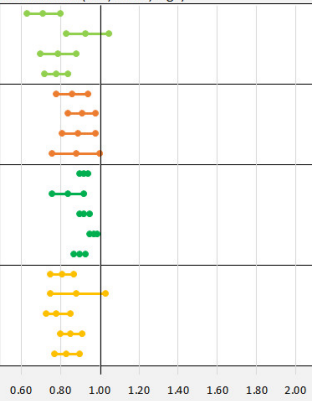
Evidence base for devising healthy diets

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



Evidence base for devising 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	

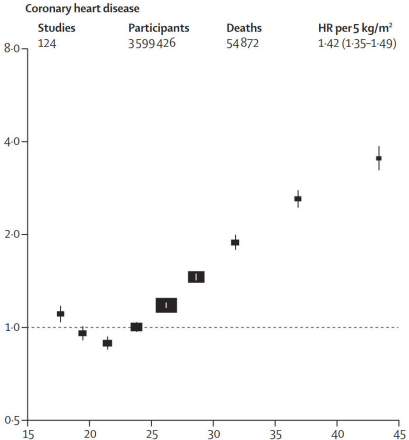


Springmann et al, 2019, *Environmental Nutrition, 1st Edition, Chapter 14*

Evidence base for devising 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

	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

Willett et al (*Lancet* 2019)

Consumption changes (%) needed by 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

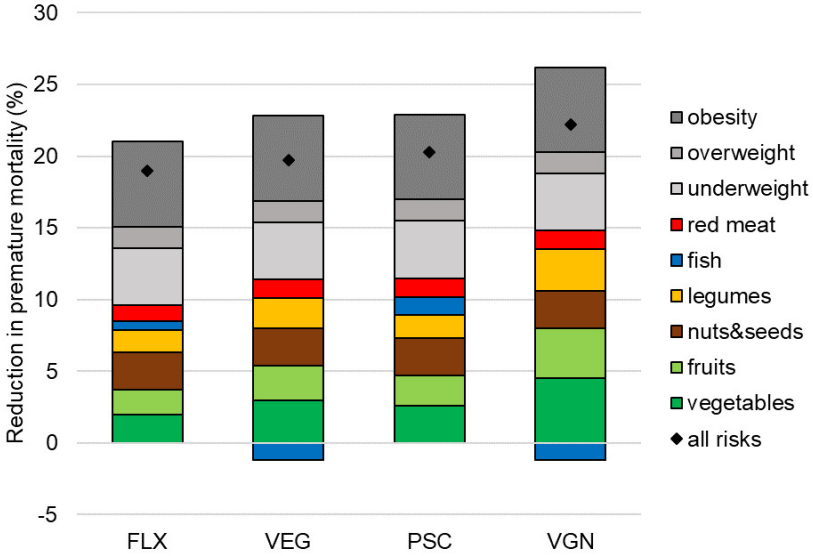
Analysis of diets:

- 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).

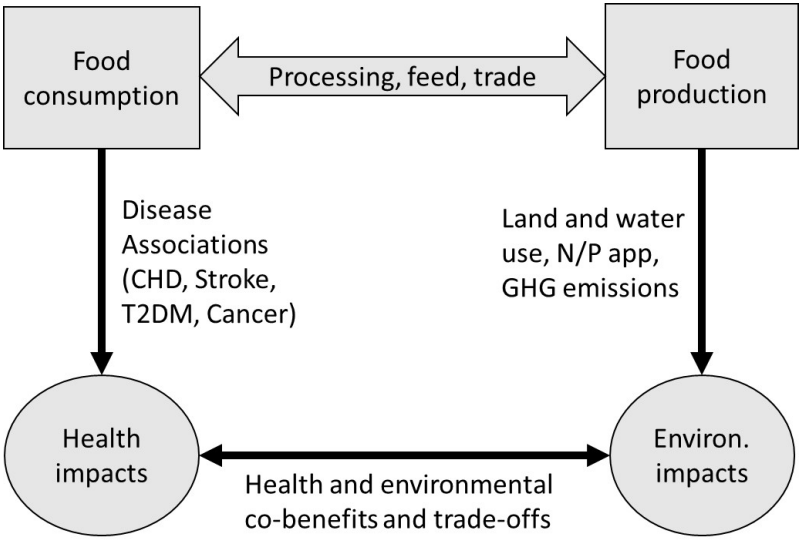
Nutritional analysis

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

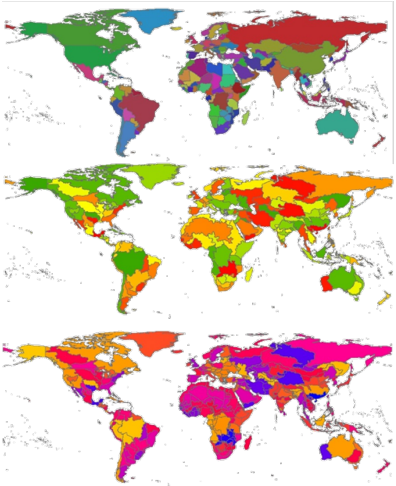
Chronic-disease analysis



Environmental and food-systems analysis



Level of detail: 62 commodities



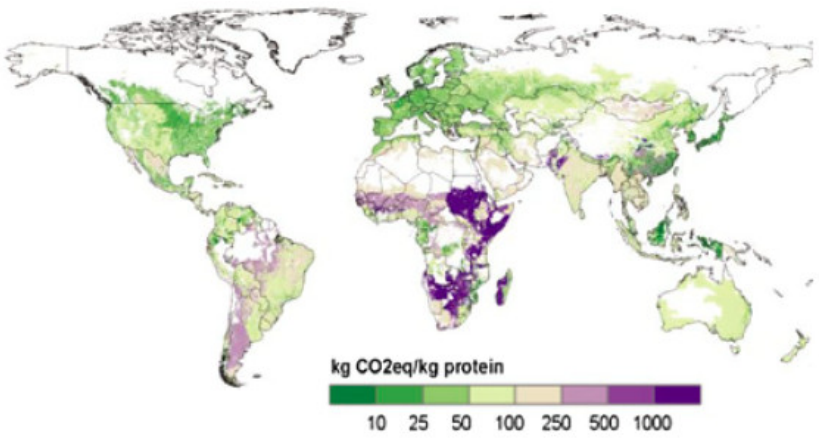
159
- Countries

154
- Water Basins

320
- Food Production Unit

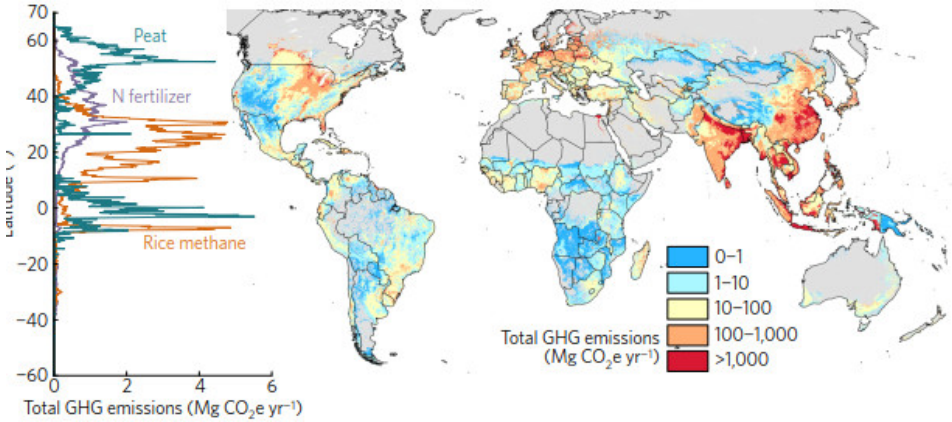
IFPRI-IMPACT model

Add to that: GHG emissions of livestock



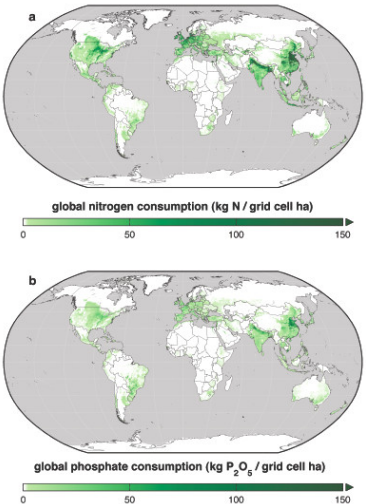
Herrero et al (2013), FAOSTAT

Add to that: GHG emissions of crops



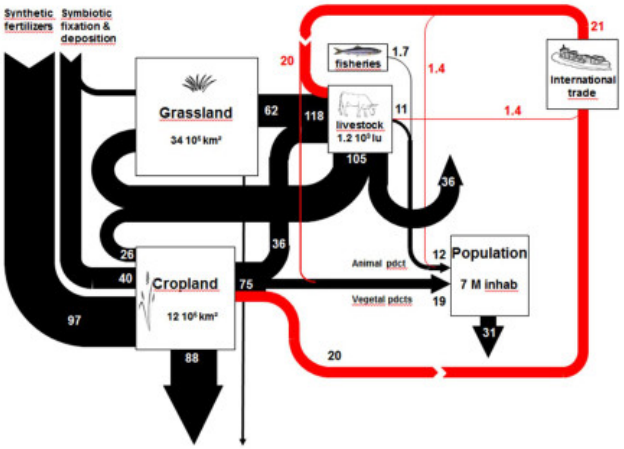
Carlson et al (2016)

Add to that: fertilizer application



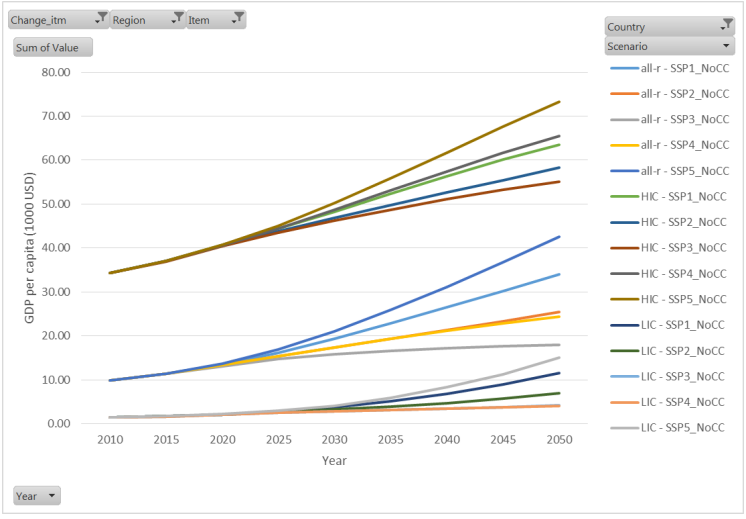
Mueller et al (2012)

Add to that: nitrogen balance model



Lassaletta et al (2016)

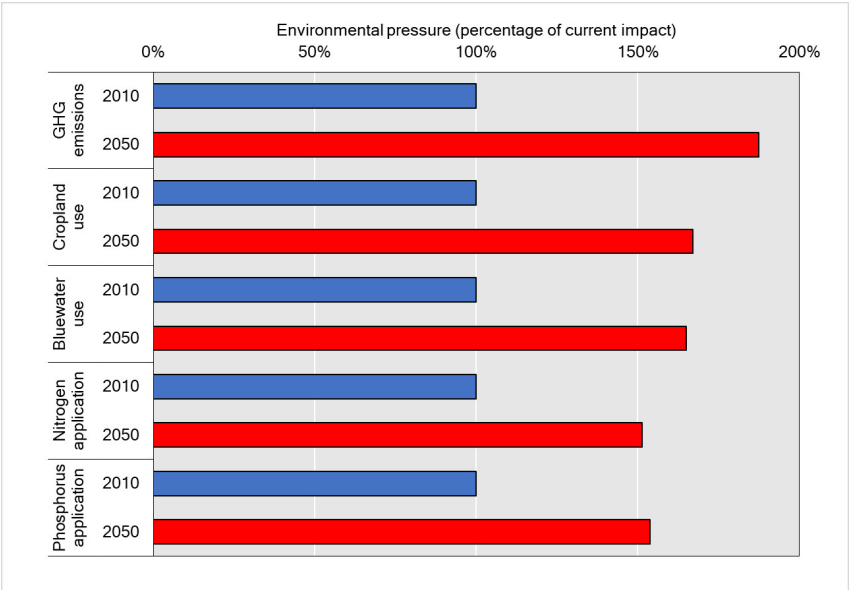
Add to that: drivers of future food demand



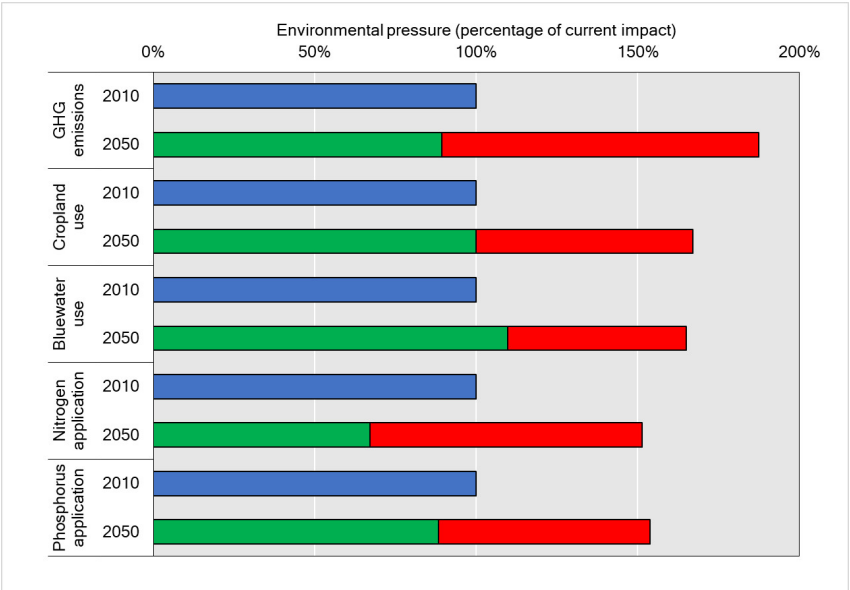
Add to that: scenario assumptions

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.

Increase in resource demand by 2050: 50-90%

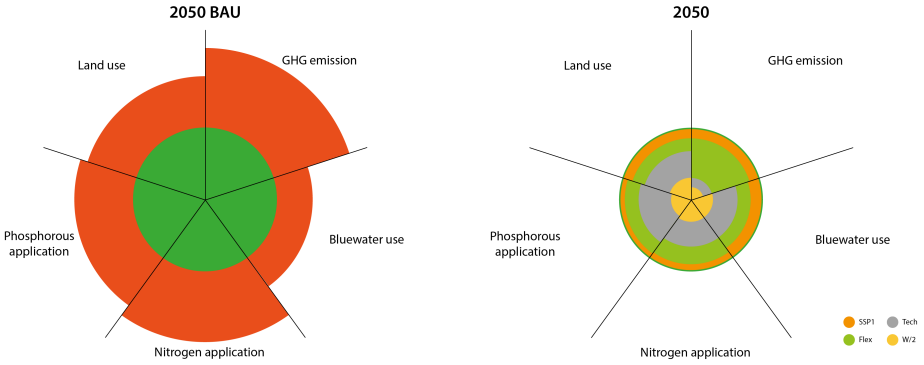


All planetary boundaries could be exceeded by 2050



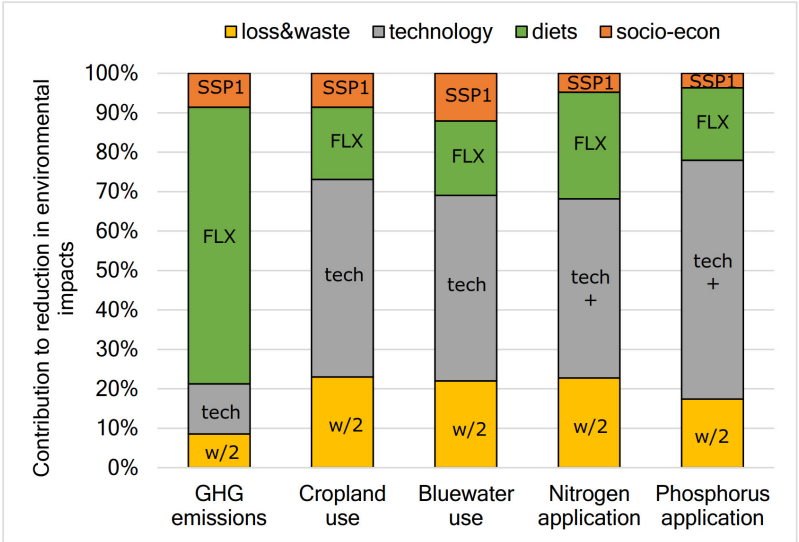
Food-systems analysis

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

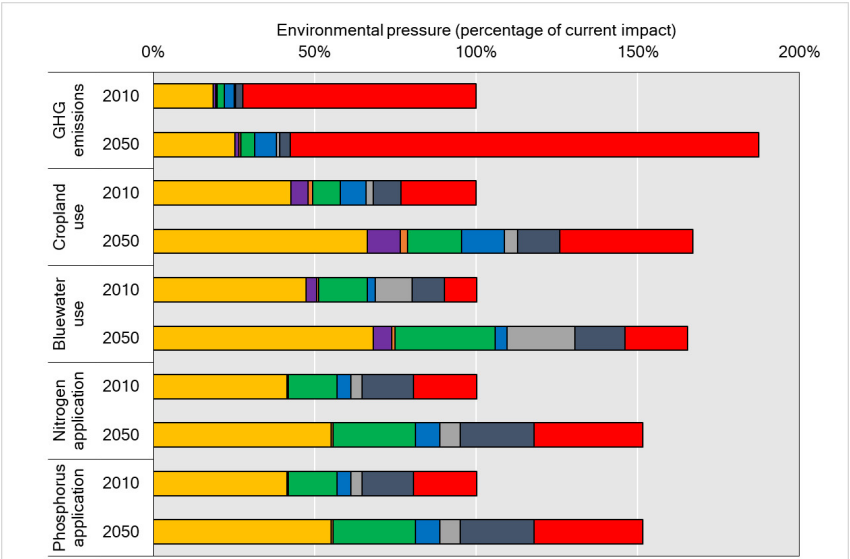


Springmann et al, *Nature* 2018

Combinations of measures to stay within limits



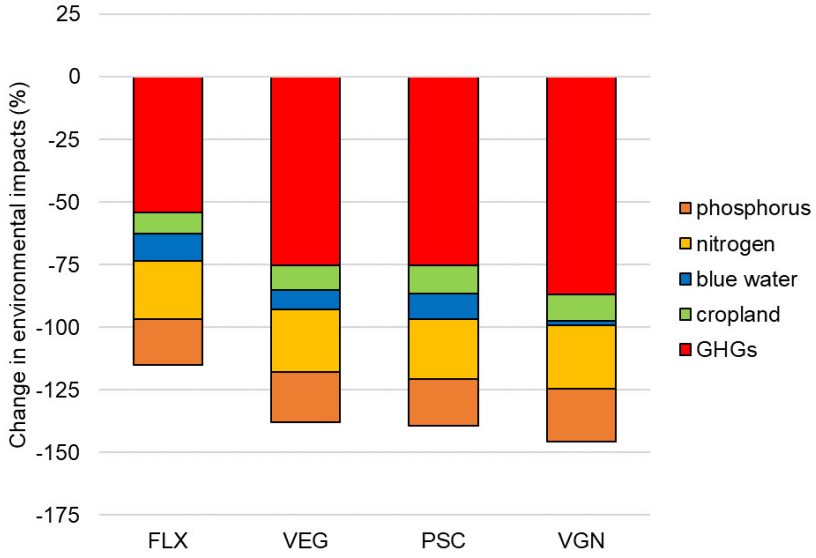
Domains: livestock-dominated or staple-crop-dominated



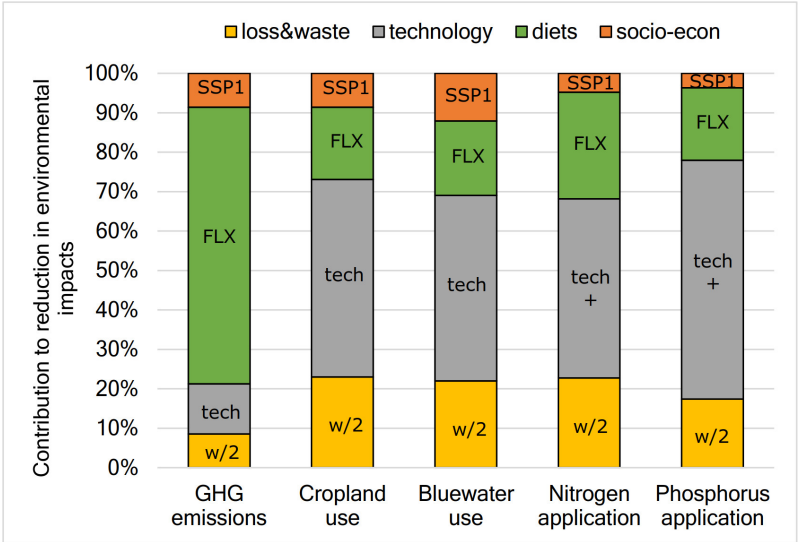
Environmental footprints per serving of food

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

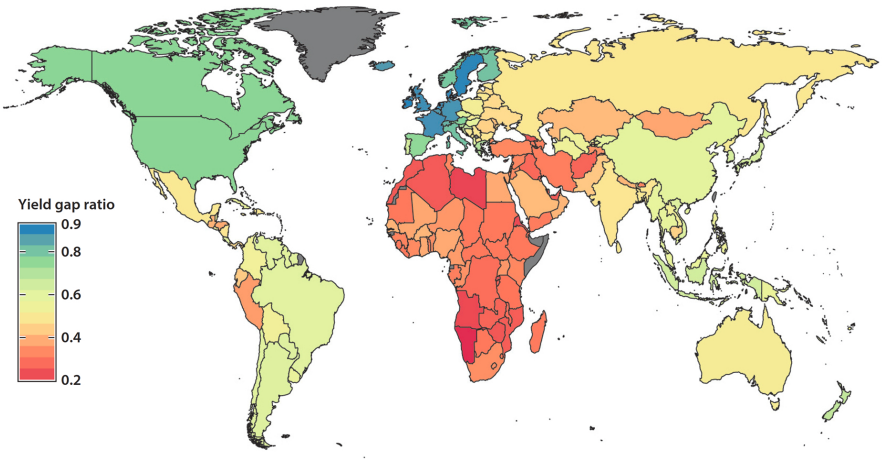
Environmental analysis



Combinations of measures to stay within limits

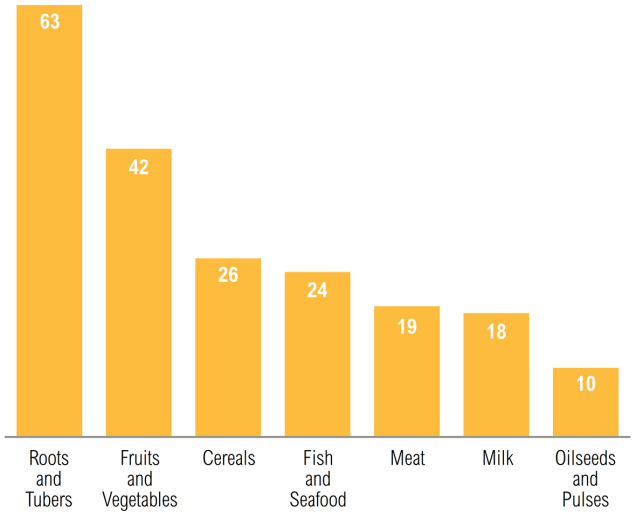


Unequal distribution of technology and capital



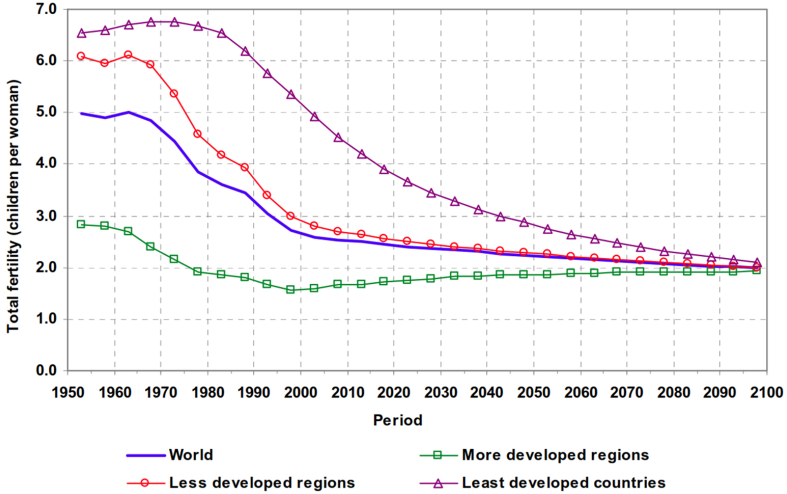
Mueller et al (2012)

Food waste by food group



FAO (2012), WRI (2013)

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
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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

Repository of dietary guidelines

Food-based dietary guidelines

Background | Regions | Resources | Capacity development

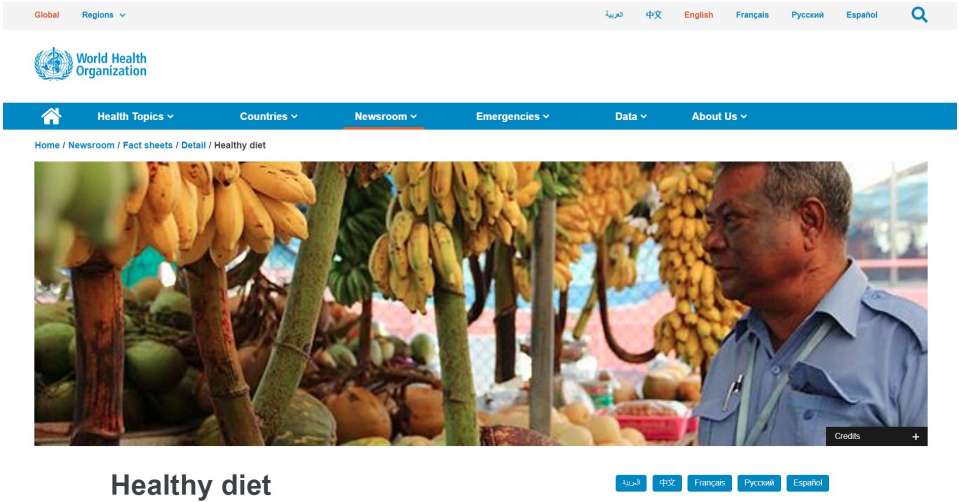
Food-based dietary guidelines (also known as dietary guidelines) are intended to establish a basis for public food and nutrition, health and agricultural policies and nutrition education programmes to foster healthy eating habits and lifestyles. They provide advice on foods, food groups and dietary patterns to provide the required nutrients to the general public to promote overall health and prevent chronic diseases.

FAO assists Member Countries to develop, revise and implement food-based dietary guidelines and food guides in line with current scientific evidence. FAO also carries out periodic reviews on progress made in the development and use of dietary guidelines, tracking changes in their overall focus and orientation.

More than 100 countries worldwide have developed food-based dietary guidelines that are adapted to their nutrition situation, food availability, culinary cultures and eating habits. In addition countries publish food guides, often in the form of food pyramids and food plates, which are used for consumer education *Read more*

Please note that individual country pages are only available in English.

Global FBDGs: WHO guidelines



Global FBDGs: EAT-Lancet recommendations

	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**

Global health and environmental targets

Planetary boundary	Motivation	Method	Global targets	Comment
Climate change	Further increasing GHG emissions increase climate-related risks to ecosystems and cultures, e.g. from sea-level rise and increased occurrence of extreme weather events, such as heat waves, extreme precipitation, and coastal flooding [82].	Food-related GHG emissions in line with limiting global warming to below 2 degrees Celsius [63] with uncertainty derived from a model comparison of integrated assessment models [58].	**Paris Climate Agreement**	The Paris Agreement's long-term goal is to keep the increase in global average temperature to well below 2 °C above pre-industrial levels; and to limit the increase to 1.5 °C, since this would substantially reduce the risks and effects of climate change. Reflected in **SDG 13** and in the plenatary boundary for climate change.
Land-system change	Further increasing the amount of agricultural land through deforestation could impact the functioning of ecosystems [3], release large amounts of carbon dioxide [1], and diminish habitat for wild species and thereby pose major threats to biodiversity [4].	Analysis of conservation levels for each forest biome in line with preserving ecosystem integrity, scaled up to a global value [12] and related to cropland use [33,39].	**Aichi Biodiversity Targets**	Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced. Related to **SDG 15** and planetary boundary for land-system change.
Freshwater use	Further depletion and overexploitation of groundwater resources impairs natural streamflow, wetlands and related ecosystems, and can lead to land subsidence and salt-water intrusion in deltaic areas [6] and, eventually, to cascading impacts on the global hydrological cycle [77].	Basin-level assessments of the environmental flow requirements of river systems [12,20] scaled to agricultural bluewater use [5,33].	**SDG target on water withdrawals**	**SDG 6.4**: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. In line with planetary boundary for freshwater use.
Bio-geochemical flows	Agricultural runoff from overapplication of fertilizers leads to eutrophication, an increase in chemical nutrients in the water [7,9], which in turn can lead to excessive blooms of algae that deplete underwater oxygen levels resulting in so-called dead zones in coastal oceans [8].	Analysis of eutrophication risk based on nitrogen and phosphorus pollution estimates of agricultural runoff and ecological thresholds [19], with an upper value in line with re-balancing of application between over and under-applying regions [32].	**SDG target on nutrient pollution**	**SDG 14.1**: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
Healthy diets	Levels of malnutrition are increasing, in particular overweight, obesity, and dietary risks. All people should have access to healthy and nutritious diets.	Review of literature on healthy eating and construction of general food-based dietary guidelines in line with healthy diets.	**NCD Agenda**	**SDG 3.4**: the target is to "reduce by one third premature mortality from NCDs through prevention and treatment, and promote mental health and wellbeing", which builds on the World Health Organization (WHO) "25x25" NCD target.

Transcribing and coding for 12 food groups and weight

Uncertainty score	Recommendation	Coded as
1	exact value	exact value
1	range of values	range with mean
1	value with qualifier	value as mean and 20% increase/decrease in high/low values for "at least"/"not more" statements
2	value but serving size is missing	value combined with standard serving size
3	eat daily	if serving size is clear, then code as one serving per day; not coded otherwise
3	value for more general food group	split general recommendation according to regional preference
4	one value across several food groups	assign in proportion to grouping, using serving size for food group of interest
4	eat regularly OR multiple times a week	if serving size is clear (legumes, nuts&seeds, eggs), then range of one serving per week to one serving per day; not coded otherwise
4	increase or decrease intake	increase or decrease by 20% (10-30%), or by value noted
5	vague qualitative recommendation	no change from baseline intake

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

Uncertainty score by food group for Spanish FBDGs

Food group	Uncertainty coding (1-5)	Recommendation
fruits &veg	2	5 servings/d
red meat	5	It is not necessary to take meat every day. It is advisable to alternate it with fish and we must include different species: beef, pork, chicken, rabbit, lamb, etc.
fish	1	2-4 servings of fish per week.
milk	3	Dairy products are the basis of the diet and should be consumed daily.
eggs	1	No more than 4-5 eggs/ week
legumes	2	Eat legumes at least 2-3 times per week.
nuts &seeds	4	In the NAOS Pyramid, nuts are important foods and can be combined with others, they are recommended to be eaten several times a week.
whole grains	4	Healthy diet must include carbohydrates with a predominance of complex carbohydrates (rice, bread, pasta, potatoes, legumes). Fibre is necessary in the diet and it is found in whole grains, legumes, vegetables, salads, fruits, nuts.
processed meat	5	
sugar	1	Intention to launch a campaign to reduce sugar consumption, recommending a maximum consumption of 50 g of added sugars per day as indicated by the World Health Organization.
weight	1	Check your BMI (normal = 18.5-24.9 kg/m2), maintain a proper weight by following the dietary and physical activity advice summarised in the pyramid.
average	2.80	

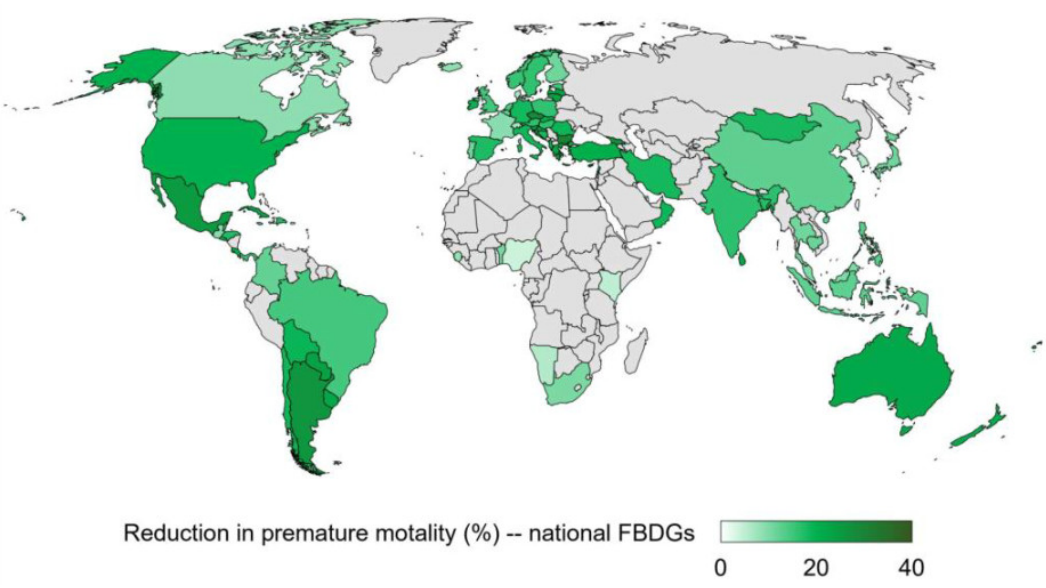
Difference between recommendations and current intake

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

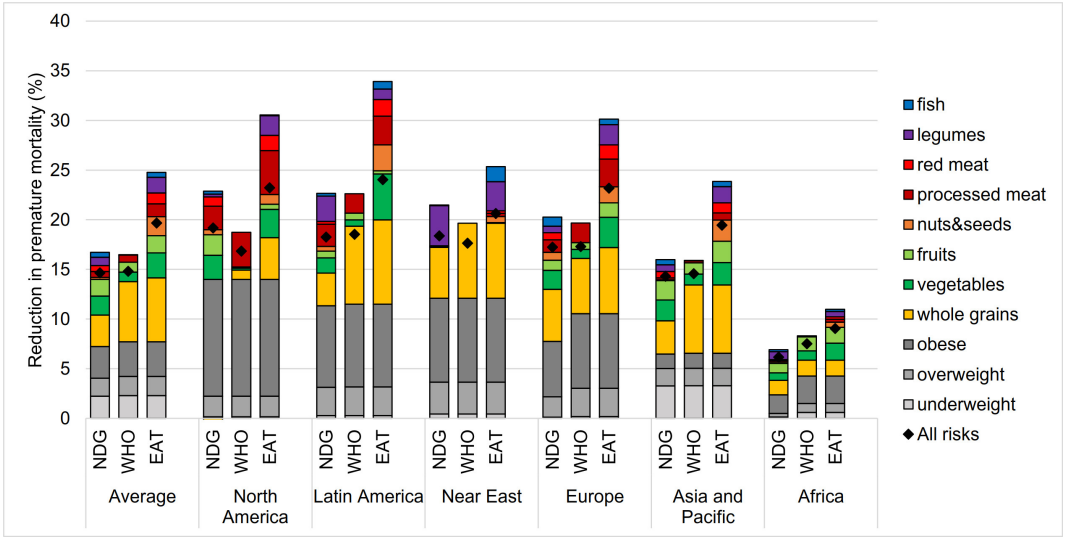
Difference in intake for Spanish FBDGs

Food group	Diet scenarios					
	NDG	WHO	FLX	PSC	VEG	VGN
whole grains	819	487	1533	1533	1533	1533
fruit&veg	3	3	28	54	79	105
legumes	20	0	427	427	603	778
nuts	0	0	172	172	172	172
oils	0	0	-35	-35	-35	-35
sugar	0	0	-37	-37	-37	-37
red meat	0	0	-85	-100	-100	-100
processed meat	0	-57	-100	-100	-100	-100
poultry	0	0	-44	-100	-100	-100
dairy	-52	0	-43	-43	-43	-100
eggs	-8	0	-63	-63	-63	-100
fish	12	0	0	7	-100	-100

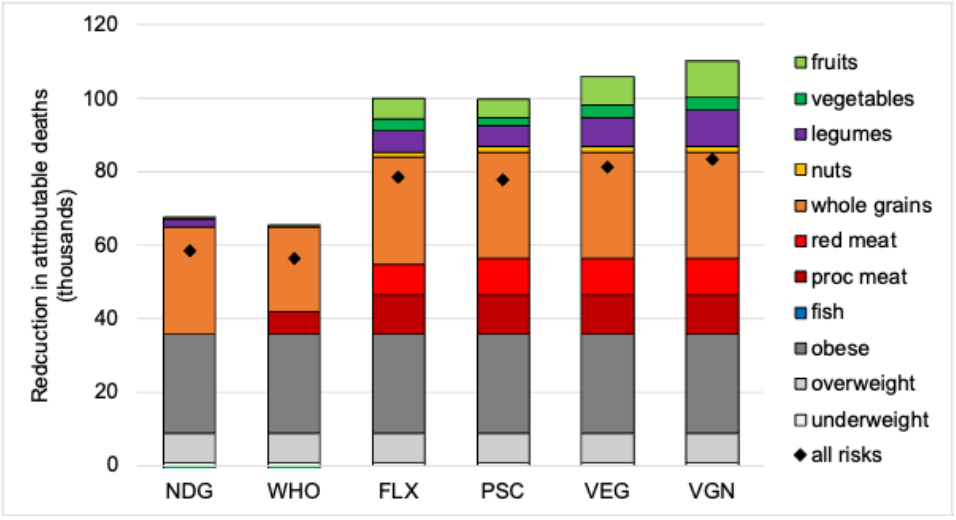
Health impacts



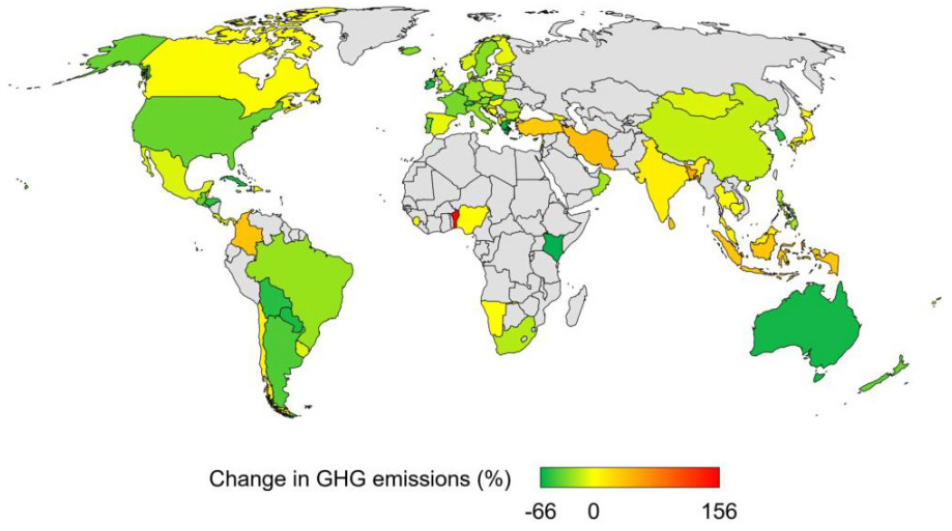
Health impacts in context



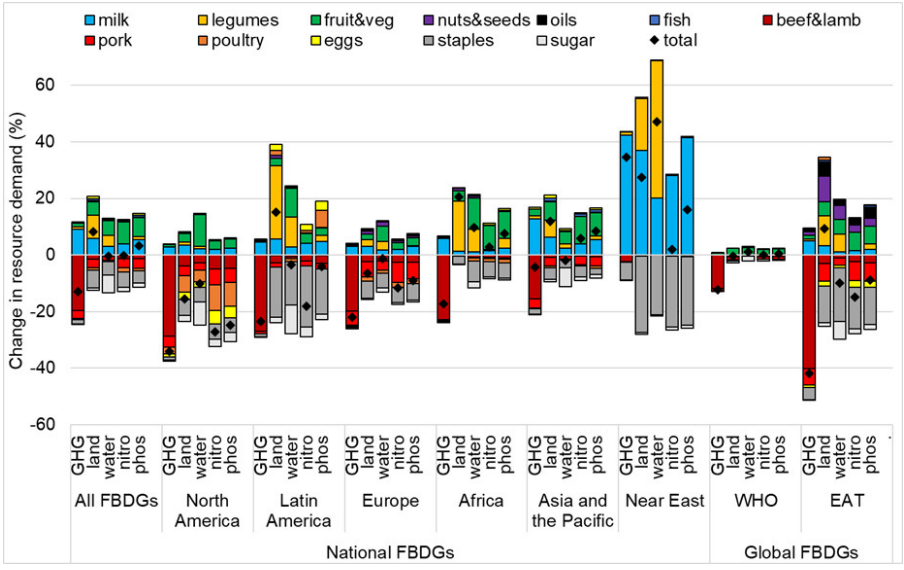
Health impacts for Spanish FBDGs



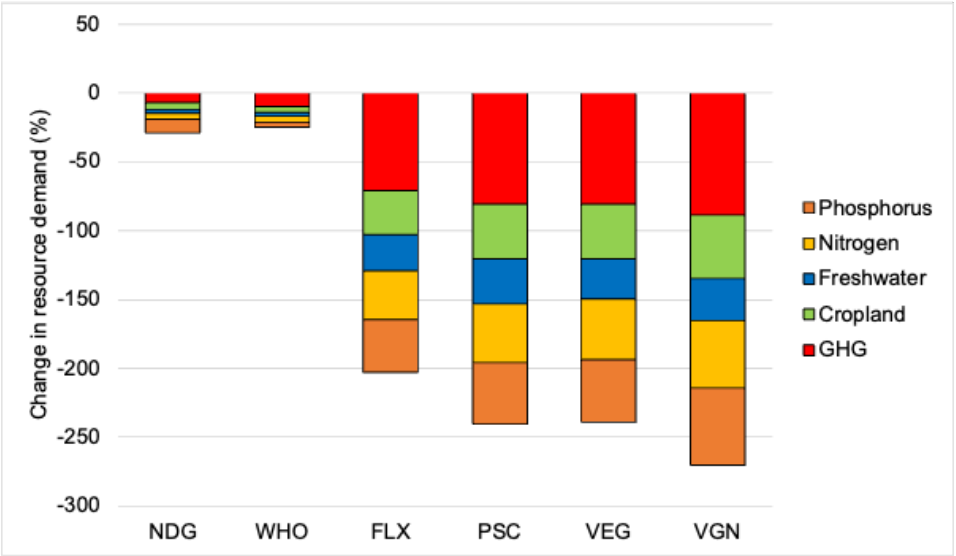
Environmental impacts



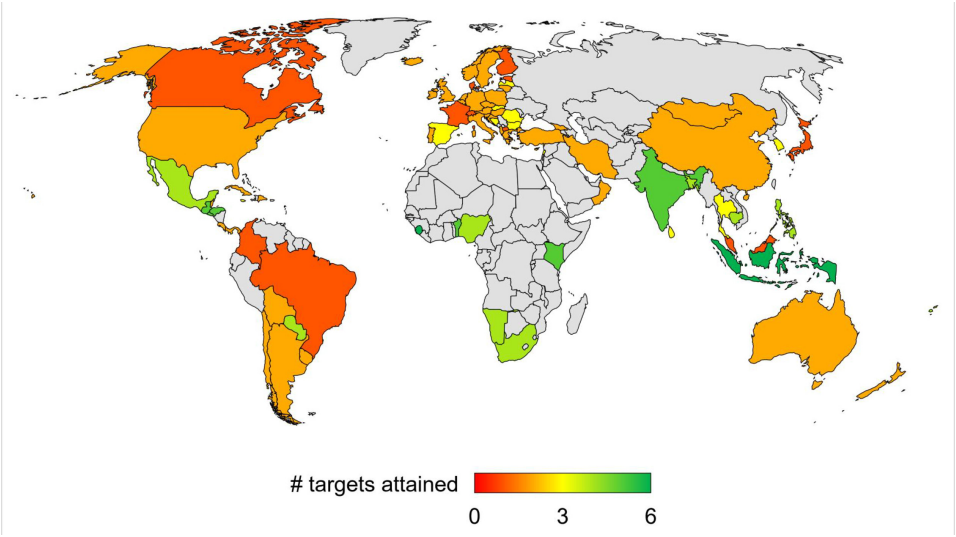
Environmental impacts in context



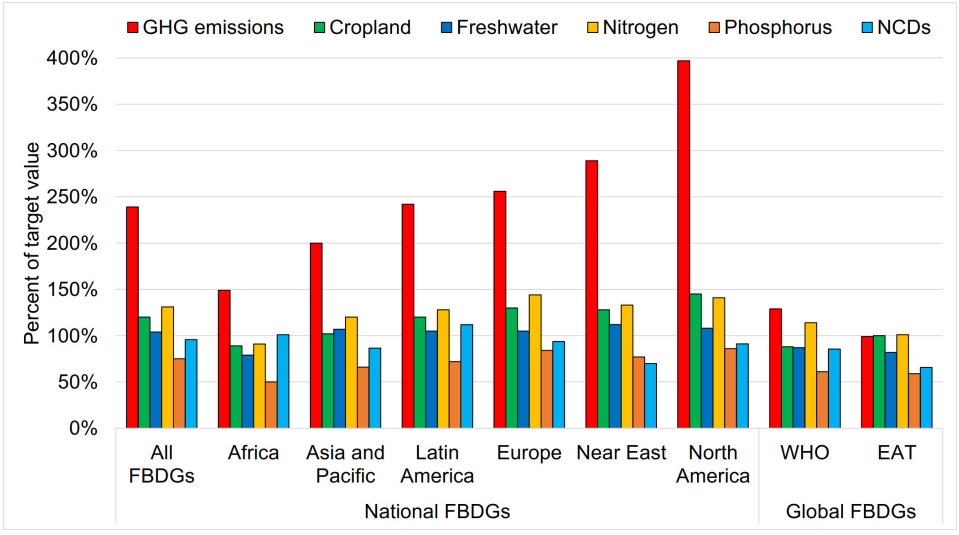
Environmental impacts for Spanish FBDGs



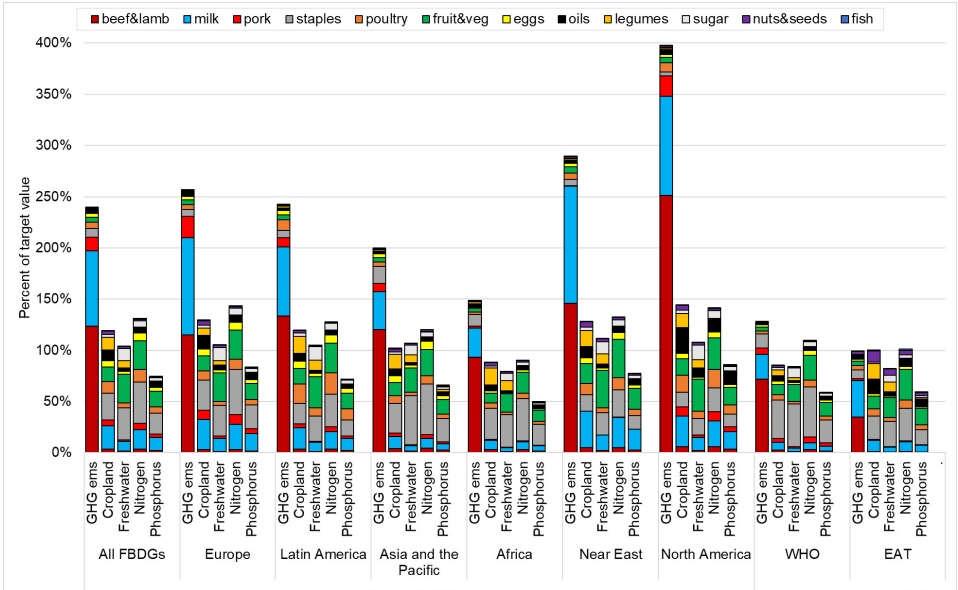
Two-thirds of FBDGs only fulfilled 1-2 targets



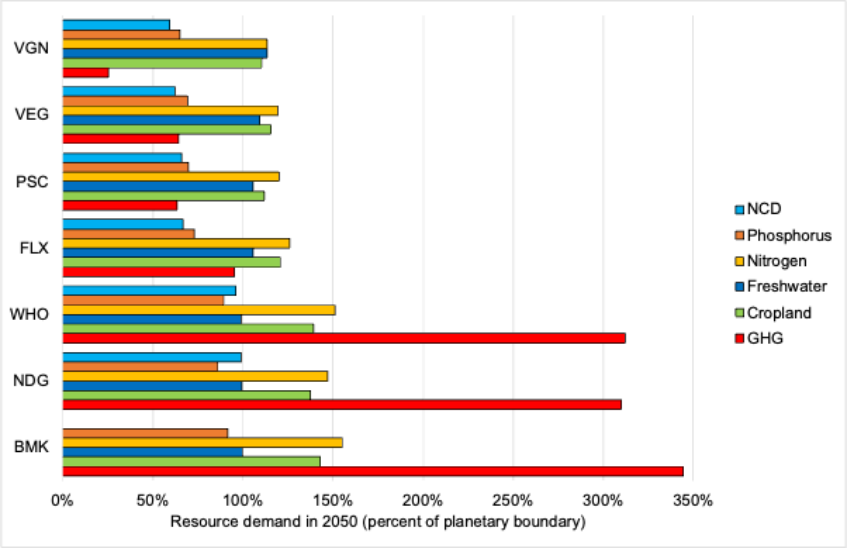
Target attainment by region



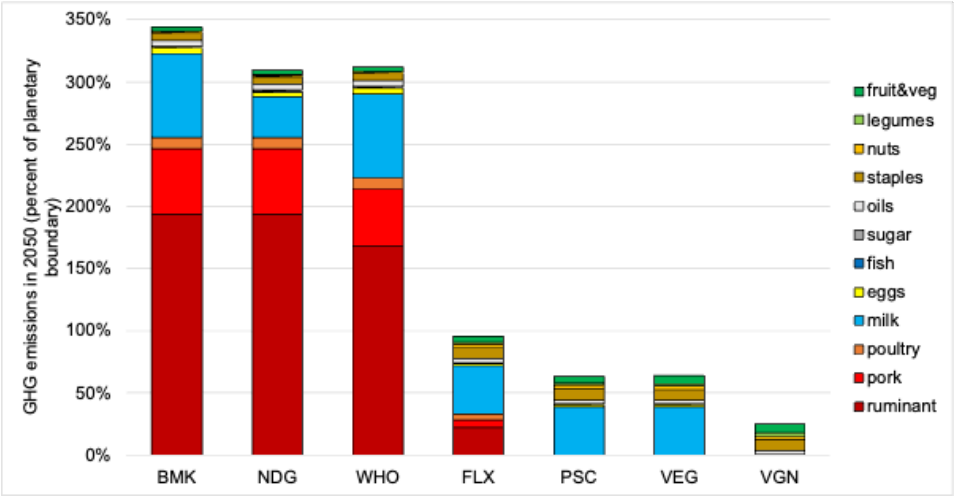
Target attainment by region and food group



Target attainment for Spanish FBDGs



Attainment of GHG target for Spanish FBDGs

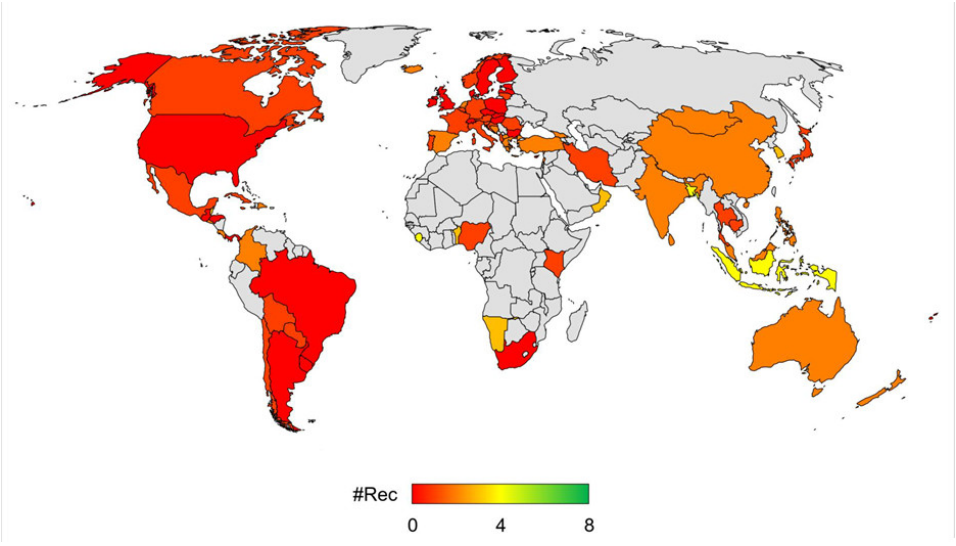


Discussion

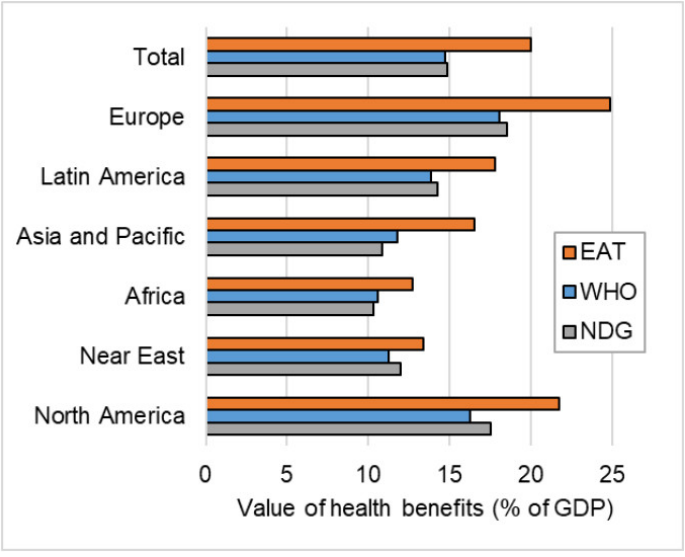
Take-away messages:

- 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.
- Important to provide concrete examples in terms of different dietary traditions and patterns, including plant-based ones

Number of recommendations achieved



Need for policy coherence and investment in health programmes



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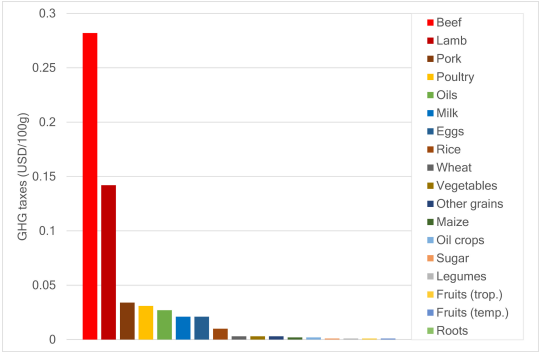
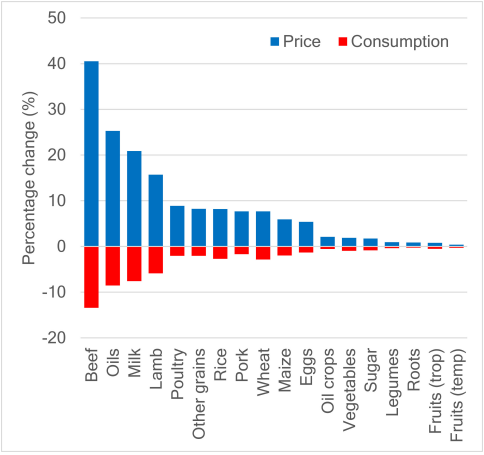
Fiscal incentives

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





Design of emissions taxes on foods

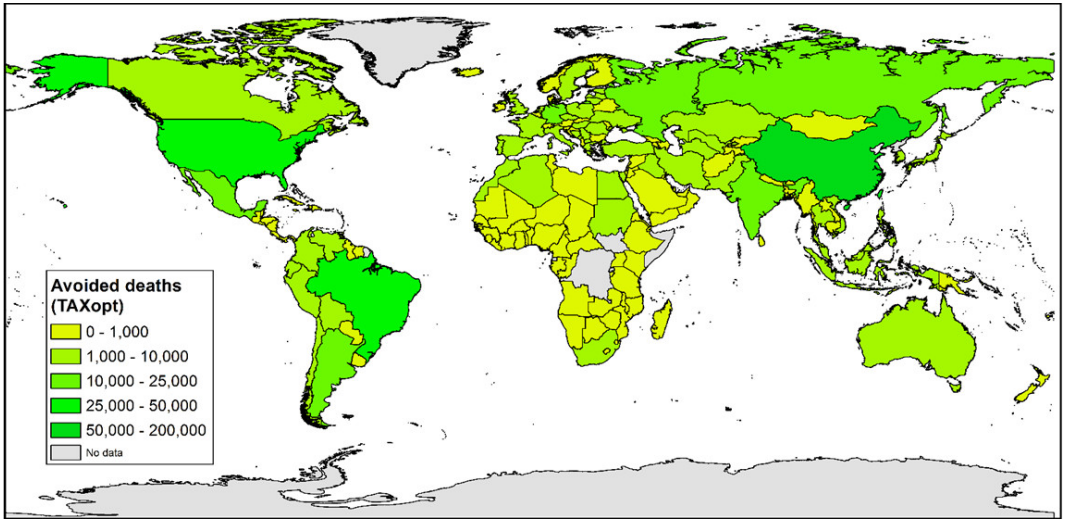
Model scenarios:

- *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

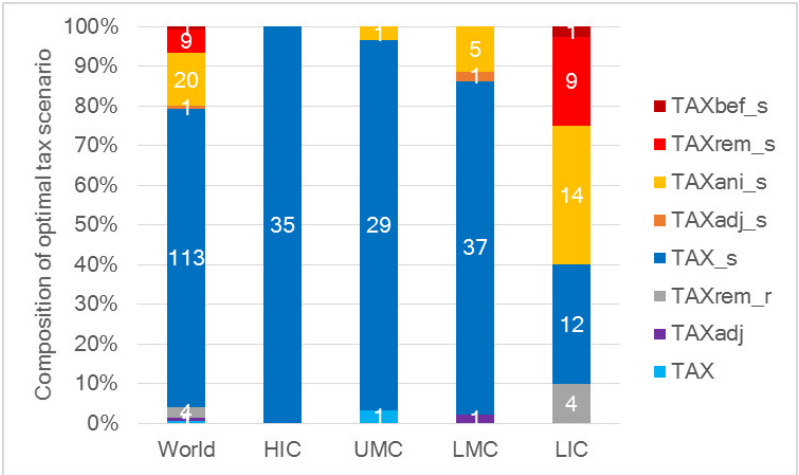
Health-sensitive taxing scheme



Optimal tax scenarios

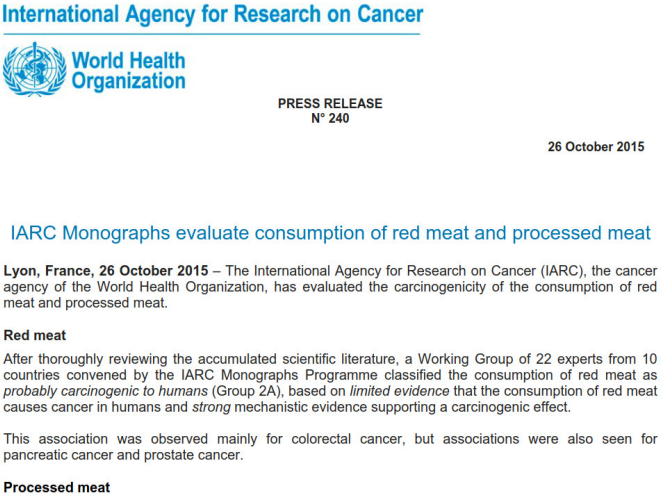
Health-maximising tax scenario for each region:

- 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

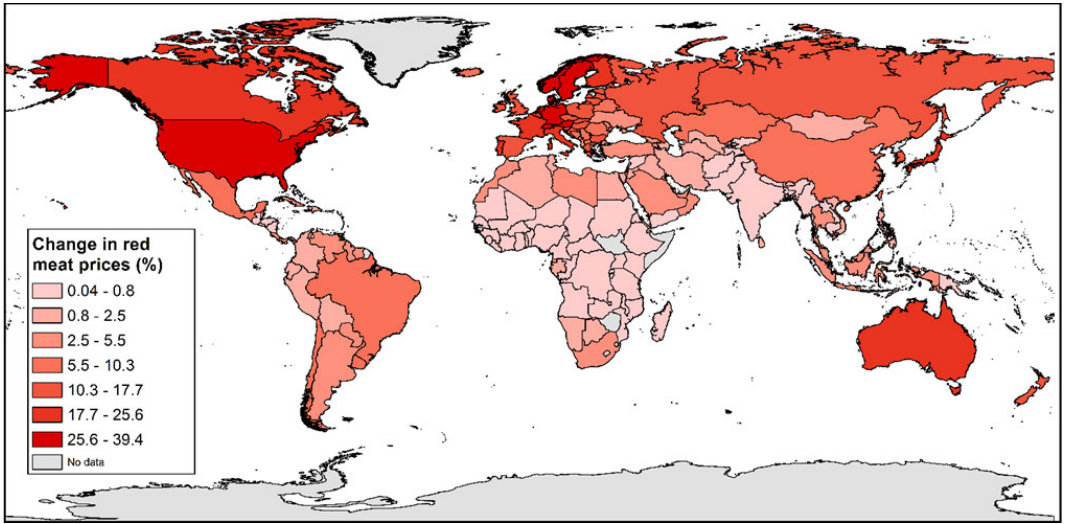
After thoroughly reviewing the accumulated scientific literature, a Working Group of 22 experts from 10 countries convened by the IARC Monographs Programme classified the consumption of red meat as *probably carcinogenic to humans* (Group 2A), based on *limited evidence* that the consumption of red meat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

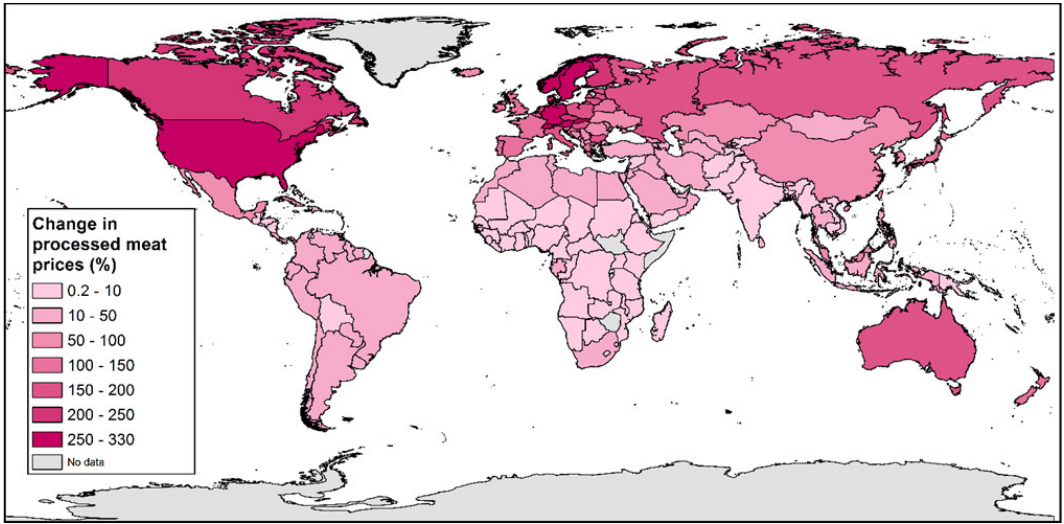
Health taxes on red meat

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



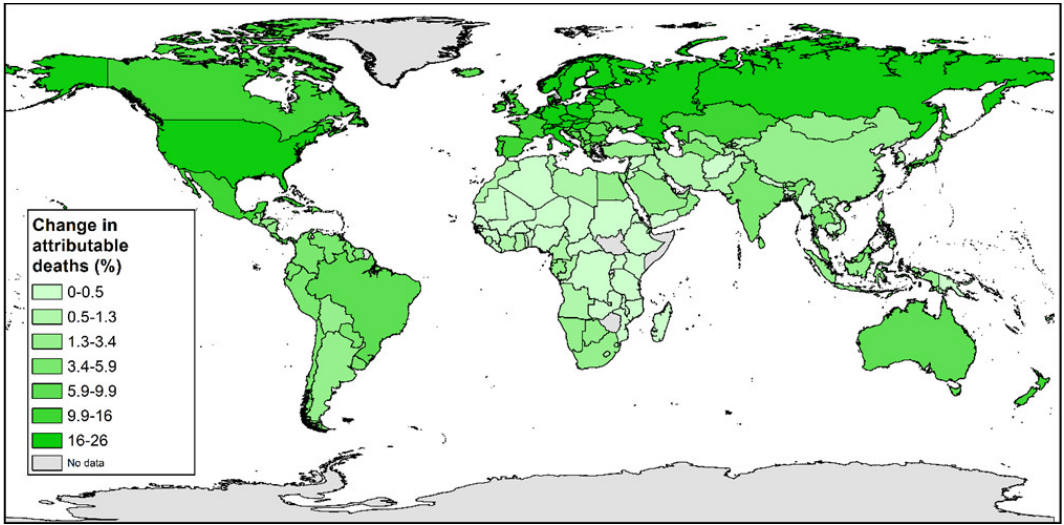
Health taxes on processed meat

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



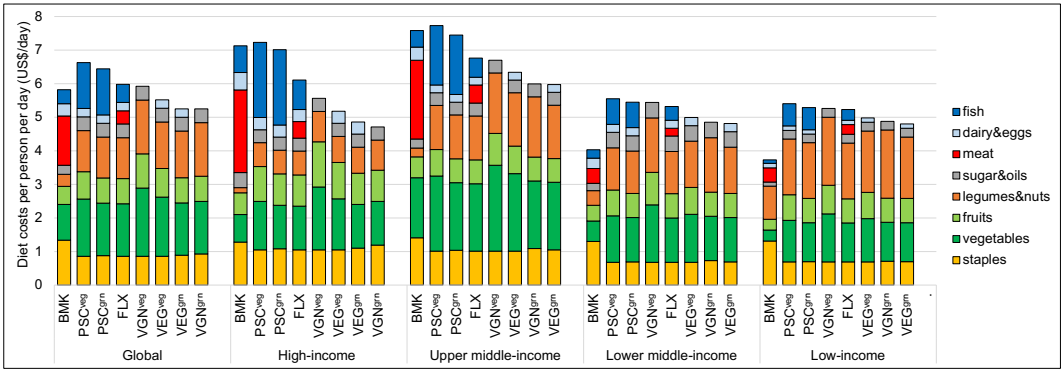
Health taxes on processed meat

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



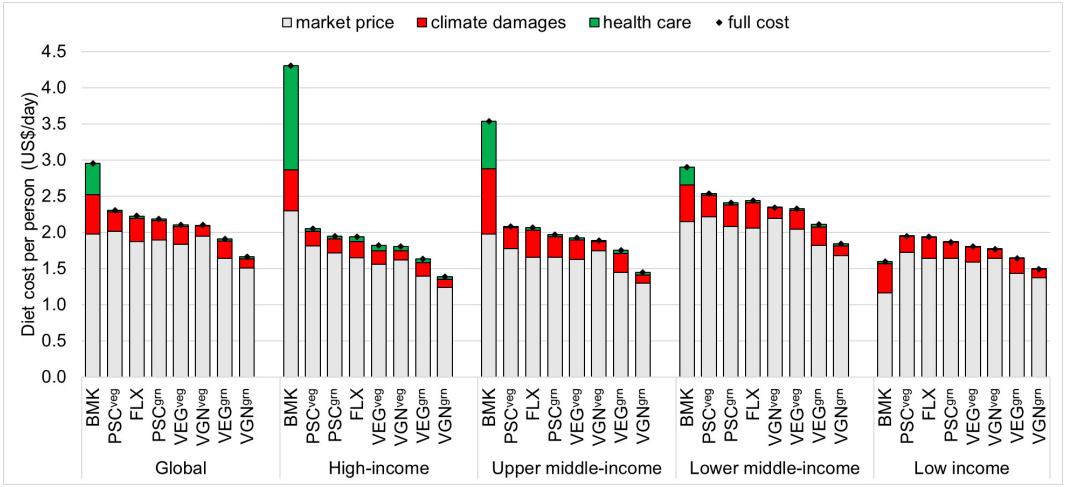
Cost of diets

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

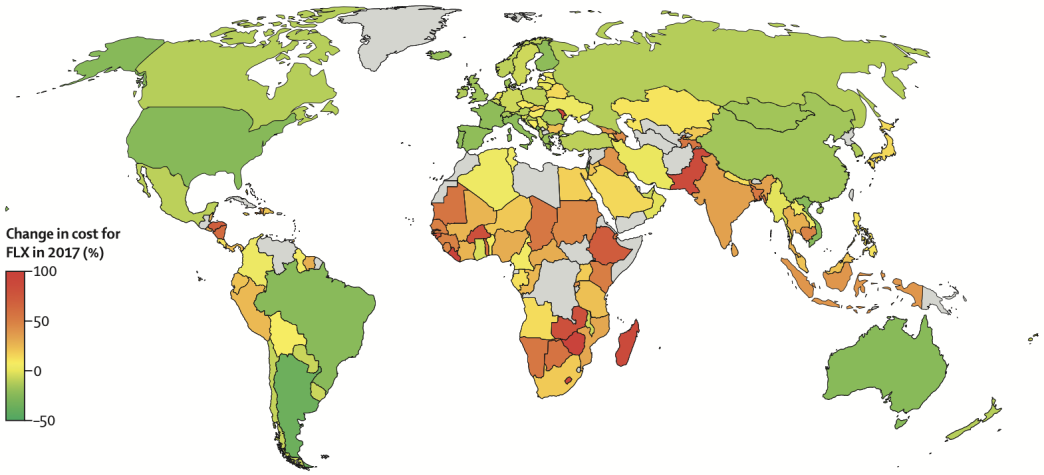


Cost of diets

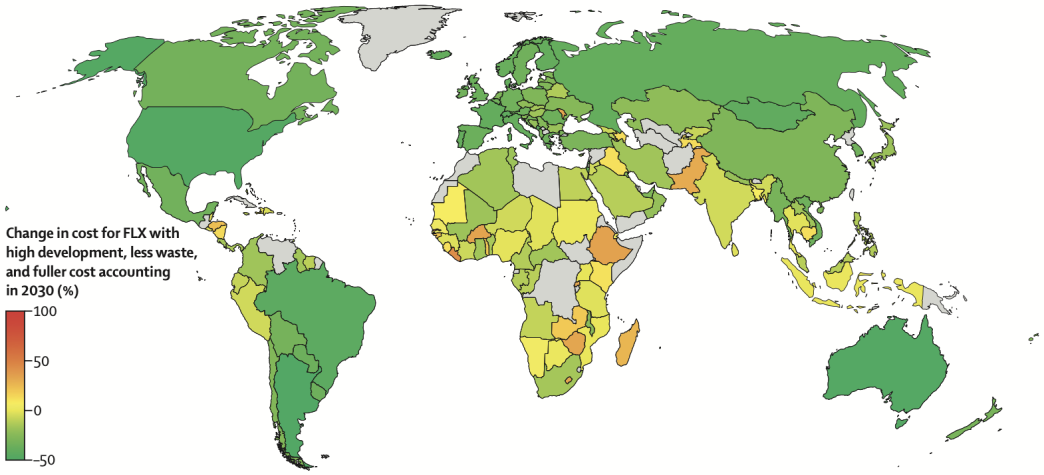
Full costing makes sustainable diets more affordable:



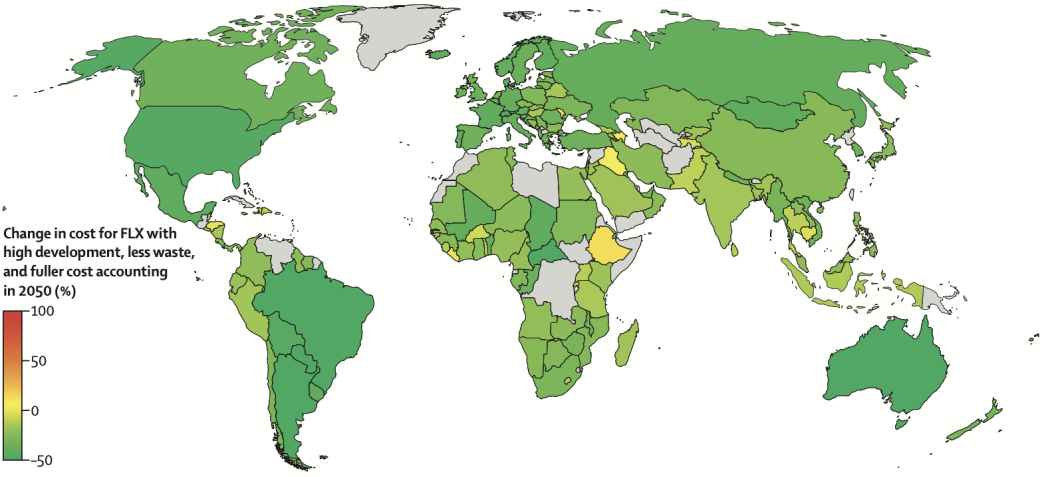
Cost of diets



Cost of diets



Cost of diets



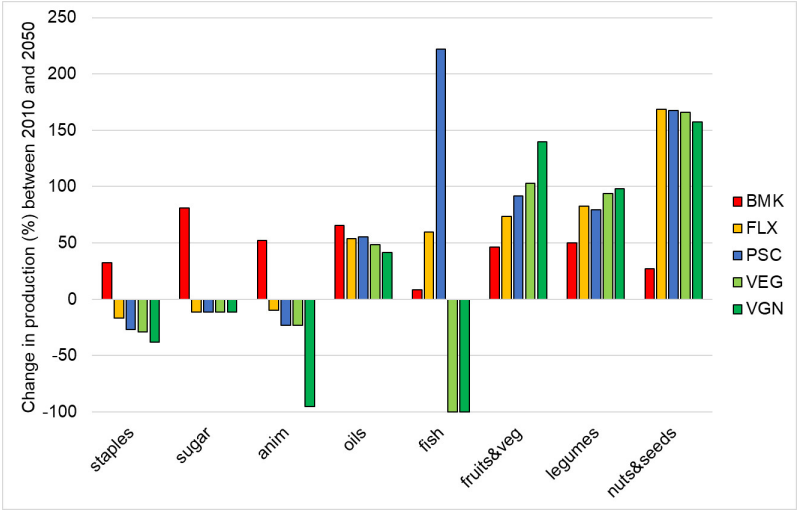
Food prices

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.

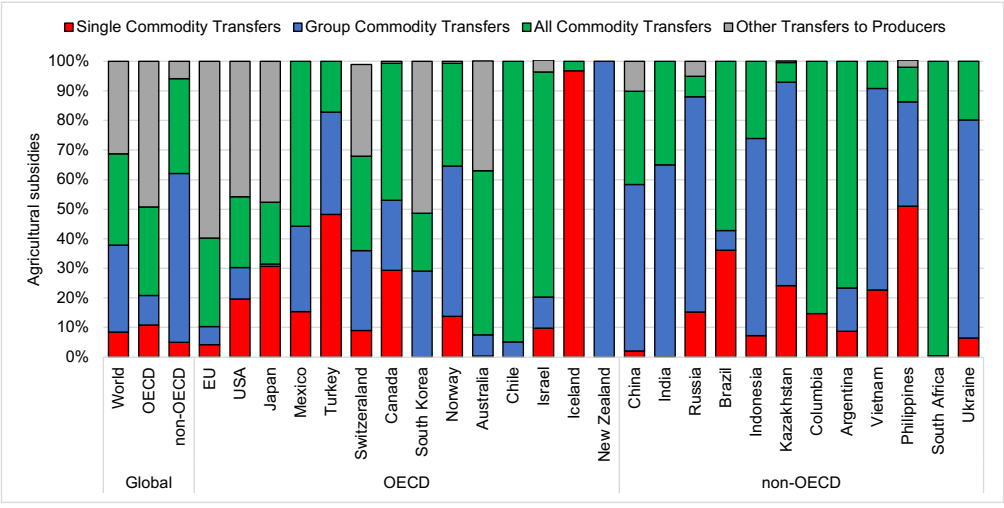
Agricultural subsidies

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



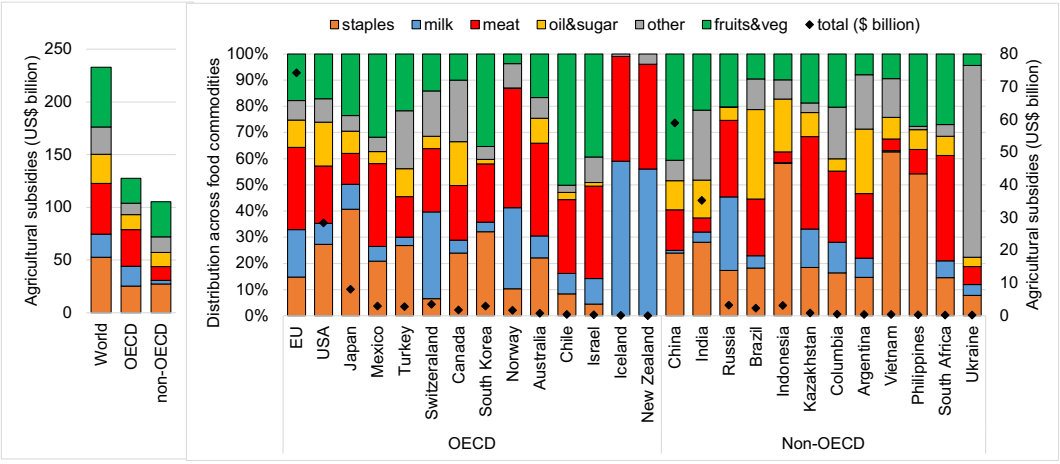
Agricultural subsidies

Agricultural support measures by **type**:



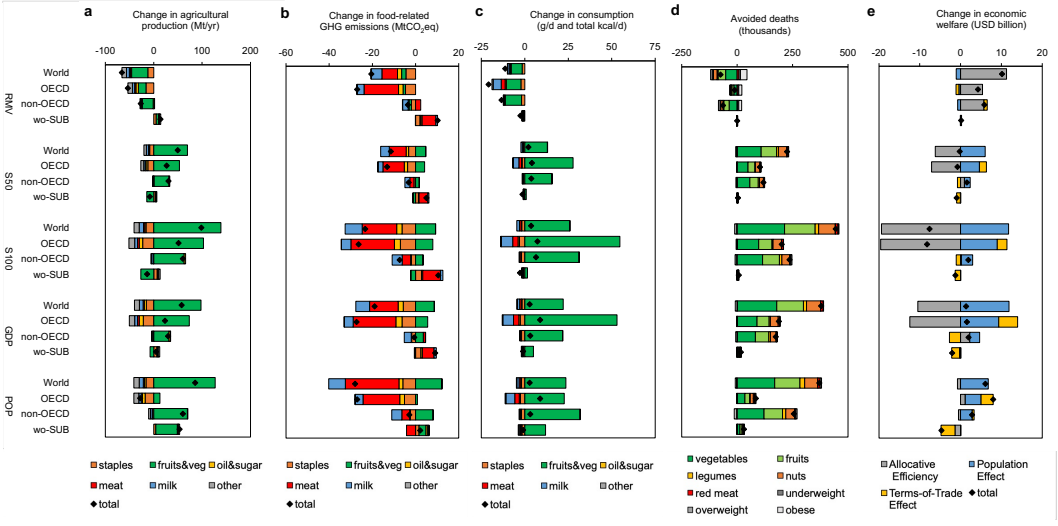
Agricultural subsidies

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;

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Thank you

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