



Food and Agriculture  
Organization of the  
United Nations



World Health  
Organization

A decorative border at the top of the page, set against a light blue background, featuring various food items in silhouette and color. The items include a green corn cob, a red tomato, a green leafy vegetable, two small red tomatoes, a purple eggplant, a yellow egg, and a yellow citrus fruit.

## SUSTAINABLE HEALTHY DIETS GUIDING PRINCIPLES

A decorative border at the bottom of the page, set against a light blue background, featuring various food items in silhouette and color. The items include a large orange citrus fruit, a red tomato, a grey mushroom, a green pear, a yellow egg, a grey fish, a purple bunch of grapes, a yellow banana, a green leafy vegetable, a red carrot, a green bell pepper, a grey tomato, and a red bunch of tomatoes.



# **SUSTAINABLE HEALTHY DIETS GUIDING PRINCIPLES**

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS  
WORLD HEALTH ORGANIZATION  
Rome, 2019

Required citation:

FAO and WHO. 2019. *Sustainable healthy diets – Guiding principles*. Rome.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) or World Health Organization (WHO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO or WHO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO or WHO.

ISBN 978-92-5-131875-1 (FAO)

ISBN 978-92-4-151664-8 (WHO)

© FAO and WHO, 2019



Some rights reserved. This work is made available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo/legalcode>).

Under the terms of this licence, this work may be copied, redistributed and adapted for non-commercial purposes, provided that the work is appropriately cited. In any use of this work, there should be no suggestion that FAO or WHO endorses any specific organization, products or services. The use of the FAO or WHO logo is not permitted. If the work is adapted, then it must be licensed under the same or equivalent Creative Commons licence. If a translation of this work is created, it must include the following disclaimer along with the required citation: "This translation was not created by the Food and Agriculture Organization of the United Nations (FAO) or WHO. FAO/WHO are not responsible for the content or accuracy of this translation. The original English edition shall be the authoritative edition.

Disputes arising under the licence that cannot be settled amicably will be resolved by mediation and arbitration as described in Article 8 of the licence except as otherwise provided herein. The applicable mediation rules will be the mediation rules of the World Intellectual Property Organization <http://www.wipo.int/amc/en/mediation/rules> and any arbitration will be conducted in accordance with the Arbitration Rules of the United Nations Commission on International Trade Law (UNCITRAL).

**Third-party materials.** Users wishing to reuse material from this work that is attributed to a third party, such as tables, figures or images, are responsible for determining whether permission is needed for that reuse and for obtaining permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

**Sales, rights and licensing.** FAO information products are available on the FAO website ([www.fao.org/publications](http://www.fao.org/publications)) and can be purchased through [publications-sales@fao.org](mailto:publications-sales@fao.org). Requests for commercial use should be submitted via: [www.fao.org/contact-us/licence-request](http://www.fao.org/contact-us/licence-request). Queries regarding rights and licensing should be submitted to: [copyright@fao.org](mailto:copyright@fao.org).

# CONTENTS

Foreword .....	5
Introduction.....	7
Aims of Sustainable Healthy Diets .....	9
Guiding Principles for Sustainable Healthy Diets.....	11
Actions for the implementation of Sustainable Healthy Diets .....	13
<b>SUMMARY PAPERS FROM THE INTERNATIONAL CONSULTATION .....</b>	<b>15</b>
SUMMARY PAPER 1: Background paper on healthy diets.....	17
SUMMARY PAPER 2: The role of healthy diets in creating environmentally sustainable food systems.....	21
SUMMARY PAPER 3: The Role of culture, economics, and food environment in shaping choices for sustainable diets .....	25
SUMMARY PAPER 4: Territorial Diets.....	29
SUMMARY PAPER 5: Background paper on food safety .....	33
Annex 1: Contributors to the consultation.....	37



Two of the major challenges of our times are malnutrition in all its forms and the degradation of environmental and natural resources. Both are happening at an accelerated pace.

The State of Food Security and Nutrition in the World Report (SOFI 2019) shows that the number of the undernourished has been slowly increasing for several years in a row, and at the same time the number of overweight and obese people all over the world is increasing at an alarming rate.

More than 820 million people go to bed hungry every night. In 2018, 1.3 billion people experienced food insecurity at moderate levels, meaning they did not have regular access to nutritious and sufficient food. Overweight and obesity and their associated diet-related non-communicable diseases (NCDs) are contributing to 4 million deaths globally. Today, 2 billion adults and over 40 million children under five are overweight. Moreover, over 670 million adults and 120 million girls and boys (5-19 years) are obese. Malnutrition is costly to the health of individuals, their wellbeing and productivity. It also has high socio-economic costs for societies in all regions of the world.

Poor diets are a major contributory factor to the rising prevalence of malnutrition in all its forms. Moreover, unhealthy diets and malnutrition are among the top ten risk factors contributing to the global burden of disease.

In addition, the way we produce and consume food is taking a toll on the environment and natural resource base. For example, food production accounts for the use of 48 percent and 70 percent of land and fresh water resources respectively at the global level.

Social, demographic and economic factors are also contributing to changing lifestyles and eating patterns, and subsequently putting pressure on resources for food production.

In 2014, the FAO/WHO Second International Conference on Nutrition (ICN2) acknowledged that: “current food systems are being increasingly challenged to provide adequate, safe, diversified and nutrient rich food for all that contribute to healthy diets due to, inter alia, constraints posed by resource scarcity and environmental degradation, as well as by unsustainable production and consumption patterns”. To address these challenges, the UN Decade of Action on Nutrition 2016 – 2025 puts a specific focus on the transformation of food systems to promote healthy diets that are sustainably produced and improve nutrition to achieve the global nutrition and diet-related NCD targets in line with commitments of ICN2 and the Sustainable Development Goals (SDGs).

Considering the detrimental environmental impact of current food systems, and the concerns raised about their sustainability, there is an urgent need to promote diets that are healthy and have low environmental impacts. These diets also need to be socio-culturally acceptable and economically accessible for all.

Acknowledging the existence of diverging views on the concepts of sustainable diets and healthy diets, countries have requested guidance from the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) on what constitutes sustainable healthy diets. The two organisations jointly held an international expert consultation on Sustainable and Healthy Diets from 1 to 3 July 2019 at FAO headquarters in Rome, Italy, to address these issues. The Consultation agreed on guiding principles for what constitutes “Sustainable Healthy Diets”. This comes at a time when the debate around the sustainability of diets is high on the agenda of governments, international organisations, civil society organisations, the private sector and academia.

These guiding principles take a holistic approach to diets; they consider international nutrition recommendations; the environmental cost of food production and consumption; and the adaptability to local social, cultural and economic contexts. At the Consultation the experts agreed on the term “Sustainable Healthy Diets” which encompasses the two dimensions – sustainability and healthiness of diets. Countries should decide on the trade-offs according to their situations and goals.

These guiding principles emphasize the role of food consumption and diets in contributing to the achievement of the SDGs at country level, especially Goals 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-Being), 4 (Quality Education), 5 (Gender Equality) and 12 (Responsible Consumption and Production) and 13 (Climate Action).

This publication aims to support the efforts of countries as they work to transform food systems to deliver on sustainable healthy diets.

We take this opportunity to acknowledge the experts who drafted the background papers and/or contributed to the Expert Consultation leading to the elaboration of the Guiding Principles: Seth Adu-Afarwuah, Ashkan Afshin, Sutapa Agrawal, Mary Arimond, Michael Clark, Namukolo Covic, Saskia de Pee, Adam Drewnowski, Jessica Fanzo, Edward A. Frongillo, Mario Herrero, Lea S. Jakobsen, Andrew D. Jones, Shiriki Kumanyika, Pulani Lanerolle, Mark Lawrence, Duo Li, Jennie Macdiarmid, Sarah McNaughton, Sara Monteiro Pires, Veronika Molina, Carlos Monteiro, Eva Monterrosa, Luis Moreno, Morten Poulsen, Modi Mwatsama, Maarten Nauta, Janet Ranganathan, Satoshi Sasaki, Shelly Sundberg, Sofie Thomsen, Stefanie Vandevijvere, and Davy Vanham (affiliations of the experts are provided in Annex 1).

This publication has been made possible by the sustained efforts of the FAO-WHO Secretariat: Anna Larrey, Nancy Aburto, Fatima Hachem, Ramani Wijesinha-Bettoni, Tomas Buendia, Eleonora Dupouy, Francesco Branca, Chizuru Nishida and Marzella Wüstefeld. Inputs from Kim Petersen, Angelika Maria Tritscher, Jason Montez, Kaia Engesveen and Kazuaki Miyagishima from WHO to the technical content of the Expert Consultation are warmly acknowledged.

Valuable review comments were received on the draft papers from Tim Lang and Gretel Pelto, and FAO staff Markus Lipp, Alice Green and Kang Zhou. The Guiding Principles have benefited from the inputs of Ana Islas, Maria A. Tuazon, Patrizia Fracassi, Pilar Santacoloma, Giulia Palma and Melissa Vargas.

This work would not have been achieved without the support of the following FAO staff: Dalia Mattioni, Maria Xipsiti, Ahmed Raza, Trudy Wijnhoven, Margaret Wagah, Chiara Deligia, Giuseppina Di Felice, Michele Rude, Cristiana Fusconi, Donna Kilcawley and Diana Calderon, and Fabienne Maertens from WHO.



Anna Larrey  
Director  
Nutrition and Food  
Systems Division  
FAO



Francesco Branca  
Director  
Department of Nutrition  
for Health and Development  
WHO



# INTRODUCTION



The UN Committee on Economic, Social and Cultural rights has recognized that the right to adequate food is of crucial importance for the enjoyment of all human rights. The committee considers that “the right to adequate food implies: “The availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals, free from adverse substances, and acceptable within a given culture; The accessibility of such food in ways that are sustainable and that do not interfere with the enjoyment of other human rights”<sup>1</sup>. The Committee on the Rights of the Child has also recognized the obligation of States to ensure access to nutritionally adequate, culturally appropriate and safe food to combat malnutrition in all its forms<sup>2</sup>.

Nonetheless, many individuals do not have year-round access to safe, affordable, healthy diets needed to promote health and wellbeing.<sup>3</sup> As a result, malnutrition in all its forms is a problem of global proportion, and no country is free from its effects. One in three individuals is currently affected by at least one form of malnutrition such as hunger, stunting, wasting, micronutrient deficiencies, overweight and/or obesity as well as resulting diet-related, non-communicable diseases (NCDs). The consequences of malnutrition include avoidable ill-health and premature death, as well as enormous economic and societal costs. Global estimates suggest that malnutrition in all its forms costs society up to USD 3.5 trillion per year,

---

<sup>1</sup> **UN Economic and Social Council. 1999.** Committee on Economic, Social and Cultural Rights (CESCR) The right to adequate food (Art.11) : 12/05/99. E/C.12/1999/5 (General Comments). [https://www.nichibenren.or.jp/library/ja/kokusai/humanrights\\_library/treaty/data/CESCR\\_GC\\_12e.pdf](https://www.nichibenren.or.jp/library/ja/kokusai/humanrights_library/treaty/data/CESCR_GC_12e.pdf)

<sup>2</sup> **UN Convention of the Rights of the Child. 2013.** Committee on the Rights of the Child (CRC) General Comment No. 15 2013 on the right of the child to the enjoyment of the highest attainable standard of health (art. 24). <http://www.refworld.org/docid/51ef9e134.html>

<sup>3</sup> **FAO & WHO. 2015.** Second International Conference on Nutrition (ICN2). Report of the Joint FAO/WHO Secretariat on the Conference. <http://www.fao.org/3/i4436e/i4436e.pdf>

with overweight and obesity alone costing USD 500 billion per year<sup>4</sup>.

While the causes of malnutrition around the world are complex, unhealthy diets remain one of the main contributors to the global burden of disease. Unhealthy diets were identified as the second-leading risk factor for deaths and disability-adjusted life-years (DALYs) globally in 2016,<sup>5</sup> while in 2017 they accounted for approximately 11 million deaths and 255 million DALYs<sup>6</sup>. To address malnutrition, diets must improve. However, the task is challenging, as drivers to changing diets are numerous and include urbanization, globalization of agricultural markets and trade, incomes, supermarket penetration and mass food marketing. Thus to improve diets, the entire food system – which encompasses the range of actors (and institutions) involved in the production, aggregation, processing and packaging, distribution, marketing, consumption and disposal of food products – must be considered.

Food systems are simultaneously a leading cause of environmental degradation and depletion of natural resources. Currently, food systems are responsible for a significant share (20-35 percent) of greenhouse gas (GHG) emissions, and are a major driver of land conversion, deforestation and loss of biodiversity. Agriculture alone accounts for roughly 70 percent of global freshwater withdrawals, and causes water pollution.<sup>7</sup> With the world's population

predicted to expand to 9.7 billion individuals by 2050, these environmental pressures and impacts do not make current food systems sustainable. The Intergovernmental Panel on Climate Change (IPCC) in their most recent report recognized that “Consumption of healthy and sustainable diets presents major opportunities for reducing GHG emissions from food systems and improving health outcomes”<sup>8</sup>.

Furthermore, the environmental impacts of agricultural production are a source of morbidity and mortality. In 2014, the FAO/WHO Second International Conference on Nutrition (ICN2) recognized that: “current food systems are being increasingly challenged to provide adequate, safe, diversified and nutrient rich food for all that contribute to healthy diets due to, inter alia, constraints posed by resource scarcity and environmental degradation, as well as by unsustainable production and consumption patterns, food losses and waste, and unbalanced distribution”<sup>9</sup>. Therefore, shaping food systems for Sustainable Healthy Diets also requires consideration of the environment.

Additionally, current food systems are characterized by inequitable power concentration and imbalance, with some actors profiting greatly while others remain impoverished. These systems are failing to deliver equitable benefits for all, and are leaving the most vulnerable behind.

Food systems across the globe are embedded in unique historical, religious, social, cultural and economic contexts, and are thus very diverse. Though healthy diets are described through dietary goals defined in terms of nutrient adequacy, or the desirable intake of specified food groups, or adherence to a dietary pattern, diets are more than the sum of nutrients and foods consumed or the dietary patterns associated with them. They are a way of life that

---

<sup>4</sup> **Global Panel.** 2016. The Cost of Malnutrition: Why Policy Action is Urgent. London, UK: Global Panel on Agriculture and Food Systems for Nutrition. <https://glopan.org/sites/default/files/pictures/CostOfMalnutrition.pdf>

<sup>5</sup> **GBD 2016 Risk Factors Collaborators.** 2017. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet*. 390(10100):1345-1422. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(17\)32366-8/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32366-8/fulltext)

<sup>6</sup> **GBD 2017 Diet Collaborators.** 2019. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 393: 1958–1972. [https://www.thelancet.com/article/S0140-6736\(19\)30041-8/fulltext](https://www.thelancet.com/article/S0140-6736(19)30041-8/fulltext)

<sup>7</sup> **FAO.** 2017. Water for Sustainable Food and Agriculture: A report produced for the G20 Presidency of Germany. <http://www.fao.org/3/a-i7959e.pdf>

---

<sup>8</sup> **IPCC.** 2019. 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. <https://www.ipcc.ch/report/srcc/>

<sup>9</sup> **FAO & WHO.** 2015. Second International Conference on Nutrition (ICN2). Report of the Joint FAO/WHO Secretariat on the Conference. [www.fao.org/3/i4436e/i4436E.pdf](http://www.fao.org/3/i4436e/i4436E.pdf)

shapes and is shaped by the way food is produced, procured, distributed, marketed, chosen, prepared and consumed. The social/cultural aspects and the economic impacts of food and food systems must be taken into account in the dialogue on responses to improve diets and eliminate hunger and all forms of malnutrition.

Each context is unique and poses specific challenges to address availability, accessibility, and consumption of diets, and therefore requires a tailored solution for support to optimal health and sustainability. Though the solutions vary, the objectives of diets that address health and environmental, social/cultural and economic concerns are the same for all healthy individuals. Articulating those objectives can facilitate defining, developing and delivering specific actions that respond to contextual needs.

Therefore, under the auspices of the UN Decade of Action on Nutrition, FAO and WHO jointly organized an international expert consultation on sustainable healthy diets. The consultation was held from 1 to 3 July, 2019 at the FAO headquarters in Rome, Italy. Prior to the consultation, FAO and WHO commissioned five background papers covering i) the elements and definitions of healthy diets; ii) the role of healthy diets in environmentally sustainable food systems; iii) the role of culture, economics and food environment in shaping choices for sustainable diets; iv) territorial diets; and v) food safety implications of Sustainable Healthy Diets. A two page summary of each paper is published as an appendix to this report. Thirty-three experts knowledgeable in the various dimensions of healthy diets and aspects of sustainability, representing low, middle and high-income countries, participated in the consultation and/or contributed to drafting the background papers.

The objective of the consultation was to develop Guiding Principles around what constitutes Sustainable Healthy Diets, to be further translated into clear, non-technical information and messaging to be used by governments and other actors in policy-making and communications. The Guiding Principles for Sustainable Healthy Diets are food based, and take into account nutrient recommendations while considering environmental, social/cultural and economic sustainability.

The following *Guiding Principles for Sustainable Healthy Diets* were the outcomes of the consultation.

## AIMS OF SUSTAINABLE HEALTHY DIETS

Sustainable Healthy Diets are dietary patterns that promote all dimensions of individuals' health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable. The aims of Sustainable Healthy Diets are to achieve optimal growth and development of all individuals and support functioning and physical, mental, and social wellbeing at all life stages for present and future generations; contribute to preventing all forms of malnutrition (i.e. undernutrition, micronutrient deficiency, overweight and obesity); reduce the risk of diet-related NCDs; and support the preservation of biodiversity and planetary health. Sustainable healthy diets must combine all the dimensions of sustainability to avoid unintended consequences.



## SUSTAINABLE HEALTHY DIETS...

### REGARDING THE HEALTH ASPECT

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 great variety of unprocessed or minimally processed foods, balanced across food groups, while restricting highly processed food and drink products.<sup>10</sup>

8

... contain minimal levels, or none if possible, of pathogens, toxins and other agents that can cause foodborne disease.

7

... are consistent with WHO guidelines to reduce the risk of diet-related NCDs, and ensure health and wellbeing for the general population.<sup>12</sup>

### REGARDING ENVIRONMENTAL IMPACT

9

... maintain greenhouse gas emissions, water and land use, nitrogen and phosphorus application and chemical pollution within set targets.

10

... preserve biodiversity, including that of crops, livestock, forest-derived foods and aquatic genetic resources, and avoid overfishing and overhunting.

### REGARDING SOCIOCULTURAL ASPECTS

16

... avoid adverse gender-related impacts, especially with regard to time allocation (e.g. for buying and preparing food, water and fuel acquisition).

15

... are accessible and desirable.

<sup>10</sup> Food processing can be beneficial for the promotion of high quality diets; it can make food more available as well as safer. However, Some forms of processing can lead to very high densities of salt, added sugar and saturated fats and these products, when consumed in high amounts, can undermine diet quality. (Global Panel on Agriculture and Food Systems for Nutrition. 2016. Food systems and diets: Facing the challenges of the 21st century. London, UK. <http://ebrary.ifpri.org/utils/getfile/collection/p15738coll5/id/5516/filename/5517.pdf>)

<sup>11</sup> Potatoes, sweet potatoes, cassava and other starchy roots are not classified as fruits or vegetables.

# GUIDING PRINCIPLES FOR SUSTAINABLE HEALTHY DIETS

**3** ... include wholegrains, legumes, nuts and an abundance and variety of fruits and vegetables.<sup>11</sup>

**4** ... can include moderate amounts of eggs, dairy, poultry and fish; and small amounts of red meat.

**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 lifecycle.

**5** ... include safe and clean drinking water as the fluid of choice.

**11** ... minimize the use of antibiotics and hormones in food production.

**12** ... minimize the use of plastics and derivatives in food packaging.

**14** ... are built on and respect local culture, culinary practices, knowledge and consumption patterns, and values on the way food is sourced, produced and consumed.

**13** ... reduce food loss and waste.

<sup>12</sup> They include up to 30-35 percent of total energy intake from fats, with a shift in fat consumption away from saturated fats to unsaturated fats and towards the elimination of industrial trans fats; less than 10 percent of total energy intake from free sugars (possibly less than 5 percent) and not more than 5 g per day of salt (to be iodized). WHO. 2018. Healthy diet. WHO fact sheet No. 394 (updated August 2018). Geneva, World Health Organization, 2018. [https://www.who.int/nutrition/publications/nutrientrequirements/healthydiet\\_factsheet/en/](https://www.who.int/nutrition/publications/nutrientrequirements/healthydiet_factsheet/en/)



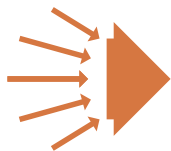
**Create an enabling environment** through government mechanisms, incentives and disincentives; legal frameworks; and regulatory instruments to promote the production, processing, distribution, labelling and marketing, and consumption of a variety of foods that contribute to Sustainable Healthy Diets.



**Analyze existing food systems** to identify potential changes needed to encourage the production, processing, packaging, storage, distribution, marketing and retailing, and consumption of a diversity of foods needed for Sustainable Healthy Diets.



**Establish a representative baseline** of current diets, when needed conducting individual dietary assessment by age, gender, income, ethnic group, and geography. Use these data to identify which shifts in diet could potentially have the greatest positive impact on both health and environment.



**Ensure policy coherence** by aligning policies across all sectors (agriculture, health, education, environment, water, trade, etc.) from local to national to international level and discussing with all actors of society.



**Identify**, in any given context, **which foods are available and accessible** in terms of quantity and quality and where and why mismatches in food supply and demand exist.

# ACTIONS FOR THE IMPLEMENTATION OF SUSTAINABLE HEALTHY DIETS

In order to make Sustainable Healthy Diets available, accessible, affordable, safe and desirable, food system changes are needed and could be guided by the following actions:



**Ensure that affordable and desirable foods for a Sustainable Healthy Diet are available** and accessible for the most vulnerable. Address inequities and inequalities, and consider the perspective of people who experience poverty and deprivation.



**Promote capacity development strategies for behaviour change**, including consumer empowerment, and effective food and nutrition education.



**Quantify and balance the potential trade-offs** to make Sustainable Healthy Diets available, accessible, affordable, safe and appealing for all.



**Develop national food-based dietary guidelines** that define context-specific Sustainable Healthy Diets by taking into account the social, cultural, economic, ecological and environmental circumstances.





SUMMARY PAPERS  
FROM THE INTERNATIONAL CONSULTATION





# SUMMARY PAPER 1: Background paper on healthy diets

*Authors: Shiriki Kumanyika, Ashkan Afshin, Mary Arimond, Mark Lawrence, Sarah McNaughton and Chizuru Nishida*

## Background

A healthy diet is one which promotes growth and development, and prevents malnutrition. In the global nutrition policy sphere, the term “malnutrition” no longer refers only to undernutrition, such as wasting, stunting, underweight or deficiencies in vitamins or minerals. Malnutrition – in all its forms – is now understood to include obesity as well as dietary factors that increase the risk of non-communicable diseases (NCDs) such as heart disease, stroke, diabetes and certain cancers [1]. NCDs are now a major cause of disability and death in all countries. Obesity and undernutrition may co-exist within communities and families. A high prevalence of undernutrition is still a major public health problem in some low-income countries and may be seen in its more severe forms, whereas many middle- and high-income countries are primarily concerned with NCDs, taking dietary adequacy for granted except among the most economically disadvantaged populations.

The consultation background paper on healthy diets identified elements of such diets from a global perspective, highlighting the implications of these elements for developing and achieving goals related to the sustainability of the food system. A consensus emerged from comparison of three, complementary, evidence-based approaches to defining healthy diets, summarized below: 1) WHO recommendations for healthy diets; 2) the Global Burden of Disease NCD Risk factor study, and 3) analyses of health outcomes associated with whole dietary patterns.

## WHO recommendations

Between 1996 and 2019, WHO developed or updated more than 50 nutrition guidelines or recommendations, some of which concern population intakes of particular nutrients. Nutrition guideline development is a challenging process reflecting the inherent limitations of scientific research on the links between diet and health as well as methodological factors. The fact that people eat foods and diets rather than individual nutrients – and that diets are made up of many separate, interdependent components — complicate the ability to attribute risk to specific components of diets, and set nutrient-specific guidance. Since 2010, WHO has used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology for guideline development, and evidence on nutrition is assessed by the WHO Nutrition Guidance Expert Advisory Group (NUGAG). This methodology provides a structured framework for assessing the quality of evidence while ensuring that processes and judgements are transparent [2]. Current WHO recommendations for a healthy diet [3], based on NUGAG work to date and prior expert consultations or reports on diet and disease [4-13], are as follows:

- Exclusively breastfeed babies for the first 6 months and continue breastfeeding until 2 years and beyond.
- Energy intake should balance energy expenditure.
- Keep total fat intake to less than 30% of total energy intake, with a shift in fat consumption away from saturated fats to unsaturated fats, and towards the elimination of industrial trans fats.
- Limit intake of free sugars to less than 10 percent (or even less than 5 percent) of total energy intake.
- Keep salt intake to less than 5 g/day.
- Eat at least 400g of fruits and vegetables a day.

## Global Burden of Disease (GBD) Study

The GBD Study uses data from 195 countries and territories, as well as subnational data from 16 countries, to model health risk and outcome associations [14]. Leading GBD risk factors for NCD includes low intake of fruits, vegetables, legumes, whole grains, nuts and seeds, milk, seafood n-3 fatty acids, n-6 polyunsaturated fatty acids (PUFA), calcium and fibre; as well as high intake of red meat, processed meat, sugar-sweetened beverages, trans fatty acids, and sodium. For each dietary factor, the GBD Study quantifies what percent of each disease could have been prevented if an optimal intake of each component of diet had been achieved (where optimal is the level that minimizes mortality from all-causes). The candidate dietary risk factors were selected based on importance to either disease burden or policy; availability of sufficient data to estimate risk factor exposure; the strength of the epidemiologic evidence supporting a causal relationship between the risk factor exposure and disease endpoints; and the availability of data to quantify the effect size of the risk exposure on disease incidence or mortality from the disease endpoint. The GBD Study analyses found that, globally, the ranking of leading dietary risk factors has not changed significantly over the last three decades, and that each leading risk factor accounted for more than 20 million Disability Adjusted Life Years (DALYs). Low intake of whole grains was the leading dietary risk factor in all WHO regions other than the Western Pacific Region, where high intake of sodium was the leading risk factor for DALYs.

### Dietary pattern evidence for defining whole diets

Dietary patterns can be defined as “the quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed” [15]. Compared to separately identified foods, characteristics of foods, or nutrients as reflected in WHO guidance and GBD Study findings, dietary patterns are more authentic regarding what people eat, and theoretically more relevant to

identifying NCD risk. Separate dietary factors, even when constructed or aggregated for concurrent consideration, cannot account for the complexity of individual foods and their interdependence within dietary patterns in terms of health effects. From a *nutrient* exposure perspective, there are synergies among the nutrients present in dietary patterns [16, 17], and their bioavailability is influenced by the physical structure of the food matrices within which nutrients are found [18]. From a *food* exposure perspective, there are synergies among the foods present in dietary patterns [17], and the degree of processing of a food can influence its physical and chemical characteristics and subsequent health impact [19]. Studies of food and health relationships have consistently highlighted associations between low intakes of plant-based foods as well as high intakes of animal products and ultra-processed foods, and poor health outcomes. These findings point to plant- versus animal-based diets and degree of food processing as priority characteristics for analysing dietary patterns in the context of sustainability considerations. The WHO NUGAG review of the evidence on this issue, pending at the time of the consultation, may provide for definitive recommendations on the importance of this issue from a health outcomes perspective.

## Conclusions

Clear consensus elements emerged from consideration and comparison of these three approaches to characterizing healthy diets. The WHO recommendations, as global reference points for elements of a healthy diet, are fitting for both preventing undernutrition and NCD risk reduction. They emphasize the importance of increasing intakes of several plant foods (fruits, vegetables (excepting starchy root vegetables), legumes, nuts and whole grains); limiting the intake of energy from free sugars and total fats; consuming unsaturated rather than saturated or trans fats; and limiting intake of salt, while using salt that is iodized as a defense against iodine deficiency. The GBD Study characterization of healthy diets based on empirical analysis of risk factor-outcome associations complements and aligns with the WHO recommendations by quantifying how much diet-related risks contribute

to the NCD burden. The GBD data also point to risks associated with high consumption of processed meat. The evidence to date on dietary patterns and health suggests a need to focus on plant foods and degree of food processing, and is consistent with key elements of the WHO and GBD findings. The implied shifts toward plant foods and away from animal foods (excepting fish and seafood) and for changes in food production systems have direct relevance to the sustainability agenda.

## References

1. **WHO.** 2018. Malnutrition. Key Facts. Updated 16 February 2018. [Cited 02 October 2019]. <https://www.who.int/news-room/fact-sheets/detail/malnutrition>.
2. **WHO.** 2014. *Handbook for Guideline Development (2nd ed)*. Geneva: World Health Organization.
3. **WHO.** 2018. *Healthy diet*. Factsheet 394. [Cited 02 October 2019] [https://www.who.int/nutrition/publications/nutrientrequirements/healthydiet\\_factsheet/en/](https://www.who.int/nutrition/publications/nutrientrequirements/healthydiet_factsheet/en/)
4. **WHO.** 2015. *Guideline: Sugars intake for adults and children*. 2015. Geneva: World Health Organization. Geneva. 49pp. (also available at: [https://apps.who.int/iris/bitstream/handle/10665/149782/9789241549028\\_eng.pdf;jsessionid=BDDB1F97184D-FA1C286809B28443589E?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/149782/9789241549028_eng.pdf;jsessionid=BDDB1F97184D-FA1C286809B28443589E?sequence=1))
5. **WHO.** 2012. *Guideline: Sodium intake for adults and children*. Geneva: World Health Organization. 46pp. (also available at: <https://apps.who.int/iris/handle/10665/77985>)
6. **WHO.** 2012. 42 pp. *Guideline: Potassium intake for adults and children*. Geneva: World Health Organization. (also available at: [https://www.who.int/nutrition/publications/guidelines/potassium\\_intake/en/](https://www.who.int/nutrition/publications/guidelines/potassium_intake/en/))
7. **WHO.** 2018. *Guidelines: Saturated fatty acid and trans-fatty acid intake for adults and children*. (Draft issued for public consultation). Geneva: World Health Organization. (also available at: [https://extranet.who.int/dataform/upload/surveys/666752/files/Draft%20WHO%20SFA-TFA%20guidelines\\_04052018%20Public%20Consultation.pdf](https://extranet.who.int/dataform/upload/surveys/666752/files/Draft%20WHO%20SFA-TFA%20guidelines_04052018%20Public%20Consultation.pdf))
8. **FAO.** 2010. *Fats and fatty acids in human nutrition: Report of an expert consultation*. Food and Nutrition Paper, 91. Rome. FAO. 161 pp. (also available at: <http://www.fao.org/3/a-i1953e.pdf>)
9. **FAO.** 2004. *Human energy requirements. Report of a Joint FAO/WHO/UNU Expert Consultation*. Food and Nutrition Technical Report Series. Rome. FAO. 96 pp. (also available at: <http://www.fao.org/3/y5686e/y5686e00.htm>)
10. **FAO & WHO.** 2004. *Vitamin and mineral requirements in human nutrition: report of a joint FAO/WHO expert consultation*. Geneva. WHO. 345 pp. (also available at: <https://apps.who.int/iris/bitstream/handle/10665/42716/9241546123.pdf?sequence=1>).
11. **FAO, WHO, & UNU.** 2007. *Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition*. Technical Report Series 935. Geneva. World Health Organization. 265 pp. (also available at: <https://apps.who.int/iris/handle/10665/43411>).
12. **FAO & WHO.** 2003. *Diet, Nutrition and the Prevention of Chronic Diseases: Report of a joint WHO/FAO Expert Consultation*. Technical Report Series, 916. Geneva: World Health Organization. 155 pp. (also available at <https://www.who.int/dietphysicalactivity/publications/trs916/en/>).
13. **WHO.** 1990. *Diet, nutrition and the prevention of chronic diseases. Report of a WHO study group*. Technical Report Series 797. Geneva. 102 pp. (also available at: [https://www.who.int/nutrition/publications/obesity/WHO\\_TRS\\_797/en/](https://www.who.int/nutrition/publications/obesity/WHO_TRS_797/en/))

14. **GBD 2017 Diet Collaborators.** 2019. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*, 393(10184): 1958-1972.
15. **USDA.** 2015. *A Series of Systematic Reviews on the Relationship Between Dietary Patterns and Health Outcomes.* [online] Arlington, VA. [cited 3 October 2019]. <https://nesr.usda.gov/dietary-patterns-foods-and-nutrients-and-health-outcomes-subcommittee>
16. **Jacobs Jr, D., Tapsell, L. & Temple, N.** 2012. Food Synergy: The Key to Balancing the Nutrition Research Effort. *Public Health Reviews*, 33(2): 507-529.
17. **Jacobs, D. & Steffen, L.** 2003. Nutrients, foods, and dietary patterns as exposures in research: a framework for food synergy. *American Journal of Clinical Nutrition*, 78(suppl): 508S-513S.
18. **Fardet, A. & Rock, E.** 2019. Perspective: Reductionist Nutrition Research Has Meaning Only within the Framework of Holistic and Ethical Thinking. *Advances in Nutrition*, 9(6): 655-670.
19. **Fardet, A., Lakhssassi, S. & Briffaz, A.** 2018. Beyond nutrient-based food indices: a data mining approach to search for a quantitative holistic index reflecting the degree of food processing and including physicochemical properties. *Food & Function*, 9(1): 561-572.



# SUMMARY PAPER 2:

## The role of healthy diets in creating environmentally sustainable food systems

*Authors: Michael Clark, Jennie Macdiarmid, Andrew D. Jones, Janet Ranganathan, Mario Herrero and Jessica Fanzo*

The global food system needs to support over 7.5 billion individuals, but it is currently a major source of poor health and environmental degradation. Diet-related non-communicable diseases (NCDs), such as diabetes, heart disease, some cancers, and obesity, are the leading risk factor for mortality globally, while over 800 million individuals remain undernourished and about 2 billion suffer from micronutrient deficiencies [1, 2]. At the same time, global food systems emit 20-35 percent of global greenhouse gas (GHG) emissions, occupies ~40 percent of the Earth's ice-free land area, results in terrestrial and aquatic nutrient pollution from excess fertilizer application, and is the largest driver of biodiversity loss [3-5]. Changing the global food system is necessary to achieve the Sustainable Development Goals (SDGs), the Paris Climate Agreement, the Convention on Biological Diversity Aichi Conservation Targets, as well as other international sustainability targets, thereby emphasizing the need for a transition to more environmentally sustainable and healthier diets [6].

The environmental and health impacts of the global food system will increase in the future if historic trends in dietary choices and population growth continue [7]. As populations become more affluent and urbanized, they demand more food, particularly more meat, fish, dairy, eggs, sugar, fats, and oils [8]. This dietary transition is associated with increased risk of diet-related diseases, while the animal source foods have higher environmental impacts per calorie or grams of food produced than do most plant-based foods. In addition, projected population growth of 2 billion people by 2050, most of which is likely to occur in currently low- and middle-income countries, will further increase diet-related environmental pressure.

Future increases in diet-related health problems and environmental impacts are projected to occur at different rates in different countries [6, 9]. Higher

income countries are projected to experience relatively small changes but their dietary habits will still add to the high risk of diet-related diseases and environmental impacts. In contrast, low- and middle-income countries – such as most of those in South and Southeast Asia, sub-Saharan Africa, and many in Central and South America – are currently or projected to experience comparatively rapid dietary transitions toward diets in high income countries that are high in calories, fats, sugars and animal products. This is driving increases in diet-related NCDs and negative environmental impacts. However, while per capita diet-related impacts are projected to increase more in low- and middle-income countries, they are likely to remain lower than those in higher-income countries. It is in high income countries where the greatest dietary changes are needed to reduce the environmental pressure.

There are several potential ways to slow, and possibly reverse, the projected increases in diet-related NCDs and environmental pressure [10]. In the short-term, the key is to identify the 'win-wins', thereby avoiding unintended consequences because it cannot be assumed that a healthy diet will have a low environmental impact or that an environmentally sustainable diet will be healthy [11]. Foremost among these is a transition to diets that contain a smaller proportion of calories from animal source foods, and particularly ruminant meat (e.g. cows, goats, and sheep) and to diets where caloric consumption is sufficient to meet metabolic requirements. In many countries this means reducing calorie intakes, but may also require increases in calorie intakes in some lower-income countries. Many studies have shown that reducing meat consumption can reduce GHGs while remaining nutritionally adequate (e.g. refs [9, 10, 12]). For example, global adoption of a low-meat diet that meets nutritional recommendations for fruits, vegetables, and caloric requirements is estimated to reduce diet-related GHGs by nearly

50 percent, and premature mortality by nearly 20 percent. In addition to dietary changes, other changes to the food system could further reduce its environmental impact, including reductions in food loss and waste; technology implementation and changes in management to improve crop yields and reduce fertilizer and pesticide runoff; and changes in food formulation, processing, and preparation.

The benefits of adopting environmentally sustainable and healthy diets will vary by country, as will the ways that these benefits will be realized [10]. To highlight the potential benefits of, and barriers to, adopting healthier and more environmentally sustainable diets, we selected four countries as case studies (Brazil, Vietnam, Kenya, and Sweden) that vary in their cultural, economic, political, and social values. In Brazil, beef, soy, and sugar are major agricultural and export commodities, yet increasing production of these is driving habitat and biodiversity loss, particularly in the Atlantic Forest, cerrado, and Brazilian Amazon. How could healthier and more environmentally sustainable diets be adopted while maintaining economic stability of the agricultural sector? In Vietnam, fish are an important source of nutrition and economic security, but the sustainability of Vietnam's fisheries is threatened by historic overharvesting and proposed dam construction. How can environmental sustainability of Vietnam's fisheries be improved, and what is the potential role of aquaculture in Vietnam's future food system? In Kenya, cows and other ruminants are an integral source of nutrition, food, and economic security especially in rural communities, but are also a major driver of environmental damage. How can cows that are culturally and economically important be maintained while simultaneously reducing their impact on the environment? In Sweden, per capita diet-related environmental impacts are high and dietary habits are major risk factors for poor health. How could diets in Sweden change to become healthier and more sustainable in a culturally appropriate way?

Shifting dietary habits, however, presents a significant challenge for cultural, political and economic reasons, and will require actions from governments, businesses, and individuals that go beyond information and education programmes

[13]. This will include interventions to change the supply and demand, not least shifting social norms away from meat-based diets. There is no "silver bullet" solution to create a sustainable food system. Instead, many changes across multiple sectors of the food system are needed [10]. This will require a series of coordinated approaches tailored to the social, political, economic, and cultural values of countries, communities and sensitive to current dietary habits.

## References

1. **FAO, IFAD, UNICEF, WFP & WHO.** 2019. *The State of Food Security and Nutrition in the World: Safeguarding Against Economic Slowdowns and Downturns*. Rome, FAO. 195 pp.(also available at: 195. <http://www.fao.org/3/ca5162en/ca5162en.pdf>).
2. **GBD risk factor collaborators.** 2015. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990 – 2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*, 386:2287–1323.
3. **Foley, J.A., Ramankutty, N., Brauman, K.A., et al.** 2011. Solutions for a cultivated planet. *Nature*, 478(7369): 337–342.
4. **Rogelj, J., Shindell D., Jiang, K., et al.** 2018. Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change. In Press.
5. **Vermeulen, S., Campbell, B. M. & Ingram, J. S. I.** 2012. Climate change and food systems, *Annual Reviews of Environment and Resources*, 37, 195–222. (also available at: [doi:10.1146/annurev-environ-020411-130608](https://doi.org/10.1146/annurev-environ-020411-130608)).



6. **Springmann, M., Clark, M., Mason-D’Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., de Vries W., et al.** 2018. Options for keeping the food system within environmental limits. *Nature*, 562(7728):519-525.
7. **Tilman, D. & Clark, M.** 2014. Global diets link environmental sustainability and human health. *Nature*, 515:518–522.
8. **Popkin, B.M.** 1994 The nutrition transition in low-income countries: an emerging crisis. *Nutrition Reviews* 52(9):285–298.
9. **Springmann, M., Wiebe, K., Mason-D’Croz, D., Sulser, T.B., Rayner, M. & Scarborough, P.** 2018. Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *Lancet Planet Health*, 2(10):e451–e461.
10. **Willett, W., Rockström, J, Loken, B., Springmann, M., Lang, T., et al.** 2019. Food in the Anthropocene: the EAT – Lancet Commission on healthy diets from sustainable food systems. *Lancet*, 393(10170):447-492.
11. **Macdiarmid, J.I.** 2013. Is a healthy diet an environmentally sustainable diet? *Proceedings of the Nutrition Society*,72:13–20.
12. **Macdiarmid, J.I., Kyle, J., Horgan, G.W., Loe, J., Fyfe, C., Johnstone, A. & McNeill G.** 2012. Sustainable diets for the future: can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *The American Journal of Clinical Nutrition*, 96(2):632–639.
13. **Ranganathan, J., Vennard, D., Waite, R., Dumas, P., Lipinski, B. & Searchinger, T.** 2016. *Shifting Diets for a Sustainable Food Future*. Working Paper. Installment 5. Creating a Sustainable Food Future. Washington, DC. 9 p. (also available at: <http://ebrary.ifpri.org/utills/getfile/collection/p15738coll2/id/130216/filename/130427.pdf>).





# SUMMARY PAPER 3: The role of culture, economics, and food environment in shaping choices for sustainable diets

*Authors: Eva Monterrosa, Adam Drewnowski, Saskia de Pee,  
Edward A. Frongillo and Stefanie Vandevijvere*

## Introduction

Dietary patterns across the world have seen a rapid shift from plant-based diets to diets with a higher proportion of energy from animal-source foods, added sugars and fats [1], and other foods of high energy density and minimal nutritional value [2]. Shaping consumer food choices towards more sustainable healthy diets requires a coherent policy package that will take behaviours, economics and food environment issues into account. We examine how the personal food system, sociocultural factors, cost and affordability, and the food environment influence food patterns.

## The personal food system

Individuals decide on multiple food choices each day. These choices are influenced by many factors, including genes, learned experiences with food, and the broader physical, social and cultural environment [3]. The decision-making process may involve value judgments and deliberate choices as well as rules and routines that are closely linked to food behaviours [4]. The personal food system interacts with, and is influenced by, sociocultural factors, food cost and affordability, and the food environment.

## Sociocultural aspect of food patterns and food choice

Sociocultural aspects of food include both physical world and cognitive elements that shape food patterns [5]. Cognitive elements refer to symbols, meanings, values, and expressions of personal and social identity. Food choice values refer to a range of aspects, from a food's attributes, food procurement or food preparation, to goals related to how we live and interact with others. Food choice values are culturally useful because they help individuals and groups negotiate and simplify choice. Sociocultural

aspects of food choice are analysed in detail by the food industry but are underused in policymaking. Ethnographic surveys and various classification tools can be used to broadly define food cultures, and identify shared practices and food choice values. Connecting food practices and values with symbols and narratives can encourage new norms for how we grow, procure and enjoy our food.

Other sociocultural factors that influence food choice are gender, religion and food prohibitions [6]. Gender expresses many of the cognitive elements and food practice norms, such as food selection and food access [7]. Food production, acquisition, preparation, cooking and disposal are gender-specific tasks. Food also serves important functions in religious practice, and religion defines food practices through various rules, symbols and meanings. Cultural prohibitions towards foods may apply to individuals based on their age, sex or social position, and there is significant intra-cultural diversity with regards to the food prohibitions. Analysis of potential policy options should consider discrimination based on religion or gender, especially in deployment of taxes or other restrictive measures on animal-source foods.

## Cost and affordability

Sociocultural aspects of food choice notwithstanding, people generally eat what they can afford. Affordability is a relative concept that encompasses the market price of a food in relation to other household expenses and household income. Other costs that merit consideration are the food preparer's time and effort and cost of fuel and water [8]. Nutritious foods are more expensive than energy-dense foods. This relationship holds in both high-income and low- and middle-income countries, and poverty constrains access to healthy foods. Insofar as 'easy to cook' foods reduce effort or save water or fuel, affordability and convenience

remain important considerations in economic access to nutritious foods by low-income groups worldwide.

There are different ways to estimate the affordability of individual foods or that of the total diet. Food expenditure data can be used to estimate the projected cost of more nutritionally adequate or more diverse diets, adjusted to 2000 kcal, for comparisons across diverse groups. There are also linear modelling methods to estimate the lowest cost of a nutritious diet for a household with different members (e.g. breastfed child, lactating mother, adult man, school-age child and adolescent girl) [9]. The Affordable Nutrition Index can be used to identify foods that provide high nutrient density at an affordable cost [8]. These modelling tools also model strategies to close nutrient gaps [11]. Strategies to improve the affordability of nutritious foods and diets include biofortification of cereals and legumes [12] or fortification of cereal flours, rice, salt and/or oil to enhance the staple-food nutrient supply [13]. Furthermore, initiatives that increase production and availability, including reducing post-harvest loss, improving transport to market, can increase farmer income and reduce retail prices [14]. Transfers of cash or food vouchers can also help equalize market access to nutrition among income classes [15, 16].

## Food environments

Food environments [17] are places where food is acquired or consumed. As such, the food environment represents the nexus of interactions between the individual and those aspects of the food system that are related to food production, processing, transportation and retail, and food disposal and waste. In the last 40 years, we have witnessed a dramatic change in food environments to one that supplies higher food energy (calories) and offers more out-of-home eating options. The food environment structure further accentuates the socio-economic inequality in access to nutritious foods. Low purchasing power of low-income neighbourhoods means that most foods offered [18] and advertised [19] are low-cost, energy-dense foods of minimal nutritional value. Food placement and prominence in retail settings also influence food purchases [20] and sales [21].

Governments play a key role in shaping food environments. A comprehensive strategy is required to improve the healthiness of food offerings [22]. The policy options for guiding or restricting consumer choice range from menu labelling, front-of-pack labels [23], to marketing restrictions [24, 25] and ultimately sale restrictions [25]. Some appear to be more effective at curbing choices for energy-dense foods, but it is still unclear how to best guide consumer choice.

## Platforms to support policy action

The policy process consists of analysis, decision-making, implementation and monitoring. In recent years, two platforms have emerged to assist policy makers with comprehensive assessments and decision-making for nutrition (World Food Programme - Fill the Nutrient Gap) and food environments (International Network for Food and Obesity/noncommunicable diseases (NCDs) Research, Monitoring and Action Support - INFORMAS). The Fill the Nutrient Gap deploys a nutrition situation analysis to identify and prioritize strategies to increase availability, affordability and choice of nutritious foods [26]. The INFORMAS approach assesses the implementation of food environment policies compared to international best practice to derive concrete priority actions to strengthen implementation [22].

## Summary and Conclusions

Although a multitude of factors influence dietary patterns, there are many tools and strategies to support analysis, prioritization of solutions, and evidence-informed decision-making. In the sociocultural domain, we suggest ethnographic modules in national food surveys to characterize cognitive elements of food culture by subgroups. These data can inform campaigns for shifting norms and making foods more desirable and enjoyable. In the affordability domain, various analyses and metrics can identify which foods are both nutritious and affordable, as well as assist in identifying strategies to improve access to affordable, nutritious choices. In the food environment domain, policy actors can deploy various instruments that guide and support choices for sustainable healthy diets. Long-term monitoring of the impacts of these actions is

needed. Most critically, cross-sector collaboration among businesses, policy makers, citizens, and academics is needed to shift food patterns and food choices towards health and sustainability.

## References

1. **Drewnowski, A. & Popkin, B.M.** 1997. The nutrition transition: new trends in the global diet. *Nutrition reviews*, 55(2):31-43.
2. **Haddad, L., Hawkes, C., Waage, J., Webb, P., Godfra, C. & Toulmin C.** 2016. *Food systems and diets: Facing the challenges of the 21st century*. London. Global Panel on Agriculture and Food Systems for Nutrition. (also available at: <http://www.ifpri.org/publication/food-systems-and-diets-facing-challenges-21st-century>).
3. **Contento, I.** 2011. Overview of determinants of food choice and dietary change: Implications for nutrition education. In *Nutrition Education: Linking Research, Theory and Practice, 2nd ed.* pp 176-179. Sudbury, MA. Jones & Bartlett Learning.
4. **Sobal, J & Bisogni, C.A.** 2009. Constructing food choice decisions. *Annals of Behavioral Medicine*, 38(suppl\_1):s37-s46.
5. **Garine, I.** 1972. The socio-cultural aspects of nutrition. *Ecology of Food and Nutrition*, 1(2):143-163.
6. **Fieldhouse, P.** 1995. *Food and Nutrition: Customs and Culture. Second Edition*. London. Chapman & Hall.
7. **Gittelsohn, J.** 1991. Opening the box: Intra-household food allocation in rural Nepal. *Social Science & Medicine*, 33(10):1141-1154. (also available at: [https://doi.org/10.1016/0277-9536\(91\)90230-A](https://doi.org/10.1016/0277-9536(91)90230-A)).
8. **Collins, S.M., Owuor, P.M., Miller, J.D., Boateng, G.O., Wekesa, P., Onono, M. & Young, S.L.** 2019. I know how stressful it is to lack water! Exploring the lived experiences of household water insecurity among pregnant and postpartum women in western Kenya. *Global Public Health*, 14(5):649-662. (also available at: <https://doi.org/10.1080/17441692.2018.1521861>).
9. **Deptford, A., Allieri, T., Childs, R., Damu, C., Ferguson, E., Hilton, J., Parham, P., et al.** 2017. Cost of the Diet: a method and software to calculate the lowest cost of meeting recommended intakes of energy and nutrients from local foods. *BMC Nutrition*, 3(1):26.
10. **Drewnowski, A.** 2010. The Nutrient Rich Foods Index helps to identify healthy, affordable foods. *The American Journal of Clinical Nutrition*, 91(4):1095S-1101S. (also available at: <https://doi.org/10.3945/ajcn.2010.28450D>).
11. **Baldi, G., Martini, E., Catharina, M., Muslimatun, S., Fahmida, U., Jahari, A.B., Frega, R., et al.** 2013. Cost of the Diet (CoD) tool: first results from Indonesia and applications for policy discussion on food and nutrition security. *Food and Nutrition Bulletin*, 34(2 Suppl):S35-42. (also available at: <https://doi.org/10.1177/15648265130342S105>).
12. **Bouis, H.E., Hotz, C., McClafferty, B., Meenakshi, J. & Pfeiffer, W.H.** 2011. Biofortification: a new tool to reduce micronutrient malnutrition. *Food and Nutrition Bulletin*, 32(1\_suppl1):S31-S40.
13. **Horton, S.** 2006. The Economics of Food Fortification. *Journal of Nutrition*, 136(4):1068-1071. (also available at: <https://doi.org/10.1093/jn/136.4.1068>).
14. **WFP.** 2017. *Counting the Beans - The True Cost of Food around the World*. Rome. World Food Programme. (also available at: <https://www.wfp.org/publications/2017-counting-beans-true-cost-plate-food-around-world>).
15. **Yen, S.T.** 2010. The effects of SNAP and WIC programs on nutrient intakes of children. *Food Policy*, 35(6):576-583. (also available at: <https://doi.org/10.1016/j.foodpol.2010.05.010>).
16. **Hidrobo, M., Hoddinott, J., Peterman, A., Margolies, A. & Moreira, V.** 2014. Cash, food, or vouchers? Evidence from a randomized experiment in northern Ecuador. *Journal of Development Economics*, 107:144-156. (also available at: <https://doi.org/10.1016/j.jdeveco.2013.11.009>).

17. **Turner, C., Aggarwal, A., Walls, H., Herforth, A., Drewnowski, A., Coates, J., Kalamatianou, S., et al.** 2018. Concepts and critical perspectives for food environment research: A global framework with implications for action in low- and middle-income countries. *Global Food Security*, 18:93-101. (also available at: <https://doi.org/10.1016/j.gfs.2018.08.003>).
18. **Hilmers, A., Hilmers, D.C. & Dave, J.** 2012. Neighborhood disparities in access to healthy foods and their effects on environmental justice. *American Journal of Public Health*, 102(9):1644-1654. (also available at: <https://doi.org/10.2105/AJPH.2012.300865>).
19. **Powell, L.M., Wada, R. & Kumanyika, S.K.** 2014. Racial/Ethnic and Income Disparities in Child and Adolescent Exposure to Food and Beverage Television Ads across U.S. Media Markets. *Health Place*, 29:124-131. (also available at: <https://doi.org/10.1016/j.healthplace.2014.06.006>).
20. **Glanz, K., Bader, M.D.M. & Iyer, S.** 2012. Retail grocery store marketing strategies and obesity: an integrative review. *The American Journal of Preventive Medicine*, 42(5):503-512. (also available at <https://doi.org/10.1016/j.amepre.2012.01.013>).
21. **Curhan, R.C.** 1972. The Relationship between Shelf Space and Unit Sales in Supermarkets. *Journal of Marketing Research*, 9(4):406-412. (also available at: <https://doi.org/10.1177/002224377200900408>).
22. **Swinburn, B., Vandevijvere, S., Kraak, V., Sacks, G., Snowdon, W., Hawkes, C., Barquera, S., et al.** 2013. Monitoring and benchmarking government policies and actions to improve the healthiness of food environments: a proposed Government Healthy Food Environment Policy Index. *Obesity Reviews*, 14 Suppl 1:24-37. (also available at: <https://doi.org/10.1111/obr.12073>).
23. **Kanter, R., Vanderlee, L. & Vandevijvere S.** 2018. Front-of-package nutrition labelling policy: global progress and future directions. *Public Health Nutrition*, 21(08):1399-1408. (also available at: <https://doi.org/10.1017/S1368980018000010>).
24. **Smith, R., Kelly, B., Yeatman, H. & Boyland, E.** 2019. Food Marketing Influences Children's Attitudes, Preferences and Consumption: A Systematic Critical Review. *Nutrients*, 11(4):875.
25. **Corvalán, C., Reyes, M., Garmendia, M.L. & Uauy, R.** 2019. Structural responses to the obesity and non-communicable diseases epidemic: Update on the Chilean law of food labelling and advertising. *Obesity Reviews*, 20(3):367-374. (also available at: <https://doi.org/10.1111/obr.12802>).
26. **Bose, I., Baldi, G., Kiess, L. & de Pee, S.** 2019 The "Fill the Nutrient Gap" analysis: An approach to strengthen nutrition situation analysis and decision making towards multisectoral policies and systems change. *Maternal & Child Nutrition*, 15(3):e12793.

# SUMMARY PAPER 4: Territorial Diets

*Authors: Fatima Hachem, Davy Vanham and Luis Moreno*

Territorial diets have become linked to specific geographies, despite the fact that they have over time integrated other influences through the movement of people and cultural and material goods, including foods. While keeping a certain degree of constancy harmonious with the cultural, social, economic and environmental local contexts, territorial diets are linked not only to the biophysical resources (soils, microclimates, landscape) that characterize agriculture and the economy, but also to particular ecologies, historical contexts, and cultural and social resources including institutions, organizations, knowledge and traditional practices.

The Japanese Diet (JD), the Mediterranean Diet (MD), the Traditional Nordic Diet and the New Nordic Diet (NND) are such territorial diets. Some of these diets, such as the MD, have risen to fame because of their associated health benefits, and continue to raise interest – especially in light of the growing challenge of malnutrition in all its forms (undernutrition, micronutrient deficiencies and overweight and obesity).

In addition to their health imparting characteristics, diets have a pivotal role in supporting the transition towards more sustainable agriculture and food systems. However, few diets have been assessed for their double duty actions, i.e. their contribution to the health of people as well as the environment.

The MD and the NND are plant-based diet, with little to moderate amounts of animal-sourced foods. The former is characterized by an abundance of vegetables, fruits, nuts, legumes, seeds and fish, with liberal use of olive oil, a moderate amount of dairy foods, and a low amount of red meat; the latter is characterized by a high content of local fruits and vegetables (especially berries, cabbages, root vegetables and legumes), fresh herbs, potatoes, plants and mushrooms from the regional wild countryside, whole grains, nuts, (native) fish and

shellfish, seaweed, free-range livestock (including pigs and poultry) and game.

The positive health outcomes associated with the MD were identified in the early 1960s, when researchers showed the protective effects against coronary heart disease of diets eaten in Southern Europe. Since then, a huge body of research has supported the beneficial effects of this dietary pattern. Strong scientific evidence showing the association of the MD with a significant reduction in total mortality, mortality from cardiovascular disease and cancer, and a lowered cancer risk has led to this dietary pattern being promoted in regions and dietary guidelines of countries far from its geographic origins.

The NND was launched in 2005. As a young diet, evidence on its health benefits is less abundant than the MD. However, there is substantial and well established evidence on the health benefits of its dietary components. Recent investigations into the associations between the NND and health outcomes show an inverse relationship with several cardiovascular risk factors, abdominal obesity, body fat, inflammatory markers and serum lipids, colorectal cancer risks and total mortality.

Adherence to both diets has been associated with lower environmental pressures and impacts in comparison to other healthy diets containing meat. In 13 Mediterranean cities, adherence to the MD has shown reductions in water footprints of 19-43 percent compared to the current diets in these cities. In Spain, adherence to the MD was also shown to reduce greenhouse gas emissions (72 percent), land use (58 percent), energy consumption (52 percent) and water consumption (33 percent). In Denmark, the NND was compared to the Average Danish Diet against 16 environmental impact categories, and was found to reduce the environmental impact in all of them.

Diets are, however, more than the sum of foods consumed or the dietary patterns associated with them. They are a way of life that shapes and is shaped by local social, cultural and economic contexts. Such aspects are important pillars of the concept of sustainability. The fast paced uptake of the NND by different Nordic countries is a testimony to how identity and culture have been key in accelerating the adoption of a constructed diet by a wide portion of the population. On the other hand, the MD is a way of life whose origins are lost in history, and embodies more than the nutritional benefits of the diet. As UNESCO highlighted when adding the MD to its list of intangible cultural heritage of humanity in 2010, it is “a set of skills, knowledge, practices and traditions from landscape to table, including crops, harvesting, fishing, conservation, processing, preparation and, in particular, food consumption”. Yet these dimensions are often overlooked in the debate on sustainability.

Adherence to diets with beneficial health and environmental impacts is challenging. Evidence has accumulated on the drift away from the MD, especially among youth, in the countries of the Mediterranean region. Different scores have been developed to assess the adherence to the MD; they all show a decline in adherence in most countries but differ in quantifying the scale and extent of this decline based on the methodology used. Recently, a study assessed the time trends of adherence to the MD over the last 50 years in 41 selected countries. The downward trend was confirmed, but it was also revealed that adherence to the MD is better in some countries than others. There are different drivers responsible for such a trend which could be summarized as the increase in urbanization; the globalization of agricultural markets; the increase in incomes; the penetration of supermarkets; the change in family structures; and the development of mass food culture. All these factors are changing the way people eat at a faster rate than has been known for centuries, and their impact differs in different countries.

In the search for diets that are healthy for both humans and the environment, the road has not always been easy. Trade-offs are necessary but this becomes more complex when diets are to be,

in addition, culturally, socially and economically sustainable. Learning from a constructed diet like the NND and an evolving diet like the MD, these dimensions cannot be overlooked.

Tools for assessing these territorial diets that take into account all these dimensions are needed so that policy-makers are able to weigh the impact of policies on the different aspects of sustainability (health, environment, culture, economy, society), as well as to assess any trade-offs and ensure policy coherence.

Data on all dimensions of sustainability and context specific indicators are also needed to make the tools relevant. These need to go beyond the production and agriculture sector and be consumer sensitive. It is important to understand the drivers of consumer food choices, and how these are shaped.

Given the different ways of understanding the sustainability of diets in the different sectors, there is a need to communicate and agree on definitions among stakeholders. The territorial approach lends itself well to such a communication need as it can offer entry points of relevance to different sectors.

Finally, policy makers and consumers can benefit from having their national food-based dietary guidelines (FBDGs) based on territorial diets and by involving the productive and environmental sectors and social actors in the process of developing them.

## References

1. **Germani, A., Vitiello, V., Giusti, A.M., Pinto, A., Donini, L.M. & del Balzo, V.** 2014. Environmental and economic sustainability of the Mediterranean Diet. *International Journal of Food Sciences and Nutrition*, 65(8): 1008–1012. (also available at: <https://doi.org/10.3109/09637486.2014.945152>).
2. **Hachem, F., Capone, R., Yannakoulia, M., Dernini, S., Hwalla, N. & Kalaitzidis, C.** 2016. The Mediterranean diet: A sustainable consumption pattern. In *Mediterra*. FAO/ CIHEAM/ Presses de Sciences Po (PFNSP), Paris, France, pp.243-261. (also available at: [https://www.ciheam.org/uploads/attachments/449/10\\_Mediterra2016\\_EN.pdf](https://www.ciheam.org/uploads/attachments/449/10_Mediterra2016_EN.pdf)).



3. **Mithril, C., Dragsted, L.O., Meyer, C., Tetens, I., Biloft-Jensen, A. & Astrup, A.** 2012. Dietary composition and nutrient content of the New Nordic Diet. *Public Health Nutrition*, 16(5): 777–785. (also available at: <https://doi.org/10.1017/S1368980012004521>).
4. **Poulsen, S.K., Due, A., Jordy, A.B., Kiens, B., Stark, K.D., Stender, S., Holst, C., Astrup, A. & Larsen, T.M.** 2014. Health effect of the New Nordic Diet in adults with increased waist circumference: a 6-mo randomized controlled trial. *The American Journal of Clinical Nutrition*, 99(1): 35–45. (also available at: <https://doi.org/10.3945/ajcn.113.069393>).
5. **Sáez-Almendros, S., Obrador, B., Bach-Faig, A. & Serra-Majem, L.** 2013. Environmental footprints of Mediterranean versus Western dietary patterns: beyond the health benefits of the Mediterranean diet. *Environmental Health*, 12(1): 118. (also available at: <https://doi.org/10.1186/1476-069x-12-118>).
6. **Saxe, H.** 2014. The New Nordic Diet is an effective tool in environmental protection: it reduces the associated socioeconomic cost of diets. *The American Journal of Clinical Nutrition*, 99(5): 1117–1125. (also available at <http://dx.doi.org/10.3945/ajcn.113.066746>).
7. **Sofi, F., Abbate, R., Gensini, G.F. & Casini, A.** 2010. Accruing Evidence on Benefits of Adherence to the Mediterranean Diet on Health: An Updated Systematic Review and Meta-analysis. *The American Journal of Clinical Nutrition*, 92 (5), 1189-1196.
8. **Springmann, M., Clark, M., Mason-D’Croze, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., de Vries, W., et al.** 2018. Options for keeping the food system within environmental limits. *Nature*, 562(7728): 519–525. (also available at: <https://doi.org/10.1038/s41586-018-0594-0>).
9. **Trichopoulou, A., Costacou, T., Bamia, C. & Trichopoulos, D.** 2003. Adherence to a Mediterranean Diet and Survival in a Greek Population. *New England Journal of Medicine*, 348(26):2599-2608. (also available at: <https://doi.org/10.1056/NEJMoa025039>).
10. **Vanham, D., Gawlik, B.M. & Bidoglio, G.** 2017. Food consumption and related water resources in Nordic cities. *Ecological Indicators*, 74: 119–129. (also available at: <https://doi.org/http://dx.doi.org/10.1016/j.ecolind.2016.11.019>).
11. **Vanham, D., del Pozo, S., Pekcan, A.G., Keinan-Boker, L., Trichopoulou, A. & Gawlik, B.M.** 2016. Water consumption related to different diets in Mediterranean cities. *Science of The Total Environment*, 573: 96–105. (also available at: <https://doi.org/http://dx.doi.org/10.1016/j.scitotenv.2016.08.111>).
12. **Vilarnau, C., Stracker, D.M., Funtikov, A., da Silva, R., Estruch, R. & Bach-Faig, A.** 2019. Worldwide adherence to Mediterranean Diet between 1960 and 2011. *European Journal of Clinical Nutrition*, 72(Suppl 1):83-91. (also available at <https://doi.org/10.1038/s41430-018-0313-9>).



# SUMMARY PAPER 5:

## Background paper on food safety

*Authors: Sara Monteiro Pires, Maarten Nauta, Morten Poulsen, Lea S. Jakobsen and Sofie Thomsen*

Calls for action to meet international sustainable development targets have highlighted the need to modify food systems globally. This paper explores the food safety dimensions of transitions towards food systems that promote sustainable and healthy diets.

### The global burden of disease due to contaminated foods

Contaminated foods are known to cause more than 200 acute and chronic diseases. Foodborne hazards include microbiological agents such as bacteria, virus, fungi or parasites, and chemicals that can originate from pollution, from processing or packaging of foods, or occur as naturally occurring toxins. Foodborne outbreaks and large contamination events that have economic implications are highly visible. However, these contribute to a small fraction of the largely unrecognized and underreported true burden of foodborne diseases. Estimates by WHO showed that, in 2010, 31 hazards in foods resulted in 600 million cases of illnesses and 420,000 deaths [1]<sup>13</sup>. These foodborne diseases (FBD) led to an estimated loss of 33 million years of healthy life globally, demonstrating that the global burden of FBD is of the same order of magnitude as major infectious diseases such as HIV/AIDS, malaria, and tuberculosis [2]. Children under 5 years of age carried 40 percent of the total global burden, but represent only 9 percent of the world population. People living in developing regions and in the poorest areas of the world were also disproportionately affected,

bearing over 70 percent of the global burden. Africa and South-East Asia had the highest incidence and mortality of foodborne illnesses across all ages.

### Healthy diets and food safety

Foods that are responsible for important food safety problems are also crucial to ensure food security in some regions, and are essential sources of nutrition. Animal source foods such as dairy, eggs and meat accounted for approximately 35 percent of the burden of foodborne disease due to all foods globally [3], but these are also important sources of high-quality nutrients, particularly in some regions, where nutritional deficiency in children can result in stunting, anaemia, or poor cognitive and motor development. Staple foods in low-income regions such as grains and nuts, fish, seafood and vegetables contribute to the disease burden of pathogens and chemicals in foods [4,5]. At the same time, an increasing number of illnesses and wide-impact outbreaks associated with fruit and vegetables have been registered in recent years [6–8]. These food groups are all important components of healthy diets, and consumers are encouraged to increase their consumption to help protect against malnutrition and non-communicable diseases.

Assessing both adverse and beneficial health consequences of food consumption is crucial to define interventions for improving health of populations. Fish consumption is a classic example of a food for which public health policy needs to consider both adverse and beneficial health effects. Several studies have assessed its overall public health impact, taking into account the beneficial effects of omega-3 fatty acids on early brain development and cardiovascular health, as well as the adverse effect of heavy metals and persistent environmental pollutants [9]. Other studied foods include nuts, which are rich in beneficial fats but can also be contaminated with carcinogenic toxins (aflatoxins)

---

<sup>13</sup> The WHO's Foodborne Disease Burden Epidemiology Reference Group estimated the global and regional burden of 31 foodborne hazards, using 2010 as a reference year. Chemical contaminants assessed were a shortlist of a range of chemicals and toxins that were considered of potential relevance. Since estimates were published, new studies have complemented with evidence on the health impacts of more hazards.

[10]; and red meat, which is a source of minerals and vitamins, but has been linked with increased risk of cancer [11]. While the trade-off between risks and benefits of some foods have been assessed in several high income countries, such evaluations are missing in low and middle income countries (LMIC), where food contamination may be higher, food availability lower, and the balance between food safety and food security more difficult to achieve. This dilemma is well illustrated by the nutritious root vegetable cassava, which is a staple food particularly in sub-Saharan Africa, but which, when not processed correctly, can lead to exposure to toxic levels of cyanide [12].

### **Climate change and food safety**

Climate change has inevitable effects on the safety of food systems. Average air and sea temperature rises and variation in precipitation can lead to increased levels of bacteria, viruses, or parasites in water and food, and promote proliferation of toxin-producing fungi in different crops. Food safety implications may be particularly relevant in fresh fruit and vegetables and in fish, either due to higher rates of microbial growth, or due to increased use of agrochemicals to balance the effects of extreme weather events and water scarcity in some regions [13]. These risks highlight the need for interventions that reduce the environmental footprint, including in food systems.

### **Affordability and accessibility of food and food safety**

In LMIC, which bear the largest proportion of the burden of foodborne diseases, food security will often be the first priority, and it is unlikely that communities discard potentially contaminated foods, even if they may be unfit for human consumption [14]. Training and education of those working in all steps of the production chain, as well as consumer awareness, have the potential to reduce the burden of foodborne diseases. Setting and enforcement of food safety standards in raw materials will also mitigate exposure to contaminants.

### **Territorial diets and food safety**

The regional variability of food consumption habits and practices is interlinked with food availability, traditions, and socio-economic transitions that influence population's diets. The health benefits of adhering to specific territorial diets, namely the Mediterranean Diet and the New Nordic Diet, are well established [15]. While they represent the dietary patterns of a small proportion of the global population, some of the basic principles that shape these diets – preference for local and seasonal foods, daily consumption of vegetables, fruits, whole grains and healthy fats – can apply to dietary patterns that are adapted to other territories and cultures. These principles are expected to lead to benefits in terms of improved sustainability and nutrition, but food safety implications have thus far not been well studied. A shift towards such dietary patterns may lead to increased exposure to foodborne hazards. Specifically, increased consumption of vegetables can lead to increased exposure to pesticides and heavy metals, or to pathogens if eaten raw; increased consumption of nuts can lead to increased exposure to mycotoxins; increased consumption of fish can lead to higher exposure to methylmercury and other pollutants; among others.

### **Transitions towards sustainable and healthy diets and food safety**

Dietary changes towards healthier diets can reduce the environmental impacts of the food system. The evidence compiled so far points to the combined health and environmental benefits of shifting towards a more plant-based diet, including vegetables and fruits, nuts, pulses and whole grains. As a shift towards more plant-based diets may also lead to higher exposures to chemicals present in these foods, an evaluation of food safety implications of such transitions is now imperative.

## References

1. **WHO.** 2015. *WHO estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015*. Geneva:WHO (also available at: [https://www.who.int/foodsafety/publications/foodborne\\_disease/fergreport/en/](https://www.who.int/foodsafety/publications/foodborne_disease/fergreport/en/)).
2. **Havelaar, A.H., Kirk, M.D., Torgerson, P.R., Gibb, H.J., Hald, T., Lake, R.J., et al.** 2015. World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. *PLoS Medicine*, 12(12): e1001923. (also available at: <https://doi.org/10.1371/journal.pmed.1001923>).
3. **Li, M., Havelaar, A.H., Hoffmann, S., Hald, T., Kirk, M.D., Torgerson, P.R. & Devleesschauwer, B.** 2019. Global disease burden of pathogens in animal source foods. *PLoS One*, 14(6): e0216545.
4. **Carrington, C., Devleesschauwer, B., Gibb, H.J. & Bolger, P.M.** 2019. Global burden of intellectual disability resulting from dietary exposure to lead, 2015. *Environmental Research*, 172: 420–429.
5. **Zang, Y., Devleesschauwer, B., Bolger, P.M., Goodman, E. & Gibb, H.J.** 2018. Global burden of late-stage chronic kidney disease resulting from dietary exposure to cadmium, 2015. *Environmental Research*, 169:72-78
6. **Callejón, R.M., Rodríguez-Naranjo, I., Ubeda, C., Hornedo-Ortega, R., García-Parrilla, M.C. & Troncoso, A.M.** 2015. Reported Foodborne Outbreaks Due to Fresh Produce in the United States and European Union: Trends and Causes. *Foodborne Pathogens and Disease*, 12: 32–38.
7. **Herman, K.M., Hall, A.J. & Gould, L.H.** 2015. Outbreaks attributed to fresh leafy vegetables, United States, 1973–2012. *Epidemiology and Infection*, 143: 3011–3021.
8. **Crowe, S.J., Mahon, B.E., Vieira, A.R. & Gould, L.H.** 2015. *Vital Signs: Multistate Foodborne Outbreaks — United States, 2010–2014*. Morbidity and Mortality Weekly Report. Atlanta, Georgia. Center for Disease Control & Prevention (CDC), pp 1221–1225.
9. **Hellberg, R.S., DeWitt, C.A.M. & Morrissey, M.T.** 2012. Risk-Benefit Analysis of Seafood Consumption: A Review. *Comprehensive Reviews in Food Science and Food Safety*, 11: 490–517. (also available at: <https://doi.org/10.1111/j.1541-4337.2012.00200.x>).
10. **Eneroth, H., Wallin, S., Leander, K., Nilsson, Sommar J & Akesson, A.** 2017. Risks and Benefits of Increased Nut Consumption: Cardiovascular Health Benefits Outweigh the Burden of Carcinogenic Effects Attributed to Aflatoxin B1 Exposure. *Nutrients*, 9(12). pii: E1355.
11. **Thomsen, S.T., Pires, S.M., Devleesschauwer, B., Poulsen, M., Fagt, S., Ygil, K.H. & Andersen R.** 2018 Investigating the risk-benefit balance of substituting red and processed meat with fish in a Danish diet. *Food and Chemical Toxicology*, 120. 50-63. (also available online at: <https://doi.org/10.1016/j.fct.2018.06.063>).
12. **Gibb, H., Devleesschauwer, B., Bolger, P.M., Wu, F., Ezendam, J., Cliff, J., Zeilmaker, M. et al.** 2010. World Health Organization estimates of the global and regional disease burden of four foodborne chemical toxins, 2010: a data synthesis. *F1000Research*, 4: 1393.
13. **Campbell, B.M., Vermeulen, S.J., Aggarwal, P.K., Corner-Dolloff, C., Girvetz, E., Loboguerrero, A.N., Ramirez-Villegas, J., et al.** 2016. Reducing risks to food security from climate change. *Global Food Security*, 11: 34–43.
14. **Jaffee, S.M., Henson, S., Unnevehr, L.J., Delia, G. & Cassou, E.** 2019. *The Safe Food Imperative : Accelerating Progress in Low and Middle-Income Countries*. Washington, D.C. World Bank. <https://openknowledge.worldbank.org/handle/10986/30568> License: CC BY 3.0 IGO.
15. **Renzella J, Townsend N, Jewell J, Breda J, Roberts N, Rayner M & Wickramasinghe K.** 2018. *What national and subnational interventions and policies based on Mediterranean and Nordic diets are recommended or implemented in the WHO European Region, and is there evidence of effectiveness in reducing noncommunicable diseases?* Geneva: WHO.



# Annex 1: Contributors to the consultation

Seth Adu-Afarwuah, University of Ghana, Ghana

Ashkan Afshin, University of Washington, USA

Sutapa Agrawal, UNICEF, India

Mary Arimond, Independent Consultant, USA

Michael Clark, University of Oxford, UK

Namukolo Covic, International Food Policy Research Institute, USA

Saskia de Pee, World Food Programme, Italy

Adam Drewnowski, University of Washington, USA

Jessica Fanzo, Johns Hopkins University, USA

Edward A. Frongillo, University of South Carolina, USA

Mario Herrero, Commonwealth Scientific and Industrial Research Organisation, Australia

Lea S. Jakobsen, Technical University of Denmark, Denmark

Andrew D. Jones, University of Michigan, USA

Shiriki Kumanyika, University of Pennsylvania, USA

Pulani Lanerolle, University of Colombo, Sri Lanka

Mark Lawrence, Deakin University, Australia

Duo Li, Zhejiang University, China

Jennie Macdiarmid, University of Aberdeen, UK

Sarah McNaughton, Deakin University, Australia

Sara Monteiro Pires, Technical University of Denmark, Denmark

Veronika Molina, International Consultant, Guatemala

Carlos Monteiro, University of Sao Paulo, Brazil

Eva Monterrosa, Global Alliance for Improved Nutrition, Switzerland

Luis Moreno, University of Zaragoza, Spain

Morten Poulsen, Technical University of Denmark, Denmark

Modi Mwatsama, Wellcome Trust, UK

Maarten Nauta, Technical University of Denmark, Denmark

Janet Ranganathan, World Resources Institute, USA

Satoshi Sasaki, The University of Tokyo, Japan

Shelly Sundberg, Bill and Melinda Gates Foundation, USA

Sofie Thomsen, Technical University of Denmark, Denmark

Stefanie Vandevijvere, The University of Auckland, New Zealand

Davy Vanham, European Commission Joint Research Centre, Italy

## **Food and Agriculture Organization of the United Nations**

Anna Lartey

Nancy Aburto

Fatima Hachem

Ramani Wijesinha-Bettoni

Tomas Buendia

Eleonora Dupouy

## **World Health Organization**

Francesco Branca

Chizuru Nishida

Marzella Wüstefeld











UNITED NATIONS DECADE OF  
**ACTION ON NUTRITION**



2016-2025

