The Science of Healthier and More Sustainable Diets

This resource provides more information on the need for food systems transformation and what is meant by a healthier and more sustainable diet. It also provides further insight into some of the key issues around more sustainable diets. You can use the links below to jump to a specific section of the document.

Poor diets are a major cause of ill health

It is estimated that poor quality diets are a major cause of death from non-communicable diseases globally and are responsible for one in five deaths. Malnutrition in all its forms, which includes both undernutrition (wasting, stunting, underweight and micronutrient deficiencies) and overnutrition (overweight and obesity), also remains a major public health concern:

- Worldwide, over 144 million children under the age of 5 suffer from stunting (a low height-for-age)
- 38 million children in this age group are estimated to be overweight or obese.
- 1.9 billion adults globally are defined as being overweight or obese, while 462 million adults are underweight.

In addition, many countries are currently experiencing a 'double burden' or 'triple burden' of malnutrition, where a combination of these issues exist together. This can

occur at the individual level, where a person is obese and deficient in one or more vitamins or minerals, through to the national level, where both undernutrition and overnutrition are prevalent in the same country.

In the UK, around two-thirds of adults (68% of men and 60% of women) in England are living with overweight or obesity. There is also evidence from the UK's *National Diet and Nutrition Survey* (Years 9 to 11; 2016/2017 to 2018/2019) of low intakes of a number of essential vitamins and minerals in some groups. For example, almost half (49%) of adolescent girls aged 11-18 years have low intakes of iron (below the lower reference nutrient intake), and 9% are below the WHO threshold indicating iron deficiency and anaemia.

Addressing the global imbalance of nutrition (and its causes) is a central aim of the United Nations' (UN) Sustainable Development Goals (SDGs), a set of 17 ambitious targets aimed at ending poverty, protecting marine and terrestrial ecosystems and ensuring peace and prosperity by 2030. Improvements in nutrition are recognised as playing a pivotal role in accomplishing all of the SDGs, with the period 2016-2025 declared a decade of 'action on nutrition' by the UN.

Source: United Nations

The environmental impact of our food system

At present, global agriculture accounts for almost 40% of global land use, approximately 70% of freshwater use, and is associated with between 19 to 37% of total greenhouse gas emissions (GHGE; e.g. carbon dioxide and methane), which are responsible for global warming. However, the environmental impacts of food production (e.g. GHGE and water usage) vary from country to country, and between

producers of the same agricultural product, depending on farming practices, among other things.

There have been huge increases in the productivity of agricultural land since the 1960s, as a result of investment and technological innovation, and more recently implementation of approaches to help mitigate the environmental impact of farming. However, finding ways to produce more food to feed a growing population (see below) in an environmentally sustainable manner remains a priority. It has been predicted that even if fossil fuel emissions from the food system and other sectors (e.g. energy generation, transport and industry) were immediately eliminated, remaining GHGE from current global food production (e.g. methane from ruminants or rice production) would make it impossible to meet the goals of the Paris Climate Agreement to restrict global warming to 1.5 °C (and difficult even to realise the 2 °C target).

Further technological innovation is likely to be needed, alongside reductions in food waste, in order to provide sufficient amounts of safe and nutritious food without exceeding scientifically defined limits for key earth system processes (e.g. water use, ocean acidification, climate change). This will involve crucial decisions about where best to produce foods efficiently, given that soil and climate conditions, as well as production practices, vary significantly around the globe. There is also a need to think about the potential impact of dietary changes on global patterns of trade, so that beneficial changes in one country (e.g. higher fruit and vegetable consumption in the UK) does not lead to a greater 'outsourced' environmental impact in other regions where foods are produced (e.g. higher water use in countries experiencing water stress).

Feeding a growing global population

The global population is set to reach an estimated 9.7 billion people by 2050, and it is predicted that food production will need to increase by more than 50% over the next few decades to meet this increased requirement for food. In addition, demand for animal-derived foods, including meat and dairy, is predicted to increase by almost 70% as a result of rising incomes in developing nations, which could place additional environmental pressures on the food system, as these foods typically require more land and water per kilogram of food produced compared with plant-derived foods. A report from the World Resources Institute has identified five key areas in which action is required to meet this rising demand for food with the amount of global land available, while also mitigating the contribution of agriculture to global warming. These include:

- Reducing growth in demand for food and agricultural products (e.g. through reduced food losses and waste, and lower demand for animal-derived foods)
- Increasing food production without expanding agricultural land (e.g. increasing livestock productivity and using plant breeding to improve yields)
- Protect and restore natural ecosystems (e.g. reforestation of abandoned agricultural land and restoration of natural peatlands)
- Increase fish supply (e.g. through improved wild fisheries management and aquaculture)
- Reduce GHGE from agricultural production (e.g. use of novel technologies to reduce enteric methane production from ruminants).

Climate change threatens food security

According to the UN Food and Agriculture Organization (FAO), the number of people affected by hunger globally has been increasing in recent years, due to a number of major drivers, including conflict, climate variability and extremes, and economic slowdowns and downturns. The worldwide prevalence of severe food insecurity (running out of food or not eating for an entire day at certain times of year) increased to 12% of the global population in 2020 (928 million people), an increase of almost 150 million people since 2019. It is predicted that it will not be possible to eradicate hunger globally by 2030 (in line with UN Sustainable Development Goal 2 'Zero Hunger;) unless there is 'bold action' to accelerate progress, including addressing inequalities in access to food.

While the COVID-19 pandemic has negatively impacted on global food security, climate change itself poses a threat, due to the effects on crop yields of drought, flooding and other 'climate shocks'. Effort is being directed towards the development of crop cultivars that are drought and heat resistant, particularly for use in lower-income countries, where the effects of climate change are already having an impact on farming.

Aside from threats to crop yields, climate change may also decrease the nutritional quality of important staple foods. Rising atmospheric CO_2 has been reported to decrease the zinc, iron and protein content of several key crops, including wheat, rice and soya beans. Micronutrient deficiencies, particularly iron, zinc, vitamin A and iodine, affect an estimated two billion people globally. Work is underway in many low- and middle-income countries to test and implement 'biofortification' programmes geared to improving the population's nutritional status of iron, zinc and vitamin A, through development of crops with a higher content of these micronutrients (e.g. zinc-biofortified rice). *Nutrition Bulletin* has published a **series of free to access articles** on biofortification.

When considered together, the inter-connected nature of the issues surrounding malnutrition, climate change and environmental sustainability of the food supply,

highlight the need for a truly collaborative approach if we are to develop an equitable and accessible global food system, which also delivers public health targets. This will require both supply and demand side changes to the way in which food is both produced and consumed in order to meet this challenge.

What is a healthier and more 'sustainable' diet?

A healthy, varied diet is recognised as important for obtaining the right balance of nutrients for health, although there is a wide variety of factors that determine the foods and drinks that we consume, including social (e.g. cultural acceptability) and economic factors (e.g. affordability). This makes it challenging to define a diet that can combine these considerations with a lower environmental impact, as highlighted in the definition of sustainable diets provided by the FAO:

> ***'Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.'*** **(FAO,2012)**

Although this statement outlines what is required to eat more sustainably, determining the specific changes needed to transform food systems to deliver this is considerably more difficult. This will require collaboration between multiple stakeholders, including producers, policy makers and consumers, to develop and deliver bold (but technically and politically feasible) actions to improve both human and planetary health.

Much of the research on healthier and more sustainable dietary patterns to date has tended to focus on the climatic impact of dietary choices in terms of the associated GHGE. However, research in this area has broadened in more recent years to consider other aspects of sustainability included in the definition above. These include factors such as cost and acceptability of proposed dietary patterns, as well as other indicators of environmental impact (e.g. water use, nitrogen and phosphorus application, and loss of biodiversity due to land use for agriculture). Nonetheless, it is increasingly acknowledged that achieving a dietary pattern that balances nutritional, health, environmental, and socio-economic factors included in the FAO's definition of a sustainable diet, will inevitably require compromises and potential trade-offs. However, it is important that nutritional considerations are central to discussions around how to transform food systems, so that we don't risk encouraging dietary changes that might benefit the environment but could be detrimental to people's health.

Challenges of choosing a healthier and more sustainable diet

Currently, it is not straight forward for us to know whether one food is more 'sustainable' than another when shopping. It may seem logical that locally produced foods would have a lower carbon footprint than those imported from overseas. However, this is not always the case because the environmental impact of a particular food is related to many factors in addition to transportation-related emissions, including packaging, seasonality and the farming system used to produce it (including water use, need for heat, fertilisers and other inputs).

A recent survey conducted by the Food Standards Agency found that transportation of food was the factor most commonly reported as contributing to the environmental impact of food (29% of respondents), and was mentioned by almost twice the proportion of respondents than for the method of production (14%), or the origin or locality of the food (6%). However, on a global scale, research suggests the 'farm stage' of the food supply chain accounts for the majority of food-related GHGE (up to 81% including emissions from deforestation), a greater proportion than for packaging or transportation (both about 5%). This highlights the importance of considering how efficiently a food can be produced in a particular region, rather than just how far a product has travelled.

For example, importing vegetables grown in unheated greenhouses in Europe is estimated to have a lower impact than UK vegetables cultivated in heated greenhouses, despite the emissions associated with transportation. In contrast, some livestock production in the UK is more efficient than in some other parts of the world in terms of GHGE. For example, the GHGE for a kilogram of beef produced in the UK are about a third lower than the global average, according to FAOSTAT data. The substantial global variation that exists between producers of agricultural products emphasises the importance of distinguishing between local and global average figures when discussing the impact that a food has on the environment.

It is also important to consider the social and economic impact of food choices, and potential unintended consequences of dietary choices. For example, green beans are a major commodity crop in Kenya, with an estimated 50,000 smallholder (<2 acres of land) farmers earning income from selling this crop, in addition to the employment opportunities further down the supply chain in processing and logistics. A decline in demand for non-seasonal imported products like these in countries such as the UK and Germany due to concerns about their environmental impact (particularly if air freighted), may have a marked effect on the lives of producers in developing nations.

Research on the balance of foods that healthier and more sustainable dietary patterns should (and should not) contain remains an emerging and rapidly evolving area. However, studies tend to agree that in high-income populations (e.g. the UK, Europe, North America, Australia) reducing meat consumption, while increasing intakes of fruit, vegetables, beans and other pulses, nuts, seeds and other plant-derived foods (e.g. plant-based meat alternatives lower in saturated fat and salt), can generally lower GHGE and land use of current diets, while offering health benefits. However, dietary changes may be less effective in reducing the water footprint of current diets, but could still offer some small benefits (e.g. 4% lower water use if following the Eatwell Guide more closely).

Vegetarian and vegan diets

Studies suggest that dietary patterns which exclude animal-derived foods, including meat, dairy, fish and eggs (e.g. vegetarian and vegan), could offer large benefits in terms of GHGE and land use, although such patterns appear less effective for achieving reductions in water use. Vegetarian or vegan dietary patterns might also reduce intakes of some essential nutrients typically obtained from animal-derived foods in the current diet (e.g. calcium, iron, zinc, iodine), or how well these are absorbed and/or utilised by the body (e.g. haem iron from meat vs. non-haem iron from plant sources), referred to as 'bioavailability'. For instance, a third of iodine intake in the average UK adult diet comes from milk. If appropriate plant-derived food sources of these nutrients are not consumed, this could compromise the overall nutritional quality of the diet. Anyone avoiding animal-derived foods should make sure that they eat a variety of foods providing key nutrients such as calcium, iron, zinc, vitamin B12 and iodine. Vitamin B12 supplements may be needed for those adopting vegan diets, as this vitamin is typically only found naturally in animal-derived foods.

Despite apparent rising interest from some consumers in reducing meat consumption, only a small proportion of UK adults (aged 16+ years) consider themselves to be completely vegetarian (4%) or vegan (1%), indicating that widespread adoption of such diets at a population level seems unlikely. It is also important to note that not all foods sold as 'vegan' or 'plant-based' are necessarily healthier, and these may be high in saturated fat, sugar or salt, and so consumers should be encouraged to check the traffic light labels on products, choosing more greens and ambers and fewer reds.

'Plant-based' diets

The concept of ‘plant-based’ diets has gained popularity in the last few years, although the term is not well-defined and appears to have created confusion among the public. Although the UK’s Eatwell Guide (and dietary guidance in many other countries) already includes advice to consume a diet that is predominantly ‘plant-based’ (e.g. mainly based on fruit, vegetables, starchy carbohydrate foods, pulses, nuts and seeds), the term appears to have become specifically associated with a vegetarian or vegan diet. For example, a nationally representative survey conducted on behalf of the British Nutrition Foundation (November 2020), found that 61% of UK adults thought that a ‘plant-based’ diet meant consuming a vegetarian (20%) or vegan (41%) diet. The same proportion (61%) also said they were unlikely to follow such a dietary pattern. These survey findings suggest a misunderstanding of what is meant when talking about ‘plant-based’ diets, which may be deterring people from acting on advice to eat more healthily.

Encouraging more moderate shifts in the proportion of animal- to plant-derived foods in the diet, to align more closely with existing national food-based dietary guidelines (FBDGs), is more likely to encourage people to select a diet that is nutritionally adequate, culturally acceptable and which can offer benefits for health and the environment. For example, a recent global study of FBDGs across 85 countries indicated that adherence to national recommendations in Europe and North America would reduce GHGE, as well as land, water, nitrogen and phosphorus use associated with current diets. Although this study highlighted that current FBDGs might not be sufficient to achieve global environmental targets (e.g. for restricting global warming to 1.5 °C in line with the Paris Agreement), there is the potential to update dietary guidelines to include environmental sustainability considerations. One such example is the recently updated **Danish dietary guidelines** (published January 2021), which now provide advice on how to achieve a ‘healthy and climate-friendly’ diet, including recommendations to eat more vegetables, to choose legumes and fish, vegetable oils, low-fat dairy products and eat less meat. Therefore, while there is scope to improve the sustainability of FBDGs, promoting closer adherence to existing recommendations appears to be a sensible ‘direction of travel’ for improving the sustainability of current diets, until research findings allow for recommendations to be made with greater certainty.

The EAT-Lancet universal healthy reference diet

A **report from the EAT-Lancet Commission** (published in January 2019) stressed that food systems have the potential to support both human and planetary health, but concluded that they are currently threatening both. Achieving healthy diets from sustainable food systems for everyone will require substantial shifts towards healthier dietary patterns, large reductions in food losses and waste, and major

improvements in the efficiency of food production. The report also called for rapid implementation of strategies to mitigate GHGE associated with agriculture and a fundamental shift in production priorities.

The Commission proposed a 'universal healthy reference diet' (see table below), based on a review of the existing literature on diet-disease relationships, which included suggested amounts (and ranges) for food groups that together represent a dietary pattern considered beneficial from both human health and environmental sustainability perspectives. The reference diet was intended as a framework to signal the required direction of travel for transforming global food systems and was designed to allow flexible global adoption across regions and countries. While not intended as a prescriptive diet to be followed by individuals, the universal diet has generated criticism from some authors regarding its feasibility as a dietary pattern to adopt at a global level.

Large gaps between current global dietary patterns and the suggested food group amounts in the reference diet have been identified, including currently low consumption (compared to suggested intakes) for fruits, non-starchy vegetables, beans and legumes, nuts and seeds, while consumption of red meat and sugars exceeds the maximum amounts in the reference diet. Meeting the recommended intake for nuts (50 g/day for peanuts and 'treenuts') could be especially difficult, as it is estimated that current global average intake is only around 3 g/day. Significant increases in global production of nuts could also have serious implications for water scarcity, as nuts are typically water-intensive crops often produced under conditions of blue water stress. It has also been suggested that the cost of adopting the reference diet (a global median of US$ 2.84 per day) may exceed the per capita household income for at least 1.58 billion people (mostly in sub-Saharan Africa and south Asia), mainly due to the cost of fruit and vegetables (31% of the cost), legumes and nuts (19%), meat, eggs and fish (15%) and dairy products (13%).

These analyses of the EAT-Lancet reference diet have highlighted some of the potential challenges in making global recommendations for healthier and more sustainable diets, including the importance of considering existing consumption patterns within specific countries, and whether changes are feasible and affordable for all.

Food group amounts (and ranges) suggested in the EAT-Lancet 'universal healthy reference diet'. (Source: Willett et al (2019) *The Lancet* **393:** 447-492)

Food group	Suggested intake [possible range] (g/day)	Caloric intake (kcal/day)
Whole grains*:		

Rice, wheat, corn and other†	*232 (total gains 0–60% of energy)*	*811*
Tubers or starchy vegetables:		
Potatoes and cassava	*50 (0–100)*	*39*
Vegetables:		
All vegetables	*300 (200–600)*	*-*
Dark green vegetables	*100*	*23*
Red and orange vegetables	*100*	*30*
Other vegetables	*100*	*25*
Fruits:		
All fruit	*200 (100-300)*	*126*
Dairy foods:		
Whole milk or derivative equivalents (e.g. cheese)	*250 (0–500)*	*153*
Protein sources‡:		
Beef and lamb	*7 (0–14)*	*15*
Pork	*7 (0–14)*	*15*
Chicken and other poultry	*29 (0–58)*	*62*
Eggs	*13 (0–25)*	*19*
Fish§	*28 (0–100)*	*40*
Legumes:		
*Dry beans, lentils, and peas**	*50 (0–100)*	*172*
Soy foods	*25 (0–50)*	*112*
Peanuts	*25 (0–75)*	*142*
Treenuts	*25*	*149*
Added fats:		
Palm oil	*6·8 (0–6·8)*	*60*
Unsaturated oils¶	*40 (20–80)*	*354*
Dairy fats (included in milk)	*0*	*0*
Lard or tallow‖	*5 (0–5)*	*36*
Added sugars:		
All sweeteners	*31 (0–31)*	*120*

**Wheat, rice, dry beans, and lentils are dry, raw; †Mix and amount of grains can vary to maintain isocaloric intake; ‡Beef and lamb are exchangeable with pork and vice versa. Chicken and other poultry is exchangeable with eggs, fish, or plant protein sources. Legumes, peanuts, tree nuts, seeds, and soy are interchangeable. §Seafood consist of fish and shellfish (e.g. mussels and shrimps) and originate from both capture and from farming. Although seafood is a highly diverse group that contains both animals and plants, the focus of the report was solely on animals; ¶Unsaturated oils are 20% each of olive, soybean, rapeseed, sunflower, and peanut oil; ‖Some lard or tallow are optional in instances when pigs or cattle are consumed.*

What is the role of meat and dairy in more sustainable dietary patterns?

Reducing consumption of meat and dairy foods has attracted much attention in the last few years as a key area in which the environmental impact of our current diets can be reduced. The UK's Committee on Climate Change has recommended consumption of meat and dairy foods is reduced by 20% by 2030 (with greater reductions of up to 35% by 2050) to help meet the UK's commitment to achieving 'Net Zero' emissions by 2050. Other organisations have also recommended reducing meat and dairy intake, including the Eating Better alliance, a charity partnered with over 60 'civil society' organisations, working to stimulate a 50% reduction in meat and dairy consumption in the UK by 2030, alongside a transition to 'better meat and dairy as standard' (see https://www.eating-better.org/). However, the detail provided about the basis for setting these various targets is variable.

It is generally agreed that meat and dairy products are associated with more GHGE and land use than other foods. Global livestock production (for meat and milk) accounts for 14.5% of total GHGE, according to FAO. In particular, meat from ruminants (cattle and sheep) has a higher environmental impact than chicken and pork, due to methane production by ruminant animals during their digestive process, which accounts for 44% of all livestock emissions.

However, environmental impacts can vary substantially according to the type of farming practices used. For instance, a kilogram of beef produced by the 10% of least efficient producers globally requires 50-times more land, and is associated with 12-times more GHGE, than for a kilogram of beef from the 10% of most efficient producers. This highlights the importance of using locally relevant figures where possible, rather than global averages, when discussing the environmental impact of meat and dairy, as well as other food types. In the UK, greenhouse gas emissions from livestock (cattle, sheep, pigs and poultry) account for 6.0% of total 'territorial' emissions, which is lower than an EU-wide estimate of 9.1%. In addition, changes to agricultural practices over time, including altering the diet of animals, looks promising as a means to mitigate some of these environmental effects.

Research shows that dietary patterns that restrict the consumption of animal products, as well as encourage substitution of some ruminant meat by monogastric sources of meat (chickens and pigs), can decrease diet-related GHGE, land use and, in some cases, water use, relative to current dietary habits in high income countries. Data from over 55,000 individuals living in the UK indicated that consuming <50 g/day of meat, compared to >100 g/day, was associated with 35% less GHGE. Those following a vegetarian (47% less emissions) or vegan diet (60% less emissions) diet had even lower diet-related emissions. However, the choice of meat replacement foods is crucial, and the nutritional adequacy of diets must be considered.

Although meat and dairy products may score relatively poorly in terms of their environmental impact, it is important that the nutritional contribution made by these foods is considered. This may be the case particularly for dairy foods (especially milk and yogurt), which have a high nutrient density relative to their intermediate environmental impact. While research findings tend to suggest a reduction in meat consumption is needed to achieve a more sustainable dietary pattern (in high income countries in particular), results are less consistent for dairy foods, likely due to the nutritional contribution of these foods. For example, dairy foods contribute a significant proportion to current intakes of calcium (34%) and iodine (32%) of UK adults. Meat is also an important contributor to dietary intakes of iron (19%), zinc (31%) and selenium (29%) among adults, while oily fish is a rich dietary source of long chain omega-3 fatty acids and vitamin D. It is therefore important to consider the potential nutritional and health implications of dietary changes toward lower meat and/or dairy consumption, alongside effects on the environment.

Overall, research indicates that dietary patterns that give consideration to the environment, nutrition, health, cost and cultural acceptability, do not have to exclude animal-based foods entirely to be both healthier and more sustainable, and that it is possible to incorporate some meat and dairy foods while having a lower environmental impact.

What about organic farming?

Whether organic agriculture is more sustainable than conventional farming techniques remains controversial. While organic farming may perform better across some domains of sustainability, such as animal welfare and low pesticide use, global analyses estimate that yields may be between 5% to 34% lower than with conventional methods, depending on the type of crop grown and the local conditions. This has led many to question the feasibility of the widespread adoption of organic methods. It has been estimated that if all food production in England and Wales were shifted to 100% organic, this would reduce direct GHGE, but that overall net emissions would increase when accounting for higher overseas land use needed to compensate for shortfalls in domestic supply.

However, in economic terms, lower yields may be offset by the higher price consumers are willing to pay for organic products in developed nations, making organic production systems more profitable for producers, irrespective of any ecosystem effects. Nonetheless, it has been suggested that organic agriculture may need to embrace emerging technologies and methods in order to improve its performance and reduce GHGE at the production stage. Overall, it is likely that a mixture of organic and other innovative farming systems will be necessary to feed

the global population, without compromising the health of the ecosystems upon which agriculture relies.

Key References

- Afshin A, Sur PJ, Fay KA et al. (2019) Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet* **393**: 1958–72.
- Aleksandrowicz L, Green R, Joy EJM et al. (2016) The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: a systematic review. PLoS ONE **11**: e0165797.
- Carbon Trust (2016). *The Eatwell Guide: a More Sustainable Diet*. https://www.carbontrust.com/resources/the-eatwell-guide-a-more-sustainable-diet (Accessed 02/06/2021)
- Clark MA, Domingo NGG, Colgan K et al. (2020) Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. *Science* **370**: 705-708.
- Cobiac L, Scarborough P, Kaur A et al. (2016). The Eatwell Guide: Modelling the Health Implications of Incorporating New Sugar and Fibre Guidelines. *PLoS ONE* **11**: e0167859.
- DBEIS (Department for Business, Energy & Industrial Strategy) (2020*) Final UK greenhouse gas emissions national statistics:1990 to 2018 (March 2020)*. Available at: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018 (Accessed 02/06/2021)
- European Commission Joint Research Centre (2010) *Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS) – Final report*. Available at: https://www.fcrn.org.uk/sites/default/files/EU_Evaluation_of_Livestock's_contribution_to_GHGs.pdf (Accessed 02/06/2021)
- FAO, IFAD, UNICEF, WFP and WHO. 2018. *The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition*. Rome, FAO. http://www.fao.org/policy-support/tools-and-publications/resources-details/en/c/1152267/ (Accessed 02/06/2021)
- FAO. 2020. T*he State of World Fisheries and Aquaculture 2020: Sustainability in Action*. Rome. Available at: http://www.fao.org/documents/card/en/c/ca9229en/ (Accessed 02/06/2021)
- Frankowska A, Jeswani HK & Azapagic A (2019) Environmental impacts of vegetables consumption in the UK. *Science of The Total Environment* **682**: 80-105.
- Garnett T. (2014) *What is a sustainable healthy diet? A discussion paper. Food Climate Research Network*. Available at: https://assets.publishing.service.gov.uk/media/57a089dfe5274a27b20002df/FCRN-sustainable-healthy-diet.pdf (Accessed 02/06/2021)
- Kennedy E, Webb P, Block S et al. (2020) Transforming Food Systems: The Missing Pieces Needed to Make Them Work. *Current Developments in Nutrition* **5**: nzaa177.
- Mbow C, Rosenzweig C, Barioni LG et al. (2019) Food Security. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation,

sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Available at: https://www.ipcc.ch/srccl/ (Accessed 02/06/2021)
- Scarborough P, Kaur A, Cobiac L et al. (2016). Eatwell Guide: modelling the dietary and cost implications of incorporating new sugar and fibre guidelines. *BMJ Open* **6**: e013182.
- Scheelbeek P, Green R, Papier K et al. (2020). Health impacts and environmental footprints of diets that meet the Eatwell Guide recommendations: analyses of multiple UK studies. *BMJ Open* **10**: e037554.
- Springmann M, Spajic L, Clark MA et al. (2020) The healthiness and sustainability of national and global food based dietary guidelines: modelling study. *BMJ* **370**: m2322.
- Steenson S & Buttriss JL (2021) Healthier and more sustainable diets: What changes are needed in high-income countries? *Nutrition Bulletin*. Available at: https://doi.org/10.1111/nbu.12518
- Willett W, Rockström J, Loken B et al. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* **393**: 447-492
- WRAP 2021. *The Courtauld Commitment 2025.* Available at: https://wrap.org.uk/resources/report/courtauld-commitment-2025-milestone-progress-report (Accessed 02/06/2021)

Note: A full list of supporting references is available on request (email postbox@nutrition.org.uk).