alliance for natural health INTERNATIONAL

SPECIAL REPORT

HAS THE EAT-LANCET COMMISSION FOUND A 'WIN-WIN' FOR PEOPLE, FOOD AND PLANET?

ANH-Intl analysis of the EAT-Lancet report aims to separate science from ideology

ANH-Intl Science Unit
Alliance for Natural Health International
The Atrium, Curtis Road
Dorking RH4 1XA
United Kingdom

Contact and correspondence:
Robert Verkerk PhD (Founder, executive and scientific director)
T +44(0)1306 646 600
E info@anhinternational.org

ANH-Intl critique of:
Willett W, Rockström J, Loken B, Springmann M, Lang T, et al. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet*. 2019 Jan 16. pii: S0140-6736(18)31788-4. doi: 10.1016/S0140-6736(18)31788-4.

NOTE: this document contains hyperlinks, including references to peer-reviewed journals.

INTRODUCTION

After two years of deliberation, the EAT-Lancet Commission, has published its report (Willett et al, 2019) [1] in the Lancet journal. The aim was nothing less than to put an international group of experts in health, environmental sustainability, food systems, economics and political governance together and ask them to go in search of a "healthy diet for all from sustainable food systems." In other words, to determine if a 'win-win' might be found, that would allow the world's expected population of 10 billion in 2050 to still be able to feed themselves in ways that ensure their good health, while in the process not destroying the environment, especially through climate change-mediated effects and loss of biodiversity.

Harvard's Prof Walter Willett and Stockholm Resilience Centre's Prof Johan Rockström, along with another 17 scientific experts (Lancet Commissioners) and 20 co-authors, were effectively charged with finding this sweet spot, if there was indeed one to be found. Along their journey, the Lancet Commissioners, largely with scientific backgrounds, were being asked to conflate science with other disciplines, such as politics, economics, as well as with human behaviour and values.

Possibly most remarkable of all, the 37 co-authors, between them, believe they have found this 'win-win' that has so far looked like an improbability, if not an impossibility.

The report proposes 5 key strategies to achieve this aim:

1. Seek international and national commitments to shift towards healthy diets
2. Reorient agricultural priorities from producing large quantities of food to producing healthy food
3. Sustainably intensify food production, generating high-quality output
4. Strong and coordinated governance of land and oceans
5. At least halve food loss and waste, in line with global Sustainable Development Goals (SDGs) [https://www.un.org/sustainabledevelopment/sustainable-development-goals/]

This special report by ANH-Intl provides an analysis of some of the main findings and recommendations of the EAT-Lancet Commission. The main purpose of this report is to promote discussion on issues that we believe are insufficiently considered by the Lancet Commission.

'WELLCOME' TO THE CONFUSING DECLARATIONS OF INTEREST

Given the Lancet report's publication in one of the world's foremost medical journals, and the paper's attempt to create a 'roadmap' for food production systems as well as eating patterns that millions are likely going to be asked to follow, it is essential to know the origin of the work's funding. The Lancet paper declares funding both from the non-profit EAT Forum in Norway and the UK-based Wellcome Trust, a biomedical research charity based in London with an investment portfolio worth £20.9 billion. The declaration of interest states: "All authors received funding from EAT and the Wellcome Trust." The Lancet's acknowledgments spells out the role of the Wellcome Trust in funding including the financial support of the "secretariat.... travel fares, accommodation, and food...". It adds: "All Commissioners were supported by their employing organisations (see author affiliations) to undertake the Commission's work". No further mention of EAT is made in the acknowledgment despite EAT being declared as a funding source in the paper.

The EAT Forum's own statement on funding reads: "The EAT-Lancet Commission report is an independent comprehensive assessment of existing science on health and sustainability....It was solely funded through the generous support of the Wellcome Trust, which had no role in the writing of the report.....Commissioners received no financial compensation from EAT or *Wellcome Trust for their contributions. Commissioners are independent scientists financially supported by their individual institutions.*"

Whatever the reality, the apparent contradiction between the two declarations needs to be urgently clarified by the Lancet journal, the two co-chairs (Profs Willett and Rockström), the Wellcome Trust and EAT Forum. In particular, the funding of each individual in relation to his or her specific role throughout the duration of the Commission's work should be declared, in line with the 'Declaration of interests' and 'Role of the funding sources' in the Lancet's own instructions for authors.

ABOUT EAT

The EAT Forum was founded in 2013 by the Stordalen Foundation, the Wellcome Trust and the Stockholm Resilience Centre at Stockholm University. EAT Forum sees itself as the "science-based global platform for food system transformation." It appears amply funded by Norwegian billionaire Petter Stordalen and is led by Stordalen's wife and Norwegian physician and PhD scientist, Dr Gunhild Stordalen. The latter was diagnosed with the typically fatal autoimmune condition, systemic scleroderma, in 2014.

REACTION

Reactions in the press have on the whole been positive – most journalists and editors have interpreted it as a good news story. After all, the concerned experts appear to have agreed that there is a way in which humans and this delicate planet of ours can co-exist until 2050 with an extra two and a half billion people aboard. That's despite being perilously close to a tipping point that could see the collapse of natural ecosystems on which life on Earth, humans included, is largely dependent.

Unsurprisingly, among the most outspoken critics have been those dependent on livestock or meat-eating. Such an example is Meat Industry Ireland (MII) which stated:

> "Ireland's grass-based food production systems provide us with a natural competitive advantage to convert this grass feed into high-quality, nutritious meat protein. Irish meat production systems are far more sustainable than in other regions of the world. Nonetheless, we continue our focus on improving environmental impact. From a sustainability perspective, it would be counterproductive to reduce meat production in Ireland, only to import food from less sustainable systems abroad."

Helen Browning, chair of the UK Soil Association, the first organic certification body in the world and herself a farmer, was more measured in her response, saying:

> "The report indicates that trade should allow countries and regions to concentrate on the products that are most suited for their geography. For the UK, that must include grass fed meat and dairy, and rapid shifts in market demand—or cheaper imported foods from countries with lower welfare and environmental standards than our own after Brexit—could put many of us out of business.…I'm all for this transformation, but at a pace that allows progressive farmers the chance to adapt, and with committed investment and government support to enable success."

The reaction among the 'low carb' movement in Western countries has been deeply critical given the growing clinical evidence and popularity of low carb, omnivorous diets, which often contain significant or, relatively, large amounts of animal-based products.

Elsewhere – especially on social media – the views have been more diverse. Much of the negative commentary being related to the report's recommendation to see a dramatic reduction in global per capita meat consumption, this affecting in particular industrialised countries that have long had a history of heavy meat consumption.

In search of this 'win-win', the report explains in its fourth and final part that there would need to be a coordinated level of transformation in food production, supply and consumption patterns at a global scale that could just as easily be viewed as a pipe dream. The Lancet authors refer to this transition as the 'Great Food Transformation'.

To-date, the development of food production systems – and decisions over what individuals choose to eat have been left largely up to the dynamics of prevailing economic and market forces as well as human preferences, albeit with some 'top-down' governmental 'healthy eating' guidance.

In its proposed Great Food Transformation, the authors are imagining a system in which various organs of the United Nations, national governments, transnational corporations, agricultural producers, the Organisation for Economic Co-operation and Development (OECD), the Intergovernmental Panel on Climate Change, corporations, and a few billion citizens all come together with a single set of goals. These include a commitment to the Paris climate agreement, the UN's Sustainable Development Goals and the EAT-Lancet Commission's newly established scientific targets for healthy eating and environmental sustainability. Is this really feasible?! We're not suggesting that it's not worth trying to do something very ambitious, but, given historical precedents set over the last century or so, it would be more than optimistic to imagine such a collaboration being pulled off successfully within a decade.

QUICK VIEW OF EAT-LANCET REPORT

For those who have the time to study all 47 pages of the Lancet report (Willett et al, 2019) [1], the following summaries from two organisations that have been directly involved with the project may be useful:

- Eat-Forum microsite dedicated to the EAT-Lancet Commission report.
- Harvard TH Chan School of Public Health Walter Willett's academic home. The summary doesn't miss the opportunity of pointing out, not unsurprisingly given Willett's chairmanship of the Lancet Commission, Harvard's own Healthy Eating Plate that we reviewed in 2016.

THE 'PLANETARY HEALTH DIET'

In collaboration with the climate change and sustainability colleagues on this Lancet Commission, Willett and his nutritional science colleagues have attempted to develop an average diet that every adult on the planet can eat that ensures the average global temperatures do not exceed the 1.5ºC set in the Paris Agreement. But, as with any model, many assumptions have been made. The authors of the Lancet Commission refer to their proposed diet as the 'healthy reference diet' – EAT Forum and the media seem to prefer the more colloquial 'Planetary Health Diet'.

Among its features are:

- Average proposed daily intakes for adults are given for 8 food groups (incorrectly, in our view, referred to as 'macronutrients' in the table heading) along with wider intake ranges to take into account social and cultural differences and diversity
- Zero to relatively small amounts of meat are proposed (an average of 43 grams of beef, lamb, pork and poultry, comprising 3.7% of daily energy). This contrasts with present levels of meat consumption in the USA of 128 grams per day (Daniel, 2011) [2]
- The reference diet proposes a greater energy 'allowance' for sugar (120 kcal) than for beef, lamb, pork, chicken, other poultry, and eggs combined (111 kcal energy)
- The proposed 'added sugars' allowance is the equivalent to over 7 teaspoons of added sugar every day (about 5% of daily energy intake)
- The reference diet proposes limited intakes of starchy vegetables, contrary to most current government guidelines
- Very limited intake of saturated fats (added animal fats limited to 5g per day, equivalent to 1.4% of daily energy) are advised
- The report proposes that palm oil, the fruit oil currently being the second most commonly used fat worldwide, should be limited to a maximum of just 6.8g per day (2.4% of daily energy)
- The proposed substitution of plant oils for animal fats will likely lead to an Omega-6 to -3 fatty acid ratio that is strongly Omega-6 dominant given the lack of stipulated Omega-3 sources and the high Omega-6 content of unsaturated plant oils (Table 1)
- The reference diet proposes a low average ratio of vegetables to fruit (fresh weight) of 3:2, although a maximum of 6:1 is possible if the maximum intake of vegetables and the minimum of fruit shown in the ranges is consumed
- It recommends a 32% contribution of daily energy from whole grains (34% from all starchy carbohydrates)
- It proposes only 8% of the daily energy contribution from all vegetables and fruit (despite these comprising half the total daily food volume, according to EAT Forum Summary Report)
- The report proposes the addition of an average of 250 ml a day of whole milk or derivative equivalents of dairy products (equivalent to about 25-40 g of cheese), although also allows for zero intake for those who are dairy intolerant

Table 1. Fatty acid ratios of various plant oils*

Fatty acids	SAF	GRP	SOY†	HMP	SFL	PMS	SES	RB	ALM	RPS	PNT	OL	COC	PKO†
SFAs	9.3	10.4	18.3	9.2	9.4	19.6	16.9	22.5	9.3	6.3	10.7	19.4	92.1	76.0
MUFAs	11.6	14.8	23.3	28.1	28.3	26.1	42.0	44.0	67.9	72.8	71.1	68.2	6.2	22.5
PUFAs	79.1	74.9	57.9	62.4	62.4	54.3	41.2	33.6	22.8	20.9	18.2	18.0	1.6	1.25
n-3	0.2	0.2	8.0	0.4	0.3	0.1	0.2	0.5	0.0	1.2	0.0	1.6	0.0	0.0
n-6	79.0	74.7	49.5	62.4	62.2	54.2	40.9	33.1	22.8	19.6	18.2	16.4	1.6	1.3

* SAF—safflower, GRP—grape, SOY—soybean oil, HMP—hemp, SFL—sunflower, PMS—pumpkin seed, SES—sesame, RB—rice bran, ALM—almond, RPS—rapeseed, PNT—peanut, OL—olive, COC—coconut oils, and PAL—palm kernel oil. Source: (Orsavova et al, 2015) [3] with the exception of SOY and PAL.

† SOY and PKO data derived from (Kostik et al, 2013) [4].

The composition of the "health reference diet" is given below (Table 2).

Table 2. The EAT-Lancet Commission's 'healthy reference diet' including recommended average intakes and ranges for adults (spelling error in Lancet paper "total grains 0-60% of energy" corrected)

THE PLANETARY HEALTH DIET

aka "healthy reference diet"

	FOOD GROUP INTAKE (POSSIBLE RANGE), G/DAY	CALORIC INTAKE, KCAL/DAY	% ENERGY CONTRIBUTION
Whole grains			
Rice, wheat, corn and other	232 (total grains 0-60% of energy)	811	32.4
Tubers or starchy vegetables			
Potatoes and cassava	50 (0-100)	39	1.6
Vegetables			
All vegetables	300 (200-600)	..	n/a
Dark green vegetables	100	23	0.9
Red and orange vegetables	100	30	1.2
Other vegetables	100	25	1.0
Fruits			
All fruit	200 (100-300)	126	5.0
Dairy foods			
Whole milk or derivative equivalents (eg, cheese)	250 (0-500)	153	6.1
Protein sources			
Beef and lamb	7 (0-14)	15	0.6
Pork	7 (0-14)	15	0.6
Chicken and other poultry	29 (0-58)	62	2.5
Eggs	13 (0-25)	19	0.8
Fish	28 (0-100)	40	1.6
Legumes			
Dry beans, lentils and peas	50 (0-100)	172	6.9
Soy foods	25 (0-50)	112	4.5
Peanuts	25 (0-75)	142	5.7
Tree nuts	25	149	6.0
Added fats			
Palm oil	6.8 (0-6.8)	60	2.4
Unsaturated oils	40 (20-80)	354	14.1
Dairy fats (included in milk)	0	0	0.0
Lard or tallow	5 (0-5)	36	1.4
Added sugars			
All sweeteners	31 (0-31)	120	4.8

The EAT Forum has also created a pie chart version (Figure 1) based on the recommended intakes that has been published in the EAT Forum's Summary Report. A statement in the contents page of the report reads: "The EAT-Lancet Commission and *this summary report were made possible with the support of Wellcome Trust*." This suggests that the Wellcome Trust and the Lancet Commissioners have had full sight of the EAT Forum report and have signed it off.

The pie chart provides the essence of the summary of the first major target of the report, namely to establish healthy diets for all. Images of the chart have been very widely circulated and disseminated by the media.

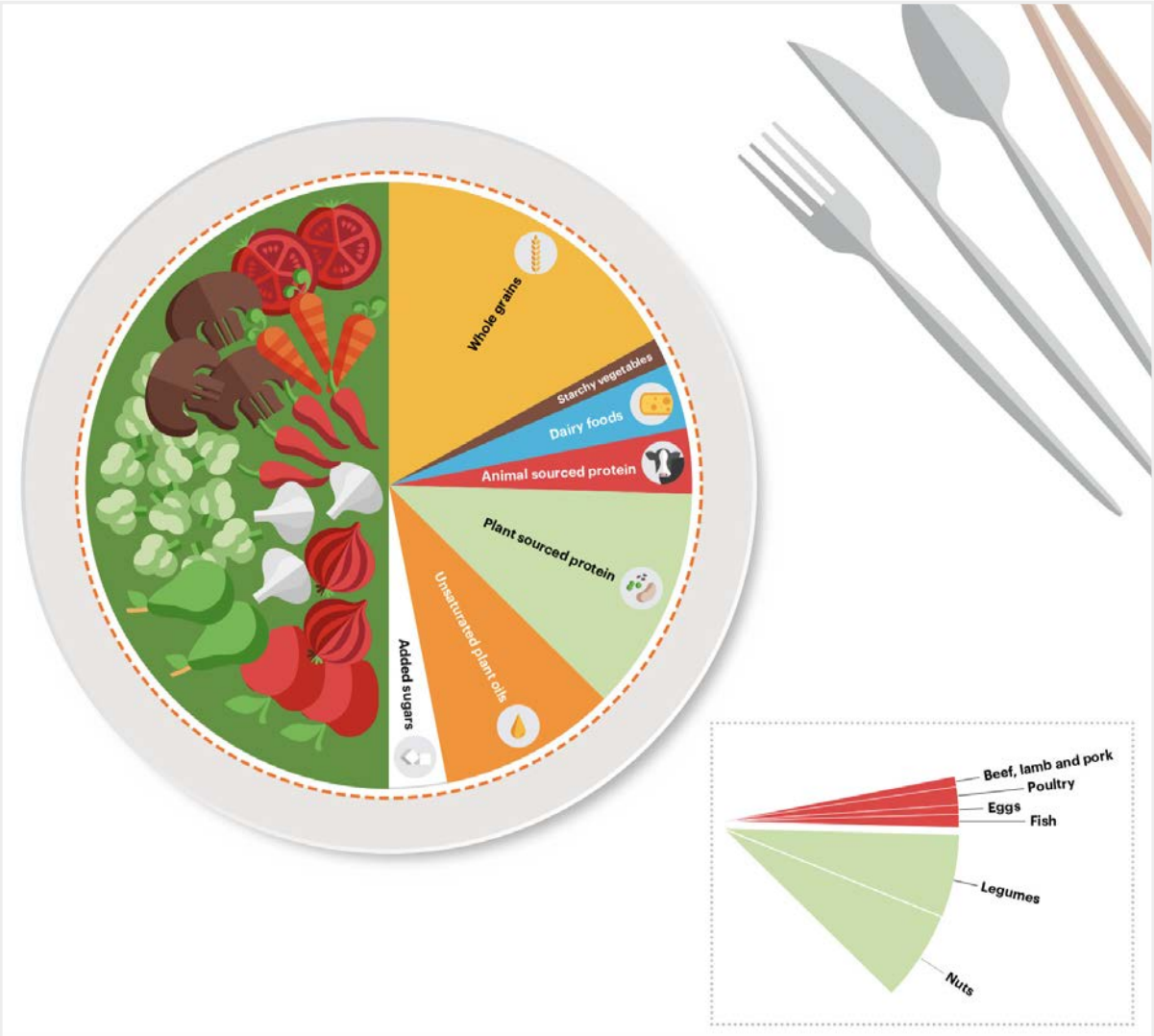

Figure 1. Interpretation of the EAT-Lancet 'healthy reference diet' by the EAT Forum (Source: EAT Forum Summary Report, p. 9) based on daily intake of 2,500 kcal (10,460 kJ).

At face value, given that the pie chart is depicted on a plate, the chart is very likely to be interpreted by members of the lay public as reflecting the composition of daily food items in terms of their volume or weight.

However, the EAT Forum has elected to mix 'currencies' on the left side and the right side of the plate which may in turn lead to public confusion. It turns out that the left side, representing fruit and vegetables, is based on volumes (not weights of fruits and vegetables), while the right side shows the contribution of the other food groups to daily energy.

While this is clearly spelled out in the figure's legend in the report (see Figure 3, p. 9), the image is being widely circulated without the detail provided in the figure legend.

Using the Lancet Commission's own data, this left side (50% by volume) represents just 8% of the total daily energy intake, given the high water content. In referring to 'volume', what does the EAT Forum mean? Is it volume of the plant matter, or the volume vegetables and fruit occupy on a plate, taking. Into account all the air spaces that will be present when food is presented on a plate? Whatever the case, the currencies are mixed and the graphic is unclear and misleading. Owing primarily to the sugar (fructose) content of the vegetables, the total vegetable intake provides, according to EAT-Lancet's figures, just 3.1% of daily energy, as against 5% for the fruit.

We have prepared two pie charts (Figure 2) that represent all food groups and their average intakes by fresh weight and energy contribution, respectively, as provided by the EAT-Lancet Commission, to avoid the conflict between different 'currencies' (i.e. volume vs energy contribution).

The reference diet is not far away from what governments have been proposing for some time (e.g. My Plate, Eatwell guide). Surprisingly in many ways, the recommendations continue to demonise saturated fats, despite an absence of sound evidence (Harcombe et al, 2015) [5].

Among the significant shifts in the EAT-Lancet targets over current dietary guidelines in countries such as the USA and UK are:

- An approximately 50% reduction in the global consumption of meat and sugar
- a reduction of intake of starchy vegetables (e.g. potatoes, cassava)
- A doubling of the global consumption of tree nuts, fruits, vegetables and legumes

Unchanged is the continued demonisation of saturated fats (including palm and coconut oil, the latter not featuring in the report at all).

While most of the commentary by third parties has been linked to the average amounts of each food group, it is important to consider the intake ranges given that they allow for considerable flexibility to cater for different dietary types (e.g. vegetarian, vegan, pescatarian, flexitarian, omnivore), cultures and socio-economic status.

Considering the ranges, rather than the averages, a dietary approach consistent with the 'healthy reference diet' selected to deliver 2500 kcal of daily energy can be derived from the following:

- Zero to 80 g of meat (beef, lamb, pork or poultry) a day
- Zero to 25 g eggs per day
- Zero to 100 g fish per day
- Zero to 500 g of whole milk or equivalent derivatives (e.g. cheese, butter)
- Zero to 225 g per day of legumes (dry beans, lentils, peas, soy foods, peanuts)
- Not less than 100 g and not more than 300 g of fruit per day
- Minimums of 200 g of vegetables and 100 g of fruit per day
- Maximums of 600 g of vegetables and 300 g of fruit per day
- A vegetable to fruit ratio between 1:1 and 6:1
- Added fats: a minimum of 20 g and maximum of 92 g
- Added sugars and other sweeteners: zero to 31 g

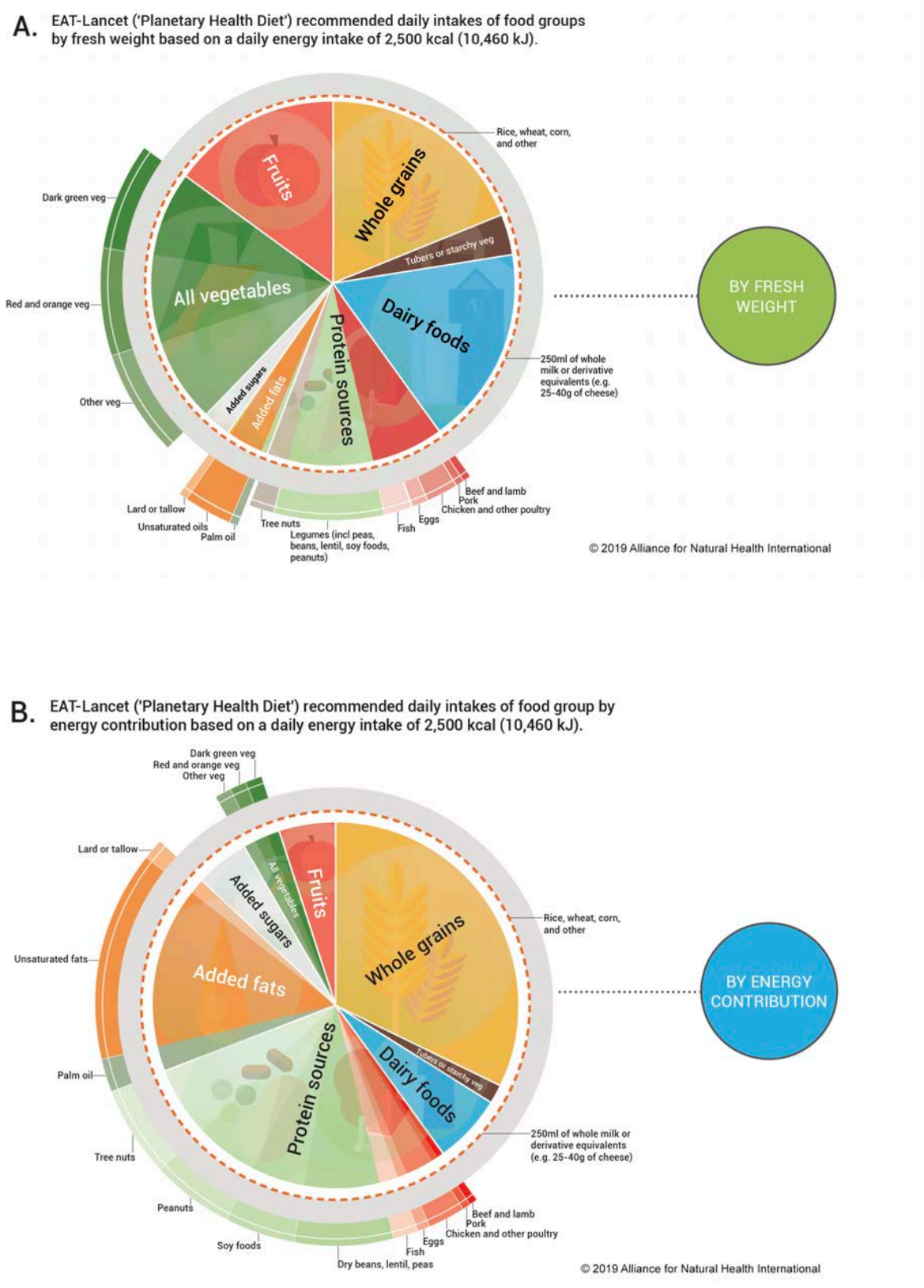

Figure 2. The EAT-Lancet 'healthy reference diet' by food group according to fresh weight of intake (A) and energy contribution (B) based on daily energy intake of 2,500 kcal (10,460 kJ).

EXPLORING THE FLEX IN THE 'PLANETARY HEALTH DIET'

The EAT-Lancet 'healthy reference diet' can be interpreted in a surprising number of different ways, given the considerable intake ranges given alongside the mean target values (see Table 2 above). The rapid increase in popularity of veganism and low carbohydrate diets in industrialised countries are two trends that reflect a public desire to deal with adverse environmental, animal welfare or adverse health impacts associated with modern omnivorous diets.

We have therefore used the EAT-Lancet targets to create three different scenarios for flexitarians and vegans, respectively. We have made selections consistent with each of the 8 food groups and drawn data from the same source database used by the EAT-Lancet authors (i.e. the USDA Food Composition Databases).

The food selections for each of the three scenarios reflect 'basic', 'low carb' and 'physically active, higher protein' choices. These three scenarios have been applied to flexitarian and vegan dietary types and key compositional criteria as well as macronutrient contributions to daily energy are shown in the following 6 tables (Tables 3.A1-C2).

Tables 3.A1-3 – B1-3. Flexitarian (A, orange table headers) and Vegan (B, green table headers) dietary types, based on 3 scenarios**,** 'Basic' (A1, B1), 'Lower carb' (A2, B2) and 'Physically-active, higher protein, higher energy' (C1, C2) based on EAT-Lancet target intake ranges.

A. Flexitarian dietary types

A1.

FLEXITARIAN 1 ('basic flexitarian')

Food group	Food	Fresh wt	kcal	Protein	Sugars	Fibre	Fats	Notes
Wholegrains	Rice (long-grain and wild)	100	357	8.93	0	3.6	0	
	Rolled oats	75	281	9.38	1.88	7.5	0	Recommended mean whole grain intake
	Brown rice pasta	57	273	5.45	1.36	4.1	2.73	
Tubers and starchy veg	Sweet potato	50	50	0.99	2.73	0.8	0	Recommended intake
Vegetables	Kale	100	36	2.94	1.21	4	0	
	Red peppers	50	13	0.49	2.1	1.1	0	Recommended mean intake of vegetables
	Butternut squash	50	44	0.81	1.22	0.8	0	
	Broccoli	100	35	1.18	2.35	2.4	0	
Fruits	Apple (Granny Smiths)	100	52	0	10.4	3.2	0	
	Blueberries	50	28	0.37	4.98	1.2	0	Recommended mean intake of fruit
	Orange	50	24	0.55	4.35	1.1	0	
Dairy foods	Mature cheddar	50	214	12.5	0	0	16.07	Dairy equivalent of recommended 250ml
	Butter	30	215	0.26	0.02	0	24.3	of whole milk
Protein sources	Chicken	29	40	1.97	0.39	0.6	1.65	
	Salmon	28	57	4.54	2.56	0	2.96	Zero red meat
	Peas	50	40	2.81	2.25	2.2	0	
	Tofu	25	29	2.23	0	0	2	Recommended intake of ancillary plant
	Peanuts	25	152	6.25	0.89	3.6	10.71	protein (and fat) sources
	Almonds	25	145	5.29	1.09	3.1	12.48	
Added fats	Extra virgin olive oil	40	347	0	0	0	40	
Added sugars	Brown cane sugar	31	116	0	31	0	0	
	TOTALS	**1115**	**2548**	**66.94**	**70.78**	**39.3**	**112.9**	
	Energy contribution:	10.5% energy from protein (0.96g/kg body weight for a 70 kg adult) 49.6% energy from carbohydrates (34.6% energy from wholegrains) 39.9% energy from fats						

A2.

FLEXITARIAN 2 ('lower carb flexitarian')

Food group	Food	Fresh wt	kcal	Protein	Sugars	Fibre	Fats	Notes
Wholegrains	Rice (long-grain and wild)	100	357	8.93	0	3.6	0	57g less wholegrains than proposed mean
	Rolled oats	75	281	9.38	1.88	7.5	0	
Tubers and starchy veg	Sweet potato	50	50	0.99	2.73	0.8	0	Recommended intake
Vegetables	Kale	100	36	2.94	1.21	4	0	
	Red peppers	50	13	0.49	2.1	1.1	0	Recommended vegetable intake
	Butternut squash	50	44	0.81	1.22	0.8	0	
	Broccoli	100	35	1.18	2.35	2.4	0	
Fruits	Apple (Granny Smiths)	100	52	0	10.4	3.2	0	
	Blueberries	50	28	0.37	4.98	1.2	0	
	Orange	50	24	0.55	4.35	1.1	0	
Dairy foods	Mature cheddar	50	214	12.5	0	0	16.07	
	Butter	30	215	0.26	0.02	0	24.3	
Protein sources	Chicken	29	40	1.97	0.39	0.6	1.65	
	Salmon	28	57	4.54	2.56	0	2.96	Zero red meat
	Peas	50	40	2.81	2.25	2.2	0	
	Tofu	25	29	2.23	0	0	2	
	Peanuts	25	152	6.25	0.89	3.6	10.71	
	Almonds	25	145	5.29	1.09	3.1	12.48	
Added fats	Extra virgin olive oil	40	347	0	0	0	40	
Added sugars	Brown cane sugar	10	38	0	10	0	0	21g less sugars than proposed mean
	TOTALS	**1037**	**2197**	**61.49**	**48.42**	**35.2**	**110.17**	
	Energy contribution:	11.3% energy from protein (0.87g/kg body weight for a 70 kg adult) 43.7% energy from carbohydrates (29% energy from wholegrains) 45% energy from fats						

A3.

FLEXITARIAN 3 ('physically active, higher protein flexitarian')

Food group	Food	Fresh wt	kcal	Protein	Sugars	Fibre	Fats	Notes
Wholegrains	Rice (long-grain and wild)	100	357	8.93	0	3.6	0	57g less wholegrains than proposed mean
	Rolled oats	75	281	9.38	1.88	7.5	0	
Tubers and starchy veg	Sweet potato	50	50	0.99	2.73	0.8	0	Recommended intake
Vegetables	Kale	100	36	2.94	1.21	4	1.5	
	Red peppers	50	13	0.49	2.1	1.1	0.15	
	Butternut squash	50	44	0.81	1.22	0.8	0	
	Broccoli	100	35	1.18	2.35	2.4	0	
	Avocado	100	167	1.96	0.3	6.8	15.41	Diversified vegetable intake to maximum intake proposed by EAT-Lancet, following recommendations of ANH-Intl Food4Health guide
	Cauliflower	65	16	1.53	1.53	1.6	0	
	Rocket (arugula)	25	6	0.59	0.59	0.3	0.15	
	Parsley	20	7	0.59	0.17	0.7	0.16	
	Onion	50	20	0.55	2.12	0.8	0.05	
	Garlic	20	17	0	0	0	0	
	Ginger	20	16	0.36	0.34	0.4	0.15	
Fruits	Apple (Granny Smiths)	100	52	0	10.4	3.2	0	
	Blueberries	50	28	0.37	4.98	1.2	0	
	Orange	50	24	0.55	4.35	1.1	0	
Dairy foods	Mature cheddar	50	214	12.5	0	0	16.07	
	Butter	30	215	0.26	0.02	0	24.3	
Protein sources	Chicken	58	80	3.94	0.78	1.2	3.3	
	Salmon	100	203	16.21	9.14	0	10.57	Maximum proposed daily amounts
	Eggs	25	36	3.13	0.09	0	2.37	
	Peas	50	40	2.81	2.25	2.2	0	
	Tofu	25	29	2.23	0	0	2	
	Peanuts	25	152	6.25	0.89	3.6	10.71	
	Almonds	25	145	5.29	1.09	3.1	12.48	
Added fats	Extra virgin olive oil	40	347	0	0	0	40	
	Flaxseed oil	20	354	0.04	0	0	40	Maximum proposed daily amounts
	Avocado oil	20	177	0	0	0	20	
	Palm oil kernel	6.8	59	0	0	0	6.8	
Added sugars	Brown cane sugar	10	38	0	10	0	0	21g less sugars than proposed mean
	TOTALS	**1509.8**	**3258**	**83.88**	**60.53**	**46.4**	**206.17**	
	Energy contribution:	10.3% energy from protein (1.2g/kg body weight protein for a 70kg adult) 32.7% energy from carbohydrates (19.6% energy from wholegrains) 57.0% energy from fats						

B. Vegan dietary types `

B1.

VEGAN 1 ('basic vegan')

Food groups	Food	Fresh wt	kcal	Protein	Sugars	Fibre	Fats	Notes
Wholegrains	Rice (long-grain and wild)	100	357	8.93	0	3.6	0	
	Rolled oats	75	281	9.38	1.88	7.5	0	Recommended mean whole grain intake
	Brown rice pasta	57	273	5.45	1.36	4.1	2.73	
Tubers and starchy veg	Sweet potato	50	50	0.99	2.73	0.8	0	Recommended intake
Vegetables	Kale	100	36	2.94	1.21	4	0	
	Red peppers	50	13	0.49	2.1	1.1	0	Recommended mean intake of vegetables
	Butternut squash	50	44	0.81	1.22	0.8	0	
	Broccoli	100	35	1.18	2.35	2.4	0	
Fruits	Apple (Granny Smiths)	100	52	0	10.4	3.2	0	
	Blueberries	50	28	0.37	4.98	1.2	0	Recommended mean intake of fruit
	Orange	50	24	0.55	4.35	1.1	0	
Protein sources	Lentils (boiled)	100	114	9.02	1.8	7.9	0	Double the legume recommendation to
	Peas	50	40	2.81	2.25	2.2	0	improve protein intake
	Tofu	25	29	2.23	0	0	2	
	Peanuts	25	152	6.25	0.89	3.6	10.71	
	Almonds	25	145	5.29	1.09	3.1	12.48	
Added fats	Extra virgin olive oil	40	347	0	0	0	40	Maximum proposed for unsaturated oils
	Flaxseed oil	40	354	0.04	0	0	40	
Added sugars	Brown cane sugar	31	116	0	31	0	0	
	TOTALS	**1118**	**2490**	**56.73**	**69.61**	**46.6**	**107.92**	
	Energy contribution:	9.1% energy from protein (0.81g/kg body weight for a 70kg adult) 51.9% energy from carbohydrates (36.6% energy from wholegrains) 39.0% energy from fats						

B2.

VEGAN 2 ('lower carb vegan')

Food group	Food	Fresh wt	kcal	Protein	Sugars	Fibre	Fats	Notes
Wholegrains	Rice (long-grain and wild)	100	357	8.93	0	3.6	0	57g less wholegrains than proposed mean
	Rolled oats	75	281	9.38	1.88	7.5	0	
Tubers and starchy veg	Sweet potato	50	50	0.99	2.73	0.8	0	
Vegetables	Kale	100	36	2.94	1.21	4	0	
	Red peppers	50	13	0.49	2.1	1.1	0	Recommended vegetable intake
	Butternut squash	50	44	0.81	1.22	0.8	0	
	Broccoli	100	35	1.18	2.35	2.4	0	
Fruits	Apple (Granny Smiths)	100	52	0	10.4	3.2	0	Recommended fruit intake
	Blueberries	50	28	0.37	4.98	1.2	0	
	Orange	50	24	0.55	4.35	1.1	0	
Protein sources	Lentils (boiled)	100	114	9.02	1.8	7.9	0	Double the legume recommendation to
	Peas	50	40	2.81	2.25	2.2	0	improve protein intake
	Tofu	25	29	2.23	0	0	2	
	Peanuts	25	152	6.25	0.89	3.6	10.71	
	Almonds	25	145	5.29	1.09	3.1	12.48	
Added fats	Extra virgin olive oil	40	347	0	0	0	40	Maximum amounts proposed for
	Flaxseed oil	40	354	0.04	0	0	40	unsaturated oils
Added sugars	Brown cane sugar	10	38	0	10	0	0	21g less sugars than proposed mean
	TOTALS	**1040**	**2139**	**51.28**	**47.25**	**42.5**	**105.19**	
	Energy contribution:	9.6% energy from protein (0.73g/kg body weight for a 70kg adult) 46.4% energy from carbohydrates (30% energy from wholegrains) 44.0% energy from fats						

B3.

VEGAN 3 ('physically active, higher protein vegan')

Food groups	Food	Fresh wt	kcal	Protein	Sugars	Fibre	Fats	Notes
Wholegrains	Rice (long-grain and wild)	100	357	8.93	0	3.6	0	57g less wholegrains than proposed mean
	Rolled oats	75	281	9.38	1.88	7.5	0	
Tubers and starchy veg	Sweet potato	50	50	0.99	2.73	0.8	0	
Vegetables	Kale	100	36	2.94	1.21	4	0	
	Red peppers	50	13	0.49	2.1	1.1	0	
	Butternut squash	50	44	0.81	1.22	0.8	0	
	Broccoli	100	35	1.18	2.35	2.4	0	
	Avocado	100	167	1.96	0.3	6.8	15.41	Diversified vegetable intake to maximum intake proposed by EAT-Lancet, following recommendations of ANH-Intl Food4Health guide
	Cauliflower	65	16	1.53	1.53	1.6	0	
	Rocket (arugula)	25	6	0.59	0.59	0.3	0.15	
	Parsley	20	7	0.59	0.17	0.7	0.16	
	Onion	50	20	0.55	2.12	0.8	0.05	
	Garlic	20	17	0	0	0	0	
	Ginger	20	16	0.36	0.34	0.4	0.15	
Fruits	Apple (Granny Smiths)	100	52	0	10.4	3.2	0	
	Blueberries	50	28	0.37	4.98	1.2	0	
	Orange	50	24	0.55	4.35	1.1	0	
Protein sources	Lentils (boiled)	100	114	9.02	1.8	7.9	0	
	Peas	50	40	2.81	2.25	2.2	0	Maximum proposed amounts for each food group
	Tofu	25	29	2.23	0	0	2	
	Peanuts	25	152	6.25	0.89	3.6	10.71	
	Almonds	25	145	5.29	1.09	3.1	12.48	
Added fats	Extra virgin olive oil	40	347	0	0	0	40	
	Flaxseed oil	40	354	0.04	0	0	40	Maximum proposed amounts
	Avocado oil	20	177	0	0	0	20	
	Palm oil kernel	6.8	59	0	0	0	6.8	
Added sugars	Brown cane sugar	10	38	0	10	0	0	21g less sugars than proposed mean
	TOTALS	**1366.8**	**2624**	**56.86**	**52.3**	**53.1**	**147.91**	
	Energy contribution:	8.7% energy from protein (0.81g/kg body weight for a 70kg adult)						
		40.6% energy from carbohydrates (24.3% energy from wholegrains)						
		50.7% energy from fats						

These scenarios demonstrate that the EAT-Lancet target ranges allow for considerable variation in dietary types. When actual foods were substituted for food groups in the 'basic' scenarios (Table 3.A1 and A2), total dietary energy approximated very closely to the target 2500kcal provided by EAT-Lancet authors both for the flexitarian and vegan diets. In both these scenarios, the minimum protein requirement indicated by the EAT-Lancet authors was achieved, except for in one of the vegan options, the Vegan 2 'lower carb' scenario (Table 3.B2). In this case, the diet provided just 0.73g protein/kg/day for a 70kg adults. It is clear, that the protein intakes are marginal at best, especially for vegans, and even more so for physically active vegans.

The EAT-Lancet authors selection of a 0.8g protein/kg body weight/day protein target is an agreed level for non-athletic individuals but is nevertheless a little below the 0.83g protein/kg per day (based on a protein digestibility-corrected amino acid score value of 1.0) set in 2007 by the WHO/FAO/UNU expert consensus. These WHO/FAO/UNU levels are also not intended for individuals with higher levels of physical activity, which is being increasingly recommended alongside healthy diets as part of a healthy lifestyle. All the vegan diets in the above scenarios (Tables 3.B1-B3), being limited by the EAT-Lancet guidelines, failed to meet the WHO/FAO/UNU target. They did, however, all meet the US Estimated Average Requirement (EAR) of 0.66 g protein/kg body weight/day (Courtney-Martin et al, 2016) [6] and the UK Reference Nutrient Intake (RNI) of 0.75g protein/kg body weight (Coma, 1991) [7] that is considered the minimum amount to maintain nitrogen balance. But these values are based on physically inactive healthy young adults only and are not optimised for physical activity level, older age groups or those with compromised health.

The protein intake in all scenarios, with the exception of the Flexitarian 3 ('physically active, higher protein flexitarian'), was considerably below that recommended for endurance athletes (1.2-1.4g protein/kg body weight/day) or for strength and power athletes (1.6-1.7g protein/kg body weight/day). The 1.2g protein/kg body weight/day threshold in the Flexitarian 3 scenario could only be achieved by maximising animal protein intake using the maximums from the EAT-Lancet intake ranges. There is also good evidence (Meier et al, 2015) [8] that older individuals have a higher protein requirement owing to anabolic resistance which is, among other factors, associated with reduced absorption of protein in the gut. Given the increasingly top-heavy age-structures of ageing populations, this is of particular concern, especially given the estimated requirement of 0.9-1.2 g protein/kg body weight/day (Courtney-Martin et al, 2016) [9] for the elderly.

These inadequate or marginal protein intakes, especially but not only for those on vegan diets, even more so if these individuals are physically active, elderly, immune-challenged or suffer from gut malabsorption issues, may compromise health further. This is because the biological value and digestibility of plant-based proteins is generally significantly less than those for animal proteins (this is explained in detail in the WHO/FAO/UNU report)..

The biological value of most plant proteins is compromised because of the inadequate levels of certain amino acids (Woolf et al, 2011) [10]. For example, leguminous vegetables tend to be limited in methionine and cysteine, grains are typically limited in lysine and tryptophan, most vegetables, nuts and seeds are limited in methionine, cysteine, lysine and threonine, and seaweed tends to be limited in histidine and lysine.

In summary, the scenario analysis revealed:

- Protein intakes as low as 8.7% of total energy for the higher energy vegan diet (Vegan 3) and as high as 11.3% of total energy for a lower carb, flexitarian diet (Flexitarian 2) were found
- The protein intakes for all three vegan scenarios (based on a 70 kg adult) were below the consensus levels set for adult humans established by the WHO/FAO/UNU expert group in 2007
- The protein intake in one of the vegan scenarios (Vegan 2) was below the level considered adequate by the EAT-Lancet authors, which reflects adequacy only for physically inactive individuals (Lonnie et al, 2018) [11]
- The amino acid profiles in the vegan scenarios may be incomplete for some individuals, particularly those who are immunologically challenged, with a higher arginine requirement (Daly et al, 1990) [12] (more readily provided in animal protein sources)
- Total energy intake from carbohydrates could be varied by different dietary compositions from 33% (Flexitarian 3) to 52% of total energy (Vegan 1)
- The contribution of daily energy from whole grains varied from 20% (Flexitarian 3) to 35% (Flexitarian 1), the latter, not the former, being close to the

EAT-Lancet target of 32%

- Given the relatively large intakes of plant foods, dietary fibre intakes in all scenarios readily met the 30g per day target (range: 35-53g) set in the landmark study (Reynolds et al, 2019) [13], also published in the Lancet journal

- The vegan diets are also likely to be deficient in a wide range of micronutrients, including vitamin A (retinol) (Kristensen et al, 2015) [14] haem iron (Miller, 2013) [15], vitamin B12 (Gilsing et al, 2010) [16] and long-chain Omega-3 fatty acids (notably eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) (Burdge et al, 2017) [17]

- High levels of phytic acid may also prevent adequate absorption of zinc, copper and iron (Lim et al, 2013) [18]

- In omnivores converting to strict vegan diets, the 100% transition to plant-based foods may illicit adverse reactions in sensitive individuals, owing to increased intakes of gluten (Schnedl et al, 2018) [19], anti-nutritional factors such as lectins (Miyake et al, 2007) [20] and phytate (Schlemmer et al, 2009) [21], goitrogens which may affect thyroid health and oxalates (Prezioso et al, 2015) [22] (e.g., high oxalate foods such as spinach and nuts) that may increase risk of calcium oxalate stones

- The EAT-Lancet recommendations do not adequately take into account adaptations of specific sub-populations to particular diets and the potential impacts on the microbiome, especially of the gut) (Gupta et al, 2017) [23] that can be associated with dietary transformation.

OTHER HEALTH CONCERNS ABOUT EAT-LANCET

In addition to some of the concerns expressed above, we have the following additional concerns:

- The authors responsible for the nutritional recommendations (Section 1: 'Healthy Diets") appear remarkably oblivious of the psychological, appetite regulating and other 'programmed' behaviours common among individuals with diet- and lifestyle-related metabolic diseases such as obesity and type 2 diabetes. Such individuals are very resistant to dietary change (Hafekost et al, 2013) [24] by top-down public health messaging or policy measures. These differences are linked to different epigenetic, genetic, dietary, lifestyle and environmental backgrounds and are associated with derangement of multiple systems, including the neuroendocrine system, metabolism, appetite regulation, as well as energy use and storage. Accordingly, a generalised dietary approach designed for every adult on the planet is unlikely to address individual needs, cultures, social norms or habitual behaviours. Despite large-scale, global public health, government and industry stakeholder campaigns to reduce obesogenic environments (Egger & Dixon, 2009),[25] little progress has yet been made given Big Food's continued desire to exploit vulnerable, metabolically dysfunctional consumers.

- While the EAT-Lancet authors recognise the negative health effects of food over-processing, they appear unmoved by the political and economic reality of Big Food's distortion of the marketplace and the effects of this on consumer behaviour. This reality has been tackled in a much more convincing manner by a parallel Lancet Commission in its just-published The Global Syndemic of Obesity, Undernutrition, and Climate Change. Despite efforts to reduce meat and poultry consumption in the USA, consumption hit a record high for 2018 at 100.8kg (222.2lb) per person.

- The EAT-Lancet authors have cast their views without a nod to the intractable positive association between meat consumption and improved standards of living. Combined with the projected

33% population increase from the present, the FAO has therefore projected a 70% expansion of consumption of agricultural products and a doubling in demand for livestock products (Rojas-Downing et al, 2017) [26] by 2050.

- The recommendation for dairy foods in the 'healthy reference diet' is based on studies of Western populations and benefits attributed to the presence of calcium for bone health and reduction of fracture risk. These studies cannot be applied to Asian countries where lactose intolerance may exceed 90% among adult populations (Bhatnagar, 2007)[27]. The global prevalence of lactose malabsorption among adults has been estimated (Storhaug et al, 2017)[28] to be 68%, being lowest (28%) in western, southern and northern Europe, highest in Asia and around 70% in the Middle East. The only mention of dairy intolerance in the report is in Panel 2, where the EAT-Lancet authors state: "*Some of these cultures have also consumed few or no dairy foods, often corresponding with lactose intolerance and lower rates of bone fracture than have countries with high dairy consumption.*" Given this view, it is somewhat surprising that the EAT-Lancet authors have included dairy foods in their reference diet (although it allows for zero intake at the minimum of the intake range).

- The health impacts of the proposed diet are very difficult to anticipate given that diet-related morbidities and mortalities assessed by the EAT-Lancet Commission are the result of historic food production systems. The rapidity of change linked to the intensification of agriculture and food ultraprocessing used today (Walls et al, 2018) [29] can only be measured in the future. Additionally, there are major, ongoing dietary transitions associated with increasingly urbanised populations, such as the consumption of increasing amounts of food outside of the home, which generally has been shown to be detrimental to health (Nago et al, 2014) [30] compared with food preparation in the home.

- Increased pressure on plant production systems will likely intensify production from protected systems such as aquaponics that may yield crops that are nutritionally different compared with soil-grown crops.

- The authors maintain an anti-saturated fat stance, and suggest a shift primarily to polyunsaturated plant oils. They do not adequately address the evidence for the pro-inflammatory nature of diets in which a high dietary *n*-6:*n*-3 polyunsaturated fatty acid (PUFA) ratio contribute to metabolic diseases (Torres-Castillo et al, 2018) [31], now among the primary burdens on healthcare systems, including in less developed countries (Ofori-Asenso et al, 2016) [32]

- The authors make a strong case for increased use of oilseed rape (canola) because of its provision of essential fatty acid alpha-linolenic acid (ALA). Twenty five percent of the world's oilseed rape is genetically modified, the vast majority of this being grown in Canada, the USA and Australia (Belter, 2016) [33], this herbicide-tolerant GM crop now developing increased glyphosate resistance. Conversion of ALA to DHA in the body is limited (Goyens et al, 2006) [34] but is critical for brain and neurological development and function. Given that intake of ALA from plant-based diets may be limited, and intake of preformed DHA (and EPA) negligible or zero, essential fatty acid deficiencies are possible in some populations. While circulating levels of DHA in vegetarians and vegans may be up to 40% less than in omnivores (Rosell et al, 2005) [35], it is surprising to find little evidence of gross DHA-deficiency (Domenichiello et al, 2015) [36]. This may be linked to adaptation in individuals, but it is important to recognise large data gaps in nutritional science related to strict vegan diets.

- The EAT-Lancet authors recognise that palm and soybean oils are the most widely used oils in food preparation, and despite recognising limited evidence of the health benefits of minimally processed red palm oil, the reference diet includes palm oil, presumably fruit-derived, up to an intake of 6.8g per day on average. There is no discussion of differences in health impacts between fruit-derived and kernel-derived oils that have distinctly different fatty acid profiles (Akanda et al, 2012) [37], the kernel being richer in healthy saturated fats and rarely used in food. However, while the use of the fruit and kernel oils

for human consumption could reduce environmental impacts, particularly from sustainably produced sources, the kernel oil would likely be rejected by the Lancet authors seeming prejudices for all saturated fats.

- The presumed health benefits of the 'healthy reference diet' were based on estimating its effects on premature mortality – not on morbidities. Using three different scenarios that represent current dietary patterns along with their known risk facts (e.g. high red meat and low fruit and vegetable consumption), the authors found the 'reference diet' might contribute to between 19% and 23.6% reduction in premature mortality. However, the EAT-Lancet authors have not taken into account the projected effects of comorbidities that may be as important, if not more important, than impacts on mortality when assessing productivity, healthcare burden, social connection, physical activity ability, and numerous other factors that influence consumption patterns, supply and demand. Given the double burden of non-communicable diseases linked to under- and over-nutrition - determinations about the relative healthiness of diets should be based on morbidity as well as mortality data.

ENVIRONMENTAL IMPACTS

It is too early to know if the EAT-Lancet report may have some impact on slowing the escalating growth of the livestock sector globally. It is interesting that despite growing awareness about the health of plant-based diets and adverse impacts of factory farming of animals over the last decade or more, there has not been any slowing in demand for livestock products. The World Health Organization (WHO) projects that annual meat production will increase to 376 million tonnes by 2030, a 72% increase from 1999.

In the context of the EAT-Lancet proposal to halve consumption of meat and double that of tree nuts, as well as fruits and vegetables, we make the following observations:

- USDA data from 2018 shows that, in the USA, the largest per capita consumer of animal products worldwide, the approximate values of cattle/calves was $66 billion, poultry and eggs $47 billion, dairy $35 billion, and hogs (pigs) $20 billion, making a total of $168 billion at the farm gate. This should be compared with corn ($46.6 billion), vegetables and melons ($19.7 billion), fruits and nuts ($31 billion), or wheat ($8.7 billion). Despite this, the US Environmental Protection Agency finds that total greenhouse gas emissions (in 2016) represented just 9% of total, with less than one-third of this being linked to animal agriculture. It is also necessary to offset additional plant-based animal feed produced in-country, notably maize, soy, hay and grass, that is required to feed the livestock. And to consider the livelihoods provided by the nearly one million cattle and calf operations, just in the USA, as well as continuing efforts across large sectors of the agricultural industry to reduce its carbon footprint and transition from being a net emitter to a net sequesterer of carbon.

- The impact of halving meat consumption and doubling nut, fruit and vegetable consumption globally has incredibly far-reaching consequences that have not been adequately considered in the EAT-Lancet report. The effects would not be only positive, as implied in the EAT-Lancet report, but also negative. This might be through increased greenhouse gas emissions as a result of increased transportation of imported goods, the use of more packaging, as well as impacts on livelihoods and on health.

- The Lancet authors recognise the immense changes that would need to be made to eating patterns and food production systems in order to meet the objectives of 1) decarbonising agriculture, 2) preventing further loss of biodiversity or further expansion of agricultural land, and 3) improving the efficiency of water use in agriculture. They also recognise the need to tailor solutions differently to different regions and countries. However, given the report's macro-and unified, 'one-size-fits-all' perspective, it has not attempted to grapple with the profound – some may argue, insurmountable – challenges that may occur at regional or country levels.

Prioritising efforts

- Given the enormity and varied tasks necessary for any attempt to bring about the proposed Great Food Transformation (Section 4 of the EAT-Lancet report), it would be useful to prioritise specific regions or countries. In this light, we have collated country data on animal and plant protein consumption and applied a 'population weighting index' to help identify countries in which net consumption is greatest (Table 4). This analysis suggests that the relative impact from meat consumption patterns (assuming similar environmental impacts, which of course is not always the case) of the five, highest impact countries (namely China, USA, India, Brazil and Russia) contribute to around twice the relative impact from animal farming in the remaining 27 countries put together. This would suggest the need to prioritise efforts in some countries over others.

Table 4. Daily per capita animal, plant and total protein consumption for selected countries and the relative impact of animal protein intake by application of a population weighting index. Data source: Our World in Data [original data source: FAO, 2013]

Country	Daily amount animal protein (g) [% of total protein intake]	Daily amount plant protein (g) [% of total protein intake]	Total daily protein supply (g/person/day)	Population	Relative impact of animal protein intake*
China	40 [40]	58 [60]	98	1,385,566,537	39.64
United States	70 [64]	40 [36]	110	320,050,716	16.12
India	12 [20]	48 [80]	60	1,252,139,596	10.84
Brazil	53 [55]	42 [45]	95	200,361,925	7.60
Russia	56 [55]	47 [45]	103	142,833,689	5.79
Japan	48 [55]	39 [45]	88	127,143,577	4.45
Mexico	41 [46]	47 [54]	88	122,332,399	3.59
Pakistan	27 [42]	38 [58]	65	182,142,594	3.58
Indonesia	18 [28]	44 [72]	62	249,865,631	3.19
United Kingdom	58 [56]	45 [44]	103	63,136,265	2.66
Vietnam	31 [38]	51 [62]	82	91,679,733	2.05
Argentina	67 [65]	36 [35]	103	41,446,246	2.00
Turkey	36 [34]	72 [66]	108	74,932,641	1.96
Philippines	25 [41]	35 [59]	60	98,393,574	1.76
South Korea	46 [48]	50 [52]	96	49,262,698	1.64
Egypt	26 [26]	77 [74]	103	82,056,378	1.56
Canada	55 [52]	50 [48]	105	35,181,704	1.39
South Africa	36 [43]	49 [57]	85	52,776,130	1.39
Iran	22 [25]	65 [75]	87	77,447,168	1.24
Nigeria	10 [15]	54 [85]	64	173,615,345	1.23
Australia	72 [67]	35 [33]	106	23,342,553	1.21
Thailand	25 [41]	36 [59]	61	67,010,502	1.20
Colombia	33 [52]	31 [48]	64	48,321,405	1.17
Malaysia	45 [56]	36 [44]	82	29,716,965	0.97
Saudi Arabia	40 [44]	52 [56]	92	28,828,870	0.83
Chile	45 [52]	42 [48]	87	17,619,708	0.58
Israel	72 [57]	56 [43]	128	7,733,144	0.40
Switzerland	60 [64]	33 [36]	93	8,077,833	0.35
Norway	66 [60]	45 [40]	111	5,042,671	0.24
New Zealand	55 [59]	38 [41]	93	4,505,761	0.18
Paraguay	34 [48]	37 [52]	71	6,802,295	0.17

* Calculated by multiplying per capita daily animal protein intake by a Population Weighting Index (computed as the fraction of a given country's population relative to the largest population [China]).

- Such comparisons, as indicated above, assume that meat production systems have equivalent impacts, both positive and negative, in all parts of the world. That is definitely not the case. The EAT-Lancet report states that Americans consume around 6.5 times the amounts of meat recommended in the 'healthy reference diet', and that South East Asians consume only half the amount. Given great differences in population sizes, grazing land availability and quality, existing land use patterns, the need to protect natural ecosystems and recognised environmental challenges, increasing meat production or imports in South-East Asia may not be beneficial to either people or planet. Nor will the impacts or benefits of expanding or contracting meat production be similar in different regions.

Marginal lands

- For example, parts of the United States, Russia or Australia have relatively large amounts of marginal land that is suitable for grazing, but not for arable or horticultural production. In fact, the concept of 'marginal land', in which land is considered marginal for agriculture, but vital for grazing (Shahid & Shankiti, 2013), [38], is integral to any large-scale, holistic, sustainable agroecosystems model. Dry lands, much of which are viewed as marginal, represent 45% of the world's land area and the role of livestock to aid the 'upcycling' of such land is viewed as increasingly important for the future of food, people and planet. Ironically, as the Global Dry Land Alliance (GDLA) member countries are only too well aware, the trend towards salinisation and desertification of dry lands is actually reducing available arable land, and increasing land suitable for grazing and restoration for mixed uses.

- Additionally, the impact of industrially farmed livestock is often confused with that of naturally grazed animals, the impacts having been popularised by Zimbabwean ecologist Allan Savory in his book "Holistic Management, 3rd Edition: A Commonsense Revolution to Restore Our Environment" (Island Press, 2016). The approach stresses the importance of stopping the burning of grasslands (over 1 billion hectares are burned in Africa alone each year), and maintaining herds of moving, grazing animals on semi-arid lands to prevent desertification. Savory argues that the rapid escalation of factory farms, in which animals are removed from grazing lands and transferred to feedlots, is a major driver of desertification and that natural grazing practices are a key part of the restoration of these so-called 'marginal lands'. In fact, animal manure is so crucial to any living soil environment, the greater part of the organic agriculture movement is dependent on animal waste as manure.

Avoiding thorns to maintain ideology

- The EAT-Lancet report fails to tackle some of the thorny questions around intensification of agriculture production systems such as the concentration of agricultural resources (e.g. seeds, fertilisers), genetically modified (GM) crops and associated pesticide usage (e.g. glyphosate), or pesticide impacts on non-target organisms including pollinators and humans. These were among the issues considered of crucial significance in the 5-year, seminal findings of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), published in 2009.

- There remains considerable confusion over the extent of agriculture's contribution to greenhouse gas emissions. For example, the US Environmental Protection Agency (EPA) estimates the contribution is just 9% of the total amount, with 28% linked to transportation, 22% to industry and 28% to electricity.

- The contribution from US agriculture can be further broken down to: 4.2% from livestock, comprising 2.2% from beef, 1.4% dairy, 0.5% swine and 0.1% from poultry. New Zealand, with just 4.6 million human population and a cattle population over double this size (10 million), produces 46% of its greenhouse gases from agriculture, with electricity production contributing nearly the same amount, at 42%. So, while per capita greenhouse gas emissions were a stunning 16 times over the global sustainable rate of 1 ton of CO2-equivalent per person, New Zealand, by virtue of its small population, is well outside the top 20 greenhouse gas

producing countries. Based on 2012 data, New Zealand produces just 206,800 kton CO2eq, versus 12,102,000 kton CO2eq for China and 6,125,000 for the USA. New Zealand's emissions are therefore 1.7% those of China and 3.4% those of the USA. Owing to these profound differences, as well as different impacts of agricultural systems on transportation, food processing and energy use, the EAT-Lancet report has conspicuously omitted prioritising countries that pose the greatest challenge to sustainability and ecosystem viability. Each country and region has its own unique circumstances and particular mix of agricultural types, production methods and requirements. It also is exposed to highly variable benefits and harms as a result of these specific agricultural systems.

- This need to create a more country or region-specific approach is even more apparent when the relative contribution of different greenhouse gases, namely carbon dioxide (CO2), nitrous oxide (N2O) and methane (CH4) are compared by country, the latter being particularly associated with livestock. Vast differences are found between countries and regions, even within the EU28.

- While seismic shift in agriculture would be required to increase fruit, vegetable and plant-based protein production globally to the levels proposed by EAT-Lancet, there is no guarantee that a globalised approach would meet the targets or be sustainable. While the Lancet authors suggest that countries focus on produce that is suited to their countries, the impacts of such a globalised food production and supply system have not been adequately explored. It is of paramount importance to compare the net impacts, both positive and negative, of diverse, more local, agroecosystem approaches that may be better suited to some parts of the world, with more globalised, high input, industrialised systems that have become the dominant systems in western, industrialised countries.

- Finally, before any serious attempts are made to impose food-specific taxes that tax products based on their climate or health impacts, much more detailed information on net benefits and harms, both to human health and the environment, are required.

CONCLUSIONS

Views about the most sustainable nutritional and agricultural practices are increasingly being informed by desk-based researchers with strong belief systems and ideologies, and little practical experience either of clinical nutrition or agriculture.

Outputs from these researchers are often from meta-analyses or systematic reviews in which large amounts of data from different and varying sources are brought together. During the analysis and interpretation of results, association is often incorrectly taken to imply causation. When the results are published, media channels that support the ideologies 'spin' the findings further – and the public and policy makers do their best to pick up the pieces and integrate them with their own knowledge, experience and belief systems.

The EAT-Lancet project is, in our opinion, a case in point. The much publicised research paper by Poore and Nemecek (2018)[39] which has been used as a justification to lambast animal-based foods, is another. With an ideology in place, it is very easy to look past the full range of factors that require consideration if truly sustainable approaches are to be found. That might include, for example, the biodiversity loss (e.g. small mammals, birds, soil organisms) attributable to soil degradation, herbicide and pesticide use, as well as the destruction of hedgerows and borders, all in the name of expansion of large-scale arable monoculture.

Another major issue with the kind of 'big picture', globalised approach that occurs when scientists and policy makers get together, in the manner of this Lancet Commission, is that they work with averages. In doing so, all the subtleties, vagaries, mysteries and wonders of the outliers are omitted from their analyses. The lack of practical experience of such examples, whether it is the resolution of autoimmune conditions through the removal of certain types of plant food from the diet, or the restoration of marginal grasslands through the re-introduction of livestock, remain invisible.

Once an ideology takes hold – as is the case with concepts such as 'peak livestock' and the perceived need to globally transition from animal to plant-sourced proteins (Harwatt, 2018) [40] momentum can gather quickly. If policy measures including taxes on foods deemed unhealthy or bad for the environment are imposed, the process of transition is likely to accelerate. In this case, it is essential that the approach – and the evidence that underpins it – is sound. It is our view, and the view of many others who have responded since the release of

the EAT-Lancet report, that the evidence is not as secure as made out by the authors.

The EAT-Lancet report, in effect, vilifies meat consumption. However, even accepting the arguments made, meat eating itself is not the problem *per se* – it is excessively cheap meat that is the problem, where the cost of the meat does not adequately take into account the true cost of its production in environmental terms. This includes how different types of animal production systems act as sources or sinks for greenhouse gases, or whether their net carbon footprints, including that related to feed that helped create the animals, have been adequately factored in.

If agro-ecological systems were to be valued for their reduced impacts on climate change, contribution to biodiversity and reduced pollution, and livestock were to be accepted as a necessary part of these systems, a degree of meat-eating, probably significantly over the levels contemplated in the 'Planetary Health Diet' would likely be tolerated. But such approaches are completely counter to the kind of industrialised animal production methods that have become *de rigeur* through much of the world.

The westernisation, simplification and globalisation of diets is a massive issue for both people and planet. This process has swept across the world at an ever more rapid pace over the last 3 or so decades, being driven as much by industry and government, as it is by consumer demand. As emphasised by research on the five 'blue zone' regions of the world, long, healthy lives are not associated with technological advancement either of food production or healthcare systems. The corollary is also true. Obesity, type 2 diabetes and the primary health burdens of the 21st century, are all associated with technological advancement. Traditional diets and agricultural practices are being 'forgotten' at an astonishing rate as adoption of technology and urbanisation gathers pace in the so-called developing nations.

It is our view, that for the sake of people and planet, a major international effort is required to compare the net harms and benefits of different strategies relating to food production systems and consumption patterns in different regions and countries. This should include comparisons between high-input, industrial-scale farming systems for plants and animals, as against low-input, sustainable systems, based on agro-ecological, nutrient-cycling principles.

As suggested by Christine King (2008) [41], these agro-ecological systems are about reconnecting people and food, and people with people – as well as helping to create community and health resilience. Fundamental to the viability and stability of these systems is diversity and the ability to function at scale.

Such considerations are of key importance given the increasing concentration of agricultural and food production resources into the hands of a small minority of actors (Hendrikson et al, 2017] [42].

As important is to evaluate the role of food security while being cognisant of the role that power, politics and economics plays in ensuring some get too much and others get too little. In evaluating approaches that can help deliver healthier diets for more people, regardless of their geography, culture or socio-economic status, it is imperative to consider food sovereignty. Central to the concept, is the notion that individual communities have the ability to define their own food and agricultural policies (Patel, 2009)[43].

We have pointed out the common confusion between associations and causation in the interpretation of scientific studies, as well as the effect of ideology and belief systems when left to policy makers and corporations. It is quite possible that the increasing momentum towards a massive reduction in animal-based foods is being driven by interests that support both the globalisation and the industrialisation of agriculture and food production. It is after all these industrialised systems that have been the main creators of obesogenic environments that have, in turn, become key contributors to the double burden of malnutrition and the degradation of natural ecosystems and loss of biodiversity.

RECOMMENDATIONS

Based on our analysis and concerns, we make the following recommendations:

1. The two co-chairs of the EAT-Lancet Commission (Profs Willett and Rockström), the Wellcome Trust and EAT Forum need to urgently clarify the declaration of interests made in the Lancet, which states: "*All authors received funding from EAT and the Wellcome Trust*" given other information that indicates the EAT Forum did not provide funding of the work or authors.

2. In media communications and in the 40 report launches planned around the world, the EAT-Lancet team need to clarify the composition of the 'healthy reference diet' by volume, weight or energy, and not mix these 'currencies' in a single presentation (Figure 1 of this report) which is misleading (see Figure 2A and B of this report).

3. There needs to be clarification as to whether the sustainability of the 'healthy reference diet' is based only on the recommended values as mean values for the global population. If the determinations for environmental sustainability include scenarios in which large subsets of the world's population were consuming foods at the upper or lower limits of the intake ranges, this needs to be made clear. If not, the authors need to make clarify that the reference diet is only sustainable assuming global consumption patterns average around the recommended values.

4. The nutrition recommendations given in the 'healthy reference diet' need to be re-evaluated in terms of their health implications for the very active, the infirm and the elderly. Our scenario analysis has suggested that interpretations of the proposed diet could be sub-optimal for significant sectors of the population. Wide variations in age structure, activity levels and health status in different parts of the world need to be factored into such reviews, which would also benefit from significant input from nutritionists with extensive experience working in clinical environments.

5. Research efforts need to explore and compare the coexistence of mixed, agroecological food production systems alongside more intensive systems of agriculture. Such analyses should allow for substantial diversity according to different geographies, cultures, economic and social systems. This need for diversity and country- or region-specific approaches appears not to be sufficiently catered for in the current proposal for a Great Food Transformation.

6. There is a need to distinguish between the net impacts, both for people and planet, of industrial animal farming based on grain feeds and feedlots, as opposed to those that are reared in natural habitats and contribute to ecosystem services, such as grazing livestock.

7. The impacts of intensification of plant-based agriculture, as proposed in the EAT-Lancet report, needs to be more thoroughly assessed because of the increased use of fertilisers, loss of soil microorganisms and minerals and effects on pollinators, soil degradation linked to continuous cropping systems, waste from hydroponic systems, and other associated factors.

Join the conversation with us at:

#ANHInternational

@anhcampaign

#EATLancet
#foodcanfixit
@EATforum
@TheLancet
@SDG2AdvocacyHub
@G_stordalen

REFERENCES

[1] Willett W, et al. *Lancet*. 2019; S0140-6736(18): 31788-4 31788-4. [Link]

[2] Daniel C, et al. *Public Health Nutr*. 2011 Apr; 14(4): 575-83. [Link]

[3] Orsavova J, et al. *Int. J. Mol. Sci*. 2015; 16: 12871-12890. [Link]

[4] Kostik V, et al. *J Hyg Eng Des*. 2013; 4: 112-116. [Link]

[5] Harcombe Z, et al. *Open Heart*. 2015; 2:e000196. [Link]

[6] Courtney-Martin G, et al. *Nutrients*. 2016 Aug; 8(8): 492. [Link]

[7] *Rep Health Soc Subj (Lond). 1991*; 41: 1-210. [Link]

[8] Meier R, et al. *Nestlé Nutr Inst Workshop Ser*. 2015; 82: 39-51. [Link]

[9] Courtney-Martin G, et al. *Nutrients*. 2016 Aug; 8(8): 492. [Link]

[10] Woolf P, et al. *PLoS One*. 2011 Apr 22; 6(4): e18836. [Link]

[11] Lonnie M, et al. *Nutrients*. 2018 Mar; 10(3): 360. [Link]

[12] Daly J, et al. *Crit Care Med*. 1990 Feb; 18(2 Suppl): S86-93. [Link]

[13] Reynolds A, et al. *Lancet*. 2019 Jan 10. pii: S0140-6736(18)31809-9. [Link]

[14] Kristensen N, et al. *Nutr J*. 2015; 14: 115. [Link]

[15] Miller J. *Cold Spring Harb Perspect Med*. 2013 Jul; 3(7): a011866. [Link]

[16] Gilsing A, et al. *Eur J Clin Nutr*. 2010 Sep; 64(9): 933–939. [Link]

[17] Burdge G, et al. *J Nutr Sci*. 2017; 6: e58. [Link]

[18] Lim K, et al. *Nutrients*. 2013 Aug; 5(8): 3184–3211. [Link]

[19] Schnedl W, et al. *Inflamm Res*. April 2018, Volume 67, Issue 4, pp 279–284. [Link]

[20] Miyake K, et al. *PLoS One*. 2007; 2(8): e687. [Link]

[21] Schlemmer U, et al. *Mol Nutr Food Res*. 2009 Sep; 53 Suppl 2: S330-75. [Link]

[22] Prezioso D, et al. *Arch Ital Urol Androl*. 2015 Jul 7; 87(2):105-20. [Link]

[23] Gupta V, et al. *Front Microbiol*. 2017; 8: 1162. [Link]

[24] Hafekost K, et al. *BMC Medicine* 2013; 11: 41. [Link]

[25] Egger G & Dixon J, et al. *Br J Nutr*. 2009 Oct; 102(8): 1238-42. [Link]

[26] Rojas-Downing M, et al. *Clim Risk Manag*. Volume 16, 2017, pp 145-163. [Link]

[27] Bhatnagar S. *BMJ*. 2007; 334: 1331. [Link]

[28] Storhaug C, et al. *Lancet Gastroenterol Hepatol*. 2017 Oct; 2(10):738-746. [Link]

[29] Walls H, et al. *BMJ Glob Health*. 2018; 3(1): e000657. [Link]

[30] Nago E, et al. *Crit Rev Food Sci Nutr*. 2014; 54(9):1103-16. [Link]

[31] Torres-Castillo N, et al. *Obes Facts*. 2018 Sep; 11(4): 344–353. [Link]

[32] Ofori-Asenso R, et al. *BMC Public Health*. 2016; 16: 1239. [Link]

[33] Belter A. *Genes (Basel). 2016;* 7(1); 3. [Link]

[34] Goyens P, et al. *Am J Clin Nutr*. 2006; 84 (1): 44–53. [Link]

[35] Rosell M, et al. *Am J Clin Nutr. 2005;* 82(2): 327–334. [Link]

[36] Domenichiello A, et al. *Prog Lipid Res*. 2015; 59: 54-66. [Link]

[37] Akanda M, et al. *Molecules*. 2012 Feb; 17(2): 1764–1794. [Link]

[38] Shahid S & Shankiti A, et al. *J Soil Water Conserv*. 2013; 1(1): 24-38. [Link]

[39] Poore J, Nemecek T. *Science*, 2018; 360(6392): 987-992. [Link]

[40] Harwatt H. *Climate Policy,* DOI: 10.1080/14693062.2018.1528965. [Link]

[41] King C. *Syst. Res.* 2008; 25: 111-124. [Link]

[42] Henrickson M et al. Power, Food and Agriculture: Implications for Farmers, Consumers and Communities, 2017 Nov: http://dx.doi.org/10.2139/ssrn.3066005. [Link]

[43] Patel RC. *PLoS Med* 2012; 9(6): e1001223. [Link]