

Why Food System Transformation Is Essential and How Nutrition Scientists Can Contribute

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Abstract

Background: The International Union of Nutritional Sciences held its 21st International Congress of Nutrition in October 2017 in Buenos Aires, Argentina under the theme – From Sciences to Nutrition Security. In addition to multiple sessions on food systems and their links to diet, nutrition and health, the Congress closing lecture focused on the need to transform food systems so as to increase their capacity to provide healthy diets, making a call for greater involvement of nutrition scientists. **Summary:** This article presents the main messages of that lecture, providing (i) an overview of global nutrition trends and their links to diets, food environments and food systems, (ii) a synopsis of the current global momentum for food system transformation and (iii) the need for nutrition scientists to leverage this momentum in terms of increased evidence generation and policy advocacy. **Key Messages:** Poor quality diets are increasingly leading

to the compromising of human health as never before; the prevalence of undernutrition persists and remains acute in vulnerable regions, and hunger is increasing concomitantly with an unprecedented rise in overweight, obesity and nutrition-related non-communicable diseases. Increasing access to healthy diets through faster, stronger implementation of supply and demand-side strategies that address the underlying drivers of today's faulty food systems is imperative to solve these problems, as well as to address related environmental and economic costs. The global momentum for such action is increasing, but the evidence base needed to galvanize governments and hold stakeholders accountable remains yet a fledgling. To date, inputs from nutrition scientists to this reform agenda have been weak, especially given the unique contributions the field can make in terms of rigorous analysis and technical advice. Strengthened par-

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icipation will require innovations in metrics and methodologies, combined with new thinking on what constitutes viable evidence and a greater willingness to engage with private sector agri-food actors.

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Global Nutrition Trends

Hunger is increasing. The number of undernourished people on the planet has increased to 815 million, up from 777 million in 2015 [1]. This number marks a return to 2012 levels and means that 1 in 9 people are currently going to bed hungry on a regular basis. In addition to a rise in absolute numbers, after years of steady decline, the proportion of the world's population that faces chronic hunger has either levelled off or begun to rise, depending on the region [1]. The food security situation has worsened, in particular, in parts of sub-Saharan Africa, South Eastern Asia and Western Asia [1].

Undernutrition persists and remains acute in certain regions and among certain population groups. Although stunting prevalence has decreased by 40% from 2012 levels, an estimated 155 million children under 5 years of age are still affected, with 130 million projected to be stunted in 2025, 30 million above the global World Health Assembly target for 2025 [2]. Stunting rates are currently highest in Eastern Africa, Middle Africa, Western Africa, Southern Asia and Oceania (excluding Australia and New Zealand) [2]. In these regions, over 30% of children under 5 are believed to be too short for their age [2]. In Africa, declines in prevalence have not kept pace with the population growth and the absolute number of stunted children has risen. Additionally, in 2016, wasting affected an estimated 7.7% (51.7 million) of children under 5 years of age worldwide, with 17 million severely wasted [2]. Undernutrition persists even among adults. Two billion people are believed to be micronutrient deficient; 613.2 million women of reproductive age are estimated to be affected by anaemia [1].

Concurrent to these trends in undernutrition, overweight, obesity and nutrition-related non-communicable diseases (NR-NCDs) have risen to unprecedented levels. Global prevalence of obesity more than doubled between 1980 and 2014 (in 2014, more than 600 million adults were obese, equal to about 13% of the world's adult population); prevalence is highest in Northern America, Europe, and Oceania, where 28% of adults are classified as obese, closely followed by Latin America and the Caribbean where the number is roughly 25% [1]. World-

wide, nearly 2 billion adults and 340 million children aged 5–19 are estimated to be overweight or obese [3].

Overweight, obesity and NR-NCD rates are rising rapidly in low- and middle-income countries [3]. In Africa, the number of overweight children under 5 has increased by nearly 50% since 2000 [3]; Africa also has the world's highest prevalence of hypertension. Nearly half of the children under 5 who were overweight or obese in 2016 live in Asia [3].

As a result, many countries in Africa and Asia now carry a double burden of overweight/obesity and undernutrition. In addition to manifesting at the population level, households and even individuals can experience this double burden, either simultaneously (e.g. when a child is stunted and her mother is obese, or when an individual is simultaneously overweight and anaemic), or over a lifetime (e.g. when a stunted child becomes overweight later in life). Though most severe in low- and middle-income countries in Africa and Asia, the double burden has been a challenge worldwide for over a decade [5–7].

Unhealthy Diets Are the Common Denominator across All Forms of Malnutrition

Low diet quality is a contributor to all types of malnutrition, whether overweight, obesity, or undernutrition, and including the “hidden hunger” of micronutrient deficiency. Moreover, NR-NCDs are now associated with more premature deaths among adults worldwide than any other risk factor [8].

Consumers' diet choices are influenced by many factors, including biologically determined predispositions (e.g., aversion to bitterness), past experiences with food (e.g., safety or lack thereof), personal and social norms (e.g., values, knowledge and skills) and broader environmental factors (e.g., cost of food, its physical availability, and the degree of information – including advertising, education and media – that exists for a given food or food group) [9]. Given these influences, healthy diets are more likely to occur when nutritious food is immediately accessible and affordable, thus making healthy foods an easy choice. The World Health Organization (WHO) defines healthy diets as:

- Adequate, comprising sufficient food for a healthy life.
- Diverse, containing a variety of foods, including plenty of fruits and vegetables, legumes and whole grains.
- Low in food components of public health concern: Sugars and salt consumed in moderation (with all salt iodised) and fats being unsaturated rather than saturated and trans fats [10].

Additionally, according to the WHO, the hallmarks of a healthy diet are abundant, diverse plant foods, limited or no ultra-processed foods such as sugar-sweetened beverages and processed meats, and appropriate consumption of other nutritious foods aligned with dietary needs for life [10]. High-quality diets also need to be safe, so they do not result in any foodborne diseases [11].

But high-quality, healthy diets are hard to achieve, given current “food environments.” Defined as the “physical, economic, political and socio-cultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food” [12], food environments can be thought of colloquially as the sum of foods that are available, accessible, convenient and desirable as people go about their daily lives, for example, foods in supermarkets, small retail outlets, wet markets, street food stalls, coffee shops, tea houses, school canteens, restaurants and all the other venues where food is procured and eaten. As such, food environments lay a heavy demand on consumers in terms of sending signals about which foods to purchase [13]. Currently, the signals sent in many of today’s food environments do not encourage choices that are consistent with healthy diets and good nutrition outcomes.

Links between Diet Quality and Food Systems: Healthy Diets Are Not the Default

Why are today’s food environments so constrained in terms of healthy diet options? To answer that question requires expanding the scope of reference to include food systems. Formally defined as gathering all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes [14], food systems should be visualized as broader and further ranging than food environments, comprising the entire spectrum of activities, people and institutions that influence those environments. Figure 1 provides a highly simplified representation of the relationship between food systems, food environment and individual diet quality.

In reality, these relationships are complex and determined by a wide range of drivers. Some of the most important are (i) long-term trends in agricultural research and investment; (ii) trade liberalization, vertical integration of food production and supply chains, and related

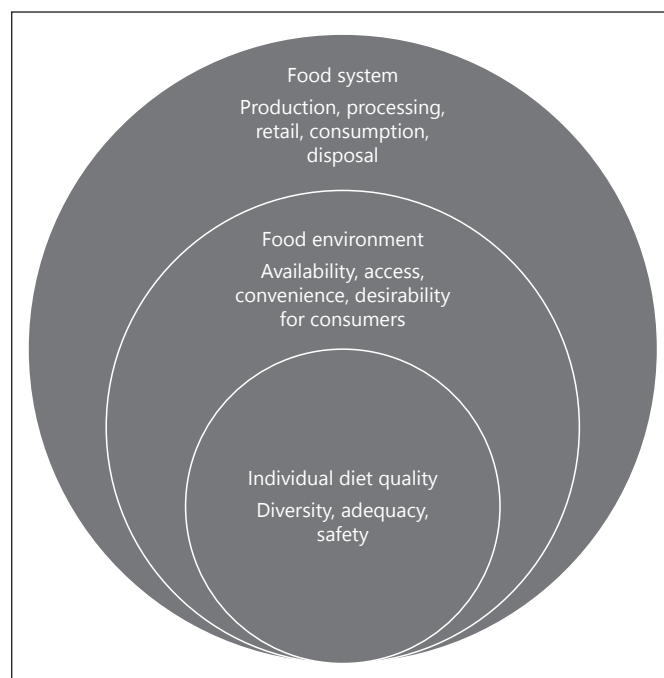


Fig. 1. Diets are shaped by food environments and food environments are shaped by food systems (Meerman [58]).

innovations in technology and processing; and (iii) shifts in consumer demand linked to changing lifestyles and marketing (Table 1).

In each of these areas, long- and medium-term developments have resulted in food environments characterized by low availability of healthy diets. Around the world, people are eating more ultra-processed foods associated with lower intakes of fiber, higher saturated fat, free sugars, sodium and energy density; more red meat; and less coarse grains, root crops, legumes, fresh fruits, and vegetables [15, 16]. Approximately 3 billion people on the planet – close to half the world’s population – currently eat low-quality diets [17, 18].

What Happens If Food Systems Are Not Transformed?

More Malnutrition and Associated Health and Economic Costs: As mentioned above, prevalence of hunger is increasing, undernutrition is persisting and remains acute in parts of Africa and Asia, and overweight, obesity and NR-NCDs are increasing most rapidly in low- and middle-income countries. Today, one in three people are affected by at least one type of malnutrition [18]. What will the costs

Table 1. Food system drivers

Agricultural research and investment	<p>Since the Green Revolution, intense research and investment in a small number of staple cereal and oil crops has eroded diversity and nutrient content in food systems. While calories have become more available, food supplies worldwide have become increasingly homogenized and correlated with increased supply of these crops, which are used in a wide variety of processed products (see below) as well as for animal feed. As a result, fruits, vegetables, whole grains, legumes, and nuts are under-represented in the food supply and in many countries are either unavailable or prohibitively costly [among others: 40–43]. As of 2009, there were many countries where per capita fruit and vegetable availability fell far short of meeting WHO and FAO recommendations [44]. The results of this trend can be assessed in terms of price shifts and sales, both of which have been well documented in a range of countries. For example, a study of price changes between 1990 and 2009/12 in Brazil, China, Mexico, South Korea, and the United Kingdom showed that fruit and vegetable prices rose across the board, while prices of processed foods decreased in the majority of cases [45]. Similarly, survey data from 79 middle- and high-income countries shows substantial increases in the sale of highly processed products over the last three decades [46]. Consequences include proliferation of food environments in which consumers are prompted to purchase highly processed foods of low nutritional value more often, and to purchase nutritious foods less. An example from the United States of this fundamental misalignment between agri-food policies and nutrition goals is provided by a comparison of U.S. dietary recommendations to federal subsidies for food production 1995–2005. Sugar, starch, oil and alcohol (from corn, sugar beet, canola, and sunflower oils), grains for human consumption, and meat and dairy received well over 95% of total subsidies, with legumes, nuts, fruits, and vegetables receiving under 5% [47].</p>
Trade liberalization, vertical integration of food production and supply chains, and related technological innovations	<p>The heavy investment in a small number of cereal and oil crops described above has been supported by trade liberalization, namely, reduced export taxes in producing countries and relaxed restrictions in importing ones. These trends have been complemented by increased vertical integration between producers and processors, resulting in the formation of large multinational food conglomerates as well as increased use of technological innovations such as extrusion, hydrogenation, and artificial flavoring. Within and between many countries, there has been a shift towards “long chain” food systems where food is transported and traded long distances post farm-gate [40, 43]. In these long food chains, whole foods are routinely transformed into processed products. For example, chicken parts are ground up and combined with vegetable oils and refined carbohydrates to become chicken nuggets and fruits are used as ingredients in processed foods and beverages high in sugars or other sweeteners [40]. The net result has been increased production and proliferation of extremely palatable, ultra-processed foods high in additives and low in nutritional quality. Readily available in a majority of countries, they dominate many food environments because they are cheaper, less perishable, more convenient, and in some cases, more suited to consumer’s gustatory and cultural preferences than nutrient-dense whole foods.</p>
Shifts in consumer demand linked to changing lifestyles and aggressive marketing	<p>Decreased physical activity and increased access to television and other media, decreased poverty, increased urbanization, greater participation by women in work outside the home, and increased access to supermarkets and fast food restaurants have all been empirically linked to increased consumption of a greater variety of foods, including those high in added fats, sugar and salt [48–51]. In many contexts, these dietary changes are encouraged and reinforced by aggressive marketing and advertising campaigns for processed and ultraprocessed foods. Many countries’ food environments are characterized by a gross imbalance between this type of advertising and campaigns that promote the consumption of healthy diets, for example, a recent study has shown that in the United Kingdom, spending on junk food advertising is nearly 30 times what the government spends on promoting healthy eating [52]. Advertising, which includes misleading information regarding nutrient content and/or which targets children, has been identified as particularly egregious [53–57]. The lack of food-based dietary guidelines (FBDGs) in many countries compounds the challenge. Intended to set out the official dietary vision or “infrastructure” for the country, FBDGs can – in theory – influence the food environment by informing policy as well as individuals and industry. FBDGs are least likely to exist in low- and middle-income countries [24], precisely the contexts where prevalence of overweight, obesity and NR-NCDs is rising most rapidly.</p>

be by 2025, when projections indicate the number will be one in two [18]?

More Food Loss and Waste: Global food losses and waste are estimated to equal 1.3 million tons, and to cost one trillion USD per year. Nutrient-dense foods are highly subject to loss and waste, given their perishability tendency. Across the world, between 30% and 60% of fruits and vegetables are estimated to rot or be wasted every year [19, 14].

More Environmental Degradation and Contributions to Greenhouse Gas Emissions: The agricultural production systems that supply today's food systems are a major contributor to greenhouse gas emissions (GHGs) and consequent global warming. At the same time, climate change adversely affects agricultural production and food security through severe weather events, decreased yields and reductions in biodiversity [20]. Climate change has also been linked to decreased nutrient levels in commonly eaten crops, as elevated carbon dioxide levels have been shown to lower concentrations of zinc, iron and protein and to raise the starch and sugar content in wheat, rice and some legumes [21]. FAO food balance sheets show that in 2010, roughly 667 million people were living in countries whose populations received at least 60% of their dietary zinc and iron from these foods [22].

Leveraging Current Global Momentum for Food System Reform

To effectively address the world's urgent and complicated nutrition challenges, rapid and radical transformation of today's faulty food systems is required. In December 2016, FAO and WHO co-hosted a Symposium on Sustainable Food Systems for Healthy Diets to discuss options for meeting this goal. Definition of "what" is needed – to change how food is produced, processed and sold to increase supply of and demand for healthy, environmentally sustainable diets – and identification of "how" – a range of supply and demand side strategies for regulation and reform – were outputs of the Symposium [23].

With respect to supply-side strategies, a key message was the need to better align agri-food policies with nutrition goals. Since foods that comprise a healthy diet are neither available nor affordable for many people, shifts in investment and research priorities are needed to increase production, supply and distribution of vegetables, fruits, pulses and sustainably produced animal source foods. This approach must include changes in agricultural systems to increase crop diversification and must also extend throughout the value chain to improve storage, transport,

transformation, marketing and retail, taking environmental sustainability into account every step of the way [23].

In terms of creating consumer demand for nutritious foods, and for exerting concomitant pressure on governments and the food industry to improve food environments, the Symposium highlighted a number of strategies that are gaining ground in multiple countries. The most important are: regulation of advertisements, so that claims are not misleading; clear nutrition labeling; and nutrition education that starts with very young children. Fiscal (dis)incentives such as taxes and subsidies, legislative mandates such as nutrition standards in government institutions and social protection programmes that include a nutrition component are additional options [23]. National food-based dietary guidelines, which establish the official dietary "vision" for a country, can be used to anchor all these measures within the same formally legislated implementation framework [23, 24]. Increasingly recognized as instrumental in providing a basis for pro-nutrition coordination and synergies across food systems [25], food-based dietary guidelines can be used to both raise awareness of what constitutes a healthy diet and provide a clear rationale for reducing proliferation and consumption of unhealthy food products.

The UN Decade of Action on Nutrition provides an important policy window for implementing these strategies. Declared in 2016 in response to the multiple and urgent challenges posed by today's malnutrition problems, the Nutrition Decade aims to accelerate action and investments to achieve global nutrition and diet-related targets by 2025, and to contribute to the realization of the 2030 Agenda of the SDGs. The Decade calls upon all countries to set, track and achieve "SMART" policy commitments across 6 nutrition action areas, the first being "Sustainable Food Systems for Healthy Diets". Each action area was formally endorsed as an outcome of the 2nd International Conference on Nutrition in 2014. Co-hosted by FAO and WHO, the International Conference on Nutrition has been critical in defining a common vision for policy and programme options to transform food systems and reduce malnutrition in all its forms.

It is important to note that the Global Panel on Agriculture and Food Systems for Nutrition, the World Bank, the Global Alliance for Improved Nutrition, the World Cancer Research Institute, the International Network for Food and Obesity/non-communicable diseases, Research, Monitoring and Action Support and many other agencies and initiatives have also recognized the pressing need for food system reform and transformation [18, 26–

30]. A plethora of publications have appeared in the last 5 years, shedding light on the challenge and proposing agendas for change. Improved data and metrics for assessing diet quality are repeatedly cited as imperative to these agendas [among others: 18, 26, 31, 32].

The Role of Nutrition Scientists

Global commitments have opened the door to transform food systems for healthy diets and improved nutrition. However, evidence on the links between these variables remains extremely weak, with the above-mentioned lack of improved data and metrics posing a fundamental block to evaluating the health impact of food system interventions. Especially critical is the need for individual-level dietary intake data and diet quality indicators and indicators to assess changes in the food environment in relation to policy and programmatic interventions [26]. Metrics for these concepts are urgently needed, as few have been validated or standardized in ways that permit timely, routine data collection [33]. As a result, very few countries systematically collect dietary information [34].

Although nutrition scientists are well placed to narrow these evidence gaps, their contributions remain minimal. More direct and proactive inputs are urgently needed, first for identification and validation of metrics on diet intake, diet quality and food environments; second proactive inputs are needed with respect to rigorous empirical research that employs these indicators to strengthen the food systems-diets-nutrition evidence base, and which highlights their importance in terms of broader human development goals. To date the role of these metrics is undervalued, as per their complete absence from the Sustainable Development Goals. Most glaring for SDG2, which explicitly links agriculture to food security and nutrition, this omission is relevant to the majority of other SDGs as well [35].

Perhaps the most obvious candidate for increased recognition and use is the Minimum Dietary Diversity for Women (MDD-W). Widely agreed upon as an indicator for assessing diet diversity – a vital element of diet quality – the MDD-W is a dichotomous indicator that classifies women as having a high- or low-diet diversity based on the number of food groups consumed over 24 h [36]. Though unanimously endorsed by academia, international research institutes, the UN and donor agencies during its introduction in 2014 [37], the MDD-W remains underutilized in both government-led and independent assessments of nutrition and health [38]. Rigorous nutrition studies that use the MDD-W as a primary

indicator or in tandem with biomarkers and other nutrition indicators are urgently needed to raise this metric's visibility and application.

Nutrition scientists could also contribute substantially to the development of new diet quality indicators that complement the MDD-W, for example, indicators to assess the intake of refined starches, sugar, red meat, and trans fat, as well as metrics, which expand assessment to capture the nutritional status of an entire population, and to predict optimal health across the life cycle [34].

Such indicators are also needed for interdisciplinary “macro” studies, which assess the various relationships that shape food systems, for example, the trends in agricultural research and investment, trade liberalization and additional factors discussed in Table 1 contribute to the relative ease or difficulty of accessing a healthy diet, as well as to food loss and waste, environmental degradation and GHGs. For example, research on neglected nutritious commodities such as fruits and vegetables, pulses, fish products and seeds and nuts needs to increase with a focus on their yield and resilience to pests, diseases and climate change [31]. Simultaneously, more demand-side research is needed to educate, equip, and encourage consumers in both low- and high-income settings to make positive choices for healthy diets [31].

Participation in research projects on these types of topics will require a willingness to integrate nutrition science with behavioral economics, agronomy, food security and other food-system relevant fields. Study designs other than randomized control trials must be considered, as the latter do not lend themselves readily to food system-type interventions studies. Rather, what should be aimed for are fine-grained mixed-method studies, which provide plausible findings regarding the dietary, health and environmental effects of food systems. Cited as “urgently needed” by Haddad et al. [31], such studies are needed to provide evidence for food systems reform. In so doing they also increase pressure on governments and the private sector to take action.

Nutrition scientists can also contribute to a definition of “Healthy Diets” that links explicitly to improved nutrition and optimal health outcomes. As per Haddad et al. [31], “People do not choose nutrients, but they select combinations of foods in differing amounts. Pairings of single foods and diseases are the basis of risk-factor analysis in global burden studies, but tell us little about diets as a whole. Although there are studies on the value of, say, the Mediterranean diet, there are few from low income countries. And even the nutritional profile of many important indigenous foods remains poorly known. A bet-

ter understanding of dose – response relationships is also needed. Is it better to eat a little of each food category frequently, or a large amount less often? Food researchers need to be more creative and research funders bolder in assessing the health implications of common combinations of foods.”

Taken together, the actions described above set the stage for nutrition scientists to play a more active role in food system research and transformation efforts, first and foremost with respect to evidence generation and concomitant advocacy for policy reform, and also in terms of building advisory relationships with agri-food firms. These firms – the largest of which dominate food sales worldwide – are facing increasing pressure to improve the nutritional quality of their products. Consumer demand for healthy foods is increasing [39], and more and more governments are implementing legislative mandates as well as fiscal and regulatory disincentives that discourage the promotion and sale of ultra-processed foods. As long as there are no conflicts of interest, nutrition scientists can play a valuable role in helping the food industry reformulate their products to better meet the higher nutritional standards, which are increasingly imposed by government and demanded by consumers.

Conclusion

The current nutrition situation points to a failed food system that is unhealthy for humans and for the planet. And while momentum for change is growing in international, academic, and some country contexts, thus far the pendulum has not swung far enough to effect the necessary changes at the global level. To achieve this scale-up, more evidence is needed on the links between health, nutrition, diet quality and the market-driven macro processes that shape food systems, food environments and consumer demand.

Nutrition scientists can contribute invaluablely to these efforts: first, through their unique capacities for rigorous dietary assessment and analysis – critical to building a viable evidence base for the links between different food system drivers and effects – and second by leveraging this evidence through policy advocacy, dialogue and recommendations. Without progress in these areas, decision makers will not be convinced of the urgent and complex threats posed by today’s faulty food systems, and governments and other food system actors will not be held accountable for solving them.

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