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SUSTAINABLE, RESILIENT FOOD SYSTEMS FOR HEALTHY DIETS

Creating sustainable, resilient food systems for healthy diets

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INTRODUCTION

Food production globally has a greater impact on water, soil, biodiversity, and greenhouse gases (GHG) than any other human activity (MA 2005; IPCC 2007 and 2013; IAASTD 2009; Rockström et al. 2009; Foley et al. 2011; West et al. 2014). Overall, food production, together with other activities of the food system including food processing, distribution, storage, preparation and waste, contribute to some 20-30 per cent of anthropogenic GHG emissions (IPCC 2007 and 2013; UNEP 2016). While the global food system contributes directly to climate change, it is also directly impacted by climate change in a vicious circle that exacerbates many of the sustainability challenges of the food system.[1] Furthermore, approximately four billion metric tonnes of food are produced globally per year, yet an estimated 30–50 per cent (or 1.2–2 billion tonnes) of it are never consumed (IME 2013). At the same time, many people lack adequate diets to support healthy and active lives. Every country on earth has a significant public health burden of malnutrition (IFPRI 2016) – often multiple burdens including undernutrition, micronutrient deficiencies, overweight, obesity and diet-related non-communicable diseases (NCDs). Poor diets are now identified as the number one risk factor contributing to the global burden of disease (GBD 2013 Risk Factor Collaborators 2015).

Vast resources are spent to produce an aggregate of food that does not adequately nourish people, much of which is wasted at an enormous environmental cost. Issues of food affordability and equitable distribution linked to socio-cultural and political factors further present challenges for achieving healthy diets. The UN Decade of Action on Nutrition is a window of opportunity to transform our current food system into one that is sustainable, resilient, and provides healthy diets for all.

1 For example, changes in food supply and quality, increased food contamination, volatility of food prices, and disruption of food supply chains (Campbell et al. 2016; FAO 2016). Increasing temperatures, unreliable rains, extreme droughts and flooding, increase not only the challenge of food production, but also of dietary quality and safety (Medina, Rodriguez and Magan 2014; Springmann et al. 2016a; Myers et al. 2017).

HEALTHY AND NON-HEALTHY DIETS

A healthy diet is one that "helps protect against malnutrition in all its forms, as well as [diet-related] noncommunicable diseases".[2] A recent review of national and international dietary guidelines, as well as epidemiologic research on role of diets in the global burden of disease show agreement on the key hallmarks of healthy diets: (i) consumption of abundant diverse plant foods (fruits, vegetables, legumes, nuts, seeds); (ii) low or no consumption of ultra-processed foods; and (iii) consumption of other foods as culturally appropriate and desired to meet energy and nutrient needs (Herforth 2016).

Most people's diets around the world fail to meet the ideal for healthy diets. It is estimated that "poor diets are responsible for more of the global burden of ill health than sex, drugs, alcohol and tobacco combined" (Haddad et al. 2016, p. 30). Only 36 per cent of children are fed minimum dietary diversity (four or more food groups), based on representative data from 60 countries (IFPRI 2016). Nearly 800 million people are undernourished, while 2.1 billion are overweight or obese (FAO, IFAD and WFP 2015; IFPRI 2016). The Global Burden of Disease Study estimates that the top dietary factors associated with the highest global burden of disease are low fruit, vegetables, whole grains, nuts and seeds, omega-3 fatty acids and fibre, together with high sodium and processed meat (GBD 2013 Risk Factor Collaborators 2015). It is precisely those foods that protect health that are the most underconsumed. Trend data indicate that, in many countries, unhealthy components in the diets are increasing more rapidly than healthy components (Imamura et al. 2015).

SYSTEMIC DRIVERS OF DIETS: CHANGES IN FOOD ENVIRONMENTS AND FOOD SYSTEMS

Key systemic drivers of observed dietary patterns globally are food environments that increasingly offer more unhealthy foods and fail to offer adequate healthy foods. Food environments include the availability, affordability, convenience, and desirability of various foods and strongly influence dietary consumption (Herforth and Ahmed 2015).

In the past few decades, there has been a dramatic increase in the availability, affordability, convenience and marketing of unhealthy foods, such as calorie-dense, ultra-processed foods, whereas growth in nutrient-dense foods, such as fruits, vegetables and legumes, has not kept pace and moreover, is not projected to meet future demands (Global Panel 2016; Remans et al. 2014; Monteiro et al. 2013; Gómez et al. 2013). Many of these changes in the consumer food environment are mirrored in agricultural production systems at large. For example, there has been a notable rise in the agricultural production of energy-dense crops, such as oilseeds and starchy staples (Khoury et al. 2014), which are transformed into ingredients that form the basis of ultra-processed foods: industrial formulations of sugar, salt, oils, fats and other substances that are not conventional culinary ingredients that contain little or no intact foods (Monteiro et al. 2016). Despite improved food conservation technologies and efficient global trade systems decoupling the availability of fresh foods from seasons (Kearney 2010), the availability of fruits, vegetables and legumes falls far short of global need (Siegel et al. 2014; Herforth 2015).

Over the past 50 years, per capita food supplies have expanded in calories, protein and fat, with increased proportions from energy-dense foods, while national food supplies worldwide have become more similar in composition, correlated with an increased supply of a small number of cereal and oil crops (Khoury et al. 2014). This food environment can be associated with human health when considering low-risk diets or diets with ingredients that reduce the risk of diet-related NCDs. Considering Khoury et al's (2014) observations of changes in crop production, the authors note that the crops with the greatest increase in spread and abundance over the last decades include several crops categorized as "harmful" in the low-risk diet concept (Khoury et al. 2014; Murray 2014). Treenuts and vegetables, which are classified as "protective", are currently underproduced, but are represented in the top ten crops produced with some signs of growth in abundance and spread, although at rates much lower than seed crops. Many of these production trends are driven by economic, cultural and socio-political factors that have driven global food systems to unsustainable modes of production with heightened consumption of resources (Breggin and Myers 2013; de Wit and Iles 2016; Gomiero, Pimentel and Paoletti 2011). Subsidies and research and development (R&D) globally generally emphasize commodities (rice, maize, wheat and oil crops) (Pingali 2015; Siegel et al. 2016). Urbanization, marketing, increased income, migration, international trade policies, and globalization of transnational fast food corporations have also influenced trends in food consumption and facilitated a global dietary transition (Kearney 2010).

2 World Health Organization (WHO) (2015) *Healthy Diet*. WHO Fact Sheet No. 394. www.who.int/mediacentre/factsheets/fs394/en/.

Table 1. TOP TEN SPECIES IN TERMS OF THEIR INCREASE IN ABUNDANCE IN NATIONAL FOOD SUPPLIES, 1961 TO 2009

Crop*	Increase in relative abundance and contribution to calories (rank)	Change in spread (rank)	Risk category
Soybean	1	2	Harmful**
Palm oil	2	5	Harmful
Sunflower	3	3	Neutral
Wheat	4	35	Neutral
Rape and mustard	5	6	Neutral
Rice	6	15	Neutral
Sweeteners	7	4	Harmful
Vegetables	8	-	Protective
Cacao beans	9	17	Neutral
Treenuts	10	26	Protective

Notes:

* These top ten species are ranked in terms of increase of spread (Khoury et al. 2014), and dietary risk (Murray 2014). Khoury et al. (2014) did not analyze animal-source foods. The geographic spread is defined as the change over time in a country's food supply in each year; a higher number indicates less change in geographic spread relative to other crops.

**Soybeans themselves would be in the "protective" risk category, but the increase in their production is mostly for livestock feed to produce red meat destined for middle- and high-income countries, which is classified as "harmful" with relation to the global burden of disease.

Sources: Derived from Figures 1A and 1B in Khoury et al. (2014) and Murray (2014).

SUSTAINABLE, RESILIENT FOOD SYSTEMS AND DIETS

Food systems and diets can be characterized on the basis of their sustainability, including environmental, economic, socio-cultural, and human health dimensions (Gussow and Clancy 1986; Johnston, Fanzo and Cogill 2014). Sustainable food systems can be defined as the complex interconnected web of resources, people and processes that encompass all aspects involved in providing adequate and desirable nourishment for human health while maintaining the ecological integrity of natural resources, as well as supporting socio-cultural and economic factors. Resilience refers to the capacity of a system to absorb disturbance and re-organize while undergoing change so as to maintain the same function, identity and feedbacks (Walker et al. 2004). A resilient food system is one that supports sustainability by absorbing shocks such as climate variability and price fluctuations while still providing healthy food to nourish people.

Drawing from the multi-faceted concept of sustainability, sustainable diets are defined as those that support nutrition and environmental outcomes while also encompassing the economic, cultural and socio-political aspects of sustainability (Johnston, Fanzo and Cogill 2014). Jones et al. (2016) identified over 30 facets of sustainability that have been discussed in the literature on sustainable diets. The most commonly measured were GHG emissions, followed by land use, consumption of animal-source foods, diet quality, energy use, and water consumption involved in producing and processing foods (Jones et al. 2016). Other less frequently measured characteristics included social justice, animal welfare, biodiversity and cultural appropriateness.

These multiple facets of sustainability imply not just dietary choices, but also a more systemic approach than can or would usually be taken by individuals. A diet is something consumed by an individual, while a food system covers all activities and institutions from production to consumption. Similarly, sustainable diets imply consumption choices by individuals, and a sustainable food system involves food production, processing, distribution, consumption and waste management and all the steps in between. Given the differences in scales of diets and food systems, it is important to design action steps that can be taken at both the individual (diet) and policy and production (food system) levels.

SUSTAINABLE DIETS: WHAT STEPS INDIVIDUALS CAN TAKE

Sustainable diets are by definition healthy diets as human health and nutrition are core parts of sustainability. Dietary guidelines, in general, are a good starting point for sustainable diets; they are designed to ensure health and are generally aligned with two other rules of thumb for sustainable diets: a diversified, largely plant-based diet, and low consumption of ultra-processed foods.

One way to conceptualize resource-intensiveness of diets is the trophic level of the diet, a basic ecological metric that describes the number of intermediaries between plants and consumers (Bonhommeau et al. 2013). As omnivores, humans can eat foods that are higher or lower on the food chain. Intakes higher on the food chain generally are more resource-intensive, although there are some exceptions based on how the animal or plant foods are produced.

The same food can be produced at varying levels of environmental and social impact. Industrialized production of meat and dairy is a primary culprit in GHG emissions, pollution, and questionable practices concerning human and animal rights. However, in some contexts and often under smaller-scale production, livestock production is not only harmless, but is positive for the nitrogen cycling and biodiversity.

A greater reliance on plant source foods reduces the trophic level of the diet and often increases its healthfulness. Depending on how they are produced and sold, however, vegetables and fruits may also be highly intensive in terms of agrochemical use, energy consumption to operate greenhouses, and packaging material; they may entail agrochemical exposure risks for labourers, who require long working hours.

A large portion of sustainable diet research, concordantly, has estimated the environmental impacts of diets according to whether they are more vs. less plant-based (Tilman and Clark 2014; Auestad and Fulgoni 2015; Jones et al. 2016; Springmann et al. 2016b). GHG emissions of different food groups and food production processes vary widely, but in general, meat and dairy contribute the most to GHG emissions in the diet (Carlsson-Kanyama and Gonzalez 2009; Wallén, Brandt and Wennersten 2004; Millward and Garnett 2010; MacDiarmid et al. 2012). A recent systematic review suggests that dietary change in areas with affluent diets has a potential for reducing GHG emissions and land use demand of current diets by up to 50 per cent, largely by reducing meat consumption (Hallström, Carlsson-Kanyama and Börjesson 2014).

The sustainability of diets can also be enhanced through lower levels of consumption of ultra-processed food. High levels of processing are often intended to increase convenience or profit margin of foods, but often diminish nutritional value and increase resource use. Foods are often consumed at different levels of processing, from unprocessed and minimally processed (e.g. milled rice), to processed (e.g. vegetable oil), highly processed (e.g. boxed breakfast cereal) and ultra-processed (e.g. soft drinks). Ultra-processed foods are increasing fastest in sales and consumption in low- and middle-income countries (Monteiro, Gomes and Canoon 2010). Studies have shown that greater consumption of ultra-processed food products is associated with obesity and lower micronutrient adequacy of diets (Louzada et al. 2015a and 2015b; Martínez Steele et al. 2015). Highly processed food also uses significant packaging; for example, in the United States of America, food packaging accounts for the majority of packaging waste, causing increased pressure on landfills or from burning it, which may cause pollution with toxic chemicals (Marsh and Bugusu 2007).

Diets lower in both trophic level and highly processed food are likely to be consistent with dietary guidelines, but many nations are taking the additional step of designing dietary recommendations explicitly to include sustainability. Brazil, Qatar, Germany, Sweden, the Netherlands, the United Kingdom and Nordic Nutrition Recommendations explicitly promote sustainability in their dietary guidelines (Fischer and Garnett 2016). Some of the key recommendations in dietary guidelines that support sustainable diets are: promotion of plant-based diets; consumption of a diversity of food groups, food species and varieties; energy limitation; consumption of less meat; consumption of local and seasonal foods; conservation of biodiversity; reduction of food waste; and the encouragement of food processes with low GHG emissions.

SUSTAINABLE FOOD SYSTEMS: WHAT IS NEEDED AT A MORE SYSTEMIC LEVEL

In addition to steps that individuals can take to enhance sustainability, it is critical for policy makers and other stakeholders of the food system to design and implement plans to support the transformation of the food system to one that is more sustainable and resilient in providing healthy diets for all. Several key actions are needed at this level.

1. Improved production policies and practices for human and environmental health

Policies need to be implemented that support diets for both people's health and planetary health, including those rich in diverse plant foods, moderate in animal-source foods, and low in ultra-processed foods. Action needs to be taken to reverse the trend of the growing supply of a few crops and foods that are harmful to dietary quality and to the environment, and increase productivity and support for a diversity of food items that are missing in diets throughout the world, namely vegetables, fruits and legumes. In addition, policies and programmes need to support not only what is grown, but how it is grown. Specifically, sustainable agricultural policies and practices need to support biodiversity and ecosystem services, promote soil conservation, protect watersheds, limit the use of agrochemicals, utilize clean energy, prevent deforestation, and have relatively low GHG emissions. These environmental outcomes need to be complemented with an equal set of criteria setting the social foundation (Raworth 2012). Agriculture and the global food systems support more than 40 per cent of jobs globally; these livelihoods need to support the well-being of those working in the food system.

2. Improved Information to consumers

Consumer choices can drive the private sector toward sustainable practices. This trend is likely to increase as consumers place heightened value on sustainability.[3] Labelling for both nutritional content and sustainability practices would allow consumers to choose food that is sustainably produced. In addition, labels can help consumers make healthy choices. For example, in Brazil, legislative actions for healthy diets have included mandatory labelling on 'nutritionally adequate serving sizes', the world's first such initiative to reinforce healthy eating patterns and provide nutrition information on raw and unpackaged foods (Coitinho, Monteiro and Popkin 2002).

3. Improved information to policymakers: expanded set of sustainable food system metrics

Food system metrics need to move beyond current metrics that focus on calories per capita, prices of commercially important commodities and basic productivity. The metrics need to match the vision of food that nourishes people, supports decent livelihoods, and has minimal negative environmental externalities. We need better information on availability and prices of nutritious diets, and on diet quality. Additionally, metrics on sustainable diets and food systems should include life cycle analyses of commodities that examine a suite of environmental indicators from cradle to grave (water, land, eutrophication), as well as metrics on biodiversity of landscapes including crop species richness (CSR) and the modified functional attribute diversity (MFAD) index. Other indicators of food safety, loss and waste should also be developed and assessed as part of sustainable food system metrics (Remans et al. 2014; Gustafson et al. 2016).

CONCLUSION

The discussion on sustainability must include diets and food systems. The Sustainable Development Goals have no indicator of diet quality or patterns, which is a major oversight for sustainability in terms of diets' impact on both human health and the environment. The UN Decade of Action on Nutrition, however, highlights the need and opportunity to make changes toward sustainable, resilient food systems that promote healthy diets that nourish all people. Actionable principles to foster sustainable food systems and sustainable diets include those discussed here.

Principles of sustainable and resilient food systems and diets

Sustainable diets (individual level choices)

1. Follow dietary guidelines, including adequate diversity and nutrient intakes.
2. Are plant-based; low trophic level.
3. Contain low consumption of highly processed and packaged food.
4. Produce low food waste.

Sustainable, resilient food systems (supported by policies and production practices)

1. Shift incentives toward the foods that are most lacking in diets globally (fruits, vegetables, legumes).
2. Implement environmentally sound production practices:
    a. Mainstream biological diversity throughout the food system – in production landscapes, value chains, markets, consumption and relevant policies.
    b. Minimize GHG emissions related to food production, transport and consumption.
    c. Control, minimize or avoid chemical pollution of soil and water ecosystems during food production, processing and waste management.
    d. Have a low water footprint.

3 John Hopkins Center for a Livable Future. n.d. *The Emergence of the Food Voter.* www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-a-livable-future/_pdf/briefs/data/food-voter.pdf.

e. Minimize food waste and loss, optimize recycling of nutrients.
f. Ensure the humane treatment of animals.

3. Ensure food safety.
4. Support the rights of workers and farming households throughout the food system, including their rights to food, water, health and decent work conditions.
5. Provide transparent information:
   a. to consumers (labeling): nutrition information and production practices.
   b. to policy-makers (monitoring indicators): access to adequate, nutritious food, diet quality, food safety and environmental impact indicators on the above.
6. Adapt production systems for resilience to local and changing conditions.

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