



Moving towards more sustainable food systems



The world faces significant nutritional challenges regarding widespread malnutrition in all its forms. Urbanisation and modernisation have resulted in dietary shifts towards higher intakes of animal-source foods, refined carbohydrates and highly processed foods, and lower intake of whole grains. Globally, intake of healthy food has increased, but at the same time intake of unhealthy food has increased more rapidly. Unhealthy diets contribute significantly to the global burden of disease. At the same time, the food system is resource-intensive and has a significant impact on the environment. In general, the negative environmental impact is lower for foods such as whole grains, fruit, vegetables, and legumes, and highest for animal-source foods, especially red meat.

The food system includes all activities that relate to production, processing, distribution, preparation, and consumption of food. The global food system needs to provide enough food for the growing world population, but at the same time it needs to provide healthy foods to prevent all forms of malnutrition. Food systems further need to be economically viable and minimise environmental degradation. When transforming food systems, the different domains of sustainable diets (nutrition, environment, economics, and society), and the trade-offs between them need to be considered.

Global food security and nutritional status

The world faces significant nutritional challenges regarding widespread hunger, undernutrition, overweight, and obesity. In many countries, particularly those of low and middle income, undernutrition co-exists along with overweight and obesity or diet-related non-communicable diseases.¹

In 2019, about two billion people globally were affected by either moderate or severe food insecurity, and as such did not have regular access to safe, nutritious, and enough food. Of these two billion people, 690 million experienced hunger, mostly in Asia (381 million) and Africa (250 million). Food insecurity and hunger, which are an underlying cause of undernutrition, are expected

to worsen because of the economic consequences of the global Covid-19 pandemic.²

Undernutrition is strongly related to poverty.³ In low- and middle-income countries, about 45% of deaths among children younger than five years old are linked to undernutrition.⁴ In 2019, 6.9% (47 million) of children younger than five years old were wasted (reflecting acute undernutrition) and 21.3% (144 million) were stunted (reflecting chronic undernutrition). Although the prevalence of stunting in Africa has decreased from 37.9% in 2000 to 29.1% in 2019, the number of children affected by stunting increased (from 49.7 million to 57.5 million) because of population growth. Africa is the only region globally with an increase in the number of children who are stunted.⁵

Unhealthy diets and lack of physical activity have resulted in a steady increase in overweight and obesity globally. Overweight in children younger than five years has increased from 4.9% (30.3 million) in 2000, to 5.6% (38.3 million) in 2019.⁶ From 1980 to 2013, overweight (body mass index [BMI] ≥ 25) in men has increased from 28.8% to 36.9%, and in women from 29.8% to 38.0%.⁶ At least 340 million children and adolescents aged 5 to 19 years and 1.9 billion adults were overweight or obese in 2016.⁷ Globally, 2.4 million deaths in females and 2.3 million deaths in males were attributed to high BMI in 2017.⁸

In addition, about two billion people globally are affected by micronutrient deficiencies,⁹ with 32.8% (or 613 million) of women of reproductive age (15 to 49 years) being anaemic.¹⁰ Regarding children under five years old, 47.4% (293 million) are anaemic¹¹ and 33.3% (190 million) are vitamin A-deficient.¹²

Africa carries a high burden of all forms of malnutrition. Of 41 countries facing the triple burden of malnutrition, 30 are in Africa.¹⁰

Shifts in dietary intakes over time

The global increase in the prevalence of overweight and obesity and the double burden of malnutrition faced by many low- and middle-income countries are the result of dietary changes together with increasing sedentary lifestyles. In low- and middle-income countries, modernisation, urbanisation, economic development

¹ $\geq 20\%$ of under-fives are stunted; $\geq 20\%$ of women of reproductive age have anaemia; $\geq 35\%$ of women ≥ 18 years are overweight or obese

and increased wealth have resulted in diets shifting from traditional, predominantly plant-based diets towards Western-style diets high in animal-source foods and refined carbohydrates.¹³ Also, highly processed easy-to-prepare and ready-to-eat foods, which are usually high in fat, sugar and/or salt, are widely available because of modernisation and the globalisation of food systems.¹⁴ According to the NOVA classification system, foods can be grouped based on the extent and purpose of their processing. In this classification system, foods are categorised as:

- unprocessed and minimally processed foods;
- processed culinary ingredients;
- processed foods; or
- ultra-processed foods.¹⁵

Compared to unprocessed foods, ultra-processed foods are more energy-dense and nutrient-poor,¹⁶ and are often more affordable.^{16,19}

Globally, between 1990 to 2010, intake of healthy dietary items increased modestly, but, at the same time, intake of unhealthy dietary items increased to a greater degree. Regional differences in dietary shifts were observed, however. Healthy dietary patterns improved in high- and middle-income countries, but not in the poorest regions (e.g. sub-Saharan Africa). Middle-income countries showed the largest increase in unhealthy dietary patterns.¹⁷

Healthier diets cost more, which contributes to differences in diet quality across socio-economic strata.¹⁸ Healthy diets are unaffordable to many people; about 57% of the population in sub-Saharan Africa and Southern Asia, for example, cannot afford a healthy diet.² Also, diets for which ultra-processed foods supply a high percentage of total energy intake may be cheaper than diets that contain proportionally less ultra-processed foods.¹⁹ Availability and affordability of ultra-processed foods could explain, at least partly, the shift towards unhealthy dietary patterns.

Consumption of ultra-processed foods is associated with various adverse health outcomes.²⁰ For example, national household availability of ultra-processed foods was shown to be associated with the national prevalence of obesity in 19 European countries.²¹ Consumption of ultra-processed foods is also associated with:

- body fat in children and adolescents;²²
- overweight and obesity;²³
- a higher risk of cardiovascular disease;
- cerebrovascular disease;
- depression;²⁴
- Type 2 diabetes;²⁵ and
- all-cause mortality.²⁴

Dietary assessment methods, however, are not specifically designed to assess food processing and, as a result, ultra-processed foods can be misclassified. This is a limitation for studies that determine associations between intake of ultra-processed foods and health

outcomes.²⁶ The lack of dietary assessment instruments to accurately record intake of these foods also makes it difficult to assess dietary shifts in the context of the nutrition transition.²⁷ It should also be noted that drivers of dietary shifts are multidimensional as both traditional and modern eating are characterised not only by *what* people eat, but also by *how* people eat.²⁸

Unhealthy diets contribute significantly to the global burden of disease. In 2019, dietary risks were the second highest contributor to global deaths in females (3.48 million, or 13.5%), and the third highest contributor to deaths in males (4.47 million, or 14.6%).²⁹ High intakes of sodium, and low intakes of whole grains, fruits, nuts and seeds, or vegetables are the top dietary risk factors for global deaths.³⁰ Food choices do not only affect human health, but also the environment.

Impact of food production and the food industry on the environment

Whereas the global food system needs to provide enough food for the growing world population, it also needs to enhance food security, prevent all forms of malnutrition, be economically viable, and minimise environmental degradation.³¹

The food system includes all elements and activities that relate to production, processing, distribution, preparation, and consumption of food.³² The cost of food is affected by all the elements of a food system.² Ericksen³³ proposed the initial framework for food systems, which is broadly outlined below:

- The interactions between and within biogeophysical and human environments, which determine a set of activities
 - The activities themselves:
 - (i) Producing food
 - (ii) Processing and packaging of food
 - (iii) Distributing and retailing food (activities i, ii and iii are all part of the food supply chain)
 - (iv) Consuming food
 - Outcomes of the activities, contributing to the following:
 - (i) Food security in terms of food availability (type, amount, and quality), food access (affordability, allocation, and preference), and food utilisation (nutritional value, social value, and food safety)
 - (ii) Environmental security (e.g. climate change, water availability, and water quality)
 - (iii) Social welfare (socio-economic goals: income, employment, and health)
 - Other determinants of food security (stemming in part from the interactions in the first bullet).³³
- The current food production system is resource intensive and has a negative impact on the environment and ecosystems (including biodiversity, soils, waterways, and climate change). Half of the world's habitable land

^b These dietary changes together with increasing sedentary lifestyles are referred to as the nutrition transition.¹³

^c Fruits, vegetables, beans and legumes, nuts and seeds, whole grains, milk, polyunsaturated fat, seafood omega-3s, plant omega-3s, dietary fiber

^d Unprocessed red meats, processed meats, sugar-sweetened beverages, saturated fat, trans fat, cholesterol, sodium

^e The dimension on what people eat includes six subdimensions, namely (i) Ingredients (e.g. plant-based versus animal-source foods); (ii) Processing (manner of production and level of processing);

(iii) Preparation (who prepares the food, and where and how the food is prepared); (iv) Temporal origin (length of time that a food has been part of the diet in any particular region); (v) Spatial origin (where the food comes from); and (vi) Variety (how large the choice is of available foods).²⁸

^f The dimension on how people eat includes six subdimensions, namely (i) Temporal aspects (duration of eating and when people eat); (ii) Spatial aspects (where people eat); (iii) Social aspects (with whom people eat, and social norms); (iv) Meals (significance and content of meals); (v) Appreciation (extent to which respect is shown for the food consumed, as well as for others at the table); and (vi) Concerns (what concerns people have when eating).²⁸

and 70% of global freshwater withdrawals are used for agriculture. Agriculture accounts for over a quarter of global greenhouse gas (GHG) emissions and over three-quarters of global ocean and freshwater eutrophication (the pollution of waterways with nutrient-rich pollutants).³⁴

The environmental impact of food production is among the lowest for wholesome plant-based foods (e.g. whole-grain cereals, vegetables, and fruit), whereas meat (unprocessed and processed) has the highest environmental impact.³⁵ Excluding animal-source foods from the diet can significantly reduce agricultural land-use, GHG emissions, acidification, eutrophication and freshwater withdrawals.³⁶ Dietary shifts to more plant-based diets will have environmental benefits, but may, however, result in higher food loss and waste, as vegetables and fruits are highly perishable and therefore prone to spoilage.³⁷

Food processing is a water-intensive industry. Sectors in the food industry that are the most water-intensive are dairy, meat and poultry, and fruit and vegetable processing. Furthermore, transporting food over long distances increases GHG emissions and depletion of non-renewable resources.³⁸

Food loss and waste

Food loss (from the post-harvest stage up to, but excluding, the retail phase) and food waste (at the retail and consumer phase) are highest for perishable foods such as fruits, vegetables, and animal products. Some level of food loss and waste is unavoidable. Reducing or minimising food loss and waste will however lead to more efficient use of natural resources and have environmental benefits.³⁷ Although reducing food loss and waste can have economic benefits, efforts to reduce food loss and waste have financial implications, for example, the cost of improved storage facilities, packaging material and transport.³⁷ Packaging can reduce food loss by preventing foods getting damaged or spoiled, but it contributes to environmental pollution.³⁸ The target for the Sustainable Development Goal (SDG) 12.3 is to “by 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses”.³⁷

Sustainable healthy diets

A healthy diet should optimise health in terms of physical, mental, and social well-being.³² Variety, adequacy, moderation, and overall balance reflect dietary quality and are key components of a healthy diet.² Sustainable diets should also have low environmental impact, be accessible, affordable, safe, and equitable, and be culturally acceptable.³⁹ However, not all healthy diets are sustainable, and not all diets that are considered sustainable are healthy.²

Friel *et al.*⁴⁰ proposed three overarching guidelines for sustainable healthy diets, namely:

1. Food consumed above a person's energy requirement is an avoidable environmental burden.
2. Consuming less discretionary foods, which are

energy-dense and highly processed and packaged, reduces both the risk of dietary imbalances and the use of environmental resources.

3. A diet with less animal- and more plant-sourced foods has both health and ecological benefits.

In 2019, the FAO and WHO³⁹ published a comprehensive list of guiding principles for sustainable healthy diets. These guidelines consider health aspects, environmental impact, and sociocultural aspects. (Table 1).

Table 1

The 16 guiding principles for sustainable healthy diets, as defined by FAO and WHO³⁹

Health aspects	1	... start early in life with early initiation of breastfeeding, exclusive breastfeeding until six months of age, and continued breastfeeding until two years and beyond, combined with appropriate complementary feeding.
	2	... are based on a variety of unprocessed or minimally processed foods, balanced across food groups, while restricting highly processed food and drink products.
	3	... include whole grains, legumes, nuts, and an abundance and variety of fruits and vegetables.
	4	... can include moderate amounts of eggs, dairy, poultry, and fish, and small amounts of red meat.
	5	... include safe and clean drinking water as the fluid of choice.
	6	... are adequate (i.e. reaching but not exceeding needs) in energy and nutrients for growth and development, and to meet the needs for an active and healthy life across the life cycle.
	7	... are consistent with the WHO guidelines ^a to reduce the risk of diet-related NCD, and ensure health and well-being for the general population.
	8	... contain minimal levels, or none if possible, of pathogens, toxins, and other agents that can cause food-borne disease.
Environmental impact	9	... manage GHG emissions, water and land use, nitrogen and phosphorus application, and chemical pollution within set targets.
	10	... maintain biodiversity, including that of crops, livestock, forest-derived foods, and aquatic genetic resources, and avoid overfishing and overhunting.
	11	... minimise the use of antibiotics and hormones in food production.
	12	... minimise the use of plastics and derivatives in food packaging.
	13	... reduce food loss and waste.
Sociocultural aspects	14	... are built on respect for local culture, culinary practices, knowledge and consumption patterns, and values in the way food is sourced, produced, and consumed.
	15	... are accessible and desirable.
	16	... avoid adverse gender-related impacts, especially regarding time allocation (e.g. for buying and preparing food, water and fuel acquisition).

Source: FAO and WHO (2019). Sustainable healthy diets – Guiding principles. Rome.³⁹

^a fruit and vegetables at least 400 g per day; free sugars < 10% of total energy (preferably < 5%); fat < 30% of total energy; saturated fats < 10% of total energy; trans-fats < 1% of total energy; salt < 5 g per day⁴¹

In 2019, the EAT-Lancet Commission report was published, and the authors argued that a predominantly plant-based diet containing low amounts of animal-source foods (Table 2) are beneficial for both improved health and the environment.³²

Table 2:
Components of a healthy diet, according to the EAT-Lancet Commission

Protein sources	<ul style="list-style-type: none"> Primarily from plants (including soya foods, other legumes and nuts), fish or alternative sources of omega-3 fatty acids several times per week Optional modest consumption of poultry and eggs Low intakes of red meat, if any, especially processed meat
Fat	<ul style="list-style-type: none"> Mostly from unsaturated plant sources Low intakes of saturated fats No partly hydrogenated oils
Carbohydrates	<ul style="list-style-type: none"> Primarily from whole grains Low intake of refined grains Less than 5% of energy from sugar
Fruits and vegetables	<ul style="list-style-type: none"> At least five servings per day (not including potatoes)
Dairy	<ul style="list-style-type: none"> Moderate consumption as an option

Source: Willet et al., 2019³²

The EAT-Lancet Commission proposes a global benchmark diet that includes ranges of intakes for each food group to allow flexibility.³² Although the estimated cost of the benchmark diet differs between regions and income groups, globally fruits and vegetables account for the biggest share of the cost (31.2%), followed by legumes and nuts (18.7%), dairy (13.2%), and meat, eggs and fish (15.2%).⁴² The diet proposed by the EAT-Lancet Commission will, however, be unaffordable to most of the population in low- and middle-income countries.⁴²

Some have raised concerns about the recommended low intake of red meat, especially for children and vulnerable populations, as this may lead to nutrient-deficient diets.⁴³ However, the EAT-Lancet Commission report does acknowledge that the role of animal-source foods in people's diets must be carefully considered in the local and regional context.³²

The EAT-Lancet diet recommends limited intake of dairy (one cup per day),³² which is lower than current recommendations. Globally, 75% of national food-based dietary guidelines (FBDGs) have a key message on dairy,⁴⁴ and for most, the recommended intake is higher than the actual intake. Increasing dairy intake to meet the recommendation would result in substantial increases in the environmental impact.⁴⁵ Drewnowski⁴⁶ argues that the environmental impact of dairy in the diet needs to be weighed against the high nutrient density of milk and milk products, as compared to some plant-based alternatives. A study done in the United Kingdom showed that although usual diets with the highest dairy content had higher potential for eutrophication (nutrient pollution in water), these diets also had higher nutrient content and better overall diet quality, and were associated with lower blood pressure as compared to usual diets with lower dairy content.⁴⁷

Dietary shifts to reduce the intake of red meat and increase the intake of healthy plant foods will improve environmental sustainability.³⁵ Aside from the environmental benefits, dietary shifts to more plant-based diets also have health and economic benefits.⁴⁸ Health benefits associated with plant-based diets include lower blood cholesterol concentrations,⁴⁹ lower incidence of Type 2 diabetes,⁵⁰ lower risk of cardiovascular morbidity and mortality⁵¹ and all-cause mortality.⁵² However, not all plant-based diets are similar, and the healthiness of plant foods should be considered when promoting dietary shifts to reduce meat intake.⁵³ Healthy plant-based diets are higher in fruits, vegetables, whole grains, and plant protein, and lower in refined carbohydrates and animal foods.⁵⁴ Examples of healthy plant-based diets that are associated with a lower risk of cardiovascular disease include a healthy vegetarian diet, healthy Mediterranean diet, planetary health diet, and dietary approaches to stop hypertension (DASH).⁵³

To enable shifts to sustainable healthy diets, adequate amounts of nutritious foods need to be supplied by the food systems. Fruits and vegetables, for example, are an integral part of sustainable healthy diets, and a daily intake of at least 400 g is recommended to reduce the risk for developing non-communicable diseases.⁵⁵ For a sizeable proportion of the population this is not achievable, as in many regions globally, availability of vegetables and fruit for human consumption is below the recommended 400 g per day. In Africa, for example, availability of fruit and vegetables was 191 g/capita/day in 2017.²

Context-specific sustainable healthy diets

Globally, food systems are diverse and there are big discrepancies in food security and nutrition status across and within countries.² Health and environmental impacts due to dietary shifts are therefore context-specific and will differ between regions. In high-income countries, for example, replacing animal-source foods and shifting towards a more plant-based diet will simultaneously reduce health risks and environmental impact. In contrast, in low-income countries that consume mostly starchy staples, food security strategies aimed at diversifying diets will reduce health risks, but at the same time increase environmental impact.⁵⁶

In lower-income countries with a high prevalence of nutrient deficiencies and undernutrition, an increase in meat consumption may be needed to supply adequate amounts of essential nutrients. Under these circumstances the priority would be to meet dietary requirements and nutrition targets, with higher environmental impact as a trade-off.²

In countries where the food system not only provides food but also drives the rural economy, the negative impact that transforming food systems may have on the income and livelihoods of smallholder farmers needs to be considered and mitigated.²

It therefore follows that sustainable healthy diets should not be implemented based solely on environmental impact.⁴⁶

The four context-specific and interconnected domains of sustainable food systems (nutrition, economics, environment, and society) and the trade-offs between these domains need to be considered when transforming food systems.⁵⁷

Promoting shifts towards more sustainable healthy diets

The FAO and WHO³⁹ recommend that context-specific sustainable healthy diets be defined in national FBDGs. Globally, 90 countries have FBDGs, according to the FAO FBDG repository.⁴⁴ Most FBDGs, however, do not address sustainability of diets⁴⁴ and are not aligned with global environmental targets.⁴⁵ It has been suggested that national dietary guidelines should be updated based on current evidence.⁵⁶ Whereas dietary changes towards achieving sustainable diets need radical transformation, dietary recommendations need to be practical, achievable, affordable, and culturally acceptable. Developing dietary guidelines that promote sustainable nutrition consequently requires continuous interdisciplinary collaboration.⁵⁸

Ranganathan *et al.*⁵⁹ developed a framework (the Shift Wheel), comprising four complementary strategies that food companies can use to shift consumers to more sustainable diets, as outlined below:

- **Minimise disruption** by minimising changes to a product's taste, look, texture, smell, packaging, and location in a shop, for example, animal product substitutes made from plant-based proteins, replicating the taste and texture of animal foods.
- **Sell a compelling benefit** by marketing a product attribute (e.g. health, affordability, taste, or product quality) that can stimulate consumers' behaviour change.
- **Maximise awareness** by increasing the visibility of a product by strategic placing of products in shops and advertising.
- **Evolve social norms** by adapting or changing the underlying social and cultural norms through informing and educating consumers.

All forms of malnutrition should be considered when promoting sustainable healthy diets and transforming food systems. This will require double-duty actions, which have the potential to simultaneously reduce the risk or burden of undernutrition, overweight and obesity, or diet-related non-communicable diseases. This will require, among others, agricultural and food system policies to support healthy diets and policies to improve food environments that consider all forms of malnutrition.⁶⁰



Conclusion

Sustainable diets should optimise health, have low environmental impact, be affordable, and be culturally acceptable. To achieve sustainable diets, transformation of food systems is needed, with a shift from animal-source foods to plant-based diets. Transformation of food systems needs to consider the trade-offs of the four main domains of sustainable food systems, i.e. nutrition, economics, environment, and society. Shifts in food systems and dietary intakes will thus be context-specific and differ among regions, depending on the local food system, and food security and nutritional status in the region. Aligning national dietary recommendations with sustainable diets will need continuous interdisciplinary collaboration.

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