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Food environments: Where people meet the food system

in this issue 2019

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About UNSCN NUTRITION

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To contribute to future issues of **UNSCN NUTRITION** or to be added to our mailing list, please email info@unscn.org. All manuscripts submitted for consideration will be reviewed, though publication is not guaranteed.

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Chair's round-up

CORNELIA RICHTER

UNSCN Chair

Vice-President of the International Fund for Agricultural Development

Dear UNSCN Nutrition reader,

As Chair of the United Nations System Standing Committee on Nutrition, I am delighted to have the opportunity afforded by this year's edition of *UNSCN Nutrition* to present valuable research to help advance high-quality and nutritious diets for all. *UNSCN Nutrition* (previously *UNSCN News*) *44* gives leading global thinkers from various fields and disciplines the chance to share their insights on ways to improve food environments for better nutritional status and health. We selected this year's theme as a springboard from which to better understand the factors that influence people's food choices within the wider food system and which enable availability, affordability and access to healthier options.

Currently, almost two billion people are overweight or obese – a figure that continues to grow and, with it, the risk of non-communicable diseases. Simultaneously, almost 821 million people are chronically undernourished, 149 million children under the age of five are affected by stunting and 49.5 million suffer from wasting. Every country is experiencing several forms of malnutrition and trends predict that the one in three people currently malnourished will soon become one in two.

To tackle these challenges UNSCN works with its partners to better understand why and how diets, lifestyles and food environments are changing and how food systems need to respond accordingly. We challenge ourselves to systematically analyse food-system dynamics, as well as the various causes of malnutrition, to assess how issues of equity, equality and non-discrimination are impacted by nutrition.

We involve stakeholders at the local, regional and global level to ensure a multifaceted and collaborative approach and to drive food security, safety and nutrition forward. Over 41 years, we have adapted and innovated, together with our UN partner agencies, to provide research-based policy guidance that is applicable and relevant. Further, we are continuously strengthening the synergies between the strategies, work plans and priorities of our Members and global intergovernmental processes, bridging thematic discussions and the application of policies around the world. This has been most visible in our ongoing work to highlight how nutrition is both a connecting force between the Sustainable Development Goals and a catalyst to achieving them.

Our efforts to support consistent and accountable delivery and concerted roll-out has meant closer collaboration with the UN Network for Scaling Up Nutrition. This harmonized approach allows us to better identify national needs to ensure that UNSCN delivers effective, responsive policy guidance.

As Chair of UNSCN, it is my pleasure to work with Members as we advance through the United Nations Decade of Action on Nutrition towards a more just and sustainable world.

Cornelia Richter
UNSCN Chair

Editorial

CHRISTINE CAMPEAU

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Every day, people buy and consume food through their food environment. This can be defined as the interface between people's diet and the wider food system. It encompasses people's ability to access nutritious food in an affordable and convenient way. It is further shaped by external factors, such as the price and availability of food, as well as its taste, the marketing that goes into promoting food and the regulations that govern it.

The food environment has been conceptualized in various ways, thanks to the work of many researchers over the past decade. The 2017 report by the High Level Panel of Experts on Food Security and Nutrition (HLPE) defines it as "the physical, economic, political and sociocultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food" (HLPE, 2017).

Others, including the Food and Agriculture Organization of the United Nations (FAO), have defined the food environment more in terms of food itself, namely, "all the foods which are available and accessible to people in the settings in which they go about their daily lives. That is, the range of foods in supermarkets, small retail outlets, wet markets, street food stalls, coffee shops, tea houses, school canteens, restaurants and all the other venues where people procure and eat food" (FAO, 2016: p. 3). It encompasses availability, affordability, convenience and desirability (Herforth and Ahmed, 2015).

More recently, Turner et al. (2018) proposed a new conceptual framework that more clearly defines the external and personal domains of food environments. The external domain includes dimensions such as availability, prices, vendor and product properties, and marketing and promotion, while the personal domain includes the dimensions highlighted by Herforth and Ahmed. All of these concepts, especially the Turner et al. framework, have been widely cited by authors throughout this publication.

But how useful is the concept of the food environment and what purpose does it serve? Does it increase understanding of how people interact with the wider food system and how dietary preferences evolve? Does it provide valuable insights into how these dietary shifts lead to a greater prevalence of overweight, obesity and deaths from non-communicable diseases? Does it explain the health effects of population movements from rural to urban settings?

The food environment is highly dynamic, interactive and constantly evolving, which makes it difficult to grasp. It links people at the community level to the highest levels of decision-making and cuts across policy areas. It examines the specifics of local food environments against the backdrop of larger national and global environments and systems. Food environments are also the arena in which tensions lie and power politics play, sometimes with explicit rules and regulations, often with inequalities underlying the outcomes.

In *UNSCN News 43*, Cecilia Rocha drew attention to the systemic blind spots, the geographical location and language of available research, which undermines our ability to get the

full picture and, instead, gives us an understanding of health impacts based disproportionately on the Global North (Rocha, 2018). Rocha notes the tensions that arise when diets are framed as a function of the broader food environment and the "persistent narratives suggesting that diet-related health is simply a question of personal responsibility" (Rocha, 2018: p. 28), rather than a full appreciation of the external forces that determine what is available. Power dynamics also come into play in how consumers negotiate with producers, as highlighted in this year's Letter to the Editor on the political economy.

In this 44th issue of (the rebranded) *UNSCN Nutrition,* several contributions reinforce the usefulness of food-environment frameworks when it comes to understanding these interactions and dietary changes. *Nutritional implications of Tibetan Plateau resettling and urbanization programmes* relates how the food environment of indigenous pastoralists was transformed by a resettlement and urbanization programme, with both positive and negative effects on the population's general health and well-being.

The transition from wild to "built" food environments is also explored in *Advancing healthy and sustainable food environments: The Flathead Reservation case*. Through a community-based methodological approach and by working to enhance the desirability of fruit and vegetables, this group of researchers hopes to reduce the diet-related health disparities of indigenous communities in the Mission Range of the Rocky Mountains in the American state of Montana. The team is adapting its efforts for cultural relevance and local context and has included wild foods in its nutrition initiatives. The importance of community-led strategies is also at the heart of *Transforming food environments through community-led action*, which describes ongoing work to build the community institutions needed to overcome hunger and encourage healthy and productive lives.

The food-environment concept also spans food-safety concerns. *Retail diversity for dietary diversity: Resolving food-safety versus nutrition priorities in Hanoi* compares traditional open-air markets with modern supermarket outlets that increase food safety on the one hand, but increase the availability of unhealthy, ultra-processed foods on the other. In Ghana, food hawking in the midst of heavy traffic has led to the identification of a traffic food environment that requires urgent attention from city authorities and food regulators, as detailed in *The nutrition, safety and health implications of food hawking in traffic.* While the traffic food environment in Accra no doubt provides food for urban commuters, their choices, to some extent, depend on their knowledge and perceptions of and attitudes towards safe, nutritious and healthy foods. It also presents an opportunity for street vendors to improve their awareness of the risks of their practices and adapt accordingly.

When designed effectively, supported by knowledge and an understanding of the food-environment concept, government policy and fiscal measures can positively influence what food is available to consumers and lead to healthier dietary choices. The food-environment concept, for example, has been crucial to understanding and tackling food deserts and swamps, as described in *Farmers markets as a strategy for improving food environments* and *The changing landscape of food deserts.*

Making more nutritious food available and accessible is an essential step. To this end, the inclusion of neglected and underutilized species is something to be promoted, as these foods are often nutritious and climate-change resilient. They can also create income-generating opportunities, as explained in *Promoting neglected and underutilized crops to boost nutrition in LMICs.*

Social protection schemes, such as cash-transfer programmes, are another central component of improving food security and alleviating poverty, but they are really only effective when healthy options are available and accessible to consumers. Efforts to maintain or increase the nutrient value along the food chain and advance post-harvest practices are essential to promoting healthier food environments. *Exploring socio-cultural aspects of the food environment: Study perspectives from Pakistan* is a very good example of the usefulness of the food-environment conceptual framework in analysing personal dimensions and consumer insights for better programme design. Good communication and consumer awareness are key.

From a food-environment perspective, initiatives that increase consumer demand for healthy diets, such as consumer behaviour-change communications, social marketing and nutrition education, are front and centre when it comes to improving nutrition. *The digital food environment* calls for greater awareness of the increasing role of digital technology and the internet in influencing food-consumption behaviour, health and nutrition. The need to tailor awareness to specific youth interventions is also explored in *The evolution and spread of industrial food: Building youth resilience through food and media literacy.*

While all actors have an important role to play in shaping healthy and sustainable food environments, governments have primary responsibility for public policy design. Working with civil-society and public-sector actors on implementation, monitoring and evaluation, they can bring about transformative policy and encourage businesses to make nutritious foods more convenient and affordable for consumers. An important example of government action is the development of food-based dietary guidelines, as in the case of Canada, detailed in *Can dietary guidelines support the transformation of food systems*

to foster human and planetary health? Another is marketing restrictions to limit the sale of unhealthy foods, of which we have seen numerous examples throughout this publication.

Workforce development and training opportunities can build the necessary skills and leadership capacity to improve food environments and awareness. Diets are context specific, so rules and regulations are important to ensure healthy and sustainable food environments. Sub-national rules and regulations can help to improve the urban food environment, for example, as an increasing proportion of the world's population now lives in an urban setting, accompanied by rapidly changing dietary and lifestyle habits.

The food-environment concept also clearly depicts how food labelling, product positioning, advertising, promotion and marketing have a particular influence on consumption patterns, especially when children are the target audience. School settings as a system for improving nutrition have received increased attention in recent years, making effective school food policies another important tool in promoting healthy, diverse and sustainable diets. *Improving the school food environment through policy: A case study of challenges and recommendations from Mexico* highlights the need to take into account the economic and structural realities of schools to be effective, as well as the safeguards required to eliminate food-and-beverage marketing and the availability of ultra-processed products on school grounds.

As the examples we present in *UNSCN Nutrition 44* demonstrate, the concept of food environments helps food policy design and monitoring, and broadens understanding of the entry points that can help transform food systems, making them work better to deliver healthy and sustainable diets. From a monitoring standpoint, looking at food and nutrition through a food-environment lens helps to make food systems more tangible and bring them closer to the people. *Cash transfers and the food environment: Eight ways to improve diet quality*, for instance, shows how a lack of information on food environments can limit understanding of why nutrition-sensitive cash-transfer programmes have or have not had the desired effect.

A food-environment framework is helpful in understanding the different dimensions of actions that need to be taken within food systems, as it looks at the various entry points from an environmental perspective. This is one reason the Committee on World Food Security's Voluntary Guidelines on Food Systems and Nutrition (expected to be adopted in October 2020) considers food environments to be one entry point for transforming food systems. Various strategies for food-system transformation are also addressed in our opening article, *Improving healthy and sustainable food environments for all,* some of which apply directly to the creation of healthy and sustainable food environments to nourish people and protect the planet.

Our call for contributions to this publication encouraged academically rigorous examples of the positive and negative effects of our current food environments on nutrition. The Editorial Board observed a lack of submissions that specifically addressed such nutritional impacts and called on the global nutrition research community to fill the gap. As Block et al. (2018) note correctly, data over a longer period of time containing historical and detailed information on food environments are vital, but remain difficult to obtain. We hope this rich collection makes a meaningful contribution to that knowledge base.

Improving our knowledge and understanding of how people's interactions with the food system determine diets, nutrition and health outcomes is essential if we are to improve food and nutrition security and tackle malnutrition in all its forms.

We hope you enjoy reading *UNSCN Nutrition 44* and welcome your feedback.

The Editorial Team

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Achieving healthy and sustainable food environments for all

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FOOD IS THE PROBLEM BUT, MORE IMPORTANTLY, THE SOLUTION

Food is critical to human and planetary health, yet food is currently threatening both people and planet. World hunger is on the rise - from 784 million people in 2014 to 821 million in 2017, millions of children remain stunted and nearly 2 billion adults are overweight or obese (FAO et al., 2017; Development Initiatives, 2017).[1] Moreover, food systems – which include all actors and sectors involved in producing, distributing, retailing and consuming food – are at the centre of many environmental challenges facing the planet. Nearly 85 percent of global water use goes to agricultural irrigation, of which 15–35 percent is unsustainable, while close to a quarter of all global land is degraded (IFPRI, 2012; Rosengrant et al., 2009). Agriculture and food systems contribute up to 29 percent of all greenhouse gas emissions (Vermeulen et al., 2012). Overall, food systems are pushing planetary boundaries in terms of greenhouse gas emissions, resource use and degradation. If crossed, this could generate abrupt or irreversible environmental changes (Rockström et al., 2009).

However, it is possible to feed the world's growing population a healthy, diverse and nutritious diet within our natural boundaries (Willett et al., 2019). To do so, these types of food must be available and accessible where people acquire and consume food – in their food environments. Food environments are the range of food sources, activities and products that surround people in their everyday lives. They are the interface between consumers' food acquisition and consumption and the wider food system, encompassing dimensions such as the availability, accessibility, affordability, desirability, convenience, marketing and properties of food sources and products (Turner et al., 2017). This is why we should aim to achieve healthy and sustainable food environments.

FOOD ENVIRONMENTS FOR HUMAN AND PLANETARY HEALTH

How can food environments better support healthy and sustainable diets for all? The EAT-Lancet Commission report brought together scientists from around the world to reach a consensus that defined a healthy diet from a sustainable food system (Willett et al., 2019). The report offers several strategies for food-system transformation, some of which apply directly to generating healthy and sustainable food environments.

1 Overweight is defined as a body mass index (BMI) of 25 or more, so it includes pre-obesity, defined as a BMI of 25 to 30, and obesity, defined as a BMI of 30 or more.

Shift towards healthy diets

There are a variety of policy options to encourage food environments to enable healthy diets. Enabling healthy food choices by focusing on marketing healthy foods or guiding food choices through disincentives, such as sugar taxation or marketing controls, can have an impact (Willett et al., 2019). One approach is nutrition labelling on packaged foods, as seen in Chile's 'warning' labels on packaged foods high in fats, sugars and salt, and in Ecuador's system of stoplight labels, with red indicating high levels of fats, sugars and salt. Mexico, meanwhile, has enacted an excise duty on sugary drinks and taxed foods with a high calorific density to curb the consumption of sugary drinks. Schools can also promote healthy food environments through mandatory or voluntary guidelines for school meals or by restricting other foods available for purchase (Hawkes et al., 2017).

Behaviour-change communication (BCC) interventions have been shown to improve infant and young child feeding practices in several countries (Kim et al., 2018). BCC can also help to improve healthy diets to fight overweight and obesity, as in the case of Ecuador's school-based programme, where targeting individual and group behaviour has decreased added-sugar and processed-food intake (Hodge et al., 2016).

Promoting healthy diets can also support environmental sustainability. For example, scenarios in which emission-intensive foods are taxed (for example, meat and dairy) could prevent more than 100,000 deaths from reduced dietary and weight-related risk factors in 2020 (Springmann et al., 2018). In examining policies and approaches to shape or promote healthy and sustainable diets, it will be critical to differentiate the approach in developed countries from that in developing countries and for poor populations. For many developing countries and the poor, undernutrition and access to healthy diets remain persistent challenges. Animal-sourced foods (ASFs) (such as dairy, eggs, fish or chicken) for young children and women during pregnancy and lactation can be crucial to nutrition and health, especially in poor populations, and research suggests a strong correlation between ASF consumption and a reduction in stunting (Headey et al., 2018; 2019).

Re-orient agricultural priorities from quantity to quality

Agricultural priorities must shift from promoting the production of high quantities of staple foods to producing healthy food in a sustainable way. For poor people, the most easily available and affordable diets are often unhealthy.

The prices of nutrient-dense foods, such as fruit, vegetables and animal foods, are often significantly higher than those of calorie-dense foods, making cost a barrier to the poor (Headey et al., 2018). Reducing prices of nutrient-rich non-staples is a powerful way of increasing the consumption of healthy diets. Promoting enhanced production and the productivity of healthy and nutritious foods will be important if we are to lower prices and increase the accessibility of healthy and sustainable diets.

In this regard, agricultural policies can play a key role in improving food environments. Investment priorities can focus on ramping up support for agricultural R&D to boost the production of more nutritious food crops and to ensure production is more sustainable and climate resilient. More investments are also needed to support value chains of more nutritious, healthy foods.

Governments can eliminate subsidies of nutrient-poor foods and convert these funds into investments in more nutritious crops, such as fruit and vegetables. Subsidies for agricultural inputs can also lead to the overuse of inputs and natural resources, exacerbating land degradation and emitting more greenhouse gases. These subsidies should be better targeted, so that they produce greater returns in terms of economic efficiency, nutrition and natural resource use, or could provide direct income or productive support for vulnerable groups, including smallholders, women and youth.

If farmers are to produce the right food, and not just more food, they must work with the local environment. For example, in Southeast Asia, one promising avenue is agroforestry, in which crops and forests are grown together, providing each other with natural protection from pests and giving growers a diversified set of foods for both subsistence and sale at market. It also keeps more carbon out of the atmosphere. Rice farmers in Vietnam, Indonesia, the Lao People's Democratic Republic and Thailand have been able to reduce climate risk by mixing trees and rice on their farms (FAO, 2017). In Indonesia, agroforestry with teak trees has restored tree cover from 2 percent to 28 percent in logged-out regions of Central Java that were suffering agricultural decline and drought-induced famine (FTA, 2016).

Reduce food losses and waste

We must also greatly reduce food loss and waste, which compound pressure on the food system to use more of the world's available natural resources to produce food and generate 8 percent of total greenhouse gas emissions (Sims et al., 2014). The overall productivity of our food system is reduced by food loss and waste, which can result in lower incomes for food producers and higher costs for food consumers, and much of the burden falls on the poor.

Food waste, which is more prevalent in developed countries, can be addressed in part by interventions targeting the food environment. Policies to curb retail food waste should be explored, such as France's ban on supermarkets throwing away quality food before best-before dates. Engaging in national and local awareness campaigns to reduce consumer waste, such as China's "Clean your Plate" campaign, can also help reduce food waste, especially in developed and emerging economies.

To address food loss in developing countries, where food losses are a bigger problem than food waste (relative to what is seen in developed countries), a whole value-chain approach is necessary. Solutions should not only benefit consumers by lowering food prices, but also support smallholder farmers. While many current interventions target food storage, conclusions from various studies suggest that targeting other points along the value chain is worthwhile. Furthermore, innovative policy solutions for smallholders could have great impact. It will be critical for policymakers and actors along the food value chain to use new knowledge and insights to take action.

TECHNOLOGY AND INNOVATION CAN BE GAME CHANGERS

While our rapidly changing world presents some challenges to food systems, it also offers new opportunities. Technological and institutional innovations are key. At the same time, solutions must be inclusive and context-specific.

Technological innovations are critical to achieving multiple wins and it will be important to promote technologies with strong evidence of their benefits. Sustainable intensification technologies and practices, such as remote sensing, precision agriculture and no-tillage, have had measured impacts on productivity and the efficient use of natural resources, while nutrition technologies, such as biofortification, have demonstrated measurable improvements in human health and nutrition (Bouis and Saltzman, 2017). Information and communication technologies can be used to distribute soon-to-expire foods through mobile apps designed to help businesses donate surplus foods. E-commerce is a new frontier in food environments. Urban consumers can now order food on their smart phones and rural farmers are increasingly connected to supply and demand information on agricultural produce and materials, as well as consumer products.

There are also exciting new and potentially transformative technologies that may enter the food environment: alternative proteins, such as lab-grown meat, can help reduce agricultural greenhouse gas emissions and resource use; gene editing for seed improvements can produce more crops and improve nutrition outcomes; and blockchain can enable traceability and transparency along the food chain. However, these technologies should be scaled up with careful consideration for their impact on smallholders, children's nutrition and employment.

CONCLUSION: WORKING TOGETHER WILL BE CRITICAL

Transforming food environments to support healthy choices is an imperative that goes hand in hand with the need to feed a growing population a nutritious, diverse diet within planetary boundaries. Policy options exist to encourage healthy and sustainable diets, including BCC interventions, regulations and better labelling practices. Shifting agricultural production to produce more healthy, nutritious foods and reforming investment priorities and subsidies can increase availability and affordability in the environments where consumers purchase food. Reducing waste will require better practices among retailers and upgrading supply chains will help reduce food losses. New technologies and innovations, meanwhile, can transform the way people engage with food systems. Healthy and sustainable diets may look different from country to country and we will need more evidence on what drives and challenges the diets of different populations. For food environments to promote human and planetary health for all, it will be crucial for stakeholders to continue to work together by sharing experiences and expanding the knowledge base.

More and better information is needed on people's diets, appropriately disaggregated across rural and urban spaces, as well as gender. Additional information is needed, too, on the drivers of unhealthy diets and the ways in which food environments shape the supply and demand of such foods. Research must also go beyond the public sector to examine the role of the private sector and find best practices in working with private partners to improve food environments for health and sustainability. Indeed, research and data will be critical to shaping and advocating for evidence-based policies and to promoting accountability among stakeholders.

By working together with a commitment to data, evidence and research, policy design and implementation, we can better promote healthy and sustainable food environments and achieve multiple Sustainable Development Goals.

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Supply-side measures improving food environments

Promoting neglected and underutilized species to boost nutrition in LMICs

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INTRODUCTION

Historically, agricultural projects have been largely unsuccessful in improving the rural food environment by increasing access to and utilization of foods (Burchi et al., 2011). Agricultural projects targeting food availability and consumption have primarily focused on increasing the yields of a select few energy-rich commodity crops and raising income from the sale of these crops to improve food and nutrition outcomes. This has resulted in several crops being over-researched and over-produced (for example, rice, wheat and maize) at the cost of more nutritious food species, including fruit, vegetables and legumes, which are generally under-researched and insufficiently available.

Despite the 5 538 food crops estimated to exist globally, 75 percent of the world's food is generated from just 12 plants and 5 animal species, with only 3 plant species providing more than 50 percent of the world's food-energy needs (FAO, 2012; FAOSTAT, 2013; Royal Botanic Gardens, Kew, 2016; Yaro et al., 2017).

The continued decline in crop diversity in agricultural production systems is making global food systems significantly vulnerable. They are more susceptible to shocks, especially smallholder systems, which keep locally adapted, hardy, climate-resilient varieties and breeds alive (FAO, 2012; Kray et al., 2019), undermining their role in feeding the world sustainably (Fanzo and Mattei, 2012). Farming communities are left with fewer livelihood options for addressing the evolving needs of households and markets (Lamers et al., 2016), including the provision of diverse nutritious foods to rural food environments.

To better understand the importance of crop diversity, it is worthwhile considering the role played by food environments and how they influence our diets and health. "Food environment" is a broad concept (Box 1) and refers to the area of the food system between the acquisition and consumption of food. Food environments can vary according to context, between different urban and rural settings, or high-, middle- and low-income countries, for example.

Rural food environments in lower- and middle-income countries (LMICs) are facing a specific set of challenges. Modern retail outlets and large value chains are often not the primary source of the foods consumed every day. Many rural consumers are also food producers who rely heavily on their own production as their primary source of food, closely followed by foods produced and sourced from within their immediate local food system. Consequently, their food environment is intrinsically and directly tied to the production system within the local landscape, the health of which is also closely correlated with the richness of the diverse foods present in both the cultivated and wild ecosystems.

The narrowing diversity of production systems means rural consumers have less choice and are consuming a smaller array of foods, resulting in less nutritious and healthy diets (Wilting et al., 2017, Lachat et al., 2018). Moreover, the degradation of the natural environment and the use of pesticides are reducing the availability of and access to wild and semi-domesticated nutrient-dense foods, such as fruit, nuts and wild vegetables. Market and income development are opening up new opportunities in the food environment, but the diversity and nutritional quality of products offered in rural markets are often limited.

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Box 1. DEFINITIONS OF THE FOOD ENVIRONMENT

Food environment definitions	Perspective	Reference
"We define the food environment as the availability, affordability, convenience, and desirability of various foods."	Markets	Herforth and Ahmed (2015)
"The food environment is the interface that mediates one's food acquisition and consumption within the wider food system. It encompasses multiple dimensions such as the availability, accessibility, affordability, desirability, convenience, marketing, and properties of food sources and products."	Food system	Turner et al. (2017)
"Food environment refers to the physical, economic, political and sociocultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food."	Food system	HLPE (2017)
"Food environments may be thought of as all the foods which are available and accessible to people in the settings in which they go about their daily lives. That is, the range of foods in supermarkets, small retail outlets, wet markets, street food stalls, coffee shops, tea houses, school canteens, restaurants and all the other venues where people procure and eat food."	Markets	FAO (2016)

UNLOCKING THE POTENTIAL OF NEGLECTED AND UNDERUTILIZED SPECIES

In addition to making urban food environments nutritionally richer by making diverse crops and animals, varieties and breeds more available and accessible, decision makers are becoming more aware of the need to strengthen agricultural production systems through "climate smart" and "nutrition-sensitive" interventions (Li and Siddique, 2018; De la Peña and Garrett, 2018). Such initiatives are increasingly becoming key strategies for improving the food security and nutrition of rural populations, but with benefits for urban dwellers, too.

In this context, there is a growing need for better research and development (R&D) coverage of 'orphan' crops, or neglected and underutilized species (NUS) – wild and cultivated plant genetic resources that are undervalued by current food environments, even though they are often highly nutritious and resilient to climate change and could provide new income-generation opportunities (Box 2) (Padulosi et al., 2011, 2013). Bringing back NUS to food environments could improve access to and utilization of nutritious foods, leading to healthier diets (Kennedy et al., 2017).

Box 2.

WHAT IS A NEGLECTED AND UNDERUTILIZED SPECIES (NUS)?

- NUS include wild, semi- or fully domesticated plants of diverse forms (field crops, trees, shrubs, vines and others), as well as edible fungi and animal species.
- "Underutilized" refers to these species' untapped livelihood and nutrition potential.
- "Neglected" refers to the lack of investment in research of these species compared with mainstream commodities.

Many NUS have similar or better nutritional profiles than more commonly available foods (Table 1). Despite being fundamental to communities around the world (see, for example, Termote et al., 2015; Boedecker et al., 2014; Ebert, 2014;), NUS from nutrient-dense food groups, including minor cereals, pulses, fruits and vegetables, have been the subject of little research to enhance yields and overcome the challenges of cultivation, processing, marketing or consumption (Kahane et al., 2013). They are rarely covered by extension work and have been relegated to the margins of mainstream agriculture. We explore the strategic role that rural advisory services can play in promoting the sustainable use of NUS later in this paper.

MAGNUM PH/FAO/CHRIS STEELE-PERKINS

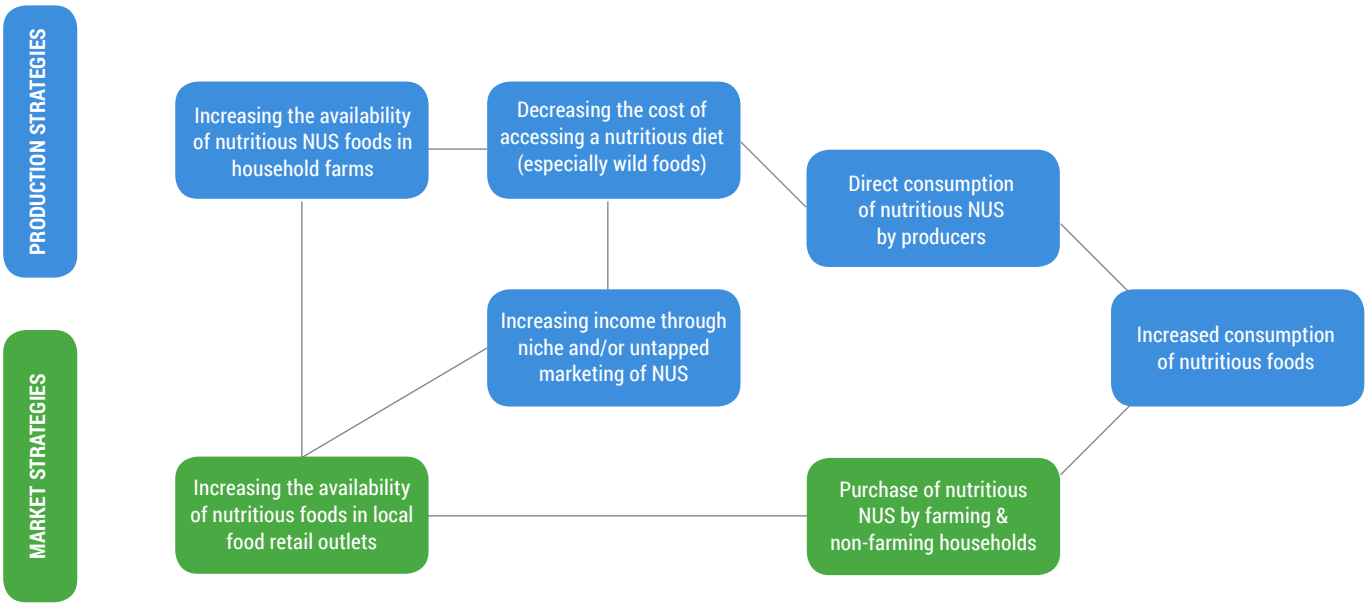
Table 1. FOOD COMPOSITION: NUTRITIONAL DIFFERENCES BETWEEN COMMONLY CONSUMED CROPS AND NUS

Fruit	Ca (mg)	Fe (mg)	Mg (mg)	Zn (mg)	Vit A (mcg)	B - carotene (mcg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin B6 (mg)	Folate (mcg)	Vit C (mg)
Common crops												
Apple*	6	0.1	5	0.04	3	33	0.02	0.03	0.1	0.04	3	4.6
Orange*	31	0.2	11	0.1	8	90	0.04	0.03	0.2	0.07	33	46.8
NUS alternatives												
Sugar apple	28.20	1.36	38.47	0.22			0.13	0.09	0.69	0.07	7.60	21.51
Peach palm	44.6	4.4	11.7	2.1	-							62.2
Acai berry	35	0.4					0.1	0.04				
Salak	127.3	19.1	7.16	35.1		48	0.18	0.2	2.4	1	3	20.41-35.02
African locust bean	118	3.6	88	1.4	405	2430	1.08	0.71	1.3	0		234
Wild mango	164	1.9		0.3			0.18	0.09	0.7			
Langsat	20				13		0.08	0.12				1
Jackfruit	45.74	0.31	26.6	0.37	150-540		0.05	0.05	0.19	0.04	35.73	17.51
Kumquat	266	1.7			2530							
Desert date	74-76	39			-							
Cereals, pseudo-cereals, roots and tubers												
Common crops												
Rice*	28	0.8	25	1.09	0	0	0.07	0.05	1.6	0.16	8	0
Wheat*	29	3.19	126	2.65	9	5	0.3	0.12	5.46	0.3	38	0
NUS alternatives												
Quinoa	128	94.85	190			11.87 - 17.71	0.15	0.43	1.2	0.2	78.1	1.4
Amaranth	159	7.6	270	2.52			0.16	0.36	1.1	0.33	24.65	
Elephant foot yam	50	0.6	30.4	0.33		158	0.04	0.05	0.61	0.22	20.5	15.22
Yam	35	1.2	21	0.24	138	83	0.11	0.03	0.55	0.29	23	17.1
Fonio	51	10	434	3.8	0	0	0.26	0.1	1.7	0.74	29	0
Tef	17-178	9.5-150										
Job's tears	54	0.8					0.48	0.1	2.7			
Finger millet	370	6	137	2.3	0.48	1.53	0.33	0.11	1.2	0.05	34.66	
Foxtail millet	37	6.2	81	2.4			0.48	0.14	2.4		39.49	
Little millet	17	1.26	133	3.7			0.26	0.05	1.29			
Barnyard millet	96	5	82	3	0.36		0.11	4.5	4.2			
Buckwheat	50	3.4					0.41	0.2	2.3			

* More common crops

Source: *Arora (2014); Ballogou et al. (2013); Baye et al. (2014); Brink and Belay (2006); Chweya and Mnzava (1997); Deme et al. (2017); FAO et al. (2010); Fasakin (2004); Feyssa Debela et al. (2015); Getinet et al. (1996); Gordillo-Bastidas et al. (2016); Jiri and Mafongoya (2016); Kamatar et al. (2013); Khatoon et al. (2015); Lester and Bekele (1981); Longvah et al. (2017); Government of Nepal (2012); Aremu et al. (2006); Porch et al. (2017); Puri and Surolia (1994); Puspitasari et al. (2017); Shaheen et al. (2013); Ministry of Health, Brazil (2002); Tirajoh et al. (2012); Wickens (1995).*

Figure 1. PRODUCTION AND MARKETING STRATEGIES TO PROMOTE NUS FOR MORE NUTRITION-SENSITIVE FOOD ENVIRONMENTS



Source: *Authors.*

NUS have the potential to improve access to nutritious foods in rural areas by (1) increasing the availability of nutritious foods for direct consumption by producers; (2) decreasing the cost of accessing a nutritious diet (especially wild foods); (3) increasing the availability of nutritious foods in local food retail outlets and markets for sale by producers, and/or by (4) increasing income through niche and/or untapped marketing opportunities, which could then be used to purchase other, more nutritious foods (Figure 1).

NUS with diverse phenology can be leveraged to improve food availability all year round. The edible leaves of certain woody species, for instance, can be harvested as vegetables throughout the year (for example, chaya, *Cnidoscolus aconitifolius* and *Moringa oleifera*). The tolerance of many NUS to abiotic stresses (such as drought, frost and heat) and biotic stresses (such as pests and diseases), as well as their lower water and nutrient requirements, can enable more resilient production under stressful conditions (Padulosi et al., 2011).

When income is a barrier to access to nutritious foods, wild NUS offer a low-cost alternative. These wild foods should to be harvested with potential over-harvesting and conservation issues in mind, however (Padulosi et al., 2008). Cultivated NUS also tend to require fewer agrochemical inputs than improved commercial varieties; seeds are typically sourced from local seed systems, unlike commercial hybrids and improved species. These are factors that can reduce the financial burden on farms in terms of accessing nutritious foods year after year.

Market development of NUS can increase the availability of nutritious foods in local retail outlets for rural populations. NUS can also enhance incomes by providing new and niche marketing opportunities and complementary or alternative income sources when staple crops fail. Farmers can be encouraged to allocate the additional income from these activities to the purchase of nutritious foods in local markets.

In many cases, NUS are already available, accepted and desirable. They are often found in traditional recipes, using traditional preparation methods, and it can be easier to broaden their usage than to introduce a completely new food. NUS are often managed by poor and vulnerable groups, such as indigenous peoples and women, who could benefit significantly from enhanced production, marketing and consumption (see Annex 1). Thus, NUS can be a tool to support the continuation and empowerment of indigenous local food systems and cultural identity and promote gender equality. The close link between these foods, local people, land and cultures offers a unique opportunity to revitalize local food culture and food systems and empower smallholder farmers, who are often the custodians of this agro-biodiverse resource.

WHY HAVE NUS BEEN NEGLECTED AND UNDERUTILIZED?

The shrinking diversity of our food basket and the marginalization of local crops has multiple causes, many of which can be traced back to the Green Revolution, which saw food companies impose widespread standardization of production systems to achieve economies of scale through intensified mechanization, from planting to harvesting, processing and commercialization. Moreover, the growing disconnect between consumers and traditional food cultures and the perception that traditional crops are old-fashioned and unattractive compared with modern ones have also contributed to this phenomenon.

The abandonment of hundreds of species that are, paradoxically, most useful today in fighting nutrition insecurity and tackling biotic and abiotic stresses (Altieri, 2002; FAO, 2011) is of great concern (Kray et al., 2019). Reducing the diversity of our food systems has created a situation that is no longer tenable for consumers and value-chain actors. Cultivation systems are experiencing a decline in fertility and regenerating capacity and becoming more vulnerable to climate change and susceptible to pests and diseases. Value-chain operators are finding they have fewer food choices to offer consumers for a healthy diet, who, in turn, are seeing their healthy food options dwindle (Kahane et al., 2013).

NUS hold the key to realizing a new Green Revolution driven by genetic and cultural diversity. Such a revolution is necessary to tackle the daunting problems of poverty and malnutrition in its diverse forms. Bringing these foods back to the table is also a matter of urgency, as most of these species are not available in ex situ gene banks and are likely to rapidly disappear before they are properly collected, identified and put to use (Mal, 2007; FAO, 2010).

There are hundreds of NUS from commonly consumed plant genera with untapped potential to increase the availability of nutritious foods to the world (Figure 2). Although NUS have many characteristics that could positively impact the lives of rural communities, there are specific bottlenecks causing their lack of competitiveness with mainstream crops. These constraints could be overcome with modest, but well-focused and concerted interventions by research, development and rural advisory services, however. Some of the main barriers to their wider utilization are related to production, marketing and consumption issues. These include:

1. Production- and harvesting-related barriers

The focus of research and agriculture projects has been on commodity crops, either cash crops or largely starchy staple food crops. This has left numerous agronomic bottlenecks encountered by NUS overlooked, including:

- poor availability of genetic diversity in ex situ and in situ/on-farm collections;
- poor availability of seed and other reproductive material, hindering wider use (particularly wild or semi-domesticated species);
- poor farmers' seed networks being required to support crop-diversity sharing;
- low-yielding varieties compared with hybrid, improved alternatives in the short term (but which may be more consistent over time – hybrid varieties can reduce yield over time and require heavy inputs);
- high and intense labour input associated with cultivation and harvesting; and
- the transformation of land usage, such as forest to agriculture and agriculture to housing, to accommodate increasing populations has led to changes in natural habitat and biodiversity loss, reducing the availability of wild NUS and the suitability of cultivated NUS.

2. Marketing- and value chain-related barriers

Value-chain development and marketing for NUS involve greater risk and investment, as they often involve product development, market development or diversification strategies. Investment decision-making on processing, packaging or pricing for NUS is challenging compared with commodity crops, for which information and precedent exist and are readily available. Some of the barriers include:

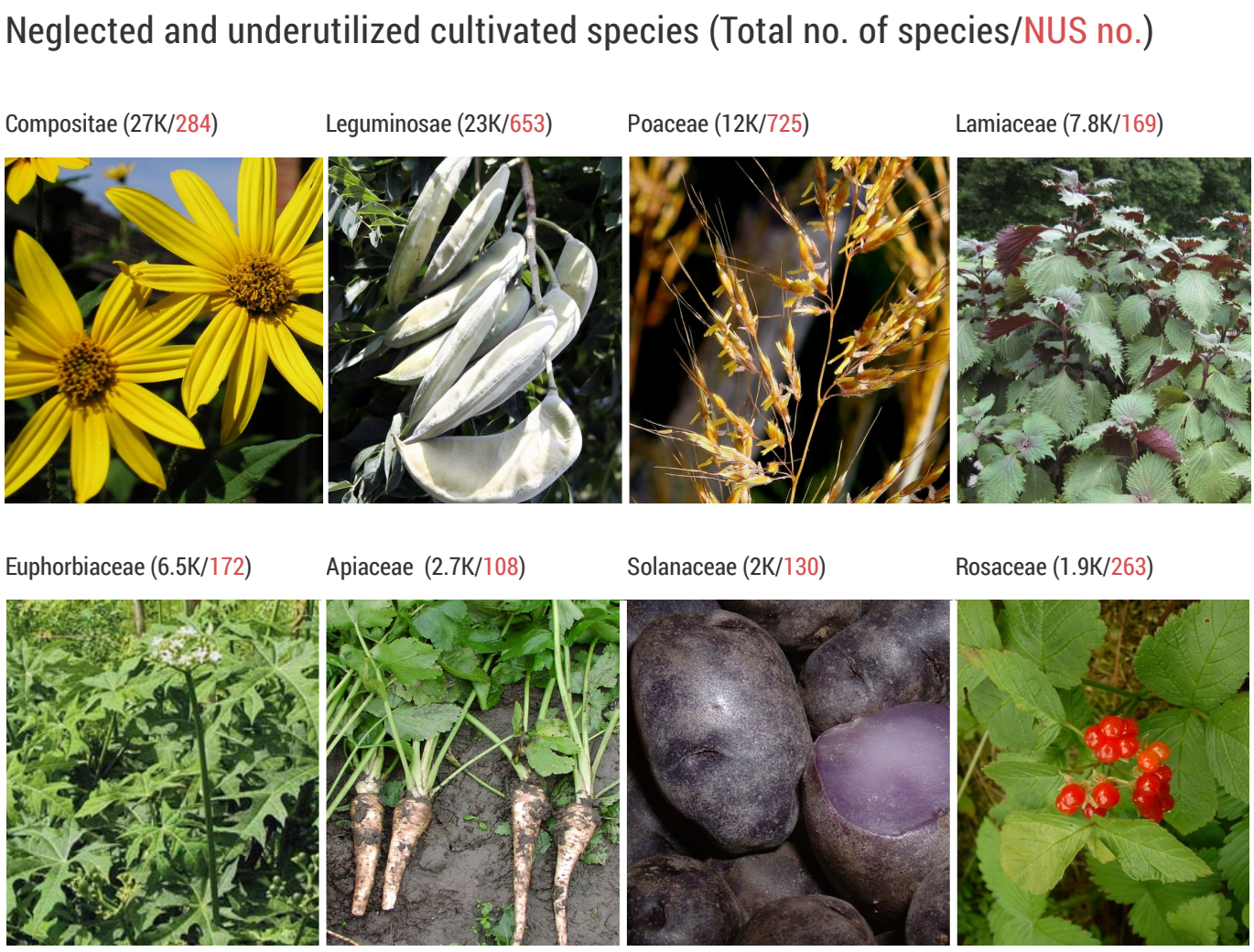
- inefficient value chains that lead to low price incentives;
- a lack of collective action and aggregation of supply;
- a lack of market knowledge and beneficial market linkages;
- a lack of entrepreneurial skills and business support services;
- a lack of proper packaging or cold chain and processing, as NUS can deteriorate quicker than hybrid varieties bred to be resistant to travel, etc.;
- high and intense labour input associated with processing, with the burden often falling on women;
- a lack of sufficient market demand from local or wider markets to justify larger-scale production; and
- policies hindering NUS marketing and value-chain development (such as subsidies or procurement that target only staple crops).

3. Consumption- and demand-related barriers

The negative perception of NUS, particularly by young people, hinders their use. They are considered "poor man's crops", foods associated with famine or periods of hardship. However, a number of large Global South economies, such as India, Brazil and Nigeria, have a substantial and fast-growing middle class and wealthy consumers in larger cities. These people are potential NUS consumers and could be targeted through their interest in connecting with their food cultures and their preference for nutritious, pesticide-free and healthy foods. However, well-conceived interventions that target the needs of lower-income households could also create strong domestic demand for these crops. Additional barriers include:

- widespread cultural erosion, leading to a loss of knowledge about food-preparation methods and the growing detachment of younger generations from ancestral foods;
- a lack of innovative food recipes that involve less cooking time and are more in tune with modern food-consumption habits and lifestyles;
- little knowledge of beneficial economic practices or the potential to improve food and nutrition security;
- a lack of consumer demand, which translates into a lack of product awareness, reducing incentives for farmers and other value-chain actors to invest in NUS development as there is limited commercial value or profit potential;
- a lack of nutritional data, undermining the case for NUS and the justification for research investment into the production of improved varieties, ultimately limiting their cultivation and consumption levels.

Figure 2. UNTAPPED NUS RESOURCES IN COMMONLY CONSUMED PLANT FAMILIES



Source: *Khoshbakht and Hammer (2008); The Plant List (2013).*

INTEGRATING NUS INTO RURAL FOOD ENVIRONMENTS: A NUTRITIONAL NEEDS-BASED APPROACH

Rural advisory services can play a key role in promoting NUS for better nutrition and livelihoods and it is important that these actors are aware of locally available NUS. It is particularly important that they promote species that can help to bridge nutrient gaps in local diets. Evaluating the constraints on the use of NUS can inform strategies to foster more effective cultivation, commercialization and consumption to secure benefits for local populations. Here, we explore some approaches to identifying priority species, assessing constraints and promoting the use of NUS.

Identification of priority species

To improve nutrition, development efforts should focus on locally available NUS from under-consumed food groups. Nutritional needs and the seasonal dynamics of hunger in focal communities and regions must be considered and an inventory should be made of locally available crops (wild and cultivated) that could fill these nutritional gaps. If information on local diet quality is not already available, assessments of micronutrient intakes can be undertaken using quantitative dietary recall (Gibson and Ferguson, 2008). A lighter-touch approach to identifying under-consumed food groups is qualitative 24-hour recall (for example, dietary diversity score) (FAO and FHI 360, 2016) or focus-group discussions (such as four-cell analysis) (Raneri et al., 2017).

Assessing the seasonal availability of foods can help identify those species available at specific times of the year when dietary gaps are heightened due to lack of access to nutritious foods. The prioritization of crops should also take into account tolerance to marginal soils or climate stress, local food preferences and cultural values, and market opportunities. Information on the beneficial properties of NUS can be gleaned from past studies, local experts and community consultations, so as to leverage local knowledge (Padulosi et al. 2019). Including older men and women in the consultation process can help to identify foods that were used in the past, but which may be falling out of use among younger generations.

Assessment of bottlenecks and constraints

People may not be using nutritious NUS for a variety of agronomic, social, economic or political reasons. Consultations with producers and consumers, as well as other actors in the value chain, can help identify why this is happening and what measures can be taken to bring these foods back to the table (Will, 2008). Questions that can guide this process include:

- Why do people not consume more of these crops?
- Why do people not market/sell more of these crops?
- Why do people not produce more of these crops?

And, more generally, with regard to the marketing of diverse crops and varieties:

- What are the market conditions under which crop biodiversity can be best promoted?
- How can social marketing be used to promote crop diversity?
- What market-based instruments (such as tax breaks or eco-labelling) or incentives (such as subsidies for purchasing inputs, procurement by government, or cash incentives to farmers) can be used to promote crop diversity in markets and value chains?

Common bottlenecks encountered in NUS promotion include the unavailability of quality seeds, poor agronomic practices, poor yields, the drudgery of harvest and/or post-harvest operations, scant nutritional and marketing information, a lack of primary processing equipment, disorganized or non-existent value chains, a lack of knowledge about nutrition or health benefits, insufficient or unenticing preparation methods, a lack of knowledge about possible climate change, pest and/or resilience benefits, and "poor man's food" perception, especially among young people (Padulosi et al., 2014).

Interventions to enhance NUS uptake

Rural advisory services can play an important role in tackling bottlenecks to enhance the use of nutritious NUS, for example, by providing quality seeds and advising on improved cultivation practices and technologies. To enhance the consumption of these species, advisory services can team up with health extension workers to improve knowledge of nutritional content and the benefits

of different species to diets, best practices to reduce spoilage, rotting or the contamination of foods, and how to prepare foods in interesting and desirable ways through community cooking sessions.

To improve the commercialization of NUS, advisory services can support the formation of alliances among growers and value-chain actors, such as farmers' associations, cooperatives and multi-stakeholder platforms. As NUS tend to have multiple bottlenecks at many steps of the chain, from seed availability and production to processing, value-chain organization and consumer demand, the best results will be achieved when several bottlenecks are targeted simultaneously (King et al., 2009; 2013; 2015; Padulosi et al., 2015).

Capacity-building and collaboration

Rural advisory services (including agricultural and health extension services) require a broad set of skills and knowledge to promote cultivation, commercialization and the consumption of nutritious NUS. Collaboration between agricultural extension and rural health services can be the most effective method of promoting these crops in diets and production systems. Training in agronomy and value-chain management is a good base for extension agents to assess the main constraints on production, processing, and marketing of these species. Familiarity with the wild and semi-domesticated plants in the local environment will assist with the identification of priority species.

Likewise, an understanding of local diets and nutrition issues in target populations will support the prioritization process. Sensitization to local consumption preferences and perceptions, and learning how to engage with farmers to collect this type of information, are important to the comprehension of demand-side issues. The capacity to recognize important actors in the value chain and rural advisory-service system, as well as a proactive attitude to reach out to engage these actors to help in overcoming bottlenecks, will help to advance the use of these nutritious species (Gruère et al., 2009; King et al., 2018).

Costs

The costs associated with species prioritization and the identification of bottlenecks are largely associated with the staffing required for background research, workshops and field visits for community and multi-stakeholder consultations. The cost of enhancing the use of NUS will depend on the nature of the interventions involved (for example, equipment, training and personnel). Wider use of NUS has the potential to decrease the cost of a nutritious diet for the people involved, however, the costs in terms of time and burden (particularly for women) to collect and process the food should be taken into account.

EVIDENCE OF IMPACT, SUSTAINABILITY AND SCALABILITY

NUS can support better diet quality for local communities (Rowland et al., 2015) and their value-chain development can enrich rural food environments by improving consumers' direct access to nutritious foods and by generating income that can be allocated to the purchase of other nutritious foods. The impact of NUS can be also seen in terms of improved sustainability, the reduced use of inputs, and the greater resilience of food systems in periods of shock. NUS may not become multi-million-dollar commodity crops, but they can realistically establish themselves as niche crops at district, national or international level, improving direct access to nutritious foods for community consumption and generating sustainable income to support local farmers and other value-chain actors involved in their promotion (see, for example, Pallante et al., 2016).

Although thorough, large-scale studies to assess such an impact are still lacking, success in promoting minor millets in India provides some examples of how NUS can be leveraged to enhance local livelihoods (see Box 3). It is very revealing that the Indian Government has included minor millets in the national public distribution system in recognition of their strategic role in the country's nutrition security, creating an unprecedented opportunity for their wider consumption (Padulosi and King, 2018).

Box 3. NUS CASE STUDIES

Minor millets in India

In the Kolli Hills of the Namakkal district of India, from 2014 to 2016, an estimated 56 tonnes of millet were produced by 759 local farming families from 45 settlements. It was used for home consumption, stored as seed or sold. The secret to the families' success is the Agrobiodiversity Conservers' Federation, a registered society involved in managing minor millets from farm to fork. The Federation's current membership stands at 1 511 members from 47 self-help groups and 62 farmers' clubs that specialise in different areas, from production and processing to value addition and distribution.

The initiative has been built up over time; it started in 1997 with 10 self-help groups and was institutionalised in 2009. Mechanised mills have reduced the drudgery of processing millet grains. Women used to spend up to an hour manually processing one kilogram of grain and now it takes just five minutes. Food fairs, innovative recipes and the successful marketing of value-added millet products have increased the amount of millet consumed across the region as a part of a diverse meal (for more, please see Mondal et al., 2016; King and Padulosi, 2017).

Chaya in Guatemala

Chaya (*Cnidoscolus aconitifolius)*, also known as Mayan spinach, is an evergreen hardy shrub, domesticated by the Mesoamerican peoples in pre-Columbian times. It is typically cultivated on a small scale in gardens and on field margins for household use. Chaya contains far higher amounts of several macro- and micronutrients than other dark green leafy vegetables, including protein (60g per 1kg of leaves), vitamin A, niacin and vitamin C. Within the framework of the International Fund for Agricultural Development European Union (IFAD-EU) NUS project, bottlenecks hindering its wider use in Guatemala were identified along the chaya value chain (Bioversity International, 2015).

Among other things, the study revealed that: (1) small-scale chaya marketing exists (within the Dry Corridor, which stretches from Southern Mexico to Panama and suffers from severe inclement weather due to El Niño), whereby farmers directly sell to consumers, or vendors; (2) companies produce nutraceutical chaya-based products for export, with a few in-country sales points targeting affluent consumers; and (3) low demand is a major limiting factor. The major barriers to demand were found to be low consumer awareness of the crop's existence or its nutritional benefits, the perception of the crop as a "poor man's food", limited recipes, and the fact that when households did consume Chaya, it was usually sourced from their own garden. Low market value, little profitability and inconsistent availability were other challenges that emerged from the value-chain assessment.

There were several interventions to promote chaya in the Dry Corridor of Guatemala, where farming communities face severe food insecurity and malnutrition, with conditions exacerbated by climate change. More than 16 700 cuttings of chaya were disseminated to farmers for planting in home gardens and communal nurseries, accompanied by training on how best to cultivate and propagate it. A women-led cooperative was established, linking local producers with small businesses, chefs and restaurants in Guatemala City. Women were trained in various processing techniques, including protein extraction and leaf drying using solar ovens, and in novel recipes developed by local chefs. Active engagement with local government led to the successful introduction of chaya, sourced from local farmers, into school feeding programmes. Recipe books, tasting samples and nutritional information were disseminated in local markets in Chiquimula to help popularize the crop. (For more on Bioversity's work on chaya, please see Bioversity International, 2018).

DISCUSSION

NUS that are nutritious, climate-resilient, economically viable and culturally important have great potential to support agricultural diversification and create synergies between strategies aimed at improving diet quality and climate-change resilience (Baldermann et al., 2016). Enhancing the use of NUS can be a cost-effective and culturally appropriate means of improving the resilience of local food systems and farming-household incomes and nutrition by increasing the diversity of nutritious foods available in rural food environments, often as a low-cost option for the rural poor most in need of better nutrition and diets.

However, there are numerous challenges and limitations being faced by smallholder farmers, who are the guardians of this local agrobiodiversity, which limit the potential for NUS to have a greater impact on the wider food environment.

Large-scale farming systems prioritize efficiency and, as there has been little investment in NUS R&D, there are often limitations when it comes to large-scale food-distribution value chains, such as how to maintain the quality and freshness of NUS during transportation or how to make processing methods more efficient. The exponential growth of large-scale and intensified farming systems has seen a prioritization of few commodity crops, in which there has been extensive R&D. The result has been the simplification of global production systems, which has ultimately decreased the diversity of foods available in our food environments and, hence, our diets.

As retail modernization continues to transform food environments through transitioning food systems, rural areas are faced with increasing exposure to more processed and industrialized foods, often replacing traditional NUS, which have become unfashionable in comparison. Policies and incentives need to be put in place to create an enabling environment that values nutritious NUS production by both the large-scale and smallholder farming operations that supply the food companies that use these foods, both in their fresh form as well as in innovative food formulations, to increase demand across the wider food environment, especially in cities. Boosting demand for NUS and NUS-based products in both urban and rural food environments will stimulate production and wider availability.

This article provides insights into how to integrate nutritious NUS into agricultural initiatives. Data generated from the implementation of these projects have a circular effect: the more investment made in NUS, the more information is generated on their potential to improve food security, nutrition, income and food-system resilience.

By the very nature of their definition, NUS are undervalued by the scientific community and, as such, there are often limited data available on their micronutrient content (Burlingame et al., 2009). Many countries are now developing specific food composition tables for NUS (Brazil, for instance) and FAO INFOODS offers a rich source of information through its Food Composition Database for Biodiversity (BioFoodComp4.0) (FAO, 2017). In cases where micronutrient content is unknown, it can be estimated based on a similar food or categorized according to the common nutritional traits of its food-group characteristics (for example, dark green leafy vegetable which can contain iron and vitamin A).

Local and scientific knowledge of prioritized species is essential, as some may have toxic or anti-nutrient properties and must be consumed in small amounts or processed in special ways to reduce toxin content. The promotion of wild species should also be undertaken with care to avoid over-harvesting; domestication can be promoted to overcome that risk.

Importantly, though, the locally available biodiversity may not be sufficient to address all issues related to poor diet quality and nutrition. Combining them with other approaches, including the introduction of nutritious species from elsewhere, may be required to plug some nutrition gaps.

CONCLUSIONS

This NUS approach is well suited to rural communities that manage and live in areas with high levels of biodiversity, especially indigenous peoples. NUS can be integrated into existing extension programmes that focus on commodity species, to improve the diversity and quality of foods available in rural food environments – both directly to households through self-production and through local market and retail outlets. NUS fruit and vegetables, for example, should be considered in any project aimed at increasing the availability and marketing of major staples.

To help extension agents integrate a nutritious NUS approach into existing programmes, supportive national and local policies are needed that recognize these species' value in improving the diversity of nutritious foods available in rural food environments – and hence rural diets and nutrition and the quality and resilience of rural livelihoods (King et al., 2017). It is equally important, however, that we encourage large-scale private-sector investment in NUS production, utilization in food formulation and marketing in modern retail outlets, including supermarkets. Public and private policies should ideally allocate specific funding and provide programmatic support for NUS development (Notaro et al., 2017). There are numerous opportunities to include nutritious NUS in school feeding programmes, tourism initiatives and national procurement programmes, all of which would help to fuel consumer demand for these resources.

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Annex 1. EXAMPLES OF NUS FROM AROUND THE WORLD, WITH VARYING LEVELS OF USE AND MARKETING

The Americas

Latin name	Common name	Family	Notes
Chenopodium quinoa *Amaranthus caudatus* *Chenopodium pallidicaule*	Quinoa Cañahua or cañihua Amaranth	*Chenopodiaceae* *Chenopodiaceae* *Amaranthaceae*	These pseudo-cereals, originating from the Andes, are very hardy and rich in protein. Out of the three, quinoa is on its way to becoming a global commodity after a major promotional campaign carried out by the United Nations in 2013. A tolerance to low temperatures (found in canahua, not in quinoa) has become a precious trait for local farmers contending with early frost due to climate change.
Opuntia ficus indica	Prickly pear	*Cactaceae*	Use of this drought-resistant, juicy fruit and vegetable from central America is becoming increasingly popular in drought-prone regions of the world, where it is used also for fodder and fencing purposes.
Hylocereus undatus	Dragon fruit (pitaya)	*Cactaceae*	This delicious fruit is now being exported to Europe and cultivated in greenhouses in Israel's desert regions. One increasingly popular use is in ice-cream manufacturing.
Bactris gasipaes	Peach palm	*Arecaceae*	The peach palm's fruit is used in many food preparations (sweet and savoury). Palm hearts are extracted from the trees and are seeing a rapid rise in demand around the world. There is a risk of the genetic erosion of species such as the acai palm, *Euterpe oleracea*, but the peach palm grows rapidly, which should help to offset this erosion if promoted.

Africa

Latin name	Common name	Family	Notes
Vigna subterranea	Bambara groundnut	*Leguminosae*	The Bambara groundnut is a good source of protein and highly resilient to drought conditions. Still, the species is at the margin of agricultural production in most African countries. It is being increasingly commercialized as a canned food in a few countries, such as Ghana and South Africa.
Digitaria exilis	Fonio	*Gramineae*	Fonio is a very small cereal grown in the Sahelian countries, but is a champion when it comes to drought resistance. The cereal has a good nutritional profile, including high values of zinc and iron, compared with rice. Yet, it is a species in which there has been little R&D investment.
Cleome gynandra	African cabbage	*Cleomaceae*	One of the most popular leafy vegetables in the region, African cabbage, is almost unknown elsewhere. The leaves are very rich in beta-carotene, folic acid, ascorbic acid, calcium and other important micronutrients. It is only over the past 20 years or so that this nutritious food has commanded attention in formal markets and supermarkets (in Kenya and Tanzania, for example), thanks to promotional campaigns.
Corchorus olitorius	Jute mallow	*Malvaceae*	Fresh leaves and young fruits are used as a vegetable, the dried leaves are used for tea and as a soup thickener. It is highly popular in Egypt as an ingredient in a popular soup, but far less so in other sub-Saharan countries, where its resilience and high nutrition profile could be most beneficial to farmers and consumers.
Solenostemon rotundifolius	Frafra potato	*Lamiaceae*	Its tasty tubers are eaten as a relish with a starchy staple food. It has seen a recent decline in consumption, making it a food rarity, but is still cultivated in some West African countries and in South Africa. Its ability to grow in dryland regions characterized by poor soils makes it an ideal option as a crop for coping with climate change.

Europe

Latin name	Common name	Family	Notes
Eruca sativa *Diplotaxis tenuifolia* *Diplotaxis muralis*	Rocket	*Brassicaceae*	A spicy leafy vegetable from the Mediterranean, which has become an almost indispensable ingredient in salads in Europe, Australia and North America, but is as yet unknown in many other regions of the world.
Triticum monococcum *Triticum dicoccum* *Triticum spelta*	Hulled wheats: Einkorn Emmer Spelt	*Graminaeae*	Once the wheats used by the Pharaohs, einkorn is today a relic species. Emmer and spelt have been promoted in Italy over the past 20 years and are much sought after as specialty foods today; their hardiness and ability to grow in poor soils (a feature appreciated by the Romans) could be leveraged for cultivating cereals in stressful conditions.
Cydonia oblonga	Quince	*Rosaceae*	Intercropped in small quantities in mixed orchards with apples and other fruit trees, the quince fruit is appreciated for its intense aroma, flavour and tartness. It is commonly used in stews (in the Middle East) or in jams, marmalades and sweets.
Ceratonia siliqua	Carob	*Leguminoseae*	Its dried, toasted pods are often used as a cocoa substitute in carob bars, sold in health-food stores. Owing to its drought resistance, it is well adapted to the conditions of the Mediterranean region and could be better valued in areas characterized by poor soils.
Artemisia dracunculus	Tarragon	*Asteraceae*	Appreciated for their flavour, tarragon leaves are a common herb in French cookery. However, they are also consumed fresh as an appetizer in some countries (in Syria, for example) and added to traditional dishes in countries such as Iran and Slovenia.

Asia-Pacific

Latin name	Common name	Family	Notes
Moringa oleifera	Moringa	*Moringaceae*	A shrub, native to the Himalayas but used across Asia, its leaves are increasingly being promoted around the globe as a nutraceutical and food supplement due to their high content of vitamin A, vitamin C, iron, calcium and protein.
Setaria italica *Panicum miliaceum* *Eleusine coracana* *Paspalum scrobiculatum* *Panicum sumatrense* *Echinochloa colona*	Foxtail millet Proso millet Finger millet Kodo millet Little millet Barnyard millet	*Gramineae*	Known as minor millets, and more recently termed nutri-cereals, these species are very rich in minerals (such as iron and calcium) and other micronutrients (folic acid, for example). They are resilient and hardy crops and can grow in tough conditions. Because of these traits, they were recently listed in India's Food Security Act and included in its public distribution system, along with wheat and rice, which should prove a major breakthrough in terms of their popular use in the country.
Colocasia esculenta	Taro	*Araceae*	Taro is a versatile plant that is primarily used for its roots, but also its leaves and flowers. The hardy tropical plant is both cultivated and harvested in the wild and is often an important source of nutrients in lean times.
Basella rubra	Malabar spinach	*Basellaceae*	Consumed in tropical Asia and Africa as a leafy vegetable, it is a fast-growing plant, with semi-succulent, heart-shaped leaves, rich in vitamins A and C and calcium. It is often used in stir-fries and to thicken soups.
Eleagnus angustifolia	Russian olives	*Elaeagnaceae*	A hardy shrub native to west and central Asia with sweet edible fruit, the Russian olive plant can store nitrogen in its roots, allowing it to thrive in poor soils with bare mineral substrate.
Phyllanthus emblica	Amla	*Phyllanthaceae*	Its edible fruits are very rich in vitamin C and widely used to in pickling with salt, oil and spices. It is also consumed fresh and in the preparation of various dishes, including sweets, made by soaking the berries in sugar syrup.
Canarium ovatum	Pili nut	*Burseraceae*	A tropical tree, it produces nuts with kernels of a similar flavour to pumpkin seeds and, when roasted, pine nuts. The kernels are also used in chocolate, ice-cream and baked goods, while its young shoots and fruit pulp are used in salads and other dishes.

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The nutrition, safety and health implications of food hawking in traffic

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ABSTRACT

- This article shows how the food environment is changing in urban Ghana, focusing on foods hawked in the midst of heavy traffic on city streets.
- Various Ghanaian meals - both health-promoting foods made from natural ingredients and attractively packaged and branded convenience foods - are being produced and hawked on traffic-laden streets, mostly by young people.
- These foods potentially meet the dietary needs of time-constrained urban commuters, but inappropriate and unhygienic processing and handling practices, poor personal hygiene and the polluted selling environment can affect their nutritional, sensory and safety properties.
- Taking into account the nutritional, health and economic importance of the traffic food environment, as well as its potential detrimental effects, we ask whether this practice should be encouraged and regulated, or limited to low-risk foods.
- Studies are needed to assess (1) the nutritional, safety and sensory properties of foods sold in traffic, (2) consumers' perceptions and experience of traffic-vended foods and (3) hawkers' knowledge of, attitudes to and practices in relation to nutrition, food safety, health and accident risk.

INTRODUCTION

Food environments encompass all of the foods that are available and accessible to people in the settings in which they go about their daily routines (Herforth and Ahmed, 2015). They include supermarkets, small retail outlets, wet markets, street-food stalls, coffee shops, tea houses, school canteens, restaurants and all the other venues where people procure and/or eat food.

Food is essential to an active and healthy life. Hence, every day, people search for different kinds of food in their food environment. Urbanization, rapid economic development, improved incomes and growing numbers of time-constrained consumers have created a shift towards out-of-home, ready-to-eat convenience foods among urban dwellers (Kennedy et al., 2004). In urban Ghana, these ready-to-eat foods are mainly obtained from informal food vendors and traditional eateries (*chop bars*), in addition to formal outlets, such as restaurants. Some consumers obtain ready-to-eat foods from hawkers who sell in lanes of heavy traffic on busy streets, especially during the morning rush hour.

Food hawking between cars and lanes in traffic-laden streets has been practised in Accra, Ghana's capital city, for a long time. Until recently, foods sold in this way were mostly snacks, such as plantain chips, cookies, bread and baked or fried pastries, such as pies and doughnuts, as well as assorted drinks, such as water, soft drinks, malt and energy drinks, and ice-creams. Now, however, urban transformation has led to a wider range of food choices, including prepared meals and freshly cut and packaged fruit.

Hawking in the cities of Ghana has enjoyed immense attention, both in the media and in academia, due to the ever-increasing numbers of youth engaged in it (Asiedu and Agyei-Mensah, 2008). Every day, young men and women are found in heavy traffic, selling goods from food items, toys and underwear to newspapers. Perilously, they compete with cars for space and chase after vehicles in a bid to make a sale. Concerns expressed over street hawking have included congestion and

the friction that ensues between street hawkers and city authorities, as this type of trading is unauthorized in Ghana (Jimu, 2005; Nduma, 1990). In this article, we discuss the contribution of the traffic food environment to urban food provisioning, as well as its nutrition, food-safety and health implications, and suggest some areas for future research.

CHANGES OBSERVED IN THE FOOD ENVIRONMENT IN TRAFFIC-LADEN STREETS

Increasingly, consumers in developing countries have become more aware of and concerned about the nutritional, sensory, safety, health and environmental aspects of the food they eat (Oosterveer, 2005; da Costa et al., 2000). This increase in awareness is largely due to the rising flow of information, especially the "pooling of knowledge" from the internet and social media (Giddens, 1990). As a result, there is greater consumer demand for healthy, nutritious and differentiated food products (Linneman et al., 1999) and food companies are now modifying their products to meet this demand. In the following paragraphs, we discuss the potential drivers of the changes observed in the traffic food environment in Accra, Ghana.

First, Ghanaians typically like to eat "real" or traditional food, such as soups or stews and starches at lunch and dinner. In most cases, they like to eat similar items for breakfast to set them up for the day (Osseo-Asare, 2005). Furthermore, Ghanaians like hot, spicy foods, believing that they cool the body and cleanse it of impurities (Salm and Falola, 2002). It is, therefore, unsurprising that different types of cooked meals are being hawked between lanes of traffic in busy streets. Dishes such as *jollof*,[1] *waakye*,[2] and *kenkey*[3] are sold in traffic from about 5:30 a.m. to 1:00 p.m. every day.

More recent additions to the street breakfast menu include lighter dishes, including different types of porridge made from maize, millet, sorghum, wheat or oats. These breakfast cereals are usually served with cupcakes, bananas, boiled eggs, muffins and/or fruit juices. Such foods were previously only available at specific outlets. They are attractively packaged, well branded and usually sold by young men and women, some of them in branded t-shirts, aprons and caps. One can find brand names such as Awo Komi (*kenkey*), Koko King (porridges) and Atomic Waakye (*waakye* with accompaniments such as fish, meat, *gari*,[4] salad or spaghetti).

Second, the traffic food environment is changing in response to various diet-related health concerns, which are known to be worsened by low consumption of fruit and vegetables and a high intake of foods containing artificial ingredients. Traffic hawkers have, therefore, introduced different types of fresh-cut fruits and juices, as well as products such as *brukina* (a drink made from millet and cow's milk), tiger-nut juice and soy milk.

Third, the rise in demand for convenience foods from Accra's large number of time-constrained urban dwellers has created a market for prepared foods among commuters. Because of the heavy traffic jams on most streets in the capital, commuters tend to leave home early, before breakfast. Consequently, both drivers and passengers are happy to save time and effort by buying convenience foods, previously only available from outlets away from the roads, from the street hawkers. The foods are well packaged and secure for ease of transportation. Furthermore, for some people, the effort and time involved in washing, peeling and cutting fruit was a barrier to fruit consumption (Omari et al., 2017), so the introduction of assorted pre-cut fresh fruit to the range of food products sold in traffic-laden streets has been timely.

Fourth, Ghana's alarming rates of youth and graduate unemployment have prompted young people to seek jobs in the food business. Atomic Waakye, for example, is a business venture established by three Ghanaian university graduates with bachelor's degrees in natural resource management, political science, and linguistics and economics. The founder and chief executive of Koko King holds a master's degree in finance. These and other entrepreneurs employ young people to prepare and sell the foods at various outlets, including in traffic. Thus, Ghana's youth have not only found job opportunities in these food businesses, but have become more innovative and creative, and are introducing elements of convenience into their operations, so that various types of food can easily be accessed by consumers, including commuters.

1 A one-pot dish prepared by boiling rice in tomato stew/sauce, which is eaten with a sauce, meat or fish, and sometimes vegetables.

2 Rice and cowpeas boiled together and eaten with stew, meat or fish, and sometimes vegetables.

3 A meal prepared from fermented maize dough, usually served with ground chilli peppers, thinly sliced tomatoes, onions and fried fish.

4 A starch made from cassava root.

POTENTIAL CONTRIBUTIONS OF THE TRAFFIC FOOD ENVIRONMENT TO NUTRITION AND HEALTH OUTCOMES

There is no doubt that the traffic food environment helps to meet the dietary needs of urban dwellers in several ways. While some commuters take the food to their destination to be eaten later, others start eating while stuck in traffic. This ability to eat in transit means fewer people skip breakfast, reducing associated health risks, such as the increased risk of heart disease (Shafiee et al., 2013). For example, US men who skipped breakfast were found to be 27 percent more likely to develop coronary heart disease (Cahill et al., 2013). A large meta-analysis of studies found that people who skip breakfast have a 15-21 percent higher chance of developing type 2 diabetes than those who eat breakfast regularly (Bi et al., 2015). The Ghanaian commuters who buy food in traffic include schoolchildren. Hence, children have access to breakfast and adequate time to eat it, fending off the effects of skipping breakfast, which include cognitive impairment, a lack of concentration and poor academic performance (Liu et al., 2013).

The gradual inclusion of foods produced from natural and fresh ingredients in the range of hawkers' foods is a way of ensuring that commuters have access to a wide variety of nutritious and healthy meals, snacks and drinks. Of particular importance are the peeled, cut and packaged fruits, which can include mango, watermelon, papaya, apple, pineapple, grapes and even cucumber.

Fruit and vegetables are the main dietary sources of important nutrients, such as carotenoids, tocopherols and ascorbic acid, which play a vital role in the prevention of various diseases. Fruit and vegetables also contain substances such as anthocyanin and phenolic compounds that have antioxidant properties and can remove free radicals from the body (Nichenametla et al., 2006); these are particularly important in the prevention and treatment of cancer. The availability of *brukina* and tiger-nut drinks, as well as single-strength (not from concentrate) fruit juices not only increases the range of value-added products made from locally produced raw materials, but also ensures that commuters have access to nutritious and healthy alternatives to soft and energy drinks high in calories and artificial ingredients.

THE FOOD SAFETY, NUTRITION AND HEALTH IMPLICATIONS OF THE TRAFFIC FOOD ENVIRONMENT

Despite of the convenience, nutritional and health benefits of traffic hawkers' foods, there are certain conditions making the foods predisposed to certain hazards and risks. These include inappropriate and unhygienic processing and handling practices, the poor personal hygiene of vendors and the polluted vending environment. The early hour at which the hawkers start selling suggests that foods are prepared well in advance of the dawn commute. Some of the foods, such as *kenkey, waakye* and porridges, are transported to the roadside, where they are displayed on raised platforms, or placed in containers or ice-chests, which can also be used as food warmers. Some hawkers pick up the items from production sites, others produce the food items themselves. Among the food-safety and health concerns here is the fact that hawkers often handle the items directly and expose them to sunlight until they are purchased. Those who sell cold or chilled drinks often put ice blocks on the drinks, but the ice melts quickly because of the high temperatures of 25–35°C, depending on the time of year. The result is that foods that are supposed to be kept hot for safety end up being handled at lower temperatures, while those that require storage at low temperatures for safety are handled at higher temperatures - both of which are conducive to bacterial growth.

In Ghana, several studies (for example, Ackah et al., 2011; Mensah et al., 2001; 2002; Rheinländer et al., 2008; Addo et al., 2007) have found street foods to be microbiologically unsafe for consumption. A commuter who occasionally buys *brukina* noted that the drink can easily go bad, so he is particularly careful when buying that product. Other products, such as fresh fruit juices, ice-creams and yoghurts, suffer similar fates. These unhygienic cooking, selling and serving environments, as well as bacterial contamination, are major food-safety concerns for the Ghanaian public (Omari et al., 2018; Omari and Frempong, 2016). Apart from food-safety concerns, some foods lose their palatability when handled at inappropriate temperatures. For example, *kenkey* and its accompaniments, including fried fish, while nicely wrapped in paper packs, are often too cold at the time of purchase, reducing its sensory appeal and edibility.

Pre-cut fresh fruit poses microbial risks, as contamination can occur at the farm, during processing (such as peeling, slicing and shredding), during washing (especially when washing water is contaminated with microbes) and during storage and selling. Over the past few decades, there has been an increase in outbreaks of food-borne illness, largely caused by e-coli and salmonella present in pre-cut fruit (Harris et al., 2003). Although proper disinfection procedures are critical to ensuring the safety of fresh fruit and vegetables, it is unclear whether such procedures are applied by fruit processors before packaging for the market.

Mensah et al. (2002) report that in Ghana, the proper handling of processing equipment, the storage of cooked food, handwashing practices and environmental hygiene need attention to improve the safety of street-vended foods in urban centres. Because of poor handling practices, the safety and quality of products begin to deteriorate even before the manufacturers' recommended dates. This is in line with the findings of Podolak et al. (2010), that even in low-risk foods, such as bakery products, salmonella cross-contamination can occur due to factors such as poor sanitation practices, poor equipment design and poor ingredient control.

The second food-safety concern is the absence of toilets and handwashing facilities in traffic-laden streets. This increases the food-safety risks brought about by poor personal hygiene. Also, like many street-food vendors, the hawkers selling in between lanes of traffic are not licensed to operate food businesses, so may not have undergone any of the medical examinations required by the Metropolitan Public Health Department prior to handling food (Tomlins et al., 2002). In most instances, however, this medical examination and other hygiene and food-safety requirements are not enforced in any case, so some vendors do not even know they require medical certificates to operate their food businesses (Omari and Frempong, 2016). The result is the potential contamination of food by the hawkers themselves, as some may be carriers of *salmonella paratyphi*, for example (Feglo et al., 2004).

Third, Accra's roads can be dusty, especially during the dry Harmattan season. Dust and vehicle exhaust can be deposited on food packaging and contaminate food that is exposed to these contaminants for hours. This is even more dangerous in the case of unpackaged peeled oranges and bananas. Dust is a major source of harmful biological agents, such as bacteria and mould, and chemical agents, such as lead and arsenic (Glorennec et al., 2012). Long-term exposure to arsenic can carry increased risk of cancer of the bladder, lung and skin, skin lesions, eye irritation and nervous-system problems (Natural Healthcare Canada, 2007). Exhaust fumes can introduce many chemical substances to the roadside foods, such as polycyclic aromatic hydrocarbons, which are carcinogenic (EFSA, 2008). Just as Osibanjo and Ajayi (1989) and Awofolu (2004) found in Nigeria, lead is still added to petrol in Ghana, and many commercial buses are not well maintained, so a high volume of exhaust fumes are released into the environment and can be deposited on traffic food. Awofolu (2004) found the concentration of deposited lead in Nigeria to be below regulatory limits, however, continual consumption of contaminated food could result in an accumulation of lead, with serious health implications for consumers. Absorbing too much lead through contaminated products can cause headaches, anaemia, blindness, kidney disease, paralysis and even brain damage, and have adverse effects on the nervous system and neurological development of children (Natural Healthcare Canada, 2007).

From a nutritional point of view, improper packaging and storage, and the exposure of foods to high temperatures and sunlight can lead to the loss of certain nutrients, especially water-soluble vitamins, such as the B vitamins and vitamin C. Cut fruit, in particular, has a greater surface area that allows oxygen to break down vitamins faster (Barry-Ryan, Pacussi and O'Beirne, 2000). Handling cut fruit and juices at inappropriate temperatures can increase enzymatic actions, leading to the destruction of vitamins, browning and fermentation, which can reduce product acceptability and consumption.

REUTER NOPALZIN II

Figure 1.

FROM LEFT: HAWKER SELLING PACKED WAAKYE TO A COMMUTER; A HAWKER CARRYING BOTTLED BRUKINA; A HAWKER HOLDING PACKED *JOLLOF* RICE

Source: *Authors' pictures*

Figure 2.

DIFFERENT WAYS IN WHICH FOODS ARE HANDLED BY THE ROADSIDE

Source: *Authors' pictures*

CONCLUSION

Food environments determine what foods consumers can access at a given time, at what price and with what degree of convenience, quality and safety. Hence, food environments can both constrain and prompt food choices. The traffic food environment in Accra no doubt provides food for urban commuters; however, their food choices, to some extent, depend on their knowledge, perceptions and attitudes towards safe, nutritious and healthy foods.

Clearly, the conditions in which foods are handled in traffic-laden streets can impact their nutritional, sensory and safety properties. Therefore, there is a need to monitor critical steps in the preparation, transportation, packaging and marketing of this food to ensure adequate safety, quality and nutrient retention and, thus, consumer acceptance and good nutrition and health outcomes.

Although food hawking in traffic has become a major business venture, it is worth noting that the practice is illegal in Ghana. As a result, city authorities often attempt to evict the hawkers from the streets – though with little to no success.
The following questions are worth considering when planning future interventions or research:

- Should the traffic food environment be encouraged, or should it be limited to only low-risk foods, such as shelf-stable, packaged foods, for example, bread, biscuits, dried fruits and plantain chips, which are less likely to cause food poisoning?
- Should city authorities accept this food environment and work with food regulators to put measures in place to regulate the hawkers' operations?
- What alternatives are available to ensure the delivery of healthy, nutritious, safe and convenience foods to time-constrained urban consumers?

It will be useful for future studies to examine the nutritional, safety and sensory properties of foods sold in traffic, compared with those obtained from other outlets. Other research recommendations are an assessment of consumer perceptions and experiences with traffic-vended foods and an examination of how the hawkers operate their businesses, including their knowledge, attitudes and practices with regard to nutrition and food safety. A further research question is whether hawkers would consider alternative locations, particularly considering the health and accident risks to which they are exposed.

Figure 3.
HAWKERS DISPLAYING PACKAGED *KENKEY*

Source: *https://www.blakkpepper.com/2018/05/meet-benjamin-dodoo-the-school-drop-out-leading-the-awo-komi-kenkey-revolution*.

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Exploring socio-cultural aspects of the food environment: Study perspectives from Pakistan

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ABSTRACT

- We explored the personal food environment through the consumption of biofortified and non-biofortified wheat flour provided as part of a community-based intervention study in rural Pakistan.
- Participants reported that the taste, kneading qualities and digestibility of the flour provided to participants were important factors affecting its desirability and their willingness to engage in the study.
- Fears that consumption of the flour might negatively affect fertility were alleviated through effective engagement with village elders.
- The results clearly illustrate the importance of cultural context when considering data-collection approaches.
- This study offers novel insights into the views and perspectives of community members. There was no evidence of negative views towards biofortified flour, provided it remains affordable.

INTRODUCTION

Zinc deficiency is widespread in Pakistan, underlying a significant disease burden (Bhutta et al., 2011). Biofortification – the production of staple crops with greater concentrations of micronutrients in the edible portion – may be a cost-effective way to alleviate it (Joy et al., 2017; Cakmak and Kutman, 2018). A variety of zinc-biofortified wheat (Zincol-2016/NR-421) has been developed and distributed to more than half a million people in Pakistan and new varieties are being developed (HarvestPlus, 2017).

The BiZiFED project is investigating the potential of biofortification as a strategy for alleviating zinc deficiency in Pakistan (Lowe et al., 2018; Ohly et al., 2019). A randomised controlled trial (RCT) of double-blind, crossover design was conducted to demonstrate the effects of consuming flour made from Zincol-2016 wheat (a high-zinc variety with an application of zinc fertilizer) on the zinc intake and status of women of child-bearing age in a low-resource setting (Lowe et al., 2018). The findings will be published in 2019.

The RCT was conducted in a marginalised community of brick kiln workers in North West Pakistan. This community was chosen because previous studies had indicated that zinc deficiency was widespread, that people's diets were limited and primarily plant-based (thus low in bioavailable zinc) and that the dietary staple was wheat (Khan et al., 2017). Wheat flour is used to make chapati, roti and paratha breads, which are typically consumed with every meal. Fifty households were provided with flour for a 16-week period (crossover design with eight weeks biofortified and eight weeks control, order unknown) and asked to consume the flour daily. Enough flour was provided to meet the requirements of all household members.

The RCT provided an opportunity to explore the acceptability of consuming biofortified wheat flour in a marginalised population. Notably, the same population had previously demonstrated a low uptake of iodised salt, despite it being available in markets. The largest barrier to the uptake of iodised salt was a belief that its consumption would negatively affect reproduction (Lowe et al., 2015).

Turner et al. (2018) define the food environment as "the interface that mediates people's food acquisition and consumption within the wider food system". An individual's food environment is determined by "external dimensions", such as product availability and prices, and "personal dimensions", such as accessibility, affordability and desirability.

In this qualitative study, we aimed to explore the personal food environment of the trial participants, potentially informing strategies to promote the adoption and scale-up of biofortified wheat in Pakistan. We also were able to consider how the cultural context of the participants might modify their responses and the effectiveness of our data-collection approaches.

METHODS

Study participants

The study was conducted in a poor and marginalised community in Khyber Pakhtunkhwa (KPK) Province, North West Pakistan. A randomly selected subset of 10 (out of 50) households from the RCT were selected for the qualitative study. Five male heads of household and five female trial participants were invited to participate in individual interviews. Recruitment and data collection were completed in April and May 2018.

Ethics and consent

Members of the research team familiar with the community consulted the *jirga* –a committee of respected village elders– to seek approval to conduct interviews with a sub-sample of trial participants. Subsequently, individual consent was obtained. An information sheet was provided and individuals were given time to consider their participation and ask questions, after which oral consent to participate was obtained. The information sheet was read to participants who were illiterate. Participants were anonymised using unique ID numbers allocated during the RCT. Ethical approval for this qualitative study was obtained from the University of Central Lancashire Science, Technology, Engineering, Medicine and Health Ethics Committee (reference STEMH 693).

Data collection and analysis

A semi-structured interview schedule was developed collaboratively by the research team. Questions related to participants' experience of using the flour which had been distributed to them, comparisons with their usual purchased flour, perception of health benefits, willingness to purchase biofortified flour if it became available in the future and wider community perception. It is important to note that the RCT had a double-blind, crossover design (Lowe et al., 2018) and that participants were not aware whether they were consuming biofortified flour or the control (non-biofortified) flour.

Interviews were conducted by a research assistant from Khyber Medical University who was already familiar to and trusted by the community. They were conducted in the local language of Pashto and then transcribed into written Pashto. The transcripts were then translated into audio English. A second transcription into written English was completed at the University of Central Lancashire. The final transcripts were then checked for accuracy.

Data coding and thematic analysis were completed and the longest transcript (around 10 percent of the data) was subject to a second review. All of the study's co-authors were involved in discussions on themes arising from the data during project meetings.

RESULTS

Study population and the local food environment

Interviews were conducted with five men (heads of household) and five women (trial participants). None of the participants had completed formal education. The local food environment was assessed as part of formative research for the trial and in consultation with local stakeholders.

Households in the study area typically purchase wheat flour from vendors in the community. These vendors source their flour from wholesalers or local chakkis (small-scale mills). Flour is normally purchased by male heads of household, while women are normally responsible for making the bread. Hence, the perceptions of both men and women can influence the desirability and uptake of biofortified flour.

Four main themes were identified that illustrated consumer perspectives on the introduction and use of biofortified flour in the rural community.

Preference for the distributed flour

All study participants said they preferred the flour provided during the trial to their usual flour. There was no indication from the transcripts that they could tell the difference between biofortified flour and control flour (provided for eight weeks each, order unknown), but they found the distributed flour easier to knead and the bread was softer, sweeter and stayed fresh for longer.

> *This flour it kneads very nicely and makes a very nice bread which is better than the bread from the market flour. When we eat paratha in the morning it makes a very good sound and it tastes very nice.* (BZ28; female)

> *The children used to love it and all the times they used to have bread in their hand and it had a very special, sweet taste and the children used to eat it with a great interest.* (BZ45; male)

Some participants explained that they had previously bought white (refined) flour from the market. Since participating in the BiZiFED project, they have switched to brown flour, because it is more like the flour they received during the trial. It is also cheaper, so they have saved money.

> *We like brown flour because we have benefitted from it and it is only 700 rupees a sack and we buy it because we have used the brown zinc-enriched flour earlier.* (BZ28; female)

Perceived health benefits

Most participants reported health benefits during the trial, for themselves and other family members. These perceived benefits included improved digestion, appetite, strength, energy levels, skin complexion, nail and hair condition, and reduced joint pain.

> *It was good for our digestion – all of us, the children, the adults. The flour that we used to use before this, it was not good, but with this flour, the digestion of the children and the adults all are very good.* (BZ49; female)

Participants were aware of the higher zinc content of the biofortified flour because this information was provided before the start of the RCT. They were also informed about the importance of zinc to the human body for growth, immune function, wound healing and diarrhoea prevention. However, some of the perceived health benefits reported by participants were not included in the information provided. Furthermore, participants did not know which arm of the trial they were in and, therefore whether they received biofortified flour followed by non-biofortified flour, or vice versa.

Some participants referred to previous deficiencies, which they felt had been alleviated during the trial.

> *We are all labourers in this area and if we don't eat very well we don't have strength to work and once if you eat well, then you have more strength and this is very good flour and gives us good strength … it has helped my wife's blood deficiency, has helped her brittleness of nails and all that has finished, my own problems with digestion has improved.* (BZ23; male)

When asked what she would tell her neighbours about biofortified flour, this participant was keen to emphasise the potential health benefits.

> *We will tell them that the benefits include that your health and stomach digestion will be good, you will gain weight, your hair will not fall and the boils and the spots on your face will get better.* (BZ49; female)

Affordability

When asked if they would like to buy more of the biofortified flour, most participants said they would, depending on the price. It would need to be affordable to be sustainable.

> *We would try because it is good flour. It does not leave any bad impact on one's health. But it is the matter of affordability. Everybody looks at his affordability.* (BZ15; female)

This participant said he would be willing to spend more on biofortified flour because of the potential (and perceived) health benefits.

> *We will definitely try to buy this flour because it has benefitted our body and if it will save us money on the medicine and even if this is 20 rupees more expensive we will buy it.* (BZ45; male)

Suspicions and fears

Despite the community engagement undertaken prior to the start of the RCT, some community members were suspicious of the biofortified flour. Rumours were spread about birth control, because we recruited women of reproductive age. Some participants described how they put their fears aside and became more confident after engaging with the trial.

> *People used to say it is for birth control, it does this and it does that, and there was some fear in our hearts as well, but now we don't have that fear, and if this flour becomes available in our village, we will buy it with great confidence.* (BZ23; male)

Some participants reported that other community members showed increasing interest in the flour as the trial progressed.

> *Once we started to receive the flour, people used to say that there are a lot of chemicals in this flour and you will not have any children and it will spread diseases and people have just made this propaganda and drama, but once we started to receive it and other people have also received it and then they have accepted it that they also wanted the flour.*
> (BZ39; male)

> *They used to tell us don't eat this flour because this is for family planning and the boys and girls who will use it they will not have children later on. We used to say that nothing will happen, and this flour is beneficial to our body and there is no disadvantage of it. Then they said that's ok if you are going to eat it, then we will eat it as well, and they became very happy and they used to say that this is very good flour.*
> (BZ28; female)

DISCUSSION

Principal findings

There is rapid scale-up of zinc-biofortified varieties of wheat in Pakistan with government and private sector support. Context-specific evidence is required to understand the potential impact of adopting zinc-biofortified wheat on zinc intakes and status. Personal aspects of the food environment, including desirability, are likely to be an important determinant of the popularity and adoption of biofortified flour.

Participants reported that taste, kneading qualities and digestibility of the flour were all important factors affecting the appeal of the distributed flour. These aspects of flour quality should be tested when developing and releasing new varieties of biofortified wheat.

Initially, many of the participants feared that consumption of the flour might negatively affect fertility. Similar fears had previously hindered the uptake of iodised salt in Pakistan (Lowe et al., 2015). However, following consultation with trusted members of the research team, villagers' fears were allayed. The *jirga* elders played an important part in permitting the study and their support may be necessary to achieve high adoption rates of biofortified wheat varieties in local communities.

In other areas of Pakistan, Lady Health Workers (LHWs) could be trained to support the introduction and acceptance of biofortified flour (World Health Organization and Global Health Workforce Alliance, 2008). However, women need to complete at least eight years of education to be eligible for the LHW programme and there were no LHWs in the trial community, where access to education is extremely limited.

Study strengths and limitations

Turner et al. (2018) note that qualitative research on food environments "remains underutilized yet has great potential" and may help to "reveal greater insights into issues such as which dimensions people perceive to be important in shaping their food acquisition and consumption". To date, there has been little qualitative study of the factors that may affect consumer uptake of biofortified wheat in Pakistan and the qualitative data generated in this study provide valuable insights into the acceptance and desirability of biofortified flour in a marginalised population.

Study limitations must be acknowledged. Social desirability bias may have influenced the responses of community members. As trial participants, they received free flour for five months – a considerable incentive in such a poor community. The interview data may reflect gratitude or desire for more free flour, despite clear communication about the purpose of the research.

Furthermore, the interviews demonstrated a significant cultural component in the responses. For example, the transcripts were remarkably similar in content and it seemed that participants were not willing to engage in in-depth

discussions. The research team felt that participants may have been uncertain how they were expected to answer the questions and did not want to disappoint the researcher, who was also responsible for providing the flour during the RCT. In future studies, additional data-collection methods (such as focus-group discussions) will be considered to improve the quality of the data.

Relevance

There are a range of strategies to alleviate zinc deficiency including dietary diversification, food fortification at processing stage, and biofortification. Two main arguments in favour of biofortification are the potential to scale-up rapidly to reach large numbers of people and the potential to reach remote and marginalised populations whose diets are dominated by staple cereals. This study offers novel insights into the views and perspectives of community members and suggests that biofortified flour could be popular with consumers, provided it remains affordable. Fears that the flour might lead to infertility, in other words, that biofortification might be a covert family planning tool, need to be addressed through community engagement. Existing community networks (where present, such as LHWs) and those in positions of authority (such as *jirga* elders) should be engaged early on if marginalised populations are to accept biofortified flour. Further research is needed to understand how socio-cultural factors may affect the sustainable uptake of biofortified wheat in wider population groups in Pakistan.

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Advancing healthy and sustainable food environments: The Flathead Reservation case study

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ABSTRACT

This case study describes a methodological approach to evaluating and improving food environments in an indigenous community in the United States of America. A community-research partnership was developed to support healthy diets from sustainable food systems. Our team implemented complementary methodologies to evaluate multiple dimensions of the food environment, including food availability, convenience, affordability and desirability. Our findings were used to design and implement multiphase food-environment interventions that elucidated the following: (1) food-environment measurements should be multifaceted and context-specific; (2) food desirability, including sensory attributes, diversity and phytonutrient quality, are important but overlooked aspects of the food environment; (3) successful food-environment interventions are community-based and incremental; (4) food-environment interventions should seek to forge links with existing institutional structures to influence policy; and (5) findings from food-environment interventions should be disseminated in various ways to diverse stakeholders.

INTRODUCTION

Nestled in the Mission Mountain Range of the Rocky Mountains in the United States of America, amid forests, valleys and rivers, is the Flathead Reservation. It is the home to Montana's Bitterroot Salish, Kootenai and Pend d'Oreilles tribes. Historically, these indigenous peoples relied on the wild foods of their surroundings by hunting, fishing and gathering (Figure 1). The colonization of tribal lands resulted in a dramatic shift from wild food environments (Ahmed and Herforth, 2017) to built ones, comprised largely of processed foods high in refined sugars, saturated fats and salt (Byker Shanks et al., 2016). The transition from place-based food systems to processed foods has been linked to the nutrition transition, with notable implications for health (Kuhnlein and Receveur, 1996; Popkin, 2001).

Food environments are the consumer interface of the food system that influence the availability, affordability, convenience and desirability of food (Herforth and Ahmed, 2015). The concept of the food environment has evolved over the past 15 years to recognize the complex socio-ecological determinants of diets (Story et al., 2008; Herforth et al., 2017b). Numerous studies have highlighted disparities in food environments among indigenous, rural and other minority communities (Story et al., 2008; Lutfiyya et al., 2012). Despite goals to eliminate health disparities and food insecurity, minority groups report unequal rates of food insecurity and diet-related chronic disease compared with the overall population (Blue Bird Jernigan et al., 2017; Satia et al., 2005; Rabbitt et al., 2016). In the United States of America, one in four Native Americans is food insecure, double the national average (Blue Bird Jernigan et al., 2017).

The Food Distribution Program on Indian Reservations (FDPIR) emerged in 1973 as a federal assistance programme to address food security challenges in Native American communities in the United States of America. Through the FDPIR, low-income residents living on and near Native American reservations receive a monthly supply of foods. While the FDPIR has

become critical for supporting local food security, it offers a very different food environment to the historical food environments of Native American communities. Canned, powdered and dried foods greatly outnumber fresh foods, with few or no local foods.

In response to the food and nutrition challenges experienced in Native American communities, we have fostered a community partnership over the past six years to evaluate and improve food environments on the Flathead Reservation. Our team comprises practitioners, researchers, food and nutrition stakeholders, policy-makers and student trainees from the Flathead Reservation, along with researcher partners from The Food and Health Lab at Montana State University. The overall goal of our project is to inform tribal and national food programmes, along with local enterprises, to improve access to foods that support sustainable diets that are affordable, convenient and desirable. Sustainable diets are defined as healthy diets from sustainable food systems that advance the human condition and conserve ecological resources in socially acceptable ways (Ahmed and Byker Shanks, 2019).

In this article, we share our community-based approach to examining and modifying food environments on the Flathead Reservation. First, we review research methodologies to evaluate the food environment, coupled with household surveys on perceptions of the food environment, food security and dietary quality. Next, we describe how we applied our food-environment and household surveys to design and implement community-based interventions to enhance food environments that support sustainable diets. We conclude by sharing lessons learned, with a view to advancing food environments through an evidence-based approach.

MULTIFACETED FOOD-ENVIRONMENT MEASUREMENTS

Multiple complementary research methods are needed to evaluate the multifaceted dimensions of the food environment. While over 500 food-environment research methods exist,

Figure 1. WILD FOOD ENVIRONMENTS OF THE BITTERROOT SALISH, KOOTENAI AND PEND D'OREILLES TRIBES

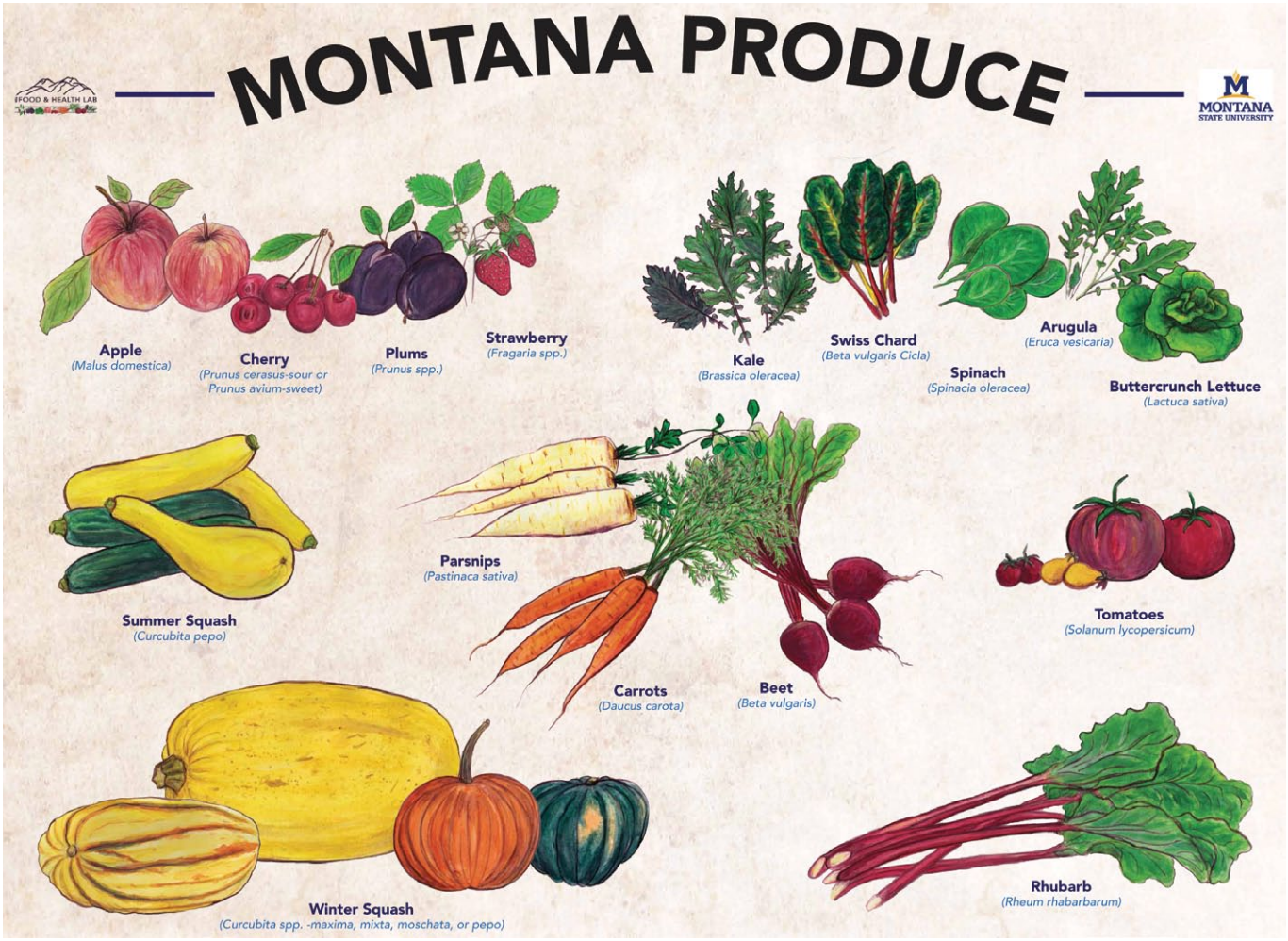
Source: *Illustration by Sashay Camel of the Flathead Reservation*

the majority use geographic analysis and observational tools to evaluate food availability and affordability (Herforth and Ahmed, 2015). There remains a need to evaluate the desirability aspect of the food environment in ways that are cross-culturally relevant (Herforth and Ahmed, 2015; Herforth et al., 2017a). Desirability of the food environment involves external factors, including marketing, product placement, social norms and food quality, that influence individual preferences and food choices (Ahmed et al., 2018). The need for measuring food desirability is especially important, as food preferences are a key component of international food security definitions (FAO, 2002; World Food Summit, 1996).

Our team developed and validated three methods to evaluate desirability of fruits and vegetables, which can be applied in diverse contexts, including the Produce Desirability (ProDes) sensory evaluation survey (Ahmed et al., 2018), the Produce Color Diversity (ProColor) inventory tool and total phenolic scores of produce (Ahmed and Byker Shanks, 2017). We focused on the desirability of fruits and vegetables, in recognition that dietary recommendations for produce consumption are not achieved across populations (Haack and Byker, 2014), particularly in minority communities in the United States of America (Lutfiyya et al., 2012), while the daily consumption of produce is associated with supporting nutrition and health (United States Department of Health and Human Services and USDA, 2015).

Table 1 describes the measurements we used to evaluate food availability, affordability and desirability. It also highlights results from our food-environment assessments and points to notable disparities in built food environments on the Flathead Reservation compared with more urban surrounding food environments. Evaluation of the FDPIR food environment using the Healthy Eating Index (HEI) found that the average total HEI score for five randomly selected food packages was 66 compared with the maximum HEI score of 100 for the diet recommended by national dietary guidelines (Byker Shanks et al., 2016). HEI results showed limited availability of nutrient-dense foods, including fresh fruits, vegetables, protein and whole grains (Byker Shanks et al., 2016).

Figure 2. FRUITS AND VEGETABLES PRODUCED IN MONTANA



Source: *Prepared by Angie Mangels.*

Table 1. MULTI-FACETED FOOD-ENVIRONMENT AND HOUSEHOLD-SURVEY MEASUREMENTS WITH FINDINGS ON THE FLATHEAD RESERVATION

Food-environment measurment	Description of food-environment measurment	Findings
Availability: The availability dimension of the food environment focuses on the presence of foods, including those that are healthy, unhealthy, sustainable, local and culturally relevant.		
HEI of food supply	The HEI is a measure of relative dietary quality compared with national dietary guidelines for Americans and can be used to measure both food supply in a given food environment and diets (USDA Food and Nutrition Service, 2019).	• Evaluation of the FDPIR food environment found that the average total HEI score for five randomly selected food packages was 66 compared with the maximum HEI score of 100 for the diet recommended by national dietary guidelines in the United States of America. • Results further show limited availability of adequate amounts of fresh fruits, vegetables, dairy, protein and whole grains – all nutrient-dense foods that mitigate diet-related chronic disease and support sustainable diets (Byker Shanks et al., 2015a).
Nutrition Environment Measures Survey – Stores (NEMS–S)	NEMS-S is among the most widely used food-environment measurements in the United States of America. It evaluates the built food environment according to availability and affordability of commonly consumed foods, as well as the quality of the 20 most commonly consumed fruits and vegetables (Glanz et al., 2007).	• For fruits and vegetables in all 20 study-site stores across Montana, the mean NEMS–S total score was 23.8 and the availability score was 17.1. • NEMS–S total scores and availability scores did not differ by rurality across sites (Byker Shanks et al., 2015a).
Farmers' Market Audit Tool	The Farmers' Market Audit Tool measures the overall availability of healthy foods at a farmers' market for various categories, including fruits and vegetables, meats, dairy and whole grains (Byker Shanks et al., 2015a).	• Findings from the Farmers' Market Audit Tool demonstrated little discrepancy based on location in our study, pointing to the valuable role of local seasonal fresh food markets for supporting diets and health (Byker Shanks et al., 2015a).
Affordability: The affordability dimension of the food environment focuses on the financial resources needed for food procurement, including the costs of healthy, unhealthy, sustainable, local and culturally relevant foods.		
NEMS–S	See above	• For fruits and vegetable in all 20 study-site stores across Montana, the mean NEMS–S price score was 2.9. • NEMS–S price scores did not differ by rurality across sites (Byker Shanks et al., 2015a).
Desirability: The desirability dimension of the food environment focuses on external factors, including marketing, product placement, social norms and food quality, that influence purchase decisions and consumption.		
NEMS–S	See above	• NEMS–S scores from grocery stores in our study found that the observational quality of fruits and vegetables was lower in more rural built food environments, including the Flathead Reservation. The mean quality score across sites was 4.5 (Byker Shanks et al., 2016).
Produce Desirability (ProDes) sensory evaluation survey	ProDes assesses the quality aspect of desirability of fruits and vegetables based on generalizable sensory characteristics, including visual appeal, touch and firmness, aroma and size (Ahmed et al., 2018).	• Significant differences were found in the means of total ProDes scores based on location. • Produce from more rural built food environments, including locations on the Flathead Reservation, had lower ProDes scores than the urban locations in our study (Ahmed et al., 2018).
Produce Color Diversity (ProColor) inventory tool	This inventory tool (Ahmed et al., forthcoming) measures the diversity and amount of produce in the food environment based on colour categories in recognition that increased variety of fruits and vegetables is strongly correlated with increased produce consumption (Oude Griep et al., 2011) and that consuming a wide variety of fruits and vegetables is crucial to procure a range of phytonutrients (Liu, 2003), many of which vary in colour (Pennington and Fisher, 2009).	• Significant differences were found in the means of total ProColor scores based on location. - Produce from more rural built food environments, including locations on the Flathead Reservation, had lower ProColor scores than the urban locations in our study (Ahmed et al., forthcoming).
Total phenolic scores of produce	Total phenolic scores are a measure of the quality aspect of food-environment desirability that evaluate phytochemical concentrations of produce linked to health-promoting attributes, flavour, appearance and shelf-life (Ahmed and Byker Shanks, 2017).	• We found that produce quality, as measured by total phenolic score and vegetable total phenolic score, was lowest for the more rural areas in our survey, while no rurality-based difference was found for fruit total phenolic scores (Ahmed and Byker Shanks, 2017).

Household survey	Description of household survey	Findings
Food-environment perceptions survey	Semi-structured interviews on perceptions of the built and wild food environment, including foods consumed within the household and community, food access, cultural value of prevalent community foods, and changes in food acquisition and dietary intake at the household and community level over time (Byker Shanks et al., forthcoming).	• While food environments have transitioned to built food environments, and grocery stores provide key food access points, residents continue to rely on wild food environments by hunting, fishing and foraging for wild foods such as fish, deer, elk, bison, berries and roots (Figure 1). • The procurement of wild foods is more prevalent among the older generation. • Produce was perceived as being an uncommon food item available and consumed within the community (Byker Shanks et al., forthcoming).
Wild foods interviews	The semi-structured interviews comprised structured and open-ended questions that we developed and validated to characterize the frequency of wild-food procurement, consumption, dietary diversity, valuation, perceptions and observations in the context of climate change (Smith et al., 2019).	• Food-gathering activities in the wild food environment on the Flathead Reservation support food security and cultural identity, while providing a sense of food sovereignty and sensory desirability (Figure 1). • Residents of the Flathead Reservation that rely on wild foods were found to be more food secure, highlighting the critical role of the wild food environment. • Wild food environments are changing globally, including due to factors linked to climate change and shifts in land use and policy. • Residents are concerned about the loss of wild-food knowledge among younger generations (Smith et al., 2019).
Food-security scores	US Adult Food Security Survey Module: Six-Item Short Form (USDA Economic Research Service, 2012).	• Food-security assessments support disparities in the food environment, with 50 percent of study participants (n=79) reporting low or very low food-security status (Byker Shanks et al., forthcoming).
Healthy Eating Index (HEI) of diets	The HEI of diets is a measure of relative dietary quality compared with national dietary guidelines for Americans (US Department of Health and Human Services, 2013). The HEI is applied to dietary intake data collected using the multiple-pass 24-hour recall method.	• Study participants posted a mean total HEI score of 45.5 out of a total of 100 points, which is notably below national dietary recommendations (Byker Shanks et al., forthcoming).
Dietary diversity scores (DDS)	DDS are calculated using self-reported data from 24-hour dietary recalls, where foods consumed are categorized into unique food groups recognized in many cultures (e.g., vitamin A-rich fruit and vegetables, eggs) and assigned a unique score (FAO, 2012).	• We found variability in dietary diversity among community members, with participants that reported higher DDS showing higher intake of dietary fibre, potassium and cholesterol than those with less diverse diets (Byker Shanks et al., forthcoming).
Survey on perceptions of health	We developed and implemented a survey on perceptions of health, asking participants if they perceived changes in their well-being, including: overall well-being, mood, optimism, mental alertness, energy, weight, flatulence, bowel movements, the way clothes fit, and skin. The survey also asked participants if they perceived fruit and vegetable consumption to impact their health, mood, energy levels and mental alertness (Ahmed et al., forthcoming).	• At baseline, 45 percent of participants reported their perceived health to be good, 45 percent reported their perceived health to be fair, and 10 percent reported their perceived their health to be poor (Ahmed et al., forthcoming).

As described in Table 1, while the Nutrition Environment Measurement Survey for Stores (NEMS-S), ProDes and total phenolic scores found disparities in produce desirability on the Flathead Reservation compared with more urban surrounding areas (Byker Shanks et al., 2015b; Ahmed et al., 2018; Ahmed and Byker Shanks, 2017), no significant differences were found in terms of produce availability and affordability. Concurrently, the Farmers' Market Audit Tool found little discrepancy based on location (Byker Shanks et al., 2015a). However, there are cultural barriers within the community to visiting farmers markets.

We found the implementation of NEMS-S to provide a useful benchmark of commonly consumed foods in the United States of America for comparative purposes, yet to be limited in its application to place-based food systems.

The ProDes and ProColor methods were useful in their adaptability to local food systems in evaluating culturally relevant produce from wild and natural food environments in a simple, cost-effective, reliable and rapid way. Overall, the various food-environment assessments have proved complementary in nature. In particular, our study highlights the importance of measuring the desirability dimension of food environments; just because specific foods may be available and affordable, this does not mean they are desirable, with notable consequences for food choices.

HOUSEHOLD SURVEYS ON FOOD-ENVIRONMENT PERCEPTIONS, FOOD SECURITY AND DIETARY QUALITY

We carried out baseline household surveys on the Flathead Reservation to better understand how food environments may impact diets and health. Table 1 describes these household assessments and findings, including surveys on food-environment perceptions, wild foods, food security, dietary quality – measured using the HEI and Dietary Diversity Scores (DDS) – and perceptions of health. Since our food-environment assessments did not evaluate convenience, we examined perceptions of convenience using surveys. As described in Table 1, survey findings reflect the disparities found in food-environment assessments and the need to enhance food environments on the Flathead Reservation.

EVIDENCE-BASED AND MULTIPHASE FOOD-ENVIRONMENT INTERVENTIONS

We applied findings from our multiple assessments, along with a community needs assessment to design culturally appropriate interventions to improve access to foods that support sustainable diets on the Flathead Reservation. The community needs assessment was carried out with our project's Community Advisory Board of food and nutrition stakeholders, comprising elders, educators, enterprise representatives, clinical practitioners and policy-makers, including a member of the Tribal Council. Each year, we incrementally enhance the intervention and its assessment based on reflection and stakeholder feedback.

In 2016, we implemented the Eat Fresh intervention with 20 low-income households participating in the FDPIR over a two-month period. This intervention was aimed at eliminating access barriers to affordable fresh and desirable produce through food and nutrition education, culinary training and the provision of fresh fruits and vegetables. We evaluated the effectiveness of the intervention using self-reported surveys on food choices, dietary quality and perceptions of health, along with measurements of blood pressure, weight and body mass index.

Multiple participants experienced improvements in various self-reported health parameters during the intervention, including overall perceived well-being, mood, optimism, mental alertness and energy. Findings demonstrate a trend of increased dietary quality based on the HEI between the pre-intervention and post-intervention periods. Significant improvement was found in fruit consumption across the intervention. However, overall food consumption for some participants increased with the promotion of fruit and vegetable consumption and resulted in increased weight gain. This unintended consequence of promoting fruit and vegetable consumption elucidated the importance of focusing on produce consumption in the context of whole diets.

In 2017, we implemented the Eat Fresh and Local intervention, with 40 households participating in the FDPIR over a three-month period. The initiative involved modification of the FDPIR on the Flathead Reservation to include fresh local produce, as well as to provide food and nutrition education and culinary training. The local produce was sourced from the Western Montana Growers Cooperative, a food hub that sources from surrounding farms that follow various sustainable agricultural practices.

We refined the food and nutrition curriculum of the previous intervention to focus on whole diets, including portion control, as well as the benefits of foods sourced from local sustainable agricultural systems. We added haemoglobin A1c as an intervention measure. Findings from the intervention highlighted notable variability in participants' interactions with the modified food environment of the FDPIR and resulting diets. Dietary quality and health outcomes improved for some participants but stayed the same for others. In addition, findings highlighted the high level of participant interest in consuming foods from local sustainable agricultural systems.

In 2018, we implemented the Healthy & Sustainable Diets for All intervention, with 40 households participating in the FDPIR and other food-assistance programmes over a four-month period. This intervention provided produce, whole grains and pulses sourced from local sustainable agricultural systems to participants, along with education on sustainable diets (Ahmed and Byker Shanks, forthcoming).

We integrated social-media modalities to target and broaden the scope of our nutrition education (Tobey and Manore, 2014). The sustainable-diets curriculum focused on the following topics: (1) sustainability, (2) biodiversity and dietary diversity, (3) indigenous food systems, (4) plant-based foods, (5) food security and sovereignty, (6) greenhouse gas emissions, (7) food waste and (8) consumers as agents of food-system change. We are currently analysing data from this intervention phase, which use the same measures as in the previous phase, with the addition of a nutrition knowledge survey. Our upcoming intervention phase for 2019 extends the duration of the intervention and adds mindfulness training with a view to enhancing consumer interaction in food environments.

LESSONS LEARNED

Our assessments and evidence-based interventions on the Flathead Reservation have produced the following lessons to date towards advancing healthy and sustainable food environments:

1. **Food environments are multifaceted and require multiple context-specific measurements to capture distinct yet complementary factors.**
   The use of various complementary food-environment methods allows for a more comprehensive understanding of the different aspects of food availability, affordability, convenience and desirability.

2. **Food desirability is an important, but overlooked measurement of the food environment.**
   Just because specific foods may be available and affordable in the food environment, this does not mean that they are desirable. It is, thus, important to measure desirability in the food environment. Our project highlights that the ProDes and ProColor methods are effective in evaluating produce desirability in both wild and built food environments in a way that is rapid, cost-effective and valid.

3. **Successful food-environment interventions are community-based, incremental and multi-phased.**
   Our research team is led and informed by members of the local community of the Flathead Reservation to ensure research questions, methods and activities are relevant and valuable to the local context. An iterative process of implementing food-environment interventions allows us to identify unintended consequences and modify activities.

4. **Food-environment interventions should be linked with existing institutional structures**.
   We have sought to improve food environments by partnering with institutional structures on the Flathead Reservation, including the FDPIR and the Western Montana Growers Cooperative. Additionally, we have sought to build local capacity through research training of local students and community members.

5. **Findings from food-environment interventions should be disseminated using a multi-pronged strategy to multiple groups of stakeholders.**
   We actively share findings with diverse stakeholders from community members to various policy platforms, including the Tribal Council on the Flathead Reservation and national FDPIR platform, through scientific papers, policy briefs, school and program curriculums and community-based art.

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The changing landscape of food deserts

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ABSTRACT

In this article, we discuss the most recent trends in food-retail access in low- and moderate-income communities in the United States of America. We begin with a review of the current literature on the number of people impacted by food deserts and then review several critical retail trends, including supercentres (such as Walmart),[1] dollar stores, farmers markets and online food retail. We discuss the growing investment in incentive programmes, as well as new understandings of the impact of food deserts on health. In the United States of America, the number of communities without adequate access to healthy affordable food has declined, though more than 5.6 percent of the population still lives in low-access census tracts. At the same time, racial and economic disparities in food access remain a considerable concern, with around 30 percent more non-white residents facing limited access to food retail than white residents. We also provide recommendations for areas of future research.

INTRODUCTION

The Scottish Nutrition Task Force first coined the term "food desert" in 1995 (Beaumont et al., 1995). Today, the term generally refers to a geographic area that lacks sufficient access to grocery stores, especially in low-income communities (Shaw, 2006). While much of the food-desert concept remains grounded in a conceptualization of geographic proximity, whereby concern remains for those that live far from affordable access to healthy nutritious foods, recent policy efforts, changes in the retail industry and new research findings have prompted new considerations about how food deserts can or should be defined. These include a broader understanding for how food deserts impact the economic well-being of communities (Richardson et al., 2017), how store quality influences access (Hilmers et al., 2012), how supercentres and dollar stores influence shopping patterns, and how new technologies (including online ordering and home delivery) may help to alleviate gaps.

In 2009, the United States Department of Agriculture (USDA) began mapping food access to identify communities where there was low availability of affordable nutritious foods and found that food deserts exist in every American state, in all types of communities. It estimated that roughly 23 million people lived in 6 529 food-desert communities (USDA, 2012). The USDA's research elicited increased recognition of the vital role of people's environment in supporting health and reducing disparities (Neff et al., 2009).

In the United States of America, national funds were allocated to address food-desert areas for the first time in 2011, following a series of city and state financing efforts, which began with the Pennsylvania Fresh Food Financing Initiative in 2004 (Karpyn et al., 2010). To date, such public efforts have provided more than USD 220 million, which has leveraged more than USD 1 billion in private investment through public-private partnerships, to fund nearly 1 000 retailers serving areas of limited food access in 35 states (PolicyLink, The Food Trust and The Reinvestment Fund, 2015).

1 According to the Merriam-Webster dictionary, a supercentre is a very large discount department store that also sells a complete line of grocery merchandise.

HAS THE NUMBER OF RESIDENTS LIVING IN FOOD DESERTS CHANGED?

In its most recent 2017 report, the USDA's Economic Research Service determined that the number of census tracts that met the classification of "low access" had declined measurably since 2010, indicating a general improvement in the proximity of supermarkets to residents across the country (Rhone et al., 2017). Specifically, the US saw a 15 percent decline in the number of individuals living in a limited-supermarket-access area. From 2010 to 2016, the share of the population living in limited-supermarket-access areas declined gradually, from 6.8 percent of the population to 5.6 percent (Rhone et al., 2017).

However, because the number of low-income communities across the country had increased by more than 5 percent since 2010, the net number of low-income and low-access communities increased 0.36 percent (Rhone et al., 2017). The overall increase in low-income areas in the United States of America – the cause of the net increase in low-income food deserts – raises concerns about the growing number of struggling households with limited access to affordable nutritious foods, and the ways in which disparities may expand in part as a result.

State by state, the greatest improvement in increasing food access, as denoted by the percentage decrease in limited-supermarket-access-area populations, was witnessed in North Dakota (41 percent), Idaho (41 percent), Iowa (40 percent), Rhode Island (38 percent), Wisconsin (36 percent), Alabama (35 percent), Kansas (35 percent), New York (34 percent), Arkansas (32 percent) and Indiana (32 percent). In contrast, several states have experienced a substantial worsening of the problem, including Maine (with an increase of 27 percent) and Nevada (with a rise of 26 percent) (The Reinvestment Fund, 2018).

In addition to examining food access at state level, research has also considered food access at the census-tract level. Census tracts are relatively small geographical subdivisions of an area, defined for the purpose of collecting national census data. Depending on definitional parameters, estimates indicate that somewhere between 35.2 million and 83.5 million individuals (5.6 percent to 17.7 percent of the US population, respectively) reside in census tracts with limited access to a store (Rhone, et al., 2017). Further, racial and economic disparities in food access persist across the country, with approximately 30 percent more non-white residents facing limited access to food retail than their white counterparts (Rhone, et al., 2017). Rhode Island, for example, was home to more than 274 000 non-white residents as of 2018 (26 percent of the state's population), yet 60 percent of those living in food deserts were non-white (The Reinvestment Fund, 2018).

NOTABLE TRENDS IN GROCERY RETAIL AND FOOD-DESERT COMMUNITIES

In 2011, as a team member of Michelle Obama's National Healthy Food Financing Initiative, Walmart announced that it would open between 275 and 300 stores to serve USDA-designated food-desert areas (Walmart Inc., 2011). In the United States of America, USD 1 in every USD 3 grocery dollars is spent at Walmart (Hauter, 2014), the country's largest food retailer. According to its 2019 annual report (Walmart Inc., 2019), Walmart increased its revenue by 6.6 percent, from USD 482 billion in 2015 to USD 514 billion in 2019. It did so in part through store expansion, increasing its retail units by 5.6 percent between 2015 and 2019, including adding 4.8 percent more supercentres (to total 3 570 such stores), 27 percent more neighbourhood markets (now 813 stores) and 18 percent more discount stores (now 386 stores). While the net result has been expansion, stores have closed as well. From 2015 to 2019, Walmart closed a total of 223 stores in the United States of America, creating at least 3 new food deserts and another 31 neighbourhoods in 15 states that no longer sell fresh produce and meat (CBS News, 2016).

Walmart entering a region can result in social concerns, including weakened union bargaining power, reduced wages and benefits, and decreased employment levels (Neumark et al., 2008; Davis et al., 2009). Large supercentres also evoke considerable worry about the viability of local retail. For example, a report by Manhattan Borough President Scott Stringer showed that (a new) Walmart on 125th street in Harlem, New York would result in 25 percent of the nearby supermarkets and bodegas going out of business within a year (CBS New York, 2011). Such concerns magnify the potential impact of superstore closings on communities.

At the same time, the nations' largest grocer has been a significant partner in several evidence-based health promotion and nutrition interventions. For example, in 2011, Walmart helped to lead a national effort to work with manufacturers to reformulate products to reduce sodium, added sugar and trans fats in frequently purchased and consumed foods without adding considerable cost for consumers (Stolberg, 2011).

The dollar-store market, although a very different model from the supercentre, has also grown considerably in food-desert communities, prompting concerns. As of 2018, dollar-store chains (including Dollar Tree, Dollar General and Family Dollar, which was acquired by Dollar Tree in 2015) grew from roughly 18 000 locations in 2009 to more than 27 000, with plans to continue expanding to more than 50 000 (Donahue, 2018). Like Walmart, dollar stores often serve food deserts, are rapidly expanding in rural and low-income communities, and have raised concerns in relation to their proclivity to decrease the profits of local grocers in the surrounding area, causing such stores to close (Donahue, 2018).

Community advocates have noted worrying ripple effects on communities, as dollar-store chains employ fewer people on average than local grocery stores, rely more heavily on publicly subsidized health care for their employees and offer a limited selection of healthy foods (Donahue, 2018). Dollar stores typically do not carry fresh produce and their selection of food is mostly processed (Donahue, 2018). Furthermore, dollar-store chains often appeal to low-income customers by offering low sticker prices, though their per-unit prices are actually higher than the competition (Hoium, 2012). Taken together, this suggests that dollar-store chains are contributing to growing economic and health disparities in rural and low-income communities across the United States of America.

Just when the physical landscape of the food desert is evolving in terms of the types of retailer sited in low-income and underserved areas, online food delivery is emerging and starting to realize its potential. While it remains unclear to what extent these types of solutions will effectively meet the needs of low-income residents, the recent merger between Amazon and Whole Foods has fuelled hope that online delivery will soon be able to reach customers whom to date have not had adequate access to healthy, affordable foods (Karsten and West, 2017).

At the federal level, in April 2019, the USDA's Food and Nutrition Service, which administers the Supplemental Nutrition Assistance Program (SNAP), launched an online, two-year pilot programme in New York to test the use of SNAP benefits in online grocery shopping and delivery systems (USDA, 2019). Specifically, Amazon and ShopRite (a full-service retailer) will be providing the service to the New York City area, while Walmart will provide online services in upstate New York locations (USDA, 2019).

The novel approach responds to ongoing questions about how receptive low-income families are to online ordering, how feasible online ordering is for them (including access to technology and internet access for online orders) and the extent to which families will be able to pay for the delivery fee associated with the service using non-SNAP forms of payment. While promising, the extent to which food purchasing patterns will be altered in the New York pilot remains to be seen. It is unknown whether the programme will increase the sale of healthier foods among food-desert residents who are receiving food-assistance benefits and decrease sales of unhealthy items.

Farmers markets, defined as a location where two or more farmer-producers sell their own agricultural products (such as fruits, vegetables, meat, fish, poultry, dairy products and grains) directly to the general public at a fixed location (USDA Agricultural Marketing Service, 2019), have also seen considerable growth in low-income areas and are proving a promising strategy for addressing food deserts. The number of US farms selling directly to consumers increased from 116 733 in 2002 to 144 530 in 2012 (Low et al., 2015).

Farmers markets, in parallel with the number of farms selling directly to consumers, have witnessed substantial growth over the past 10 years, with more than 8 767 such markets in operation nationally as of 2018, up 200 percent from 2006 (Low et al., 2015). Local farmers markets, in addition to providing locally grown food in low-income areas, have a positive job multiplier effect, with each full-time-equivalent job created at a farmers market supporting approximately half of another full-time-equivalent job in other sectors of the region's economy (Low et al., 2015).

Evidence from the past 10 years shows a steady increase in SNAP-benefit use at farmers markets. In 2015, more than USD 19.4 million SNAP redemptions were honoured by farmers markets, compared with only USD 2.7 million in 2008 (USDA Food and Nutrition Service, 2015). Despite increased farmers-market usage, however, lower-than-recommended fruit-and-vegetable consumption patterns persist among low-income residents (Moore et al., 2015),

while rates of diet-related chronic disease remain high (National Center for Health Statistics, 2016). And while early data on the health and economic benefits of increased SNAP shopping at farmers markets suggest positive impacts on fruit and vegetable intake and body mass index, especially where additional financial incentives are available (Dimitri et al., 2015), these studies remain limited in geography and research design (for example, no comparison group) (Savoie-Roskos et al., 2016). Consequently, it is unclear whether the improved diet is a result of increased access alone, or whether it is mediated by the individual characteristics of the farmers-market shopper, who may be inherently more likely to purchase and consume healthier products.

HOW DO FOOD DESERTS IMPACT COMMUNITIES?

Food deserts and their consequences are far more complex than once thought (Richardson et al., 2017). Research has evolved to support a growing understanding of the causes of food deserts and their economic impacts in terms of lost wages, reductions in the local tax base and lost potential for food retail to serve as an anchor institution for other retail development. The economic impacts of a new grocery store or retention of an existing, but struggling grocery store, reflect our growing understanding of the multi-faceted importance of employment and community on health and well-being (Horster et al., 2016; Hardcastle et al., 2015; Buro et al., 2015).

Research has further re-defined adequate store access beyond store counts to include measures of store quality, community acceptability, healthy and unhealthy food-marketing practices, product quality and affordability (Adam and Jensen, 2016). In addition, new approaches to incentivizing healthy food have taken centre stage as a mechanism for helping low-income consumers (Broers et al., 2017). New research has also emerged, which estimates that 9 percent of nutritional inequalities are attributable to food deserts (Allcott et al., 2017). However, more recent conversations about the need to solve the food-desert problem emphasize the importance of both ensuring the fundamental human right to food and the economic value of community retail, and de-emphasize the role of food deserts as an obesity-prevention or obesity-reduction strategy, where connections are likely more distal (Haspel, 2018).

Food insecurity is also closely tied to wellness, and to the availability of healthy food, disproportionately affecting those in low-income communities (FAO, IFAD, UNICEF, WFP and WHO, 2018). Food insecurity, or a lack of secure access to sufficient amounts of safe and nutritious food for an active healthy life, and normal growth and development, is a result of limited food availability due to inadequate physical access to food (in other words, food deserts), limited economic access to food (namely, poverty, or high food costs), inadequate utilization (for example, lack of kitchen or household facilities for food preparation, or challenges in meeting the costs of living in a way that adequately addresses food needs), or a lack of stability in one's environment or income, further disrupting physical, economic or utilization capacity.

Inadequate access to affordable, nutritious food, particularly when combined with stress, anxiety or depression, disordered eating patterns and/or inadequate pre-natal and child nutrition, results in an inadequate diet and contributes to excess and/or insufficient nutritional quality. Consumption of calories, protein, vitamins or minerals and intake of sugar, salt and/or fat are often impacted, in terms of either excess consumption or inadequate consumption, or both. In turn, child stunting and wasting, micronutrient deficiencies and overweight and obesity result (FAO, IFAD, UNICEF, WFP and WHO, 2018).

NEW UNDERSTANDINGS OF THE ECONOMIC POTENTIAL OF FOOD DESERTS

In spite of food deserts' negative attributes, there is increasing evidence that such areas offer significant economic potential. To date, food deserts have witnessed substantial grocery "leakage" due to unmet demand for food retail. For example, analysis in Newark, New Jersey showed that residents of low-income areas underserved by food retailers were travelling more than twice as far to full-service food-retail locations as residents of similar areas that were solidly middle income (PolicyMap, 2018). Newark's low-income residents still need to purchase food – corresponding to retail demand of USD 24 million – but

as these low-income families are underserved by food retail, their available food supply is only valued at about USD 6 million, meaning that almost USD 18 million of total retail food demand is leaking outside these low-income areas (PolicyMap, 2018).

In addition to this untapped retail demand, food deserts offer potential to decrease unemployment rates among the formerly incarcerated. In the US, close to 700 000 persons are released from prison each year, many of whom are low income and in need of jobs (SHRM, 2019). Supermarkets are one of a limited number of employers that will hire and train formerly incarcerated individuals (Von Bergen, 2017). The US Congress and others have recognized the critical nature of such opportunities for families and recently passed the First Step Act (December 2018), which includes increased rehabilitation programming, among other things, to support former prisoners (115th US Congress, 2018).

PROVIDING FUNDING AND INCENTIVES FOR LOW-INCOME RESIDENTS TO PURCHASE HEALTHIER FOOD

Dating back to 1939, Congress began providing financial benefits to citizens needing assistance to purchase food to meet their nutritional needs in the form of a food-stamp programme (USDA, 2018a). While the original programme ended in 1943, Congress restarted the provision of food assistance in 1961 and this has remained uninterrupted (USDA, 2018a). Since 1973, food assistance has been authorized and funded by Congress as part of the Farm Bill (Farm Policy Facts, n.d.). This legislation is typically revised and reauthorized every five to six years and is administered by USDA (Snap to Health! 2018).

Relatively recent and noteworthy developments related to the provision of food assistance include the establishment of electronic benefits transfer (EBT) (USDA, 2018a). Also, to reduce the stigma of receiving benefits and in recognition of those benefits as a significant source of nutrition, the programme was renamed the Supplemental Nutrition Assistance Program (SNAP) in 2008 (USDA, 2018a). SNAP is the largest programme in the United States of America's hunger safety-net (USDA, n.d.), providing nutrition assistance benefits to approximately 42.1 million Americans as of September 2017 (Cronquist and Lauffer, 2019). Furthermore, the aforementioned online purchase programme for SNAP beneficiaries was launched in April 2019 (USDA, 2019).

To help address disparities in food access and nutrition among low-income residents, a series of efforts have been made to provide financial discounts, or "bonus" dollars, for the purchase of healthy foods, often in conjunction with SNAP. Efforts to understand incentive programmes largely began in 2008 when that year's Farm Bill provisions for the SNAP programme committed USD 20 million to projects intended to incentivize recipients to increase their purchase of fruits and vegetables and other healthful foods at the point of sale (Rosenbaum, 2008).

In 2011, a USD 4.4 million healthy-incentive pilot was the first attempt in this area of research to systematically study the impact of fruit and vegetable incentives on SNAP participants' purchase and consumption patterns (Bartlett et al., 2014). Results showed that by instituting a 30 percent incentive within a retail setting for purchases of targeted fruits and vegetables, among a randomly selected sample of 7 500 SNAP participants, mean total fruit and vegetable intake increased by 0.32 cups per day compared with the control group (Bartlett et al., 2014). Researchers reported an increase from 2.294 to 2.616 cups per day of all fruits and vegetables, including potatoes, legumes and 100 percent juice (Bartlett et al., 2014). More recently, the USDA Food Insecurity Nutrition Incentive grant programme was established by the 2014 Farm Bill (USDA, 2018b) and renewed in the 2018 Farm Bill, with more than USD 100 million to be dispensed over five years to support projects that utilize incentives (financial and non-financial) to increase the amount of fruit and vegetables purchased and consumed by SNAP participants.

CONCLUSIONS

Since the term's emergence in 1995, the nutrition field's understanding of how to address food deserts has evolved into a far more nuanced and complex web of considerations and, perhaps, we now have more questions than answers. Research to date shows that a new supermarket in a low-income neighbourhood is unlikely to have an effect on obesity reduction (Adam and Jensen, 2016; Dubowitz et al., 2015a; Pechey and Monsivais, 2015); however that new supermarket will probably have an impact on community health and well-being, including economic benefits (Adam and Jensen, 2016; Dubowitz et al., 2013; Dubowitz et al., 2015b; Aggarwal et al., 2014; Cannuscio et al., 2013). At

the same time, online food retail is nascent and it remains unclear to what extent this new phenomenon will help food-desert residents to purchase healthy food, or perhaps perpetuate inequities by causing new store closings, reducing the number of bricks-and-mortar stores across the nation.

Choice is an important variable in the food-desert discussion and residential shopping is determined by an increasingly evolving retail landscape, driven by price, convenience, and cultural and practical considerations, which together add a significant nuance to the "if we build it, they will come" interpretation of the food-desert definition (Dubowitz et al., 2015b).

Our next generation of efforts to make healthy foods "accessible" to residents of food deserts requires an understanding of meaning and context, as well as of place and space. Both quantitative and qualitative research are needed to understand how food retail availability and store operations – including retail jobs, community and family perceptions of the relative value of healthy and less healthy foods, food cultures and traditions, food marketing efforts and food prices – collectively impact health.

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Farmers markets as a strategy for improving food environments

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For shoppers in the United States of America, the term "farmers market" brings to mind a certain image that is both a new development within the food system and one with its roots in antiquity. Open-air markets can be traced back to the earliest days of human civilization, tied to the development of agriculture and trade (Bintliff, 2002), and have remained a common method of selling agricultural products in much of the world since.

While the shift away from produce markets was a gradual one in the early 20th century across the United States of America, the rise of supermarkets and advances in technology made storage and long-distance shipping feasible (Macfadyen, 1985) and led to municipalities selling off their shed markets, restricting street vending (Taylor, 2005), eliminating central markets (Donofrio, 2007) and moving agricultural activities outside city limits (Brinkley and Vitiello, 2014). These factors and others led to the near extinction of farmers markets by 1970 (Brown, 2001).

It is only over the past 40 years that farmers markets have become a strategy for farm viability and food access, partly due to the passage of the Farmer-to-Consumer Direct Marketing Act of 1976. According to the US Department of Agriculture (USDA) statistics, the number of farmers markets nationwide has risen steadily from 1 755 in 1994 (Tropp, 2014) to more than 8 700 today (USDA Agricultural Marketing Service, 2019.[1] While different communities may define farmers markets differently, for the purposes of this paper, we will use the USDA Food and Nutrition Service definition: "A farmer's market is two or more farmers that sell their produce directly to the general public at a fixed location.[2]

A growing body of evidence suggests that farmers markets have become a viable strategy for improving food environments on a number of fronts. As there is limited research on the roles that farmers markets can play in improving sustainability (Bentley, 2005; Hunt, 2007) or increasing social cohesion (McCarthy, 2007), this article will focus on the economic benefits on regional economies, as well as the improved food-security and health impacts on low-income populations. While the academic literature on farmers markets continues to expand, research on the organizations that manage markets remains extremely limited. In recent years, the amount of data being collected by and about these organizations has increased (Wolnik et al., 2019) and will allow for wider analysis on impacts in future.[3]

FARMERS MARKETS BOOST FARM VIABILITY

Economists at the USDA Economic Research Service (ERS)[4] used Census of Agriculture data to show that 61 percent of farms with direct-to-consumer (DTC) sales in 2007 were in business under the same operator in 2012, compared with 55 percent of farms without DTC sales (USDA, 2016a).[5]

1 USDA began to identify and tabulate farmers markets in 1993, with the first nationwide count in 1994.

2 https://www.fns.usda.gov/snap/farmers-markets-definitions.

3 Based on unpublished data from the Farmers Market Coalition gathered survey data in November 2018 to better understand the organizations that operate farmers markets. Four hundred and thirty-seven market organizations responded (with an average of two market locations), representing all 50 states and the District of Columbia. Some 67 percent were operating as not-for-profit corporations, 14 percent were operating under the oversight of a municipality or government agency, 6.7 percent were operating as for-profit corporations, 6.2 percent had no formal incorporation, and 1.2 percent were operating as a legal cooperative.

4 https://www.ers.usda.gov/.

5 In a comparison of farms across four size categories (defined by annual sales in 2007), farmers with DTC sales had a higher survival rate in each category.

According to the ERS report, census data showed that farms with direct sales required less machinery and land to achieve a certain level of sales. Moreover, these farms had lower debt levels than similarly sized farms with no direct sales (Low et al., 2015). In Sacramento County, California, direct market producers' annual production and marketing expenses averaged USD 155 235 in 2013, according to a University of California study (Hardesty et al., 2016). The marketing expenses of those producers in the Sacramento region who were not engaged in direct marketing averaged USD 214 486, some 39 percent higher (Hardesty et al., 2016).

FARMERS MARKETS INCUBATE SMALL BUSINESSES

Almost 80 percent of Sacramento area vendors interviewed for the University of California study reported that farmers markets provided the greatest opportunity for developing their business compared with other marketing outlets. Farmers indicated that farmers markets helped them to improve skills in customer relations, merchandising and pricing, as well as to increase their business self-confidence. Entrepreneurial activities were also enhanced by farmers markets, be it expanding a product line, adding a new product category, or making new business contacts (Hardesty et al., 2016).

Feenstra (2003) found that small-scale vendors (based on gross sales) used farmers markets as the primary outlet for their part-time operation, in addition to an incubator for new businesses. Medium- and large-scale farms used farmers markets to expand their existing operations" (Feenstra et al., 2003).

A study of farmers markets in Washington State found that 82 percent of vendors had developed or expanded business beyond the market within the previous three years, most often by opening a "bricks-and-mortar" store, opening a restaurant, or starting a farm stand (Ostrom and Donovan, 2013).

FARMERS MARKETS CREATE ECONOMIC GROWTH AND GENERATE JOBS

In most local food-system studies, multipliers are used when evaluating the impact assessment of adding outlets for direct-marketing businesses and consumers, or when analyzing new linkages between existing channels. Multiple studies have shown that farmers markets and other forms of direct agriculture marketing stimulate significant economic activity. Their multipliers of 1.86 (Hardesty et al., 2016) and 1.91 (Market Umbrella, 2012) respectively, are higher than nearly all other industries. Manufacturing, traditionally the industry with the highest multiplier, comes in at 1.33 (Manufacturing Institute, 2014), while Hardesty et al. (2016) note that competing land uses in the Sacramento region produce lower multipliers.

Another USDA ERS report concluded that farms engaged in local food sales generate 13 jobs per USD 1 million in revenue, while farms that do not sell food locally only generate 3 jobs per USD 1 million (Low and Vogel, 2011). A 2011 Union of Concerned Scientists report estimated that farmers markets each created between 2.4 and 5.4 jobs and that the reauthorization of the Farmers Market Promotion Program (a federal programme designed to increase consumption of local foods and to boost DTC sales through farmers markets) could create 1 200 to 13 500 jobs over a five-year period (O'Hara, 2011). The programme was reauthorized in 2014 and again in 2018, although no follow-up studies have been conducted on the job creation of the reauthorization.[6]

FARMERS MARKETS IMPROVE NUTRITION FOR LOW-INCOME SHOPPERS

Farmers markets have been at the forefront of developing strategies to improve access and increase fruit and vegetable consumption. Due to the comparatively low-capital nature of starting a farmers market, the presence of a high proportion of healthy food and informal learning opportunities, farmers markets can serve as a viable strategy for increasing food access and improving nutritional outcomes for low-income populations. While this approach has gained traction in recent years, its roots can be traced to a few of the early, modern farmers markets. The first farmers markets in Southern California in the late 1970s and early 1980s were

6 From the USDA Local Foods Economic Toolkit: "One of the challenges in using multiplier analysis to examine the impact of a change in local foods activity is determining what the value of the multiplier is, or, more directly, obtaining an appropriate multiplier. Consequently, the default multipliers in the modeling software reflect the averages for the region of analysis, whether it is a county or a State, which means the resulting multipliers are reflective of the average farm within those categories. However, producers of locally marketed foods are likely to have very different supply chain relationships than, say, a local, industrial-scale vegetable producer selling directly to food manufacturers. Accordingly, one has to modify modeling systems to more adequately convey the economic worth of local food enterprises". Furthermore, "while there are no hard and fast rules about multipliers because each industry and community is unique, it is useful to note that researchers typically use multipliers that are less than 2.0, with multipliers for smaller rural areas hovering closer to 1.3 and those for larger, more urban areas hovering closer to 1.9." (USDA, 2016b). pp.73 and 79.

sponsored by the Interfaith Hunger Coalition, with the goal of bringing fresh food to low-income residents after grocery stores fled the inner cities (Parsons, 2006). More recent research has also demonstrated a connection between farmers-market locations and food deserts in Wisconsin, noting that "a higher percentage of FM census tracts were food deserts compared with census tracts without a FM" (Roubal, 2015).

The location of markets in these areas may be intentional, to achieve a food-access goal. As the Center for Disease Control (CDC) says, "Farmers markets are a mechanism for purchasing foods from local farms and can augment access to [fruit and vegetables] from typical retail stores or provide a retail venue for [fruit and vegetables] in areas lacking such stores" (McGuire, 2013). Several studies have found that farmers markets in food deserts have lower prices and higher-quality produce than corner stores and grocery stores, and that neighbourhoods with farmers markets have higher rates of consumption of fruit and vegetables (Park et al., 2011; Suarez-Balcazar et al., 2006). At least one study found that neighbourhoods with farmers markets had higher consumption of fruits and vegetables among immigrant Hispanic women (Park et al., 2011).

This access has come through federal programmes and partnerships and by making technological advances. For example, in 1992 the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) created the Farmers Market Nutrition Program (FMNP), which provided fresh fruits and vegetables to WIC recipients for the first time. In 2001, a comparative Senior Farmers Market Nutrition Program (SFMNP) was piloted to increase fruit and vegetable consumption by older people on low incomes. Under both programmes, research suggests that the recipients increased, in some cases substantially, their fruit and vegetable consumption (Stallings et al., 2016; Kunkel et al., 2003; Kropf et al., 2007). In 2010, the FMNP and SFMNP served nearly 900 000 seniors and 2.15 million WIC recipients (USDA, 2012).

Kaiser Permanente, the largest private, non-profit health-care system in the country, created a campus market system in 2003 to increase the availability of fresh fruit and vegetables for its employees and patients. In 2019, over 60 farmers markets are listed on the Kaiser Permanente website. Seventy-four percent of patrons surveyed at their hosted markets consume more fruit and vegetables as a result of shopping at the market and 71 percent of them indicated that they were eating a greater variety of fruit and vegetables (Cromp et al., 2012).

Between 1994 and 2004, the Supplemental Nutrition Assistance Program (SNAP), formerly known as food stamps, moved to the Electronic Benefit Transfer (EBT) card. As states phased in the EBT card, SNAP redemption at farmers markets plummeted from USD 9.5 million in 1993 to a low of USD 1.7 million in 2007 (Cole et al., 2013), as most markets operate without access to electricity or phone lines. However, through concerted efforts by market operators, technical assistance providers and state and government support programmes to purchase and pilot wireless card-processing systems, SNAP spending at farmers markets surpassed $22 million in 2017 (USDA, 2017). In a study based on two urban Atlanta farmers markets, SNAP shoppers reported that the market made it easier to purchase fresh fruit and vegetables and 80 percent said they had increased their consumption of fruit and vegetables as a result (Woodruff et al., 2018).

One method to encourage low-income consumers to use their food assistance (FMNP or SNAP) dollars at farmers' markets is by "matching" their benefits, allowing the consumer to purchase more produce.

Wholesome Wave, a non-profit organization, offers a "double-value coupon programme" of which 40 000 customers availed at 300 farmers' markets in 25 states in 2012. (Community Science, 2013). (The organization has since expanded its highly successful programme to supermarkets, enabling it to reach 1 million people in 2017) (Wholesome Wave, 2018). The strategy of offering a centralized card-processing system paired with cash and nutrition incentives has offset the cost of new or expanding production and increased the availability of fresh fruits and vegetables in food deserts (Briggs et al., 2010).

A 2019 report based on data collected at the Bloomington Community Farmers' Market, as well as a comparison between SNAP market users and SNAP users who did not shop at the market, showed that SNAP users reported consuming a greater quantity and variety of fruits and vegetables because of their attendance at the market, while spending about the same amount of money, out of pocket, as non-SNAP users at the market (Farmer et al., 2019).

Multiple studies have shown that such financial incentives that reward the purchase of fruits and vegetables by SNAP recipients at farmers markets result in increased purchases of fruit and vegetables by low-income shoppers, reducing food insecurity (Bowling et al., 2016; Farmer et al., 2019;

Dimitri et al., 2015; Savoie-Roskos et al., 2016; Alaofè et al., 2017). A 2018 report on the California Market Match Program found that 73 percent of shoppers increased the amount of fresh fruit and vegetables they purchased, while 85 percent bought new or different types of fruit and vegetable. The report also concluded that "changes in dietary intake likely to result from such incentives were sufficient to result in a 1.7 percent reduced incidence in type 2 diabetes, which in California translates into a health care savings approaching USD 469 million a year" (Ecology Center, 2018).

A 2017 report by the Farmers Market Coalition on the Food Insecurity Nutrition Incentive (FINI) Program in farmers-market settings during its first year reported multiple benefits (Farmers Market Coalition, 2017). In Utah, there was a near immediate improvement in food security. "At baseline, 30% of participants reported they experienced very low food security as compared to only 3% at the 4-week follow up" (Farmers Market Coalition, 2017, p. 3). Incentive programmes were also found to increase the variety of produce that participants eat and encourage them to add new produce to their diets. The Food Trust's Food Bucks programme found that, "Food Bucks users were more likely than non-Food Bucks users to have purchased a fruit or vegetable at market that day and to report having tried a new fruit or vegetable since first visiting the market" (Farmers Market Coalition, 2017, p. 3).

Another recent innovation that has gained traction in a much broader context is produce prescription programmes, whereby doctors "prescribe" produce to patients suffering from diet-related illness through a voucher scheme.

From national market programme partner Wholesome Wave: "Participating providers enroll patients into the program for 4-5 months at a time. Doctors and nutritionists provide $1/day per household member in produce prescriptions, which can be redeemed for fresh produce at participating markets and grocery stores" (Wholesome Wave, 2016).

Such strategies that increase purchase of healthy foods through a series of programmes and rewards at farmers markets can be employed by retail outlets as well as Wholesome Wave's grocery-store incentives illustrate (Wholesome Wave, 2018). However, these programmes were conceived, tested, and proven to be effective by the operators of farmers markets, demonstrating the proactive measures these types of organizations employ to improve food access. Furthermore, the very design of farmers markets, which encourage direct interaction between producer and eater, and include educational and social spaces, have not yet been duplicated by grocery stores, which are designed to maximize sales per square foot.

What little data exist on the success of incentives in grocery stores suggests that redemption in grocery-story settings is far below that of farmers markets. Three large-scale FINI grantees that have operated incentive programmes at both farmers markets and grocery stores since 2015 report redemption rates of 6.3 – 20 percent in grocery stores, compared with 84 – 96 at farmers markets (The Food Trust, 2018; Washington State Department of Health, 2018; AARP Foundation, 2018). Still, many of the FINI grantees are teaming up farmers-market organizations with grocery retail in expanding and improving the outcomes of incentives to both retail formats.

FARMERS MARKETS – AREAS FOR IMPROVEMENT

While a strong body of research demonstrates the important role that farmers markets have played in improving food environments, it is important to recognize the challenges they face as they attempt to fulfil myriad roles:

- Farmers markets typically operate for a relatively small number of hours each week, making them difficult to access for people with fixed schedules or limited transportation. This is a barrier for shoppers with limited time and a particular challenge for low-income shoppers, who are more likely to work multiple jobs or have limited transit options.

- Furthermore, while farmers markets are reflections of their communities, that reflection may not fully mirror all aspects of a given community. Connor et al. (2010) and Alkon (2012) both explore ways in which farmers markets reflect values more common in white, middle- and higher-income communities, which can cause groups of other races and socioeconomic classes to feel unwelcome, or feel that they are being viewed with suspicion when shopping at farmers markets. While these perceptions are not universal among non-white farmers-market shoppers (Suarez-Balcazar et al., 2006), they do pose a challenge for market operators when it comes to ensuring that their market provides a welcome and equitable shopping experience for all members of the community.

- As Farmer et al. (2019, p. 166) noted, "Working within a food justice framework requires more than simply increasing financial access to food; managers must also consider the types of food available at the market and the values advertised and addressed by the managers of this food space."

- Another critical area to consider in light of the research on the role that farmers markets can play in improving food access and nutrition, particularly for low-income shoppers, is that farmers markets are often run by non-governmental organizations with limited resources and growing responsibilities. Even markets that have a strong interest in accepting federal nutrition benefits face many barriers (Roubal et al., 2016). "Calls to expand food assistance programs to all farmers markets will continue to be met with challenges as many markets will not have the capacity to operate them. Targeting farmers markets with strong organizational capacity may increase the probability of successful implementation, but building the organizational capacity of farmers markets may be necessary for widespread adoption." (Mino et al., 2018, p. 823).

- While new market locations in previously underserved areas or food deserts can be a viable strategy for improving food access, it is important to consider the impact on farmers and vendors. Often, farmers-market vendors, particularly farmers, are spread too thin, expected to anchor multiple markets and sell through intermediate or even wholesale channels. As new markets are added, farmers are often put in the position of having to sell at more markets to make the same amount of revenue.

- Farmland continues to be targeted for development across the United States of America, with the result that small farms are struggling to keep the next generation in the business and on the land.

CONCLUSION

A body of academic research supports the idea that farmers markets have had a broad range of significant human and economic effects. We conclude that the ability of farmers-market organizations in the United States of America to continue and increase their direct services and develop programmes for greater community equity and sustainability is contingent on the ongoing growth and support of state market and farmer associations, national organizations, such as the Farmers Market Coalition, and government support at the local, state and national level. This support is necessary to maintain programmes such as WIC, FMNP, SFMNP, SNAP and other incentive schemes, as well as those providing resources to farmers-market organizations, such as the Farmers Market and Local Foods Promotion Program. Funding is also needed for new programmes to support growers in the wise stewardship of productive land and to increase the social bridging and bonding that happens at well-designed, inclusive farmers markets.

Published research indicates that markets have been successful in achieving positive changes in food environments, thanks to farmers-market operators intentionally embedding multiple goals to positively impact local and agricultural economies, highlight land use for production and increase access to healthy foods for residents, including those most at-risk.

These measurable goals have resulted in positive economic outcomes for the businesses involved, information and access to healthy food for shoppers, and social capital impacts on the host area. To know whether farmers markets can continue to expand their effects on a larger set of outcomes for individual communities will require more support for those organizations to conduct pilots programmes and gather data. This would lead to more partnerships within and around food and civic systems to develop more far-reaching solutions and healthier communities.

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Retail diversity for dietary diversity: Resolving food-safety versus nutrition priorities in Hanoi

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ABSTRACT

Amid rapidly transforming urban food environments, Asia's cities are faced with the dilemma of ensuring food and nutrition security for their populations while also combatting food-safety concerns.

The current food environment in Hanoi, Viet Nam, only provides a minimal level of diet quality for the urban poor. Modernization policies aim to improve food safety by promoting the closure of open-air markets in favour of supermarkets and convenience stores. Traditional open-air markets are the urban population's main source of food and ensure a healthy diet, but they do not offer formal food-safety guarantees. In contrast, modern retail outlets, such as supermarkets and convenience stores, provide foods with safety guarantees, but are not utilized by the urban poor for myriad reasons, including cultural shopping preferences, habits and convenience (hours of operation, formality, cost and perceived freshness). Though designed to increase the consumption of safe foods in Hanoi, these modern outlets may also stimulate the consumption of unhealthy ultra-processed foods and reinforce food-access inequality. The continued closure of traditional open-air markets in favour of modern retail outlets may be jeopardizing the future diet quality of Hanoi's urban poor. We recommend that food-safety policies embrace the existing diversity of local food retail systems and identify opportunities to improve food safety at open-air fresh food markets.

FOOD SAFETY AND NUTRITION IN TRANSITIONING URBAN FOOD ENVIRONMENTS

Food and nutrition security have long been primarily a rural agenda. However, rapid urbanization and food-system transition present urgent challenges when it comes to the provision of safe, nutritious and sustainable food in cities (Tefft et al., 2017). Emerging economies of the Global South are experiencing this most intensely, particularly in Asia, where the rapid rate of urbanization has resulted in a concurrent rise in (i) non-communicable diseases (NCDs) (Abarca-Gómez et al., 2017; Boonchoo et al., 2017; Do et al., 2017); (ii) the urbanization of poverty (Asian Development Bank, 2014; Ravallion et al., 2007; Kanbur and Zhuang, 2013); and (iii) malnutrition (Mohiddin et al., 2012). For emerging Asian economies, food-safety concerns not borne by developed regions and western societies (Mylona et al., 2018) complicate these issues (Ortega and Tschirley, 2017; World Bank, 2017).

These food-safety concerns are affecting food retailing policies. Across Southeast Asia, rapid economic development, accelerated by foreign direct investment, has resulted in the "supermarketization" – the closure of open-air markets in favour for modern retail outlets – of urban food environments (Reardon and Timmer, 2012; 2014).

The increased presence of modern retail outlets is also associated with food-access inequality, for two main reasons. First, supermarkets are unevenly distributed within cities (private supermarket companies mainly target middle- and higher-income areas), and replacing markets with supermarkets catalyses the gentrification of lower-income areas (Moore, 2013; Cohen, 2018; Wertheim-Heck et al., 2015). Second, in Asia, the replacement of open-air wet markets with supermarkets has been shown to exclude lower-income populations, as they are either unaffordable, unsuitable or unwelcoming. The restricted affordability is not only down to supermarkets' higher prices, but also to parking fees for bikes and motorbikes, and the fact that supermarket shopping is often geared towards large-volume, weekly purchases. The urban poor tend to buy food daily, based on a daily food budget.

What's more, supermarkets have restricted opening hours that do not fit with those daily, early-morning food-shopping practices. Shopping at supermarkets is also a time-consuming process if one takes into account parking, weighing of produce and waiting at checkouts, especially given the low-volume daily shop.

Lastly, although the urban poor tend to visit supermarkets and malls to window-shop as a leisure activity at the weekends, they do not feel welcome in supermarkets, which generally have security guards and lack the personal vendor interaction of traditional outlets (Maruyama and Trung, 2007; Wertheim-Heck et al., 2015). Consequently, the right of access to safe and healthy food for all is being challenged.

This modernizing transformation of the food environment has had mixed consequences for urban consumers, especially in Asia (Baker and Friel, 2016; Hawkes et al., 2017). Negative impacts on diet and health have been observed as a consequence of decreased consumption of fresh fruit, vegetables and traditional foods generally, coupled with the increased availability and consumption of ultra-processed and packaged foods (such as sausages, ready-to-eat meals and instant noodles), which are often high in salt, fat and sugar and have been associated with NCDs (Hawkes, 2006; Leite et al., 2018; Luiten et al., 2016; Moubarac et al., 2013; Hyseni et al., 2017; Popkin, 2014; Popkin and Reardon, 2018; Poti et al., 2017; Toiba et al., 2015).

At the same time, there have been positive impacts, such as improved food safety and hygiene (Fuchs et al., 2011), greater convenience (by reducing the amount of food-preparation time for women) and better availability of nutritious foods, including animal-source foods, such as dairy and eggs. Improvements have also been observed in the quality of diets (Burns et al., 2004; Hawkes, 2006; Laraia et al., 2004; Popkin and Reardon, 2018).

The cost of food has decreased in some contexts and increased in others (Latham and Moffat, 2007; Larsen and Gilliland, 2009; Liese et al., 2007; Goldman et al., 1999; Reardon et al., 2009), but there has been a visible increase in the inequality of access to food. The dietary and nutritional consequences appear to depend very much on context (regional, cultural, level of development/national GDP, urban or rural). Currently, we know little about the extent to which this transformation of the food retail environment has impacted shopping practices and diets, specifically those of the urban poor in Asia.

INNOVATIVE APPROACHES TO UNDERSTANDING THE FOOD SAFETY – NUTRITION DILEMMA

These issues are often approached from a consumer-led "rational choice" perspective, which views food consumption as the outcome of conscious and deliberate choices by individual buyers. A novel approach to the transition of food systems is to view household food-shopping practices and consumption – and, hence, dietary intake – as inherent activities that make up everyday life. This approach combines dietary research with a social practice-oriented perspective by including the habitual nature of food consumption (Warde and Southerton, 2012) and assessing how this is affected in a transforming food retail environment. Dietary intake is core to the design of such a framework and is assessed as a dependent variable, first to food-shopping practices and then food retail provisioning and urban lifestyle. Food-shopping practices are measured as an independent variable to dietary intake, but assessed as a dependent variable in relation to food retail provisioning and lifestyle. Food retail provisioning and lifestyle are both considered independent variables.

Viet Nam case study: Hanoi

Viet Nam's Doi Moi economic reform[1] in the late 1980s and 1990s brought about significant changes in lifestyle and dietary patterns, including lower consumption of rice and traditional foods, fresh fruits and vegetables in favour of more protein- and fat-containing foods, such as meat and processed foods (Petracchi and Ha, 1999; Nguyen and Pham, 2008; Thang and Popkin, 2004).

Hanoi authorities subsequently developed a master plan to transform the city into a modern metropolis (MoPI, 2011; MoIT, 2012), including the transformation of the local food environment through retail modernization that promoted supermarket development to gradually replace traditional food retail outlets (Moustier, 2006; MoIT, 2009; Dries, 2013; Wertheim-Heck and Spaargaren, 2016). This policy was supported by serious public health concerns over the agrochemical and bacteriological safety of the most commonly consumed fresh foods, as supermarkets implement private food-safety management systems and maintain food hygiene standards, unlike traditional food markets. Moreover, by national regulation, all vegetables entering modern retail outlets are required to carry official Vietnamese certificates attesting to their production in accordance with national safety regulations (Wertheim-Heck et al., 2014).

Ensuring healthy and safe food access, together with food and nutrition security, in low-income urban groups is a critical challenge facing Vietnamese policymakers (Wertheim-Heck et al., 2015). Consumers and policymakers alike have to deal with the competing priorities of food safety and nutrition. Food safety is being prioritized, however, as evident by the recent transformations in urban food-safety governance towards "supermarketization" as a remedy for recurrent food-safety incidents – at the cost of the forced closure of traditional wet markets.

Around one-third of Hanoi's population lives on less than USD 5 per person per day and 44 percent of household income is spent on food. These households heavily rely on wet markets to access fresh and nutritious produce.

The forced closure of these markets is designed to channel consumers into supermarkets and convenience stores. An important element of Hanoi's urban planning is to transform traditional markets into shopping malls, with the aim of reducing the 67 permanent inner-city markets (as of 2010) to just 14 by 2020 (MoIT, 2009). In the meantime, supermarket development is spiralling, from just 2 in 2000, to 24 in 2010 and 800 in 2017, to an estimated 1 000 in 2025 (Wertheim-Heck et al., 2015).

The increased cost of food and the dietary changes associated with supermarkets and exposure to ultra-processed foods (Monteiro et al., 2016) put food and nutritional security at risk. Shopping at supermarkets is associated with a rise in the consumption of ultra-processed foods and increased rates of obesity and NCDs, whereas wet-market shopping is associated with increased vegetable consumption (Kimenju et al., 2015; Banwell et al., 2013; Kelly et al., 2014).

Vegetables are critical to good health and nutrition and are an integral part of the traditional Vietnamese diet. They are affordable and easily accessible. Yet, on average, Vietnamese people do not consume sufficient quantities to meet WHO recommendations (Bui et al., 2016). Unfortunately, these and other fresh foods are among those raising most concern by government and consumers alike in terms of food safety. The actual public health risk is low, however, and there is little evidence from food-safety and bio-contaminant analysis to date to support the contention that such foods sold in wet markets are unsafe. Consequently, the planned closure of almost all formal markets, which looks to be based on fear alone, may be unnecessary.

The challenge is to identify strategies and opportunities to prevent potentially undesirable nutritional effects on the urban poor. This article addresses the impact of current policies on their diet quality. We make practical recommendations that may assist policymakers in preventing negative impacts on diet quality, while recognizing the urgent need for a more equitable and nutritious urban food environment in Viet Nam.

Complimentary value considerations of open-air markets

Open-air markets offer multi-dimensional value to consumers beyond just providing access to food. These values contribute to the well-being and empowerment of local communities and are:

- *Cultural:* for example, flexible shopping practices (preferred shopping).
- *Social:* for example, places to meet friends and interact with neighbours.
- *Financial:* for example, supporting local small business and livelihoods related to food.
- *Tourism:* for example, food tours for visitors interested in experiencing traditional foods and markets.
- *Livelihoods*: for example, local communities relying on vendor-related activities for income.

1 Economic reforms introduced in Viet Nam in 1986 to create a "socialist-oriented market economy".

Methods

A study was conducted to assess consumer food-access capabilities, by mapping Hanoi's food retail environment against the food-shopping practices, preferences and dietary intake of 400 households in Hanoi, with a focus on women who were primarily responsible for food provisioning and were of reproductive age. The sample size calculation was based on being able to detect a difference in micronutrient intake (mg of iron from previous research) of women across study strata, with a confidence interval of 95 percent, a statistical power of 80 percent and a design effect of 2 (Gorstein, 2007).

Households were randomly selected using a door-to-door sampling strategy from four strata that were characterized by their proximity to supermarkets and wet markets (Figure 1), the two retail options that are the focus of Viet Nam's retail modernization policy (MoIT, 2009). The following inclusion criteria were applied: gender (women), age (childbearing age, born after 1966), residency (at least two years at their current address), household size (excluding single-person households), income (per capita daily income of less than USD 5.50) and a role in household food acquisition (primarily responsible).

Five methods were used to collect data: (1) a food retail-outlet census, (2) a food-shopping practices survey, (3) price data-collection, (4) quantitative 24-hour dietary recall and (5) in-depth multigenerational interviews with a subset of women to gain more in-depth understanding of whether the transformation of the city's food system was impacting their food choices and, if so, how.

WHAT IS HAPPENING TO URBAN DIETS?

The study found consumers were aware that nutrition was important, with 83 percent and 87 percent stating that under- and over-nutrition were serious issues, respectively, and 81 saying that diet diversity was important. Nutritional knowledge was limited and the understanding of nutrition concepts was basic. On average, 81 percent of women were able to correctly recall the purpose of the Vietnamese food pyramid, but could only correctly identify two out of the eight food groups.

Figure 1. THE FOODS MOST COMMONLY PURCHASED FROM DIFFERENT TYPES OF RETAIL OUTLETS

MODERN RETAIL Hyper-/supermarket	CONVENIENCE Chain/"mom and pop" stores	TRADITIONAL RETAIL Wet/street market
Dairy Snacks Ready-to-eat foods Sweets & cookies	Rice, cereals and starch Dairy Snacks Ready-to-eat foods Sweets & cookies Oils and fats Spices	Fish Meat Eggs Vegetables Fruits Legumes Nuts & seeds Insects

Overall, the diet quality of the urban poor was minimal. Women only consumed half of their daily nutrient requirements and 25 percent did not reach minimum dietary diversity (FAO and FHI 360, 2016). Foods purchased from traditional retail outlets (wet markets and street vendors) were mostly fresh, unprocessed foods that maintained a healthy diet and contributed most to daily nutrient intake: 70 percent protein, 56 percent energy, around 80 percent vitamin A and C, and about 70 percent calcium, iron and zinc.

Modern retail outlets were largely used only to source ultra-processed foods, such as instant noodles and porridge, sweetened beverages and packaged confectionery (such as biscuits, cakes, buns) that contained high quantities of salt, sugar and fat. Ultra-processed food consumption was still quite low, with a mean daily consumption of 60g, accounting for only 6 percent of daily energy intake. Convenience stores and supermarkets were the main sources of the ultra-processed foods, with 68 percent and 17 percent of the mean daily quantity consumed acquired from them, respectively.

People were found to not be opposed to supermarkets. Although they considered them expensive (85 percent, compared with just 1 percent who found wet markets expensive) and too time-consuming (56 percent compared with 3 percent for wet markets), they also deemed shopping in supermarkets interesting (72 percent, though less than the 86 percent for wet markets) and food safe (68 percent compared with 60 percent for wet markets).

Viet Nam's policy has been effective in providing safe vegetable outlets in lower-demographic areas where wet markets are no longer easily accessible. This has largely been in the form of convenience stores, which were more abundantly and equally distributed than supermarkets and offered a variety of safe and fresh vegetables (Uyen et al., 2017). However, there was still limited consumer trust in terms of safety guarantees, the prices were slightly more expensive than in the wet markets and opening hours did not match preferred shopping times. Consequently, the urban poor were largely excluded.

Nearly all (90 percent) of households still preferred to shop at traditional (in)formal markets (wet markets and street markets), with 70 percent of their diet sourced from these outlets. The study revealed that supermarkets and convenience stores offered a higher percentage and wider range of ultra-processed foods than traditional open-air markets (65 percent and 25 percent, respectively) and that stores were frequented mainly to purchase and consume these less healthy foods. An overwhelming 99 percent of the urban poor did not use supermarkets or convenience stores for primary grocery shopping, even when a supermarket was located close to home (45 percent). In 83 percent of cases, when a wet market was beyond walking distance, consumers chose informal street markets rather than modern retail outlets. Unfortunately, street vending is unregulated and more unhygienic than formalized wet markets, so potentially carries greater food-safety risk.

Figure 2. PERCENTAGE OF TOTAL FOOD INTAKE AND ULTRA-PROCESSED FOOD INTAKE PER RETAIL OUTLET TYPE

MODERN RETAIL Hyper-/supermarket	CONVENIENCE Chain/"mom and pop" stores	TRADITIONAL RETAIL Wet/street market
8% food 17% ultra-processed	11% food 67% ultra-processed	70% food 7% ultra-processed

84% ultra-processed foods consumed

The main drivers of continued shopping in traditional (in) formal markets, even when far from home, was largely driven by preferred shopping practices, including the diversity and perceived freshness of products offered, convenient location, overall enjoyment of open-air market shopping, the availability of healthy foods, lower food prices and the perception of trusted food safety. Social considerations were also raised, including habitual nature and concerns about maintaining the culture and tradition associated with market shopping, and the influence on cooking of traditional dishes. Women explained that while their generation's dietary preferences had not yet shifted, they were starting to adapt their cooking practices to include new westernized dishes requested by their children in an attempt to appease their taste preferences, as food was one of few affordable treats, and to encourage them to eat. Amid food shortages and stunting, their reasoning was that children would eat more when they liked the food and would grow better when they ate more.

Lastly, more than 40 percent of household income was spent on in-home food consumption. Vast differences in retail-outlet food prices were observed, particularly between traditional (in)formal markets and food-safety-regulated modern and hybrid outlets. Supermarkets were, on average, 35 percent more expensive, but still considered somewhat affordable. Furthermore, over 85 percent of households reported that the price of formal food-safety-regulated food items was too high and, when sold through specialized retail outlets, also unaffordable.

The in-depth, multigenerational, qualitative interviews gave insights into women's perceptions and opinions on how the transforming food environment was impacting their and their family's diet. Women reported that they did not feel empowered in voicing their needs and concerns when it came to coping with food-safety and nutrition issues in everyday life. Consumers understood the government's rationalization that traditional wet markets were being closed due to hygiene and food-safety concerns and understood that food retail needed to modernize. However, collectively, they still wanted to keep wet markets as part of their daily food environment and expressed concern about the current, rather one-dimensional direction of food retail. They expressed ideas about more hybrid alternatives that involved co-sharing of responsibility in managing food safety at the markets.

SO, WHAT DOES IT ALL MEAN?

Nutrition and food-safety issues coexist and compete when it comes to food-policy governance in Hanoi. Traditional open-air markets remain crucial to maintaining a minimal level of diet quality for the urban poor, although they do not provide formal food-safety guarantees. No studies have yet been done to compare food-safety measures between foods with and without formal safety guarantees, however, it is generally assumed – reinforced by the Government – that formal guarantees mean safer food. Modern retail outlets provide formal food-safety guarantees, but the urban poor often cannot or do not access or use them as their primary source of food, even when traditional markets are beyond walking distance. When formal markets are not available, consumers turn to informal street markets, which are unregulated and pose even higher food-safety risks. Supermarkets are mostly used for purchasing ultra-processed foods, leading to unhealthy diets and jeopardizing the future dietary quality with the urban poor (Kelly et al., 2014).

Viet Nam has made significant progress in decreasing its rates of undernutrition, however, obesity and the prevalence of NCDs is increasing – particularly in the urban areas – putting pressure on public health systems (Development Initiatives, 2018; GBD, 2017). The trend of sourcing ultra-processed foods mainly from modern and convenience retail outlets could suggest a risk to diet quality and nutrition if the modernization policy is completely effective in changing the primary food environment, so that it becomes wholly dependent on supermarkets. It could (i) drive people towards unhealthier diets, with greater consumption of ultra-processed foods and less consumption of fresh foods, which may lead to a rise in NCDs (Moubarac et al., 2013), and/or (ii) increase food insecurity due to the additional spending required to acquire the same fresh, unprocessed foods in modern retail outlets than from current, traditional markets in order to maintain diet quality.

Although the often unhygienic conditions and lack of adequate control mechanisms of traditional open-air markets are not contested, the limits of pushing modernization and banning traditional retail structures without inclusive consultation of the urban poor is risking their food and nutrition security.

What the people think – the active participation of consumers

A short documentary, entitled *Retail Diversity for Dietary Diversity: Food Safety and Nutrition for the Urban Poor*, was developed to give agency to the voice of the urban poor and give policymakers insight into their daily food realities (Fresh Studio, 2018). It can be viewed here: https://www.youtube.com/watch?v=3ZiZ2xSvffY&feature=youtu.be.

POLICY RECOMMENDATIONS

Policy must focus on how to mitigate the undesirable economic access barriers of food-safety certification and "supermarketization" for the urban poor, so as not to degrade diet quality. Under current policy, supermarkets are expected to function increasingly as the primary food source. Consumer awareness campaigns are, thus, recommended to improve consumer trust in the food-safety guarantees provided by these outlets and to promote their use in the absence of wet markets rather than a reversion to informal street markets. These same campaigns should also educate consumers about the dietary and health risks associated with increased consumption of ultra-processed foods and emphasize the importance of the continued consumption of fresh foods.

However, policymakers must acknowledge that wet markets are crucial to maintaining quality of diet of the urban poor. We would, therefore, recommend that food-safety policies be revised to recognize the importance of these types of retail outlet for diet quality and be designed to embrace and include retail-outlet diversity in urban food systems.

Considerations for testing interventions to improve food safety in wet markets

- Co-shared responsibility with local actors at each location.
- Blockchain to validate a Participatory Guarantee System (PGS)-type system (FAO, 2018)
- Technologies to improve traceability from production (including smallholder farmers)
- Improved hygiene, food handling and preparation awareness of wet-market vendors and consumers
- Active participation of populations whose diets depend on wet markets

Insufficient attention has been paid to identifying innovative policies and interventions to improve wet-market vendor hygiene and food-handling practices that guarantee food safety, such as community-based guarantee systems. Low-cost local food-safety control mechanisms and policy to renovate and upgrade existing informal fresh food outlets with deficient food-safety standards must be established and offered as an alternative to closure. Evidence demonstrating that these retail outlets can provide equivalent food safety to supermarkets could rebuild government and consumer trust in these outlets. The process should include the active consultation and participation of representatives from all socioeconomic strata, households and local authorities.

To ensure that public authorities meet their dual mandate of improved access to diverse, safe and nutritious foods for the urban poor, current one-dimensional, ideal-type policies on food safety and public health need to become more diverse and participatory (Wertheim-Heck, 2018).

Equitable urban food systems that empower all residents to access nutritious and safe food for a healthy diet require food-safety policies that recognize the importance of versatile and diverse food retail environments. There is an opportunity for the co-creation of an equitable and nutritious food environment with the active participation and involvement of (vulnerable) consumer groups, food producers, retailers and policymakers. Such an approach would generate new insights into the cultural, social and economic dimensions of food practices, habits, preferences and consumer needs.

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FAO/HOANG DINH NAM

Demand-side measures improving food environments

The fight against non-communicable diseases: A snapshot of fatty-food taxation in Tonga

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ABSTRACT

Non-communicable diseases (NCDs) have been declared a global crisis and are a particular problem in the Pacific region, where they are responsible for high rates of morbidity and mortality. Nearly one in four people in the Kingdom of Tonga is likely to die prematurely from NCDs. Increased globalization and trade liberalization have led to increased imports of unhealthy food into Pacific countries at cheaper prices. Taxation measures were implemented in Tonga in 2013, 2016 and 2017 with the aim of raising levies on food products deemed unhealthy and reducing them on healthier ones. A study was conducted of food taxation in Tonga, with a specific focus on fatty meat taxes. The perspectives of various stakeholders were sought on the effectiveness of food taxes and the processes followed. Data were collected using a qualitative research approach, based on focus-group discussions with consumers and key informant interviews with stakeholders from various government, civil-society and non-government organizations, as well as a review of documents. One positive outcome was a decrease in the consumption of mutton flaps, but the consumption of chicken-leg quarters does not appear to have been affected. The lack of affordable healthier food alternatives appears to be a major issue.

Recommendations are given on how to improve future taxation initiatives, such as the need for collaborative efforts involving consultation with relevant government ministries and other stakeholders, including consumers, and the need to consider Tongan culture and traditions in decision-making processes.

INTRODUCTION

Non-communicable diseases (NCDs) have been declared a global crisis and are a particular problem in the Pacific region, where they are responsible for high rates of morbidity and mortality. In Tonga, many adults in their prime have to cope with disabilities and loss of income as a result of NCDs. Diabetes has increased in prevalence from 5.2 percent to 19.0 percent over the course of four decades, while the incidence of obesity has increased from 56.0 percent to 70.2 percent of the population over the same period (Lin et al., 2016). Life expectancy in Tonga has fallen to less than 70 years of age as a result of NCDs (Anderson, 2013; Hufanga et al., 2012). The probability of premature mortality from NCDs was estimated at 24 percent in 2015 (WHO, 2018). Almost 80 percent of deaths in Tonga are attributable to NCDs, such as diabetes, cardiovascular diseases and lung disease (WHO, 2012). Tonga's national health accounts show an increase in the cost of NCDs as care moves from the primary level, where the focus is on prevention, to more advanced care at the main referral hospital (Anderson, 2013).

The Tongan diet has undergone a transition from a traditional diet of fish, root crops, fruit and vegetables to a more convenient, cheaper western diet of imported, less healthy packaged foods, such as noodles, salty snacks and fatty meat. The main drivers shaping Tongan diets are a decrease in local food production as a result of urbanization and an increase in imports of affordable, but less healthy, food into the country (Pauli, Naati and Taoi, 2015), together with a growing number of international trade agreements with western countries. Tonga has one of the highest national expenditure levels of the Pacific Islands on total imported food items (54 percent), with the largest percentage of this being on processed food (34 percent) (Sahal Estime, Lutz and Strobel, et al., 2014). There is no large-scale manufacturing of food in Tonga.

Although the country relies on agricultural subsistence – 95 percent of agriculturally active households are engaged in subsistence or semi-subsistence activities (Sahal Estime, Lutz and Strobel, 2014) – the majority of basic food items are imported. The top imported foods are meat and edible offal (beef, mutton and poultry) and processed foodstuffs, such as tinned meat and tinned fish (Statistics Department Tonga, 2014). The imported foods are generally sold in local retail stores, which are small to medium in size.[1] These are locally owned and operated. Some of the major store owners are also the main importers of food products. Furthermore, there is a large informal sector of unregistered private enterprises in Tonga selling agricultural and fish products in markets, from stalls and on the roadside. The rural and outer-island population accounts for 75 percent of Tonga's population, the majority of them outside the formal sector.

The role that food plays in Tongan culture also contributes to unhealthy eating patterns. Food and the collectivist culture of sharing are associated with almost every event in Tonga – weddings, funerals, other family events, church events, etc. These occasions occur frequently and food must be in abundance to ensure that there is enough for everyone to eat, as well as to take away.

The volume and variety of food exchanged expresses a Tongan's generosity, hospitality and warm-heartedness (Mavoa and McCabe, 2008). Traditionally, the food prepared for these occasions would be root crops, fish, fruit and vegetables, but these have been replaced by cheap imported food products, such as fatty meat, in recent years.

Some of the main food-system drivers of the world's obesity epidemic include the increased supply of cheap, energy-dense foods, improved distribution systems that make food more accessible and the persuasive marketing of food (Swinburn et al., 2011). The proximal drivers of obesity include behavioural patterns in which physical activity is low and energy consumption is high, while distal drivers include taxation regimes and the marketing of unhealthy food products (Swinburn et al., 2011). One of the policy options available to governments in their fight against NCDs is the use of economic tools, such as taxation, to help create a healthier food environment.

Although some evidence is available suggesting the effectiveness of such taxes in high-income countries, little data are available for lower-income countries such as Tonga

1 Small stores in this context refer to dairy shops with one counter and less than 50 m^2 of floor space and medium stores with less than100 m^2 of floor space. Large stores would be the three main supermarkets on the main island of Tongatapu, which have more than one check-out counter and floor space of at least 200 m^2.

(Falbe et al., 2016; Mytton et al., 2007; Silver et al., 2017; Thow, Downs and Jan, 2014; Wright, Smith and Hellowell, 2017). Tonga introduced food-related policy changes as upstream policy interventions to decrease the consumption of unhealthy food and improve dietary choices in 2013, 2016 and, more recently, in July 2017. This paper provides a snapshot of the impact of these taxes from different perspectives in Tonga, based specifically on the taxes imposed on certain fatty products in 2016, as shown in Table 1. The full report was published in 2017 (FAO, 2017).

MATERIALS AND METHODS

Study design and interview guide

Participant information sheets, questionnaires and focus-group guides were developed and translated into Tongan, piloted and revised. The topics and questions are shown in Table 2. The participants were asked to focus on the 'fat tax' passed in June 2016 (Crown Law Tonga, 2016a and 2016b) when answering the questions and anyone who was not aware of the tax was updated as to its content.

Data collection

The project was approved by the National Health Ethics and Research Committee of Tonga in February 2017 and data collection was conducted in the following month. Letters of request for interviews, including brief information about the study and ethics approval, were sent to respective offices and followed up via telephone. The purpose of the study was reiterated and consent was obtained at the interviews. Information was also compiled from published literature, national reports, government documents and media articles.

Participants

Key informant interviews included participants from government ministries and retail businesses on the main island of Tongatapu. Interviews were held with senior officials from various ministries who were involved in the tax-policy change process: the Ministry of Revenue & Customs, Ministry of Health, Ministry of Labour and Commerce and Ministry of Finance. Of the 20 stakeholders from government ministries approached, three did not respond. Small- to middle-sized store owners and keepers were also interviewed. Five major grocery stores and supermarkets were approached, with two non-responders. An attempt to interview restaurant owners was unsuccessful.

Three focus-group discussions (FGDs) were carried out with unemployed women and men from a rural district, as well as with groups of employed women, given women's responsibility for purchasing and preparing food for the family. There were six participants per FGD group, comprising women and men over 18 years of age. FGD participants were recruited through the Community Health section coordinator of the Ministry of Health.

Data analysis

Interviews and FGDs were conducted in Tongan and English and audio-recorded. The recordings were transcribed and translated into English and validated. Analysis was guided by the research questions and with major issues and themes that had been identified. The collected data were triangulated using information obtained from the key informant interviews, FGDs and a document review. The research team also collaborated closely with a World Bank research team, which prepared and conducted household surveys to understand the impact of NCD-related taxes on price, consumption behaviour and revenues. The data in this qualitative study has, therefore, also been triangulated with the World Bank team's data.

Validation of findings via a stakeholder workshop

A stakeholder consultation workshop, entitled "Taxation as a component of food systems action for a healthy diet in Tonga", was held in Nuku'alofa on 20-21 September 2017 to validate the study's findings, jointly organized by the Government of Tonga, FAO and the World Bank. Around 40 people participated in the workshop, consisting of senior government representatives and technical experts from the Ministries of Finance, Agriculture, Health, Commerce, Revenue & Customs, Education, Fisheries and Internal Affairs, as well as the Department of Statistics, the National Food Council, the Tonga Health Promotion Foundation, the Tonga Chamber of Commerce, the Tonga Retail and Wholesale Association, the Tonga Trust Fund, civil-society organizations, churches and donor agencies.

Results

This section is organized according to the main themes identified in the study.

HOW THE TAX FITS INTO TONGA'S BIGGER POLICY PICTURE

The main goals of the food-taxation policy are aligned with the country's national priorities (Ministry of Finance and National Planning, 2015) and the National NCD Strategic Plan, called the Hala Fononga (Ministry of Health, 2015). Strategy 2.2 of the NCD Strategic Plan focuses on ensuring that Tongans have a healthier diet, with specific activities to ensure the affordability of healthy food and to increase the cost of less healthy food through the use of economic measures, such as taxation (Ministry of Health, 2015).

Tonga became a member of the World Trade Organization in 2007 and, in June 2017, signed the PACER[2] Plus agreement along with nine other Pacific countries (Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change & Communications, 2017). This regional free trade agreement aims to increase opportunities for trade in the Pacific by lowering trade barriers, creating jobs and increasing exports. A petition was made by Tonga's Public Service Commission to defer Tonga's signing, so as to consider the implications for businesses, employment and the health of Tongans triggered by the potential importation of cheap, low-quality food products (Radio and Television Tonga News, 2017). The petition was unsuccessful, although it highlighted an important issue that would impact future taxation procedures on imported food into Tonga.

AWARENESS OF FOOD-TAX IMPLEMENTATION AND REACTIONS

Most businesses and consumers were not aware of government plans to impose taxes on various products. Those who were aware had little knowledge of the complete list of food products to be taxed. Information was disseminated through national television and radio programmes after the food taxes had been passed and implemented in July 2016. Some businesses did not know of the tax until they showed up to pay for containers of imported goods. Many consumers were not aware of the tax changes until they noticed price changes when purchasing items at grocery stores.

Most participants reported that they would have appreciated more information about the tax. Retail businesses would have preferred a comprehensive outline of the food items to be taxed or exempted from tax. All participants wanted more information on why particular food items were taxed, as well as access to evidence justifying why taxes were being imposed or removed on certain food products. Some participants appeared to have only realized during the FGDs that taxes had been raised for health reasons.

> *There was no widespread consultation. Mostly, what they do is that the programme is brought on the radio … Consultation is important. We want to know what they know and the evidence that they have. It has to be from both sides … The people, they have to know their ideas …* (Participant, focus-group discussions)

EFFECT ON PURCHASING BEHAVIOUR: REACTIONS FROM RESPONDENTS

Retailers noted a decrease in the overall sales of mutton flaps and turkey tails, but not in the sale of chicken. Overall, retailers thought that the tax was more of a problem for Tonga's low-income-earning population and would not work. The following quote summarizes a common response:

> *Sales are not affected, only the people who don't have the money – that's the problem. They get the money and spend it all on food – no one buys vala [clothes], no one buys other things, but people still go and eat.*
> (Retailer, key informant interviews)

Chicken is the most affordable meat, at just under TOP 4 per kilogram (kg). Turkey tails cost TOP 6-7 per kg and mutton flaps cost the most, at TOP 13-14 per kg, depending on location. According to average retail prices, the cost of chicken pieces initially went up after the tax was implemented, then decreased notably several months later, according to the Department of Statistics. The reason cited was that retailers were taking advantage of the tax change to raise their chicken prices beyond what was required. The Tonga Competent Authority, tasked with monitoring prices, soon brought this situation under control.

2 Pacific Agreement on Closer Economic Relations

Retailers see a sharp spike in sales around national events, such as the Free Wesleyan Church Conference.[3] These events run for more than a week. In addition to functions such as funerals and weddings (which also take place over several days), food provision for the masses is expected on these occasions. Food, including fatty meat and mayonnaise, continue to be purchased, despite price hikes.

Overall, consumers thought that the increase in prices had only changed purchasing behaviour for sipi (mutton flaps). It seems that *sipi* are now only eaten as a treat. As one government worker said:

> *Yes, I just don't understand buying sipi for USD 14 per kg. If I do, it's for Sunday.*
> (Senior Government official, key informant interviews)

However, people will continue to buy them when they have the opportunity:

> *Buying will never stop if you continue to make it available to us. Even if you continue increasing the prices, buying will continue too. With development, the young generation now is used to the taste of imported food. You try to go back to eating traditional food – it's hard for them … you feel sorry for your children and try to provide them with what they want.*
> (Participant, focus group discussions)

Purchasing behaviour is dictated by consumers' earning power. This was apparent in interviews, with those on higher incomes, for example, government workers or business owners, basing their choice on other reasons besides cost. Some bought goods based on health, while others bought food because of taste preference.

Consumers cited chicken as the main meat eaten at home. Putting *kiki* (meat) on the table is the main priority, often at the cost of other household expenses.

> ***The problem is with these prices going up, there are additional problems in our overall cost of living. For example, I can't pay my electricity bill in full so I just pay half – in order for me to buy food for my family.***
> (Participant, focus group discussions)

Parents, intent on providing the best for their children, aim to ensure there is *kiki* for their children every day, if they can.

> *We still have to buy meat. Looking at our children, we still have to buy meat to make an evening meal with …*
> (Participant, focus group discussions)

Those directly involved in policy development and implementation of the food taxes were positive about the initiative, though they acknowledged that it would take time for change to happen:

> ***I think the tax will make us healthier. It's a good tool in terms of changing mindsets. It's generational. These things will take generations, just like it took generations for us to become addicted to sipi. We have to acknowledge that.***
> (Senior government official, key informant interviews)

AVAILABILITY AND ACCESSIBILITY OF HEALTHIER SUBSTITUTES

Mutton flaps are imported from Australia and New Zealand, while turkey tails come from the United States. These unhealthy meats are deemed a delicacy in Tonga. Imported chicken is mainly from the US (Evans et al., 2001; Statistics Department Tonga, 2014) and contains more fat than chicken imported from New Zealand (which accounts for less than 5 percent of imported chicken pieces) and local chicken. The healthier alternatives to fatty meats are fresh or tinned fish, leaner meats, or beans and lentils as a protein replacement. Although local chicken is available and healthier than imported chicken, it is only consumed on special occasions, as preparation is time-consuming.

Tonga did reduce taxes on fresh fish and tinned fish in its first food-tax initiative, but respondents complained that healthier foods were the same price or more expensive than the taxed items:

> *They say on the radio that tinned fish has decreased, but it is more expensive than chicken. Tinned fish used to be USD 2.80, and now it's USD 4. The cheaper tinned fish has a bitter taste and we never buy it.*
> (Participant, focus group discussions)

3 The largest religious denomination in Tonga, which is predominantly Christian.

Deep-sea fish, such as tuna and snapper, caught in Tonga are mainly for export. Taxes were removed from other imported meat, as well as food categories such as crustaceans (crabmeat), molluscs (scallops) and caviar, but not much is available in supermarkets and stores. Efforts are currently being made to increase the availability of fish. An agreement between the Government of Tonga and foreign operators requires that a portion of their catch (5-6 tonnes) is sold at the local market at a lower price. However, according to anecdotal evidence, restaurant owners purchase the bulk of this fish. Lean meat is scarcely available, or not available at all. The Ministry of Agriculture is working with its Chinese counterpart on a breeding programme to provide ducks (as a meat source) for Tongan households. The Tonga Health Promotion Foundation has been funding an egg hatchery distribution programme, providing chicks to all outer islands and rural areas of Tonga since the beginning of 2017 (Latu, 2017; Radio New Zealand, 2017). The sustainability of such an initiative, however, is an issue, as the costs of maintaining the chickens are likely to fall on households.

AVAILABILITY OF COMPLEMENTARY AWARENESS AND EDUCATION PROGRAMMES

Tonga's current National NCD Strategic Plan contains activities to be implemented in parallel with economic measures on food, including licensing measures to encourage retailers to sell a healthier mix of food products and nutrition education to increase knowledge and attitudes toward healthy eating (Ministry of Health, 2015).

The Ministry of Health's NCD/Health Promotion Unit conducts aerobics sessions in various workplaces and some villages. The unit has also released some videos of cooking lessons using local products. The Maie5 campaign in certain schools[4] encourages the consumption of five servings of fruits and vegetables a day. But specific advice on meat alternatives and healthier eating is currently non-existent. According to respondents, current programmes are not well coordinated with the tax intervention and tend to be implemented in a fragmented manner.

Moreover, the 2016 taxes appear to have been driven more by revenue generation considerations than a desire to address unhealthy diets, so there was not much collaboration with other ministries. The task of revenue collection falls under the remit of the Ministry of Revenue and Customs, which was the main driver of policy formulation in this case.

DISCUSSION

This study provided useful information on the circumstances surrounding the development and adoption of the 2016 food taxes, the reactions to the tax from different players in the food system, and people's views on how successful the tax has been at encouraging people to reassess their preferences at the point of purchase. In addition, it identified aspects that need to be considered in similar actions in future.

The lack of affordable healthy substitutes was clearly an issue. While local chicken is available, its long preparation time (plucking and boiling for hours because of its tough meat) makes imported chicken the preferred option, especially to feed large families on a regular basis. Only selected food products were taxed; other, less healthy meat products are still available for consumption, including corned beef, salted beef and sausages. Despite efforts to make fresh and tinned fish more affordable, tinned fish was still more expensive than chicken in 2017. Efforts to sell local fresh fish at a cheaper price appear to have succeeded only in urban areas in the capital, Nuku'alofa. It is also difficult to monitor prices in the large informal sector, which has no business licences to sell food and is not monitored by government.

Tongan culture and religion have significant influence on the population and need to be taken into account in any intervention aimed at behavioural change. Children are very important in Tongan society and providing them with a meat-based daily meal is a priority. There is a belief that eating western or imported foods, including meat, is a reflection of wealth and prestige (Cassels, 2006; Morton Lee, 1996). Food is associated with almost all events in Tonga and food must be available in abundance for frequent family events (Mavoa and McCabe, 2008; Mahina, 1999). Church leaders, for example, will have an important influence on changing the mindset of people when it comes to food preparation for various occasions.

The study found that the process of policy implementation was mainly a decision of the Ministry of Revenue and Customs, with little, if any, advice from the Ministry of Health as to which food products to tax or exempt. Unlike the 2013 tax-policy changes, the development of these policy changes was not a multi-sectoral collaborative effort. There does not

4 Government Primary Schools of Ha'alalo & Ha'akame, Popua, Longolongo,'Atele, Lotolu, Mu'a, Lapaha, Ha'amonga, Ocean of Light and Acts Community School.

appear to have been any consultation with the public. One of the overarching principles of the Global Action Plan for NCDs is a multi-sectoral approach to NCD prevention and control that involves the coordinated multi-stakeholder engagement of a range of ministries and partnerships with relevant civil-society and private-sector entities (WHO, 2013).

Complementary consumer awareness and education programmes that should run parallel to the food-taxation strategy have not been well coordinated and have, thus, failed to reach their full potential. Programmes were not implemented together with other government ministries, which could have made people aware of the price-control list, potential substitutes and alternative food recipes, and allowed them to prepare for a smooth transition to healthier foods and a healthier overall lifestyle.

STUDY LIMITATIONS

This study attempted to provide a snapshot of the status of specific food taxes in Tonga. The views represented are specific to the participants, who were limited in number. Furthermore, interviews and FGDs were held only on the main island of Tongatapu. Import volumes of taxed goods and consumer surveys before and after tax implementation would have complemented this qualitative data and provided definitive answers. Research into the regressivity of the tax is also needed. Research into the cost-effectiveness of such interventions, particularly on the amount of revenue generated, would also be of interest. The World Bank, with direct support from Tonga's Ministry of Finance and other ministries and in collaboration with other partners, including FAO, has conducted further work on the overall effectiveness of NCD-related taxes in 2016 and 2017. The findings reported here are in line with the findings of this more comprehensive study, which are currently being reviewed for publication.

CONCLUSIONS AND RECOMMENDATIONS

In summary, based on these qualitative data, it seems that the intended effects of the taxes on fatty meat are positive when it comes to the consumption of mutton flaps. Overall, however, consumers still purchase and consume fatty meat (mainly chicken) on a regular basis, with consumption increasing during functions and events, which are frequent in Tonga.

Our recommendations based on these findings are as follows:

- For future NCD-related food taxes, there needs to be greater collaborative efforts among relevant government ministries and stakeholders to ensure improvements in health, as well as economic development.
- Those directly affected by the policy changes must be consulted through various means of communication, so that they understand the benefits of the changes.
- Tongan culture and traditions are very strong and must be acknowledged and taken into account during the decision-making processes.
- Incentives should be put in place to increase the availability of alternative, healthier food products, for example, the production of nutritious local substitutes.
- The implementation of various NCD interventions should be conducted in tandem with food-taxation policies. This should be coordinated efficiently through the National NCD Committee.
- A monitoring and evaluation framework on the impact of these policy changes must be developed and embedded within the country's national development framework.
- Important decisions involving a population-based approach must be evidence-based and well researched to justify change.

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THE FIGHT AGAINST NON-COMMUNICABLE DISEASES: A SNAPSHOT OF FATTY FOOD TAXATION IN TONGA

Table 1. FOOD TAXES PASSED IN TONGA, JULY 2016 [TOP (TONGAN PA'ANGA) 1 = USD 0.45]

	Old rate	New rate	Average price (Tongan Pa'anga/TOP) as of March 2017
Turkey tails	-	USD 1.50 per kg excise duty	USD 5.50 per kg
Chicken leg quarters	-	40 seniti per kg excise duty	USD 3.50 per kg
Mutton flaps/lamb breast and lamb flaps	-	15% customs duty	USD 13 per kg
Mayonnaise	-	15% customs duty USD 2 per kg excise duty	USD 15–18 for a 500g jar
Lard/dripping	USD 1 per kg	USD 2 per kg	Not available

Source: *Crown Law Tonga, 2016a and 2016b.*

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Table 2. TOPICS AND QUESTIONS USED IN INTERVIEWS AND FOCUS-GROUP DISCUSSIONS. AN "X" INDICATES THAT A PARTICULAR QUESTION WAS POSED TO A PARTICULAR GROUP OF RESPONDENTS

Questions	Policy makers	Food importers	Retailers	Restaurant/ fast-food outlet owners	Consumers	CSOs
Policy process and context						
How familiar are you with the process involved in the development and adoption of this policy? (Follow-up question for those who have been involved: Please elaborate on how the tax was developed)	X					X
How does this policy fit into the bigger policy picture in Tonga?	X					X
What alternative policy options were considered (if any), instead of the fat tax? (Follow-up: Why was the fat tax selected?)	X					X
Were there any barriers to the introduction of this tax? Give details.	X					X
Policy impact						
What are the expected impacts of this policy? [Prompts: i) economic impact, ii) social impact, iii) environmental impact] In relation to different groups i. Children and adolescents ii. Adults and elderly iii. Private sector iv. Different socio-economic groups	X					X
What mechanisms have been put in place to monitor the effectiveness of the tax?	X					
Has there been any evaluation of impact since its implementation? If yes, what were the findings?	X					
Do you know of any anecdotal evidence that suggests the tax is changing the way people buy/sell/prepare foods?	X				X	X
How has the policy affected you as an individual/ business owner/ policymaker?	X	X	X	X	X	X
Do you have any data regarding the amount from the tax increase passed on to the consumers? (Per food item)	X	X	X	X		X
What is your perspective on the timing of tax adoption and its potential to achieve the intended effect?	X					X
What media coverage did the tax receive? (Follow-up question: In which media? (Prompt also for social media)	X	X	X	X	X	X
Policy enforcement, monitoring, evaluation and sustainability						
Can you comment on the compliance and enforcement of this particular tax?	X					
Was a monitoring and evaluation plan put in place to assess the policy impact?	X					
Do you know what the tax revenues will be used for?	X	*X*	X	X	X	X
Are any supporting policies/programmes planned, to support the fat tax? Example: to increase the availability or affordability of healthier food substitutes.	X					
Are there consumer awareness programmes and other health promotion/advocacy programs that complement the tax? (Can ask policymakers if any are planned)	X	*X*	X	X	X	X

Questions	Policy makers	Food importers	Retailers	Restaurant/ fast-food outlet owners	Consumers	CSOs
Personal reactions to the tax						
Are you aware of this tax? (Check what they know)		X	X	X	X	
How did you first get to know about this tax?		X	X	X	X	X
Why do you think this tax was introduced?		X	X	X	X	X
Which foods have you noticed going up in price since the tax was introduced?		X	X	X	X	X
Has this tax affected the way you buy/sell or prepare food? If yes, how?	X	X	X	X	X	X
Have you substituted any particular food you used to buy with others? Which ones?	X	X	X	X	X	X
Do you buy less of any particular foods because of this tax? Which foods? (Follow up question: if the food is quantifiable, try to get an idea of the quantity, per day/week/month. e.g. two fewer cans per week).	X	X	X	X	X	X
Do you buy more of any particular foods because of this tax? Which foods?	X	X	X	X	X	X
Has this tax affected your other expenses? Which ones? How?	X	X	X	X	X	X
Do you think the changes you have made have been for the better or for the worse? Why?	X	X	X	X	X	X
In your opinion, will this tax help to make Tongans healthier/ eat healthier foods? Why?		X	X	X	X	X
If you have cut down on fatty foods, what was your main reason for doing so? (Choose one of the following: price increase; health consciousness; both; other)	X	X	X	X	X	X
In your opinion, is it easier/cheaper to find healthy foods such as fish, fruit, vegetables, legumes and root crops, since the tax was introduced?		X	X	X	X	X
What else is needed, to help Tongans eat healthier food and live healthier lives?	X	X	X	X	X	X
In your opinion, what should the government use the revenues from this tax for?		X	X	X	X	X
Number of questions	**25**	**20**	**20**	**20**	**20**	**25**

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Nutritional implications of Tibetan Plateau resettling and urbanization programmes

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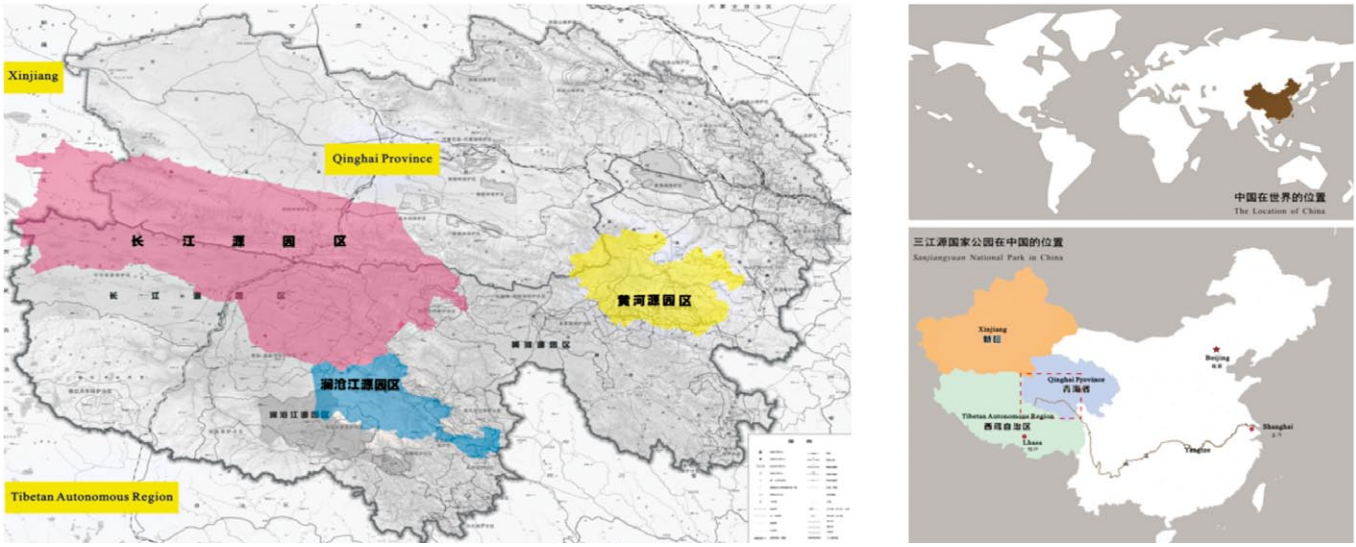
ABSTRACT

Since 2005, indigenous pastoralists on the Tibetan Plateau have been subject to resettlement and urbanization under Chinese Government programmes to conserve water sources and alleviate poverty. As a result, there have been rapid and substantial changes in their food environment: traditional foods and culture-specific food practices have become less available and affordable, while market foods have become more accessible. Some of the market foods that have been introduced, such as fruit and vegetables, have diversified the pastoralists' narrow diet. Other, western foods have had a negative impact on their health, however, leading to high prevalence of non-communicable diseases (NCDs). A community-based survey involving 1 003 settled pastoralists revealed that 33.9 percent of participants were overweight, 18.7 percent obese, 40.3 percent had non-alcoholic liver disease and 16.6 percent suffered from hypertension. Actions need to be taken before the NCDs reach crisis proportions. Local government, non-governmental organizations and research institutions need to come together to develop a culturally sensitive programme, integrating health, environmental and cultural aspects, to tackle the challenges created by the changes in the pastoralists' food environment, to preserve dietary traditions and improve the indigenous population's general health and well-being.

INTRODUCTION

The Tibetan Plateau is one of the world's highest inhabited regions, with an average elevation of more than 4 500 metres above sea level. The Sanjiangyuan headwater areas of the Yangtze River, the Yellow River and the Mekong River are located in the centre of the Tibetan Plateau (Figure 1).

Figure 1. MAIN RESETTLEMENT PROGRAMME AREAS



Source: *The Sanjiangyuan National Park Administrative Bureau.*

Note: The larger map on the left is the Sanjiangyuan area; the pink, blue and yellow areas are in the Sanjiangyuan National Park.

Since 2005, indigenous Tibetan pastoralists in these areas have been resettled and moved to urban areas in a bid to both conserve water sources and alleviate their poverty. Their food environment has, thus, changed substantially and rapidly, affecting their dietary patterns, lifestyle and health outcomes.

This article describes the food-environment changes brought about by this resettlement process and its health effects on the Tibetan pastoralists. It also explores possible actions to tackle the nutritional and health challenges involved.

RESETTLEMENT FOR ECOLOGICAL CONSERVATION IN THE SANJIANGYUAN AREAS

The Tibetan Plateau resettlement programmes came about due to environmental pressures stemming from grassland degradation caused by climate change, overgrazing and the uncontrolled mining of gold, iron and copper in the Sanjiangyuan area of Qinghai Province. The region is one of the world's most sensitive areas to global warming, which has led to increased evaporation and land desertification.

As the local population increased with the introduction of improved health care and greater exposure to the outside world, people had to raise more livestock to feed themselves and to meet the needs of higher living standards, accelerating grassland degradation. Eventually, the deteriorating grassland resources were insufficient to feed the growing population, prompting the resettlement programmes.

From 2005 to 2012, the ecological migration project moved 10 140 indigenous Tibetan pastoral households, or 55 773 people, to new settlements in or adjacent to existing towns for easy infrastructure (Fan, 2014). The eco-migration was based on voluntary participation and the eco-migrants were required to sell their livestock and rest their grazing land. They were given free housing and a living allowance for a ten-year transitional period.

The second resettlement project, from 2009 to 2014, moved 113 000 households, or another 530 000 pastoralists, to the new settlements (Xinhua News Agency, 2014). These pastoralists were required to reduce their herds and pay a small amount towards house-building if they wanted a residence in town, at a cost far below market price. A 60m^2 apartment with well-built infrastructure in the suburbs of the city of Golmud, for example, cost the pastoralists about USD 5 300 (roughly the price of two yaks), compared with a market price of around USD 30 000. The settlements built in this programme were largely expansions of the previous settlements built for eco-migrants. Currently, there are two populations living in the settlements: eco-migrants without pastureland or livestock and settled pastoralists with reduced herds.

Since 2011, a larger-scale subsidy programme has been under way for all pastoral households, both settled and nomadic. In late 2017, more than 10 000 pastoralists were employed as ecological guards on the Sanjiangyuan National Park project. Eco-migrants returned to the land on which they previously lived to protect the environment, rather than herd on it, while settled pastoralists worked alongside them, protecting and herding simultaneously. More such jobs are being created as a result of increased investment in the Sanjiangyuan National Park project (The State Council Information Office of the P.R.C., 2018).

A third round of resettlements is currently under way as part of the national "poverty alleviation through relocation" policy framework, which is separate to the original environmental resettlement programme. It will continue to promote resettlement to the towns in the Sanjiangyuan areas, though.

The resettlements have had a significant influence on the pastoralist communities, on everything from their livelihoods and way of thinking to their lifestyles and modes of transportation (Wang et al., 2010; Ptackova, 2011; Bessho, 2015). In this article, we focus on the changes the resettlements have caused to pastoralists' food environment and the consequent shifts in their diet and health outcomes.

FOOD ENVIRONMENTS IN TRADITIONAL PASTORAL AND URBAN RESETTLEMENTS

FAO describes the food environment as the interface at which people interact with the wider food system to acquire and consume foods (FAO, 2016). An analysis of the food environment in the context of the wider food system (Turner et al., 2018) will facilitate more comprehensive understanding of the food situation on pastureland and in towns.

Indigenous pastoral Tibetan food systems prior to resettlement

The traditional Tibetan pastoral diet is livestock-based. It is highly dependent on local natural resources and very narrow. Home-produced meats and dairy products from yaks, goats and sheeps are the most important daily foods. *Zanba* (roasted Tibetan barley) and black tea, key elements of traditional pastoral diets, are acquired by trading locally produced butter, cheese or other livestock-based products. Jiegu Town and Labu Town in the Yushu Tibetan Autonomous Prefecture used to be the regional trading centres for merchants from both lowland and highland areas. The core components of the traditional pastoral diet persist in indigenous pastoral settings.

Interviews with senior members of the pastoralist community suggest hunting and gathering once supplemented the traditional diet. In the late 1980s, hunting was banned and gathering was abandoned, as foraged food was hard to come by in the highlands.

In the 1950s, fruit and vegetables, such as Chinese cabbage, potatoes and apples, began to be imported in limited quantity from the lowland areas and became available for purchase in towns. These were rarely consumed by the highland Tibetan pastoralists, however, probably because of difficulty of accessing the town markets and a lack of desire to do so.

In the 1980s, when local markets and private business started to recover from 10 years of economic stagnation under the national reform and opening up policy of 1978, the foods available in town markets became more diversified. Before 1978, all businesses were state-owned and there was no private enterprise. Initially, there was an increase in fresh and unprocessed foods in markets. Later, discretionary foods, such as sweets, cakes and sugary drinks appeared and sales of these items grew rapidly.

Food-environment changes – from traditional pastoral to urban settled

Turner et al. (2018) describe the food environment as including external and personal domains, with four dimensions in each: availability, price, vendors, and product properties, marketing and regulation in the external domain, and accessibility, affordability, convenience and desirability in the personal domain. Table 1 compares the food environments before and after the resettlement programmes in the traditional pastoral and urban settled environments.

Changes in the accessibility of foods probably triggered the major shift in dietary patterns. Town dwellers have greater access to market foods, but limited access to traditional foods, leading to changes in other dimensions of the food environment (desirability, affordability, etc.) These changes are presented in detail in Table 1.

The food environment for settled Tibetan pastoralists is a mixture of both the pastoral and urban settings. Informal markets and the trading of livestock and their derivatives persist between those still living on pastureland and those resettled in towns. Some urban households help to look after the school-aged children of families still living in the highlands and receive traditional pastoral foods for these services (food transfer).

The mixed food environment in town was indirectly confirmed by a nutrition survey in late 2018 of 1 003 adults in two urban settled communities in Tibet. Dietary assessments identified three major dietary patterns – urban, western and pastoral. Because of the generally high level of beef and mutton consumption, the urban diet was characterized by high to moderate consumption of vegetables, tubers and roots, and refined carbohydrates, reflecting the increased food diversity of the urban setting. The western diet was characterized by its high consumption of processed foods, such as sugar-sweetened drinks, snacks and desserts, reflecting the impact of the western food industry. The pastoral diet, in contrast, featured high consumption of traditional Tibetan foods intrinsic to the pastoral livelihood, including zanba, Tibetan cheese and milky or buttered tea (Peng et al., forthcoming). The three dietary patterns identified were consistent with current environmental factors – urban, western and pastoral factors, which may impact people's food acquisition and consumption habits.

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Table 1. FOOD-ENVIRONMENT CHANGES BEFORE AND AFTER RESETTLEMENT AMONG TIBETAN PASTORALISTS

Domains	Dimensions	Traditional pastoral	Urban settled
External	Availability	Meat and dairy products are available from own production. *Zanba*, black tea, vegetables and fruit are available in town markets. Discretionary foods are available in town markets or goods with a long shelf life are available in village grocery stores.	Meat and dairy products are available in town markets and informal markets among people living on pastures and in town. *Zanba*, black tea, vegetables and fruit are available in markets within, or close to, the community. Discretionary foods are more diverse than those in the pastoral setting and available in nearby markets.
	Prices	The only foods that are purchased are *zanba* and black tea, which are generally not expensive. The pastoral dietary pattern is neither varied nor price-sensitive.	Food prices depend on where the food is produced, shelf life and ease of transportation. For example, prices of fresh foods with short shelf life, such as vegetables and fruit, are more expensive in remote settled communities than in those connected by main roads.
	Vendor/product properties	Food stores, vendors and wet markets in town, selling both fresh and packaged foods.	Possibly also downtown supermarkets if the community is in the suburbs of a major city.
	Marketing and regulation	Little exposure to advertising; largely unregulated except by traditional culture.	Full exposure to advertising and mass media; better regulated by law.
Personal	Accessibility	Good access to livestock-based foods, less access to market-based foods. Long distances, poor road conditions, and low ownership of vehicles are barriers.	Increased accessibility to all market-based foods. Meat and dairy products from industrial food producers or other value chains gradually replace the native pasture-sourced products.
	Affordability	Good affordability of foods necessary for pastoral diets from markets.	Possible decreased affordability of livestock-based food (e.g. meat, butter) for the poor. Reasonable affordability of plant-based foods, which are cheaper than animal-based foods in markets.
	Convenience	Traditional foods are convenient for preparing or cooking in resource-limited pastoral environments. Preparing introduced foods is time- and effort-consuming.	Improved convenience for cooking because of the infrastructure in town (e.g. water, electricity and gas). The use of some healthy foods (e.g. pulses) is constrained by limited cooking skills (inconvenience, knowledge).
	Desirability	Limited food choices and exposure to discretionary foods, thus reduced desirability.	Increased desirability of discretionary foods among young people because of attractive taste and greater exposure to advertising.

DIET AND NUTRITION CHALLENGES ARISING FROM THE SHIFT IN FOOD ENVIRONMENT

Several nutritional issues need to be addressed in relation to the shift in food environment for the urban settled pastoralists: the weakening of traditional pastoral diets, the decline in affordability for the urban poor, the reluctance to prepare foods (convenience) and the desirability of western foods among young people.

From our field investigation, the weakening of traditional diets was evident in the fact that those individuals following the pastoral diet were older. Another example was the decrease in consumption of Tibetan *lala* cheese. Its preparation requires sophisticated traditional skills that are typically passed from generation to generation. Only a limited number of senior Tibetan women have been able to pass on their culinary knowledge, however. Younger women in the settled pastoralist communities tend to have little desire to learn and practise such skills. Without proper documentation, *lala* cheese preparation and other, unique, culture-specific food knowledge and practices may disappear. The health benefits of traditional knowledge and practice have been discussed in other studies (Kuhnlein and Receveur, 1996; Singh et al., 2010). At local level, effort is needed to document and preserve traditional foods.

The affordability of food, particularly among the urban poor, is tied to the issue of food insecurity and how to cope with it (Peng and Berry, 2019). Because of the cash-based economy in towns, affordability is determined by total income. Due to language barriers, their generally low level of education and a lack of skills other than herding, few settled Tibetan pastoralists have been able to get decent work since resettlement. This has made some households dependent on government subsidies.

The issue of sustainable livelihoods for settled pastoralists has to be addressed, particularly for those who no longer have pastoral property. In the early phases of eco-migration, the issue of substitute livelihoods was explored together with local government, the urban community and a number of international foundations. The Norway Foundation, for example, funded a fur-sewing project in Yushu Prefecture in 2007. Unfortunately, these early attempts proved unsuccessful,

Figure 2.

LALA CHEESE AND DRIED BEEF HANGING FROM THE ROOF

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probably due to the cultural gap between pastoral and urban settings. Now, some eco-migrants have returned to their traditional pastoral settings to work as herders for large livestock owners. Some local governments have also piloted moving settled pastoralists back to the pasturelands, helping them to form animal husbandry cooperatives, under the "poverty alleviation through relocation" framework. The pastoralists' close connection to their native lands and their community cohesion seem to fuel their ability to cope with food insecurity (Peng et al., 2018).

The issue of convenience in the personal food-environment domain is a less common topic of discussion. In traditional pastoral settings, food preparation and cooking are simple, almost non-existent. Dried raw meat is a favourite traditional food. Eating habits have adapted to the traditional nomadic lifestyle, which generally involves extensive efforts to get water and fuel (dried yak dung) for cooking while intermittently on the move.

The persistence of the pastoral culinary culture has impeded the optimal use of some nutritious foods easily accessed and affordable in town, such as pulses and their derivatives. Raw (and as yet unpublished) data from our aforementioned 2018 survey of settled pastoralists suggest that pulses and their derivatives (bean curd, soymilk, etc.) are consumed by only 20 percent of participants at least once a week, making them one of the least consumed food groups. Interviews reveal the principal barriers to be an inability to cook pulses, or the inconvenience involved. Another example

is the cooking of vegetables: frying or stir-frying together with red meat is almost the only preparation method used – and, clearly, not the best way of preserving their nutritional value. This observation also underlines the need for nutritional education among the urban settled population.

Western foods have become increasingly popular in towns, particularly among young people. While western foods seem to appeal in terms of taste, they are also portrayed by the mass media as being modern and chic. Advertising, a key dimension of the external food-environment domain, has promoted western food-consumption by emphasizing its desirability. Indeed, the western food industry has provided accessible (foods distributed everywhere), affordable (cheap energy), convenient (ready-to-eat) and desirable (taste and promotions) foods.

Our team interviewed elderly people on the timeline of these foods, from their appearance on the market to the point at which they achieved broad appeal among the locals. For fruit and vegetables, it took around 40 years, but for discretionary foods, such as sweetened drinks, confectionery and cakes, it took "only" 10 years or so, even in the remote Tibetan Plateau. From a policy perspective, it may be necessary to redefine the role of the food industry as part of the nutritional solution, incentivizing it to become a healthy food provider and to make healthier foods available.

THE EFFECTS OF FOOD-ENVIRONMENT CHANGES ON HEALTH OUTCOMES

The health impacts of the change in food environment and the nutritional transition have been studied (Monteiro et al., 1995; Moreno et al., 2002; Zhang et al., 2014), including among indigenous populations (Kuhnlein et al., 2004). Most studies deemed the dietary transition during urbanization to be associated with increased obesity and other metabolic disorders. Our 2018 survey suggests a high prevalence of overweight and obesity among settled pastoralists (overweight 33.9 percent, obesity 18.7 percent, according to WHO criteria)[1] that surpasses the findings on the general Chinese population in 2012 (overweight 27.1 percent, obesity 5.2 percent) (China CDC, 2015). Our initial (and as yet unpublished) data show other common metabolic disorders in the surveyed population, including non-alcoholic fatty liver disease (40.3 percent), hypertension (16.6 percent) and dysglycemia (17.1 percent).

The increased burden of NCDs and their association with lifestyle is of global concern. The real question in this specific context is how to better utilize both the traditional and market foods to promote a more balanced diet. It is an over-simplification to attribute these poor health outcomes solely to diet, however. The human body is a complex biological system, in which the interaction of diet and physiology may play a more important role than diet alone (Archer, 2018). Social factors also help shape health outcomes (Berry, 2011).

FUTURE ACTIONS BY STAKEHOLDERS

From a public-health perspective, our survey raises some issues for discussion and potential topics for future work.

First, for example, the local government, local CDC, primary health care institutes, and other public health institutions, need to find a solution to the imbalanced diet and consequent prevalence of NCDs within the community, possibly using a "positive deviance" approach (Baxter et al., 2016). "Positive deviance" is based on the observation that in every community there are certain individuals or groups whose uncommon behaviours and strategies enable them to find better solutions to problems than their peers, while having access to the same resources and facing similar or worse challenges (Positive Deviance Collaborative, 2017).

The key question here is, what enables some members of the community (the "positive deviants") to have more balanced diets and better health outcomes than others with the same resources. Interventions could be designed and implemented, drawing on the experience of the "positive deviants" before the underlying causes are fully addressed. The "positive deviance" approach uses local assets available to most community members and is independent of external resources, thus potentially making the intervention programme sustainable (Baxter et al., 2016; Positive Deviance Collaborative, 2017).

1 https://www.who.int/dietphysicalactivity/childhood_what/en/.

Second, it is crucial that stakeholders work together with the local community. There is a growing body of evidence underscoring the importance of cultural sensitivity in health services. As the 2014 Lancet-University College London Culture and Health Commission wrote, "the systematic neglect of culture in health and health care is the single biggest barrier to the advancement of the highest standard of health worldwide" (Napier et al., 2014). In the unique natural and cultural environment of the Tibetan Plateau, local involvement in programme design may help breed success (Schembri et al., 2016).

Third, local government, local non-governmental organizations (NGOs), research institutions and the community need to come together to find a solution to the deteriorating dietary habits of the indigenous population. Government support is the premise in a local context, while the local NGO is usually the most active body that connects others in the chain. This model has been proved successful in the ecological conservation field in the Sanjiangyuan areas, with Green River and Shanshui good examples of effective NGOs. In the public health area, such working models need to be explored further.

The food environment (and its wider system) is not just a tool for or determinant of nutritious and healthy foods. It also serves as a connection point to the environment and to the continuity of local culture. Together, food systems have added immensely to the overall picture of health determinants and to the environmental and cultural sustainability of Tibetan pastoralists – as they have for many other indigenous populations in food-environment transition.

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Using legal frameworks to build healthy and sustainable food environments

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ABSTRACT

An international legal framework for healthy and sustainable food environments must protect and promote agricultural and food diversity.

The determinants of a healthy and sustainable food-environment concept are intrinsically intertwined with those of sustainable food security.

Territorialized legal frameworks are evolving in favour of healthy and sustainable food environments that take into account the cultural particularities of their respective territories.

Implementing an efficient legal framework for healthy and sustainable food environments is one of the best ways for territories to fulfil their various international commitments in the field of human rights, including children's right to health and the right to food

The development of an international legal instrument that promotes local, sustainable, equitable, accessible, resilient and multifaceted food systems is necessary for healthy and sustainable food environments.

INTRODUCTION

The food environment is a key concept in the areas of public health and nutrition, but one rarely addressed from a legal perspective. Various definitions of the food environment have been proposed and all indicate that it influences consumers' behaviour, interventions and decision-making in terms of the food they buy and eat (GLOPAN, 2017; FAO, 2016). According to the High Level Panel of Experts on Food Security and Nutrition, the food environment "refers to the physical, economic, political and sociocultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food" (HLPE, 2017: 28).

The main determinants of the food environment are physical (proximity) and economic (affordability) access to food, food promotion, advertising and information, and food quality and safety (HLPE, 2017; Caspi et al., 2012; Swinburn et al., 2014; Hawkes et al., 2015).

While the international regulatory frameworks do not yet refer to the concept of food environment, the concept of sustainable food security is integrated into various legal instruments, including those related to the trade liberalization of agricultural and food products (WTO, 1994; CARICOM, 2001; EAC, 1999; COMESA, 1993). Therefore, it is necessary to establish a correlation between these two concepts to more clearly anchor healthy and sustainable food environments in a human rights-based approach, among other things, by implementing the right to food.

By joining and committing to the Food and Agriculture Organization of the United Nations (FAO), more than 182 states have declared that "food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996).

Thus, the concept of sustainable food security is based on the following determinants: the availability of food products, physical and economic access to food, and the utilization of food – namely, a safe and adequate diet that respects

food preferences, reaching a state of nutritional well-being where all physiological needs are met (FAO, 2006). Those determinants must be stable over time to achieve sustainable food security for all current and future generations (FAO, 1996; Duhaime and Godmaire, 2000; De Schutter, 2014).

It is, therefore, possible to conclude that the determinants of a healthy and sustainable food environment concept are intrinsically intertwined with those of sustainable food security. Both are based on the importance of physical and economic access to food, as well as food quality and safety. The "utilization of food" determinant of the sustainable food security concept underlines the importance of non-food inputs to food security, such as food promotion, advertising and information. Ultimately, a healthy and sustainable food environment helps achieve sustainable food security at all levels.

Thus, an efficient legal framework for a healthy and sustainable food environment contributes to the efficiency of the broader international legal framework in achieving sustainable food security.

This article discusses the various roles of regulation in implementing a healthy and sustainable food environment and demonstrates the importance of a territorialized legal perspective. Indeed, in addition to the usual way of considering legal frameworks – from international law to local regulations – we think it is important to reflect on healthy and sustainable food environments from a local perspective. Therefore, in this article, we adopt a bottom-up approach that we think can nourish the development of an international framework for healthy and sustainable food environments.

The law, from a legal pluralist perspective (Delmas-Marty, 2006), has at least two roles in the implementation of a healthy and sustainable food environment. The first, as we discuss in the next section, is fundamental, because a healthy and sustainable food environment must be based on the respect of human and fundamental rights. The second is operational, where legal and regulatory instruments become tools to operationalize the healthy and sustainable food environment concept and to ensure that the cultural and environmental peculiarities of the territories and communities it serves are taken into account. These two roles make the law both a powerful vector of social change and an important science that should be included in food-environment discussions.

THE FUNDAMENTAL ROLE OF THE LEGAL FRAMEWORK

The legal framework is, first and foremost, the basis of the concept of food security (Brodeur et al., 2010; Thériault and Otis, 2003), especially through the right to food, the right of everyone to an adequate standard of living for him- or herself and his or her family, and the fundamental right of everyone to be free from hunger, as provided for in Article 25 of the Universal Declaration of Human Rights of 1948 and Article 11 of the International Covenant on Economic, Social and Cultural Rights of 1966 (United Nations, 1999; De Schutter, 2014).

Because of the convergence between the determinants of a healthy and sustainable food environment and those of food security, these fundamental rights can, therefore, be considered the basis of a healthy and sustainable food environment.

Moreover, in his final report, Olivier De Schutter, United Nations Special Rapporteur on the Right to Food (2008–2014), underpins the link between the two concepts by indicating that one of the ways to achieve sustainable food security and implement the right to food is the reconstruction of local and sustainable food systems (De Schutter, 2014). Thus, a healthy and sustainable food environment can be seen as the interface between the food system and the consumer (Turner et al., 2017).

The Rome Declaration on Nutrition adopted by the Second International Conference on Nutrition in 2014 confirms the importance of promoting "sustainable, equitable, accessible in all cases, and resilient and diverse food systems" in implementing the right to food (FAO and WHO, 2014, Art. 13 (c) and 14 (b)).

However, the Rome Declaration on Nutrition is a non-binding instrument. Apart from human rights (including the right to food and the right to an adequate standard of living), there is currently no universal, general and binding international legal instrument that encourages sustainable food systems to contribute to healthy food environments and diets, despite civil-society recommendations (CI and WOF, 2014).

Thus, work still needs to be done to solidify the international legal foundation of healthy and sustainable food environments. We think an international binding instrument or, at least, international guidelines, should be developed to achieve this goal. To this end, certain objectives should be prioritized.

- First, human rights must be at the heart of any such instrument, as they are at the heart of any healthy and sustainable food environment. Healthy and sustainable food environments must contribute to the implementation and respect of the right to food and children's right to health, for example, as they are particularly vulnerable to food environments (Cairns, 2013; UNICEF, 2018).

- Second, the development of an international legal instrument that promotes local, sustainable, equitable, accessible, resilient and multifaceted food systems is necessary for healthy and sustainable food environments, as well as the achievement of food security and the fight against climate change (Rastoin, 2018; UN-Habitat, 2018; FAO, 2014).

- Third, it must protect and promote agricultural and food diversity (Parent, 2013). Indeed, agricultural and food diversity is disappearing at an alarming rate even though, from a nutritional point of view, it is an essential component of healthy and sustainable food environments and diets (FAO, 2016; FAO, & ITPS, 2015; FAO, 2014; HLPE, 2012a; FAO, 2010; FAO, 2007; Declerck et al., 2011; Bisseleua and Niang, 2013).

State actors must grasp that implementing an efficient legal framework for healthy and sustainable food environments is one of the best ways to fulfil their numerous international commitments in the field of human rights, including children's right to health and the right to food.

A TERRITORIALIZED LEGAL FRAMEWORK AS A VECTOR OF SOCIAL CHANGE

Cultures and food traditions are part of healthy eating. Healthy and sustainable food environments must, therefore, reflect the diversity of cultures, territories and communities they serve. In a context where there is still no binding international framework to guide the implementation of healthy and sustainable food environments, they can still be shaped by the use of more targeted, territorialized legal instruments. These can help operationalize the healthy and sustainable food-environment concept and become a powerful vector of social change.

From a legal pluralist perspective, territorialized legal and regulatory instruments may emanate from a variety of legal systems, public and private. Thus, legal and regulatory instruments that may positively influence the determinants of a healthy and sustainable food environment may not only come from national, provincial or state laws and regulations, but also from local or decentralized authorities, municipal school boards and private organizations.

For instance, the legal framework that ensures food quality and safety mostly emanates from national law. However, for the other three determinants of a healthy and sustainable food environment, provinces, states, regions and different stakeholders may contribute to the elaboration of the legal framework.

With this in mind, it is useful to give some examples of specific normative instruments that positively shape the different determinants of a healthy and sustainable food environment. As the purpose of this article is to discuss the different roles of law in implementing such a food environment, it is not necessary to give an exhaustive list of all existing legal instruments in order to underline the importance of the territorialized legal frameworks in this process. From the bottom up, because they reflect the cultural peculiarities of the territories they serve, those regulatory examples must nourish the development of an international legal framework for healthy and sustainable food environments.

PHYSICAL ACCESS (PROXIMITY)

When it comes to the availability of food (proximity), a large number of stakeholders can contribute to the legal framework for a healthy and sustainable food environment. For instance, national, provincial or state laws can (and should) set governmental targets on purchasing healthy, local and sustainable food products through public tenders (UN-Habitat, 2018). In Canada, the Ontario Local Food Act is a shining example. It aims to reduce administrative barriers to the use of local food by public-sector organizations. This goal should make it easier for organizations, such as colleges, universities, hospitals and municipalities, to gain access to local food (Government of Ontario, 2013).

Cities, municipalities and other local authorities can also adopt regulations that positively shape food environments, particularly with a view to eliminating food deserts and food swamps. With this in mind, they should include the development of healthy and sustainable food environments in their land-use and urban planning regulations.

The development of regulations in favour of urban agricultural development is also a way forward. In fact, urban agriculture, though still marginal in practice, is a way to provide local access to healthy and nutritious food products and diversify diets. Yet, even today, several municipal and city regulations do not allow or limit the practice of urban agriculture, often for the simple reason that these regulations have not kept pace with growing interest in this activity. The need for stronger urban–rural linkages is at the heart of a wider reflection on creating an enabling environment for healthy and sustainable diets (UN-Habitat, 2018; De Schutter, 2014).

In recent years, several Canadian cities have created food-policy councils (Montreal, Toronto and Vancouver, for example) in order to foster the development of a healthy and sustainable food environment that ensures sustainable food security within their territory. These local authorities, due to their specific territorial knowledge, play a leading role in implementing regulations for healthy and sustainable food environments.

Schools also take an active role in this legal framework. They may contribute to building a healthy and sustainable food environment through the quality of the menus they offer in their cafeterias, their choice of local food supply, their decision to ban soft-drink vending machines or other ultra-processed foods, or healthy snack rules, whereby only snacks made from fresh fruit, yoghurt or fresh cheese may be consumed on or around school premises.

ECONOMIC ACCESS (AFFORDABILITY)

The legal environment surrounding economic access to food has great potential. Food prices influence consumption patterns (HLPE, 2017) and governments must ensure the implementation of the right to an adequate standard of living for all, including food (UN General Assembly, 1966: Art. 11) , through social policies and social assistance (HLPE, 2012b).

The adoption of tax incentives through national, provincial or state law, therefore, is an effective regulatory instrument for promoting initiatives to encourage a healthy and sustainable food environment. The positive impact of recent moves by numerous countries to introduce a tax on sweetened beverages is relevant in this regard. In fact, in most cases, these new regulations have led to a decline in sales of sweetened beverages, which suggests a decline in their consumption (Chaput and Paquette, 2018).

While tax incentives are an attractive avenue for changing dietary behaviour, it is important to assess the economic, social and cultural context and gather all relevant information before imposing a tax on unhealthy food products that may have adverse effects on health.

PROMOTION, ADVERTISING AND INFORMATION

The restrictive regulation of unhealthy food advertising seems to have positive outcomes for dietary intake (Hawkes, 2013). The legal restrictions mainly concern food marketing aimed at children and populations that are vulnerable because of the condition of their health. The World Health Organization (WHO) has developed strong recommendations to reduce the impact of marketing unhealthy foods on children (such as foods high in sugar, saturated fats and salt) (WHO, 2010; Hawkes, 2013). The United Kingdom of Great Britain and Northern Ireland is one of the most advanced countries in this field and the work of United Nations Children's Fund (UNICEF) in this area demonstrates the importance of adopting a children's rights-based approach to the regulation of unhealthy food marketing (Friant-Perrot and Garde, 2014; UNICEF, 2018).

Food labelling can also help to provide consumers with relevant information on the foods they eat while encouraging them to adopt healthy and sustainable eating behaviours. Thus, several stakeholders can contribute to building the legal framework for a healthy and sustainable food environment.

National, provincial or state laws usually regulate food labelling to protect consumers from false or misleading information (Government of Canada, 1985; 2012). Many European countries and the province of Quebec regulate the use of agricultural, fish or food product designations, such as geographical indications – protected geographical indications, or PGIs, and administrative protective orders, or APOs, for example – or organic labels. Trademark legislation can also be relevant in matters of food labelling.

Even though this kind of legal framework is usually built on national, provincial or state law, local or regional authorities may also regulate the identification of food products from their territory. For example, AgroBoréal is a label for products grown, picked, raised or processed north of the 48th parallel on the North Shore of the St. Lawrence River in the Canadian province of Quebec. This normative framework also includes private organizations, which intervene by proposing certification mechanisms allowing the use of other labels, for example, to promote sustainable agricultural products, fair-trade products or antibiotic-free animal products. Given the plethora of information and labels, the problem of consumers obtaining the right information for a healthy and sustainable diet needs to be addressed.

Lastly, education and consumer awareness contribute to the emergence of a healthy and sustainable food environment. Education, communication and consumer-awareness programmes for healthy and sustainable food diets can be established through laws (Parent and Desjardins, 2015). For instance, the Ontario Local Food Act aims to improve food literacy in respect of local foods (Government of Ontario, 2013: Section 4 (1)(1).

CONCLUSION: LAW AS AN IMPORTANT COMPONENT OF MULTIDISCIPLINARY THINKING

Law, from a legal pluralist perspective, lies at the core of the concept of a healthy and sustainable food environment and is also key to its operationalization. As the effectiveness of healthy and sustainable food environments is greatly enhanced by multidisciplinary thinking, an effective multidisciplinary approach should include a legal and regulatory analysis.

Normative interventions by various levels of government and multiple stakeholders are necessary to operationalize an effective healthy and sustainable food environment. Although an international legal framework is desirable, we need to recognize that legal solutions that are only built from a top-down perspective and homogeneously applied to all territories are not the answer.

Indeed, it would appear that territorialized legal frameworks that take into account cultural particularities are currently to the fore. To develop an international legal framework, we need to take into account the territorialized legal frameworks and solutions that are adapted to the characteristics and specificities of each territory, its cultures and food traditions.

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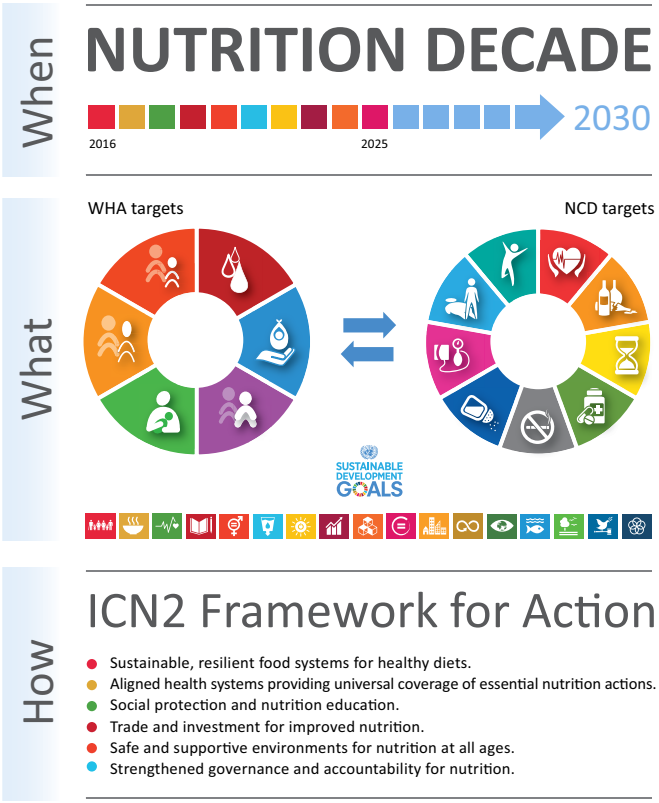
Announcement: Government action to encourage nutrition labelling

Nutrition labelling is a policy implementation tool to promote healthy diets by giving consumers key information to guide their food choices. Its implementation has been recommended and promoted in various official World Health Organization documents adopted by the World Health Assembly (WHA), such as the Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition (endorsed together with the six Global Nutrition Targets for 2025 in May 2012), the Global Action Plan for the Prevention and Control of Noncommunicable Diseases (NDCs) 2013-2020 (adopted together with nine voluntary Global NCD Targets for 2025 in May 2013) and the Report of the Commission on Ending Childhood Obesity in May 2016.

The Codex Alimentarius Commission (Codex) defines nutrition labelling as "a description intended to inform the consumer of nutritional properties of a food". It provides guidance on how to design and implement labelling, including how to formulate nutrient declarations, the nutrients to be declared, the reference values to be used and how labels should be presented (including legibility criteria). However, despite the Codex guidelines and progress on nutrition labelling policies, their impact and effectiveness have varied from country to country in terms of specific outcomes (for example, consumers' nutrition and health and food reformulation).



Action Networks are one of the mechanisms for implementing the commitments of the Nutrition Decade. To boost the impact of food labelling, therefore, the Global Action Network on Nutrition Labelling was formed to exchange country experiences and good practices, share successes and challenges, and provide mutual support to accelerate the implementation of effective nutrition labelling policies. At a two-day launch meeting in Paris in February 2019, 19 countries from around the world presented their national situations and shared their experience. They then discussed a joint Network workplan and next steps. At the meeting, WHO also presented and shared its work on guiding principles for front-of-pack labelling systems, an ongoing evidence review, and nutrition labelling policy guidelines being developed as part of guidelines for promoting a healthy diet.

Action Networks such as this are part of the backbone of the Nutrition Decade and provide a platform for countries to exchange good practices and provide mutual support to accelerate progress in specific areas. The first Global Action Network on Sustainable Food from the Ocean for Food Security and Nutrition was launched by the Government of Norway in 2017, while Italy and other countries will soon launch an action network that will work around the theme of traditional healthy diets. More is expected before the end of the year.

FAO/DESMOND KWANDE

The evolution and spread of industrial food: Building youth resilience through food and media literacy

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ABSTRACT

The rising global supply of industrially processed foods by large transnational corporations, also known as Big Food, is displacing traditional diets and local food systems in low- and middle-income countries (LMICs). There are more than 1.2 billion youth worldwide who will experience and develop in this industrial food system. Young people in LMICs are particularly vulnerable to Big Food, as a result of aggressive marketing efforts and ubiquitous exposure during critical periods of growth, leaving them susceptible to poor health outcomes later in life. While important policies are being developed and concerted efforts are being made by United Nations agencies and national governments to promote the transition to a sustainable food system and healthy diets (for example, through the Sustainable Development Goals, or SDGs), such efforts are complex and may take several years to achieve in LMICs.

The objectives of this article are to (1) bring attention to the vulnerability of youth to the rapidly evolving industrial food landscape in LMICs and (2) propose the context-specific implementation of food and media literacy at scale, to build youth resilience to the Big Food environment and to enhance the impact of current interventions to promote sustainable health solutions. We discuss why young people are particularly vulnerable to the industrial food landscape and we consider food and media literacy interventions to be an overlooked public health strategy for targeting youth in response to the spread of Big Food in LMICs. Based on existing theories, we propose a framework for potential interventions to build resilience among young people to the industrial food system and its potential health consequences.

INTRODUCTION

Traditional dietary patterns are native to culture and to local agricultural systems. The dietary shift from staple foods to industrially processed foods has led to a nutrition transition that has become a global public health challenge (Popkin, 1998). This trend is largely the result of foreign direct investment (FDI), which is the primary mechanism by which transnational food corporations enter new markets (Hawkes, 2005). Large North American and European food corporations have a significant presence in low- and middle-income countries (LMICs) and are responsible for the "unification" of food supplies and "convergence" of the food landscape worldwide (Hawkes, 2006).

The trade-offs involved in FDI in growing LMIC economies are a topic of intense debate. While transnational food corporations have been instrumental in offsetting food insecurity, they have also negatively impacted human health by lowering dietary quality and promoting chronic disease. As a result, the World Health Organization (WHO) has called for action to address the threat of chronic disease associated with processed foods (WHO, 2004).

The 2019 Lancet Global Syndemic Commission Expert Report recognizes that despite sufficient production of food per capita to cover the caloric requirements of the world's population, poor diet is the largest contributor to the global burden of disease (Swinburn et al., 2019). The report states that the industrial food system is a key driver of the global syndemic of obesity, under-nutrition and climate change that intensifies the double burden of over- and under-nutrition (Swinburn et al., 2019).

While the emerging food landscape affects all age groups, youth (younger than 20 years) are particularly vulnerable to the industrial food system. Aggressive marketing and ubiquitous exposure to industrially produced foods during critical periods of growth and development can alter dietary decision-making among young people and leave them susceptible to poor health outcomes throughout adulthood.

The purpose of this paper is to bring attention to the complex and changing food environment in LMICs and its potential implications for youth health, and to recommend the context-specific implementation of food and media literacy at scale, to build youth resilience to the rapidly evolving industrial food environment. Such strategies will enhance the impact of existing public health efforts to curb the deleterious impact of industrial food environments and create long-term, sustainable health solutions. Targeting youth in general, and girls in particular, is likely to have a multiplier effect on their families, communities and future generations.

THE CHANGING FOOD LANDSCAPE IN LMICS: THE GLOBALIZATION OF ULTRA-PROCESSED FOODS

Highly processed, industrially produced food formulations, also known as ultra-processed foods, are omnipresent and include soft drinks, snack items, ready-to-eat or -heat foods, and confectionery items (Monteiro et al., 2013). These foods are typically energy-dense, nutrient-poor and include multiple additives, such as flavourings, colouring agents, emulsifiers and preservatives (Moodie et al., 2013). In 2011, 75 percent of global food sales were of processed foods (Moodie et al., 2013).

As markets in high-income countries have reached saturation, transnational food companies have increasingly focused their market efforts on LMICs (Moodie et al., 2013). Transnational food companies purposefully engage in aggressive promotional efforts and predatory marketing strategies, causing demand for and the supply of ultra-processed foods to skyrocket (Hawkes, 2005). This is clearly visible in countries such as Brazil, where ultra-processed foods, as a share of total calories purchased by the average household, increased from 18.7 percent to 26.1 percent between 1987 and 2003 (Monteiro et al., 2013).

Several factors have resulted in the globalization of food consumption patterns and influenced the agrifood economy. There have been significant food supply changes in retail, including an increase in the number of supermarkets, the year-round availability of food, long-shelf-life products, intensive food-production methods and food-industry marketing (Kearney, 2010). Extensive distribution networks and transport infrastructure established by multinational corporations have resulted in better transportation systems, thereby increasing access to foreign suppliers and food imports in the overall food supply (Hawkes, 2006).

There has been a rapid "supermarketization" of LMICs. The proliferation of supermarkets and their expansion from urban to rural areas illustrate the major inroads major corporations have been making into the low-income food-retail arena. For example, within a single decade (1990-2000), supermarkets grew from about 10-20 percent of the national food retail sector in South America and Mexico to 50-60 percent (Reardon et al., 2003), transforming agrifood markets in the region. Supermarkets make ultra-processed foods affordable and highly accessible and have been instrumental in the disruption of the farm-to-fork consumption of food, thereby promoting the globalization of food consumption patterns (Hawkes, 2005; Rayner et al., 2006).

While the consumption of ultra-processed foods is still much higher in high-income countries in absolute terms, most of the growth is occurring in LMICs. For example, snack-food sales more than doubled, to 2.8kg per capita per year from 1.3kg, in lower-middle-income countries between 1998 and 2012, while soft-drink sales almost quadrupled, to 20.9l per capita from 5.6l. During the same period, there was a smaller increase in high-income countries (to 22kg from 21.5kg and to 124.5l from 117.1l per capita, respectively) (Monteiro et al., 2013).

A prime example is the evolution of snacking practices in Thailand, which were non-existent before concerted efforts by the food industry to infiltrate the market with inexpensive ultra-processed snacks (Hawkes, 2006). Snacking has since become commonplace in Thailand. Another example is the "coca-colonization" of Latin American countries, particularly Mexico, where there has been a surge in sales of sugar-sweetened beverages and where carbonated soft-drink consumption has become intrinsic to the culture in recent years (Popkin and Hawkes, 2016). A "Fill the Nutrient Gap" analysis of snack-food consumption shows that in LMICs, where there are already challenges in terms of access to and affordability of healthy meals, the consumption of non-nutritious snacks has driven up dietary costs and intensified the challenge of meeting nutritional needs (Bose et al., 2018).

Ultra-processed foods are commonly marketed using health or nutrient claims that may deceive consumers into believing that certain products are nutritionally superior to traditional foods (Monteiro, 2011). Evidence has consistently shown that higher consumption of ultra-processed foods is associated with poorer dietary quality, being lower in fibre, protein and essential micronutrients and higher in saturated fat, refined carbohydrates, added sugars and salt (Cediel et al., 2017; Louzada et al., 2015; Martinez Steele et al., 2017).

This is consistent with findings that US households with higher diet quality purchase a significantly lower proportion of ultra-processed foods than households with poorer diet quality, acquiring 47.4 percent of their calories from ultra-processed foods compared with 67.3 percent, and 36.6 percent of their purchased calories from minimally processed foods, compared with 19.1 percent, respectively (Juul et al., 2018). Furthermore, results from a recent randomized clinical trial noted that participants consumed an additional 500 kcal per day, on average, when given *ad libitum* meals composed of ultra-processed foods rather than foods that were minimally processed (Hall et al., 2019), underlining the potential role played by ultra-processed foods in increasing the risk of disease.

YOUTH IN THE CONTEXT OF THE INDUSTRIAL FOOD LANDSCAPE

There are 1.2 billion youth (defined by UNICEF as young people aged 10-20 years) in the world today (UNICEF, 2018), making up around 16 percent of the global population. They will experience a food system defined by Big Food that has significantly deviated from traditional diets. It is imperative that we invest in health through the continuum of the life course and into the second decade of life to ensure their long-term health and prosperity and for intergenerational impact (UNICEF, 2018). Youth are vulnerable from many perspectives:

Physiological demands on youth are high, due to periods of rapid growth and development as they approach adulthood. Thus, appropriate adolescent nutrition is a prerequisite to prevent stunting, delayed growth and to achieve full growth potential. This places a burden on youth to meet their nutritional needs within industrialized food environments that are often nutritionally deplete (Prentice, 2018). Adolescent girls of reproductive age are at a further disadvantage due to menstrual loss and childbearing. It is estimated that 16 million adolescent girls aged 15-19 years give birth every year (Blum and Gates, 2015), highlighting their greater nutritional needs.

Early-life primers for chronic disease: Unsurprisingly, higher consumption of ultra-processed foods has been associated with the global rise in obesity and cardiometabolic diseases (Moodie et al., 2013), specifically in youth (Costa et al., 2018; Rauber et al., 2015; Tavares et al., 2012). Therefore, establishing appropriate dietary behaviour in childhood and adolescence is of particular importance, due to its long-term health implications. The development of excess adiposity in youth is especially worrying, as obesity tracks into adulthood (Singh et al., 2008). A systematic review of epidemiological studies from multiple countries supports the view that dietary patterns rich in ultra-processed foods and the consumption of specific ultra-processed foods (for example, sugar-sweetened beverages, convenience foods, fast foods) are associated with greater adiposity in childhood and adolescence (Costa et al., 2018).

Higher consumption of ultra-processed foods has been associated with higher prevalence and probability of developing metabolic syndrome among adolescents and greater increases in total, and low-density lipoprotein (LDL) cholesterol from age 3-4 years to 7-8 years among children in Brazil (Rauber et al., 2015; Tavares et al., 2012). Briefly, hypothesized biological mechanisms include metabolic dysregulation, dysbiosis of the gut microbiota and diet-induced inflammation, among other factors, however, specific mechanisms are still under investigation (Poti et al., 2017; Zinöcker and Lindseth, 2018). Replacing home-cooked meals with ready-to eat or -heat packaged foods may also promote poor dietary habits, such as frequent snacking and over-eating, potentially leading to increased energy intake with its concomitant implications for obesity and cardiometabolic health (Moubarac et al., 2013).

Local and virtual food environments experienced by youth: The marketing muscle of large food corporations is aimed at young people, intensifying marketing exposure among those aged less than 20 years (Hawkes, 2002). There are several media outlets through which to reach youth, from advertisements in their physical environment to television and the internet. For example, child-oriented advertisements for ultra-processed foods are present in almost all stores in the proximity of schools in Guatemala (Chacon et al., 2015). Food corporations have taken advantage of the global technological explosion and youth's enthusiastic use of digital media. Food companies

have adopted online, interactive marketing strategies, through web pages, social networks, advergames and mobile-phone applications to create intimate relationships and brand loyalty (WHO Regional Office for Europe, 2016; Montgomery and Chester, 2009). Coke™, McDonald's™ and Burger King™, for example, were among the most popular Facebook pages in Brazil in 2015 (Horta et al., 2018).

Psychosocial factors during adolescence: With increasing independence, decision-making autonomy and an evolving system of knowledge, attitudes and beliefs, youth make purchasing decisions within the context of their food environment. As independent mobility increases and as parental control diminishes with age, peers and school environment come into play and are instrumental in modifying eating behaviours established at home. Psychosocial factors, including nutrition knowledge, self-efficacy, nutritional autonomy, peer influences and social norms, can also negatively influence food choices (Story et al., 2002).

FOOD AND MEDIA LITERACY: AN OVERLOOKED PUBLIC HEALTH STRATEGY

The need for tailored youth interventions

Interventions to mitigate the influence of the industrial food landscapes targeted specifically at youth in LMICs are urgently needed. Although the SDGs are a landmark endeavour to achieve a sustainable food system and healthy diets, such efforts are complex, not always politically palatable and may take long periods to enforce. The EAT-Lancet Commission 2019 expert report concluded that a complete transformation of the global food system is necessary to make healthy and nutritious food accessible and affordable and to alleviate the current global epidemics of under-, over- and malnutrition, and the double burden of malnutrition (Willett et al., 2019). This type of paradigm shift is likely to take several years, and alternative solutions need to be put in place until the food system has been successfully revamped.

Large-scale strategies to increase the resilience of youth to the industrial food environment are imperative. One such strategy is to enhance nutritional knowledge and empower youth to make informed decisions on food consumption through food literacy and food-related media literacy. Food literacy refers to the degree to which individuals are proficient in food-related skills and the knowledge necessary to make appropriate food decisions to meet nutritional needs and improve health (Truman et al., 2017). Evidence suggests that greater food literacy is associated with healthier dietary practices among adolescents, and that food skills and eating behaviours learned in adolescence are sustained over time (Vaitkeviciute et al., 2015). Increased food literacy among youth has the potential to both complement and enhance the impact of current interventions aimed at finding sustainable solutions to health.

The development, dissemination and implementation of food-literacy interventions would benefit from the empirical knowledge base for socio-ecological, theoretical models that have achieved success with other health behaviours, such as tobacco control. To operationalize the role of the Big Food industry vis-à-vis individual dietary behaviours, the authors adopted the host-agent-vector-environment (HAVE) framework and the notion of corporate vectors, through which industrial actors oversee the distribution and promotion of food products (agents) for public consumption (Jahiel, 2009). The socio-ecological model (Bronfenbrenner, 1979) and modern derivations of Social Cognitive Theory (Bandura, 2001) extend naturally from the HAVE framework, incorporating micro-processes of behaviour and the dynamic relationships between higher-level corporate vectors, hosts and the products they choose to consume.

Based on HAVE, the socio-ecological model and Social Cognitive Theory, we developed a conceptual framework (Figure 1) to address the role of food- and media literacy in protecting youth from poor health outcomes in the context of the growing industrial food system in LMICs. This kind of multilevel theoretical framework provides organizational structure for both the empirical validation and pragmatic implementation of food-literacy interventions in these contexts (Damschroder et al., 2009).

Evidence suggests that interventions related to the food landscape must account for the dynamic, adaptive context of Big Food industry vectors. Data from LMICs support concerns that physical food environments in neighbourhoods and schools will also influence youth diet quality and weight status (Azeredo et al., 2016; Chiang et al., 2011). It is critical to decipher street-level environments in real time and place, rather than aggregate individual information as a community-level proxy. Thus, personal level literacy interventions must consider the dynamic interaction between youth and their local food environment, and not static, aggregated neighbourhood estimates alone (Williams et al., 2014).

Food literacy

As local food systems and traditional diets give way to an industrialized food system and create an over-reliance on packaged foods, knowledge of customary healthy dietary patterns and cooking skills may not be transferred to the next generation. Therefore, insufficient food literacy among youth in the context of their new food environments may, in turn, increase the risk of poor dietary quality and be detrimental to their health (Figure 1). For example, a qualitative study in Indonesia highlighted increased consumption of fast and processed foods and a lack of practical cooking and food-preparation skills as key determinants of adolescent females' nutritional status (Savage et al., 2017).

The purposeful focus by corporations on nutrients, as opposed to foods, creates confusion around what constitutes a healthy diet (Mozaffarian and Ludwig, 2010). The current nutrient-based paradigm is advantageous to food companies, as claims such as "fat-free", "sugar-free" and "high in fibre" can be used to promote ultra-processed products as healthful (Mozaffarian and Ludwig, 2010). As a result, consumers are distracted from questioning the overall quality of the food product.

In light of this nutritional misinformation and the insufficient knowledge of foods, there is value to developing targeted food-literacy interventions for youth as a "stitch-in-time" approach to the expected surge in chronic diseases in these countries, while simultaneously alleviating under-nutrition. It may prove advantageous to reintroduce cooking skills and methods of sustainable agriculture in a population in which these skills are diminishing rapidly. Creatively infusing food literacy using culturally sensitive, education-based programmes with parent and teacher involvement, or through peer-education, may be a key approach in LMICs.

However, in designing these interventions, we need to address the fact that over 200 million adolescents do not have access to schools, especially girls (UNICEF, 2018). Therefore, alternative platforms for delivering said inventions need to be considered. While evidence from LMICs is sparse, we draw on studies in high-income countries that concur that adolescent cooking skills are associated with better nutritional indicators and that cooking education interventions may improve youth's dietary preferences, attitudes and behaviours (Hersch et al., 2014; Utter et al., 2016).

Media literacy

Overwhelming media messages focused on ultra-processed foods and a lack of counterbalancing messaging on healthy foods, combined with poor knowledge of the pivotal role of diet in chronic disease risk, make youth more vulnerable. Addressing media literacy in parallel to food literacy is another potent strategy to improve resilience to Big Food. Media literacy refers to the ability to recognize, evaluate and understand media messages and serves to improve critical evaluation skills to decompose media messages and recognize the underlying purpose (Aufderheide, 1993). It is common for youth in LMICs to be exposed to rampant food marketing via the media (Cairns et al., 2009).

Because youth are not sufficiently equipped with the cognitive ability to evaluate media and advertising content critically, they are more vulnerable to media influence than adults (Wilcox et al., 2004). Higher exposure to advertisements is associated with greater purchasing desire among children (Cairns et al., 2009). Food advertising directed at youth tends to emphasize ultra-processed foods (Cairns et al., 2009) and must be counterbalanced. Moreover, studies in high-income countries support the view that school-based interventions combining media and nutrition education can improve nutrition knowledge and dietary behaviour among children (Nelson and Kehr, 2016; Grassi et al., 2016). Drawing on lessons from this line of research, context-specific school or non-school-based interventions could be developed to target adolescents in LMICs.

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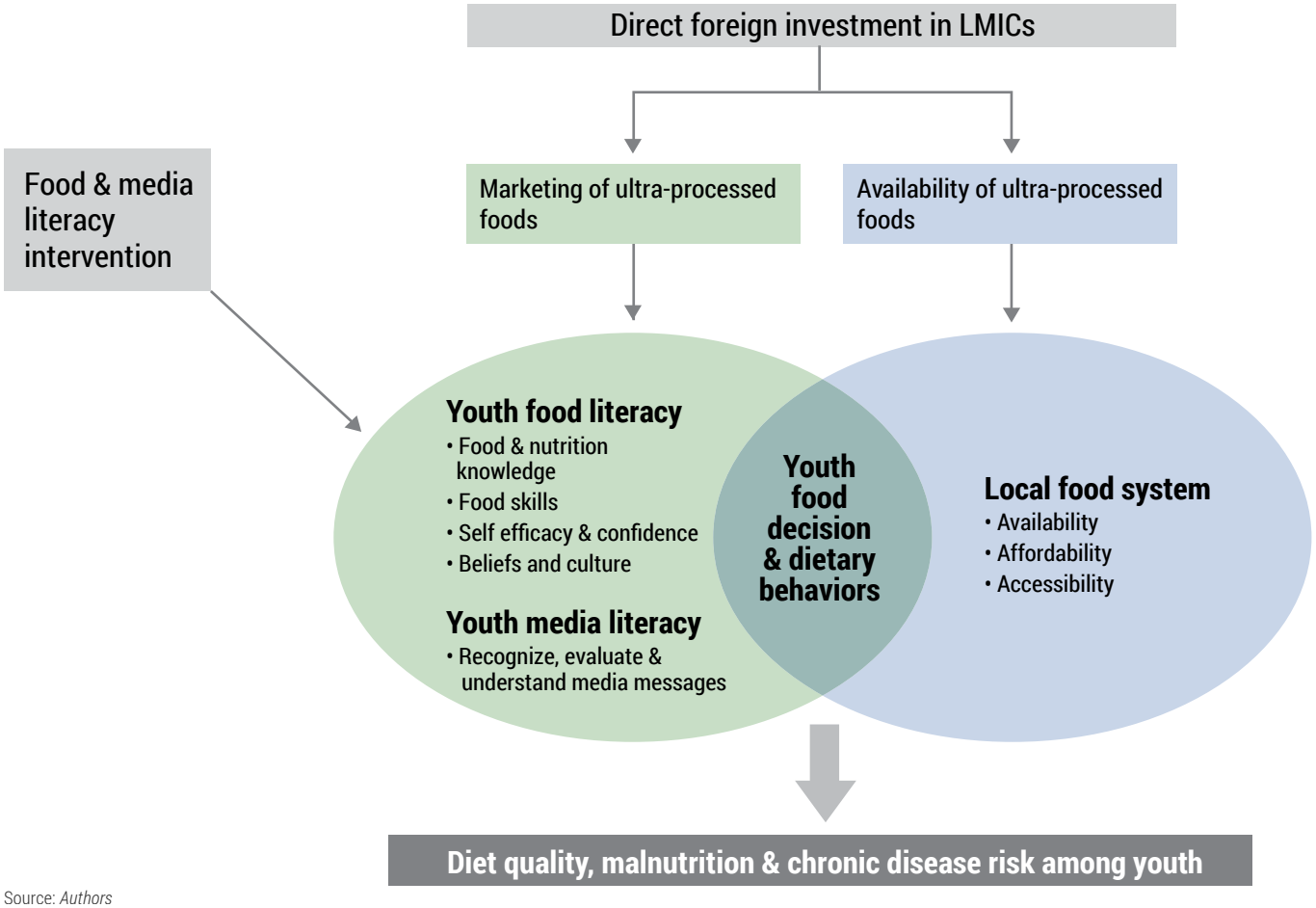
CONCLUSIONS

Food landscapes are rapidly evolving around the world and it is critical to act now to avoid the long-lasting, deleterious effects of poor diets on current and future generations. Food literacy and related media-literacy programmes are underutilized strategies to build resilience to the complex and dynamic industrial food environment. Such knowledge will complement and enhance the effectiveness of existing global efforts undertaken to improve food systems, sustainability and health (World Food Programme, 2018).

Empowering youth, who are particularly vulnerable to Big Food, to make appropriate decisions on food acquisition and consumption and the reintroduction of cooking skills may serve to disrupt the burden of over-and under-nutrition and the projected intergenerational health challenges in LMICs. We advocate multisectoral investment in food and media literacy interventions at scale for youth. Such interventions will be instrumental in responding to the environment in which young people are developing. They will provide educational platforms that engage community, teach life skills and promote behavioural change, elements that are critical to the future of global public health.

Figure 1. FOOD AND MEDIA LITERACY AS A MEANS OF PROTECTING LMIC YOUTH FROM BIG FOOD INFLUENCES



Source: *Authors*

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Improving the school food environment through policy: A case study of challenges and recommendations from Mexico

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ABSTRACT

An effective school food policy is an important tool in promoting healthy, diverse and sustainable diets and can contribute to obesity and chronic disease prevention and help eliminate all forms of malnutrition. This article reviews the topical literature to date and makes policy recommendations aimed at fostering healthy school food environments. These recommendations are based on an exploratory study charting the food environment in Mexican state primary schools and exploring the obstacles to implementing the country's federal school food regulation.

This article argues that school food policy needs to be based in a human rights framework, with particular attention to the Rights of the Child, the Right to Adequate Food and Nutrition and the Right to Water. It emphasizes how policy needs to take into account the economic and structural realities of schools to be effective, for example, the funding constraints facing schools and school food vendors.

Furthermore, policy needs to protect children from access to ultra-processed foods and the marketing thereof, both on and around school grounds, in addition to ensuring access to safe water. Implementation and operational aspects, especially financial viability, must be considered part of policy design, rather than an afterthought. Policy should be safeguarded from conflicts of interest and industry interference and should aim to support sustainable food systems and the promotion of culinary culture and practices. Lastly, school food policy must be aligned with nutritional, agricultural and trade policies and the Right to Adequate Food and Nutrition.

INTRODUCTION

A healthy school food environment is important to obesity prevention and, as such, essential to achieving the 2030 Agenda – in particular, SDGs 2, 3, 4, 6 and 12 – and to guaranteeing the Right to Adequate Food and Nutrition, the Right to Health, the Right to Water and the Rights of the Child. Recommendations to transform schools into healthy food environments that support nutrition and obesity prevention have been put forward by the World Health Organization (WHO, 2016), the Pan American Health Organization (PAHO and WHO, 2014), the Report on Food Systems and Nutrition of the UN Committee of World Food Security and Nutrition (HLPE, 2017), the Second International Conference on Nutrition Framework for Action (FAO and WHO, 2014), and the Work Programme of the UN Decade of Action on Nutrition (FAO and WHO, 2017).

CHILDHOOD OBESITY IN MEXICO AND THE POLICY RESPONSE IN SCHOOLS

Mexico ranks first in terms of overweight and obesity in the member countries of the Organization for Economic Co-operation and Development (OECD, 2017). One in three Mexican children is either overweight or obese and, according to recent projections, one in two Mexican children (born in 2010) will develop diabetes over the course of their lifetime if action is not taken to reverse this trend (Meza et al., 2015). One factor that has contributed to the rise in overweight, obesity and diabetes in Mexico is the food environment, particularly in schools.

In response to national and international recommendations underlining the importance of ensuring a healthy school environment, and recognizing Mexico's grave obesity epidemic, in 2010, the Government of Mexico developed its "General Guidelines on the sale and distribution of prepared and processed food and beverages in schools that make up the National Educational System". These guidelines (hereafter referred to as the school food regulation) were made more stringent in 2014. They are mandatory and prohibit ultra-processed food products from being sold in schools from Monday to Thursday. On Fridays, only ultra-processed products that comply with certain nutritional criteria are permitted (Government of Mexico, 2014).

Figure 1. FOOD AND DRINKS PERMITTED AND PROHIBITED IN PRIMARY SCHOOLS UNDER MEXICO'S FEDERAL SCHOOL FOOD REGULATION

The Mexican school food regulation promotes the sale of fruits, vegetables, whole grains, seeds, nuts and legumes, as well as access to potable water on demand, and prohibits the sale of soda, sweet and salty snacks, and flavored yogurt and milks.

SNACK TIME IN MEXICAN STATE PRIMARY SCHOOLS

Mexico's school recess, or snack time, is similar to that of other Latin American countries and developing countries elsewhere, but different in many ways to that of the United States of America (USA), Canada and some European countries. In Mexico, 86 percent of primary school students attend state school. Some 87 percent of these schools have a standard four- to five-hour school day. Primary schools with these hours have a 30-minute recess, in which students can consume food purchased at school or brought from home. These schools typically do not have the infrastructure for kitchens or cafeterias, so food is generally not prepared on the school grounds, but brought in ready to eat. There are also state schools with extended hours, with six- to eight-hour days, which do have the infrastructure to prepare meals, but they are far less prevalent. The recommendations presented in this paper, therefore, refer solely to the most common primary schools with four- to five-hour days.

The sale of food and beverages during recess is generally carried out by vendors who arrive a few minutes beforehand to set up stall on the school grounds. These vendors sell their products from mobile stands or tables in the school yard or corridors. There are, on average, three food vendors in each school during recess.

THE SCHOOL FOOD ENVIRONMENT IN MEXICO: THE EVIDENCE BASE

Community monitoring, in addition to various scientific studies, shows that the Mexican school food regulation has not been properly implemented to date.

The My Healthy School online platform[1] developed by non-profit organizations El Poder del Consumidor and the Mexican Network for Children's Rights (REDIM) allows members of the school community to evaluate implementation of the regulation in their school. The platform has received around 8 000 individual reports of non-compliance over the past five years from teachers, parents and students at primary schools across the country.

1 https://miescuelasaludable.org/.

These reports suggest that non-compliance has been on the rise. There has been an increase in the proportion of reports indicating that sugary soft drinks and ultra-processed foods are being sold in schools, as well as an increase in reports complaining that fruit and vegetables are not sold and that potable water is not freely available. Furthermore, schools are supposed to have established a committee to monitor and oversee compliance with the regulation, but these do not exist in the overwhelming majority of primary schools.

Research by academics at the National Institute of Public Health in Mexico provides more detailed evidence on the Mexican school food environment (Théodore et al., 2018; Pérez-Ferrer et al., 2018; Jimenez-Aguilar et al., 2017; Barquera et al., 2018). Their work indicates that 80 percent of schools continue to sell sugar-sweetened beverages, that only one-third of schools have access to potable drinking water (i.e. water fountains) and that the sale of ultra-processed foods continues on school grounds, despite it being prohibited (Pérez-Ferrer et al., 2018; Instituto Nacional de Salud Pública, 2014). One study found that fruit, vegetables and water accounted for only 7 percent of the total food and drink on offer (Jimenez-Aguilar et al., 2017). It was also discovered that 73 percent of foods sold in schools were prohibited under the school food regulation (Perez-Ferrer et al., 2018).

Figure 2. SEVEN KEY ELEMENTS TO ACHIEVING HEALTHY SCHOOL ENVIRONMENTS

The research project described in this article identified seven key elements necessary to achieve healthy school food environments in Mexico. Existing evidence demonstrates that many schools in Mexico face obstacles for implementing these elements.

A research project carried out by *El Poder del Consumidor*[2] provides further insight into the unhealthy school food environment in primary schools (Bahena, Torres and Calvillo, 2018). The study complements prior research, as its primary focus is on understanding the barriers to policy implementation, especially the structural, economic and political barriers, with a view to developing recommendations to improve implementation and enforcement.

The study was conducted in nine state primary schools in urban areas in three state capitals in central Mexico. The majority were characterized as having unhealthy food environments, with the school food regulation encountering serious barriers to implementation (Bahena, Torres and Calvillo, 2018).

The food and beverages sold inside the schools were primarily ultra-processed products, such as potato chips, pastries, flavoured milks and yogurts, cookies and confectionery, as well as sugary beverages. The study also revealed that schools had a very limited sales of fruit and vegetables, and that when fruit and vegetables were offered, there was a very limited variety (i.e. sliced jicama, carrots and cucumbers) and in insufficient quantity to feed all students at the school.

The study further showed that hardly any schools made drinking water freely available to students (i.e. water fountains or water jugs). Even when drinking fountains were present, they were often not functioning or being used for other purposes than drinking. The schools also sold prepared foods (made off school grounds), such as tacos, quesadillas and pizza; some of these were healthy, such as cactus (nopal) tacos, while others were highly processed. It is important to note that food and beverage marketing was also present on school grounds. In addition, a variety of ultra-processed foods and beverages were being sold at the school entrance or on the school periphery as children entered and exited. These foods were frequently purchased by both parents and children.

The study identified various barriers to effective implementation of the regulation. Schools had very limited budgets and the sale of ultra-processed products was perceived as a key means of bringing in funds for school maintenance. The roles and responsibilities of the authorities in charge of implementation were not clearly stated in the regulation and, as a result, training, monitoring and dissemination of materials to inform the school community of the regulation was broadly lacking. Furthermore, the sale of ultra-processed food on the periphery of the school grounds made food vendors inside schools hesitant to adjust

2 https://miescuelasaludable.org/investigacionescuelas/

their own offering for fear of losing business. Lastly, food and beverage brands often provided equipment (such as refrigerators) to school in return for business, which made schools hesitant to stop stocking those brands.

These qualitative and quantitative academic studies, as well as the community monitoring platform, demonstrate the food environment in state primary schools in Mexico to be unhealthy or obesogenic and illustrate the lack of effective implementation of the national school food regulation.

RECOMMENDATIONS FOR SHAPING POLICY TO PROMOTE HEALTHY SCHOOL FOOD ENVIRONMENTS

Based on Mexico's experience and a review of literature on the topic, we believe a few key considerations should be taken into account when developing school food policy in similar contexts. Policy to improve school food environments should:

Acknowledge the interdependence of human rights to achieve the Right to Adequate Food and Nutrition

To advance the Right to Adequate Food and the Right to Health, related human rights must also be upheld, for example, the Right to Education, the Right to Water and the Rights of the Child.

The Right to Education and the Rights of the Child: Educators and educational authorities often find themselves overwhelmed by the scope and demands of their various roles and responsibilities. When a health- or nutrition-related policy is imposed on a school, it is often difficult to find educators willing and able to dedicate the time and resources needed to implement it. This is not only due to their already heavy workload, but the fact that they do not necessarily see the link between healthy school food and educational success, so view the policy as being beyond their remit. It is important to work with educational authorities to foster the widespread understanding that a school food environment that promotes health and nutrition is one that promotes education and optimal human development. The link between the Right to Adequate Food and the Right to Education must be acknowledged in policy development and practice.

Guaranteeing the Right to Water is essential to achieving the Right to Adequate Food and Nutrition: Many schools do not have access to potable or running water, as is the case in Mexico. Ensuring that potable water is freely available in schools is critical to reducing the reliance on sugary drinks and promoting the consumption of water. Thus, guaranteeing access to potable water within schools is critical to ensuring the Right to Adequate Food and Nutrition. Countries may consider fiscal policies, such as a tax on sugary beverages, to help finance the installation of drinking fountains in schools. In Mexico, the civil-society advocates and academics behind the national sweetened-beverage tax also called for a portion of the resulting tax revenues to be utilized to install water fountains in schools. Although it was not possible to directly earmark the revenue, a law was approved soon afterwards requiring schools to provide drinking fountains. A National Drinking Fountain Programme was developed for this purpose, although few fountains have been installed to date and there is a general lack of transparency over the utilization of the tax revenues in question.

Address the financial and structural realities facing schools

The Mexican study demonstrates that many schools rely on food sales to fund school maintenance costs and this is also the case in many other Latin American countries (Dárdano and Álvarez, n.d.). Many vendors and school principals believe that changing the school food offering will lead to a reduction in profit from food sales, thereby jeopardizing the functioning of the school. This has two implications for policy development that should be considered. First, policy to improve the school food environment must be accompanied by efforts to ensure funding for public schools, as this will reduce the need for principals to rely on food sales to generate income for school maintenance. Finding ways to finance schools and increase the educational budget is critical as a parallel policy goal, to ease pressure on school principals and allow school communities to focus on maximizing the quality and nutrition of the foods on sale on school grounds, rather than on generating income.

Second, it is important to engage with school administrators and vendors to identify how the sale of healthy food can prove economically sustainable, especially where schools continue to rely on food sales for maintenance. There are studies from the USA and Latin America that illustrate how the transition to selling healthier food in schools actually resulted in increased revenue and that concerns over losses were overestimated, in part because when unhealthy snack options disappeared from the environment, more money was

spent on purchasing prepared foods (Center for Weight and Health, University of California, Berkeley, 2007; Wharton, Long and Schwartz, 2008). Policy implementation must identify techniques for transitioning to healthier foods in ways that are economically sustainable in the specific country context. Economic subsidies for healthier and more sustainably produced foods must be considered as an important option (Mozaffarian, Rogoff and Ludwig, 2014).

Acknowledge the impact of ultra-processed products on the food environment

Research has demonstrated the clear links between ultra-processed food consumption, obesity and diet-related chronic diseases: the replacement of minimally processed or unprocessed food with heavily marketed, ultra-processed products has had a negative outcome on nutritional health, the food system, the environment and cultural practices. It has been suggested that efforts to reverse this dietary shift should be a central goal of the UN Decade of Action on Nutrition and the UN Sustainable Goals (Monteiro et al., 2017). Because of the significance of ultra-processed foods in shaping the state of global nutrition, close attention should be paid to identifying and reducing the presence of ultra-processed foods in the school environment. This objective should be an important guiding principle of school food policy.

The NOVA food classification system (Monteiro et al, 2012, 2017), which categorizes the extent and nature of food and beverage processing, could be useful in designing school food policy. The simplicity of the NOVA system could enable quick identification of the foods permitted and prohibited for sale, especially in resource-poor settings, where monitoring processes are limited.

Engage civil-society and public-sector actors in implementation, monitoring and evaluation

Policy implementation, including training, monitoring and evaluation, cannot be an afterthought to policy design. Rather, policy development must put these processes at its core, or it will struggle to be effective. School food policy typically involves multiple actors, spanning the education, nutrition/health and agricultural sectors. The roles and responsibilities of these actors, as well as how they will cooperate to jointly implement a policy, must be clear. Government agencies responsible for policy implementation should, therefore, be consulted during policy design so that potential barriers to implementation are prevented or can be addressed early on.

Figure 3. CAMPAIGN EFFORTS TO BAN JUNK FOOD IN SCHOOLS

El Poder del Consumidor launched the campaign **"Schools 100% free of junk food"** in May 2019, as part of the "My Healthy School" initiative, to inform the school community of the Mexican school food regulation and to advocate for its full implementation.

It is critical to involve the school community and civil society in every stage of school food policymaking, from formation to evaluation. Communicating new or existing policies to the public (parents, teachers and children) is an essential part of the process and key to increasing understanding of the importance of a healthy school food environment, as well as to impart knowledge about healthy and unhealthy foods. It will also increase the accountability of school principals and authorities in implementing the policy. One recommendation for improving knowledge of Mexico's school food regulation is the development of posters or banners for the front of each school to inform the community about the regulation and its details, in addition to other informational material and talks, aimed in particular at school principals, vendors and teachers.

Civil society should participate in the monitoring and evaluation of a school food policy to foster accountability and to provide insight on the differential impacts of the policy on children and schools. Monitoring how the policy is experienced "on the ground" is key to creating a feedback loop for policy improvement.

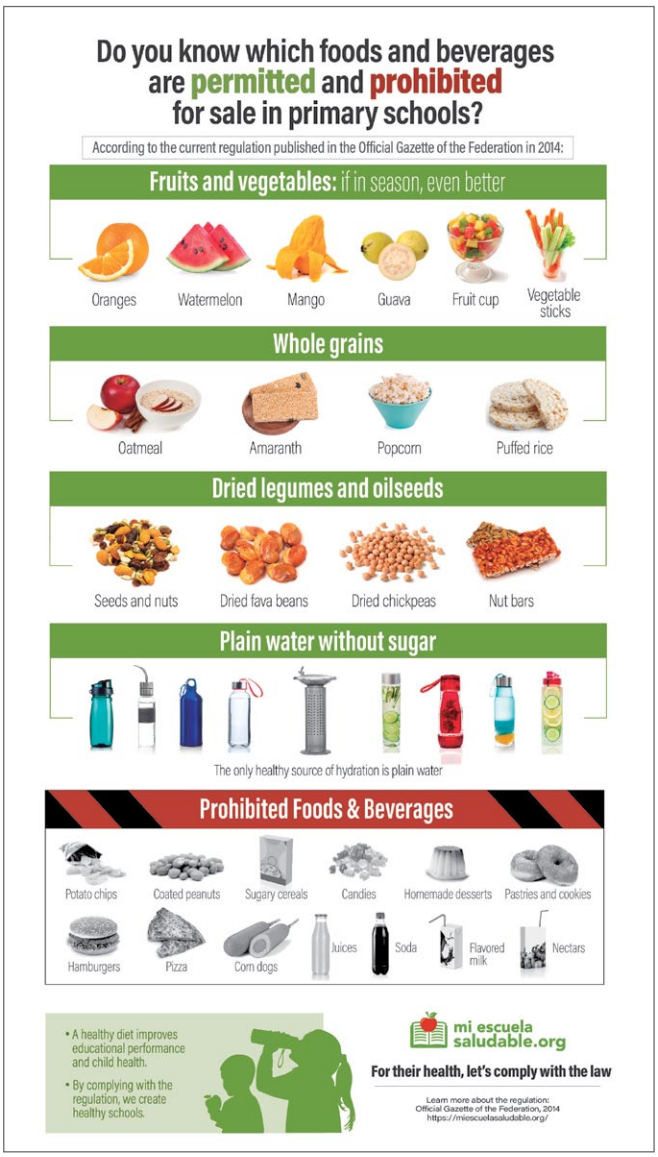
Safeguard against conflicts of interest and industry interference

The food and beverage industry has an interest in ensuring that packaged foods and beverages, and the marketing thereof, are present in schools. Consequently, school food policy tends to attract interest from the ultra-processed food industry, which is concerned about the impact any policy changes may have

on its profits. The design, implementation and evaluation of school food policy must be safeguarded from potential conflicts of interest to ensure that the policy has public health and children's rights as its primary objectives. The food and beverage industry should be kept informed on policy to ensure that prohibited products (and their marketing) do not enter schools and to enhance reformulation efforts.

Importantly, nutritional information and educational workshops within the school should also be free from conflicts of interest. Such information should be evidence based and not be aimed at promoting industry arguments or justifying the consumption of any particular food or beverage brand.

Figure 4. BANNERS ATTEMPT TO EDUCATE PARENTS AND CHILDREN



As part of its campaign **"Schools 100% free of junk food"**, *El Poder del Consumidor* developed this banner for installation in primary schools. The banner illustrates which foods are permitted and prohibited for sale, according to the Mexican school food regulation. The "My Healthy School" initiative is inviting school authorities to install this banner in primary schools nationwide.

In terms of school food provision, efforts should be made to enable direct collaborations between small-scale farmers and producers selling unprocessed and minimally processed foods. In countries with strong school food policies seeking to prohibit ultra-processed foods, it will be easier to allocate a large part of food provisioning to local producers and producer organizations rather than the ultra-processed food and beverage industry. These collaborations should also be transparent and any possible conflicts of interest managed.

Look beyond the school grounds

It is important to consider aspects beyond the school grounds when developing school food policy. Effective policy may also require regulating the sale and marketing of unhealthy or ultra-processed foods outside the school grounds, so that school food sales are not affected by competition from these products. The impact of the sale of unhealthy foods outside the school is particularly strong where children have access to these foods at lunchtime (i.e. if they can leave the school grounds to make purchases, or purchase the foods through the schoolyard fence). School food policy must take this into account and include ways to reduce the marketing and availability of unhealthy foods and beverages on the school periphery (Center for Weight and Health, University of California, Berkeley, 2007; Poppendieck, 2010; Barquera et al., 2018).

Promote sustainable food systems and culinary knowledge

School food regulations should not have the sole focus of improving the nutritional quality of the child's diet, but also promote healthy and sustainable food systems and the diversity of culinary cultures and techniques. It is, therefore, imperative that school food policy be developed in such a way that promotes the sale of unprocessed or minimally processed foods from small-scale producers and supports a shift from foods produced via the agro-industrial complex towards more sustainable production that promotes agro-ecology and local and territorial markets. School food policy should consider procurement policies to support such food-system transitions.

In addition to supporting sustainable food systems, school food policies should promote the richness and diversity of culinary knowledge and techniques. It should encourage the consumption not only of unprocessed fresh fruits and vegetables, but also of freshly prepared culinary dishes, when possible, using regional vegetable, fruit and grain varieties. There has been a shift away from selling freshly

prepared culinary dishes in Mexico towards the sale of ready-to-eat snacks in schools. Proponents argue that it is easier to guarantee the hygiene and safety of packaged foods, especially when kitchen facilities are not present in schools. Nevertheless, it is critical that policies recommend and support the sale of freshly prepared dishes, while following hygiene and food-safety protocols, because such dishes are generally healthier than packaged snack foods and simultaneously help to promote the maintenance of cultural and culinary practices. The Mexican case study showed that children often preferred prepared dishes because they were satiating, particularly when children came to school on an empty stomach. Thus, increasing the availability of such dishes could be an effective element of school food policy.

Ensure policy coherence

Lastly, school food policy should be coherent with related nutritional policies, such as food labelling, regulations governing food marketing to children and fiscal measures, as well as policies that promote the sale of healthy food around schools. In this sense, setting harmonized nutritional criteria is key. For example, the nutritional profile used in a country's front-of-pack labelling and to determine which products are banned from being marketed to children should be consistent with the profile used to determine whether a product should be permitted inside schools. Under Chile's food labelling and advertising law, for example, front-of-pack labelling, marketing and school food policy are harmonized so that a product that is barred from advertising cannot be sold in schools. Policy coherence would also ensure that a country's marketing regulations outlawed school food marketing and that school events or activities could not be sponsored by the food and beverage industry.

Furthermore, agriculture and trade policy and physical-activity programming must be consistent with school food policy and, thus, with the Right to Adequate Food and Nutrition.

CONCLUSION

Primary schools in Mexico are currently characterized by unhealthy food environments and a series of barriers to implementing the country's school food regulation, which are impeding the promotion of healthy and sustainable diets, as well as the prevention of malnutrition, including overweight and obesity. Recommendations for shaping effective policy for healthy school food environments include the need for a rights-based approach and policy design that is comprehensive, coherent and informed by the structural, social and economic barriers that condition the school food environment. School food policy should promote civil-society involvement, reduce the presence of ultra-processed foods in the environment, contribute to a more sustainable food system and guard against conflicts of interest.

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The digital food environment

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ABSTRACT

- Food environments are the "collective physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status" (Swinburn et al., 2013).
- Unhealthy food environments have been linked to inadequate dietary intake and diet-related health conditions, such as obesity and non-communicable diseases (NCDs).
- The current approach to food environments pays little heed to the increasing role of digital technology and the internet in daily life and to the particularities of the digital world in influencing health and nutrition.
- Digital food environments encompass the digital components that may be part of food environments and influence health and nutrition. They are composed of digital actors (such as governments, academia, food industry and digital influencers) who perform digital activities (such as digital health promotion, digital food marketing and information sharing) in digital settings (such as social-networking sites, websites, blogs, smartphone apps).
- It has been suggested that digital food environments are already having an impact, particularly when it comes to body-image disorders, eating disorders and possibly overweight, obesity and NCDs. Some digital interventions have shown promising results in areas such as weight management.
- Further research is needed to characterize and assess the extent of the impact of digital food environments on health and nutrition in different contexts (low-, middle- and high-income countries) and different population groups, as well as their linkages with the broader food system (food access, affordability and safety) and policy implications.

INTRODUCTION

The promotion of healthy food environments has received much attention in strategic policies at the global level in recent years. The United Nations (UN) Decade of Action on Nutrition (2016–2025), proclaimed by the UN General Assembly in 2016, has as one of its six pillars the promotion of safe and supportive environments for nutrition at all ages (WHO and FAO, 2018). It also features in policies and strategic documents at country level around the world. An emerging debate takes a human-rights approach by proposing a 'right to healthy environments', anchored in international human-rights law, which would comprise healthy food, physical activity and environmental sustainability concerns (Swinburn et al., 2019). Healthy food environments encompass adequate food-labelling standards; restrictions on the marketing of unhealthy food products; good practices by food retailers, for example, in relation to the placement of products in stores; economic tools, such as subsidies and taxation, to address the affordability of foods; healthy settings, such as schools and workplaces; and safe neighbourhoods that offer opportunities for physical activity, among other things (Hawkes et al., 2013).

Given the widespread cultural, social and technological shift towards a digital society (which we term a "digital turn"), attention has increased on the use of technology and digital media, in particular, the use of social media and digital marketing to sell unhealthy foods to children and adolescents (WHO, 2016; WHO, 2019). Digital food marketing is unlikely to be the only digital element to influence nutrition and health, however. Research has only recently begun to explore and understand some of the consequences of this shift. This paper highlights some of these research findings and proposes a conceptual framework for digital food environments and its implications for nutrition and health.

THE "DIGITAL TURN"

The rapidly increasing role of technology and the internet is a global phenomenon that has penetrated all facets of everyday life. The number of internet users worldwide reached 3.9 billion in 2018, a number that has nearly quadrupled since 2005 (Statista, 2019a). With the emergence of Web 2.0 in the early 2000s, user engagement with the internet has been redefined towards a model of increased user activity and production (rather than just consumption) of content (Brossard, 2013).[1] In this sense, user-generated content is a key feature of Web 2.0 and has been expressed, in particular, through social media.

Social media has been defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content" (Kaplan and Haenlein, 2010). They include blogs, microblogs (such as Twitter), photo- and video-sharing platforms (such as Instagram and YouTube), wikis (such as Wikipedia), social-networking services (such as Facebook and LinkedIn) and, more recently, multimedia messaging apps (such as Snapchat and WhatsApp). The global use of social media is high, with the number of monthly active social-media users expected to surpass 3 billion by 2021 (Statista, 2019b).

"Digital", according to Lunenfeld (1999), refers to more than systems dependent on electronic computer technologies that operate using binary code (recording, transferring and storing information as series of the numbers 0 and 1). Rather, it refers to technologies and systems that shape how we understand and experience the world around us and, in fact, shape the world around us (Ash et al., 2018). Our engagement with digital technology results in different logics and discourses that affect the practices of our everyday life and has analogue[2] (physical) effects (Ash et al., 2018). In that sense, our food and nutrition-related engagement with digital technology (in other words, our engagement with the digital food environment) has the potential to influence (positively or negatively) food choices, body-image perception and overall health and nutrition status.

A conceptual framework on digital food environments is presented in Figure 1. Digital actors are the agents that produce and frame the digital food environment. This includes the usual – analogue – food-environment actors, such as governments, academia and the food industry, as they also have a presence in the digital world. At the same time, new actors, such as digital influencers, have emerged. Digital influencers are individuals who have established a large following audience online and who can "mediate messages and affect communities in the digital environment, where messages can be disseminated rapidly and easily with a potentially viral effect" (Uzunoglu and Kip, 2014). Some influencers act in an individual capacity; others are so successful that their image and personal brand develops into a business. Even though content has the appearance of having been produced by an individual on a very small scale, it is not uncommon that it is the result of an effort by a team of several people that research, write, produce, direct, edit, publish and market digital-influencer content online.

Digital activities refer to the actions taken in the digital world by digital actors. It includes health-promotion efforts, marketing, food retail, information, education and research, among other things. These activities take place in digital settings, or digital arenas, which are technological platforms of various sorts, from social-networking services to websites and wikis.

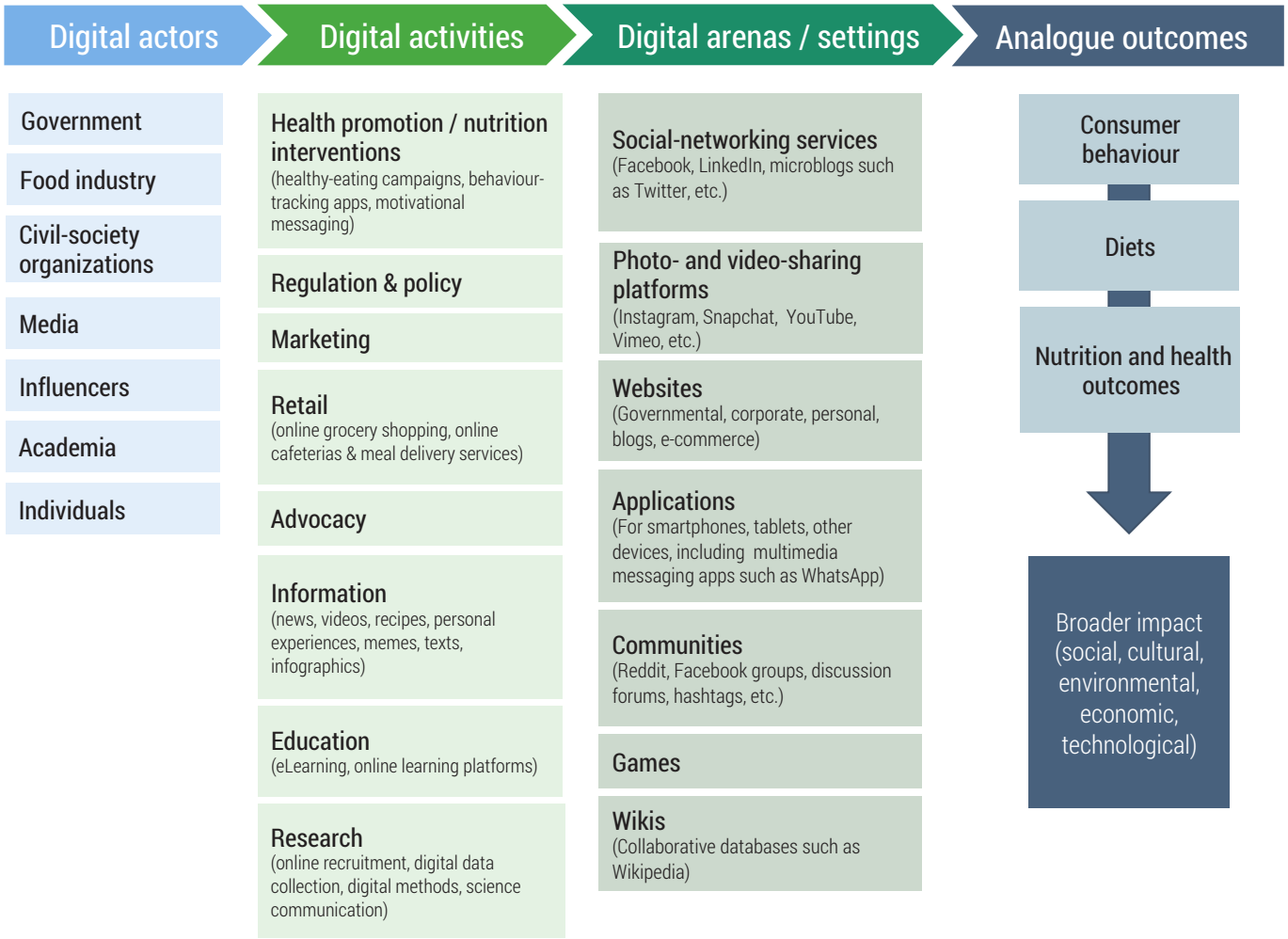
The result of such activities in the digital food environment may have impacts on consumer behaviour, diet, nutrition and health outcomes, and ultimately a broader impact on society as a whole. A full discussion of all elements in the conceptual framework is beyond the scope of this paper, but we outline the most relevant components in terms of their potential implications for health and nutrition.

FAO/DAN WHITE

1 Importantly, is has been argued that the world is currently experiencing a transition to Web 3.0 (Nations, 2018), a new internet paradigm that would be characterized by decentralized ownership of data, the increased personalization of services based on analysis of user context, an increased role for artificial intelligence (machine learning, data mining), among other features, which are likely to impact digital food environments through, for example, new forms of digital food marketing. Given the lack of consensus and the dynamic nature of Web 3.0 discussions at the time of writing, this paper operates in the Web 2.0 paradigm to explore the concept of digital food environments. However, Web 3.0 developments must be taken into account moving forward.

2 For the purposes of this article, *analogue* is defined as the opposite of digital. In other words, what happens in the physical, 'real' world.

Figure 1. A CONCEPTUAL FRAMEWORK OF DIGITAL FOOD ENVIRONMENTS IN THE CONTEXT OF WEB 2.0 (WORKING VERSION)



Source: *Author*

1. Digital health promotion

Increasingly, digital technologies are being used as interventions to promote healthy behaviours, both by private actors (for example, for-profit mobile apps for sale) and by governments. Several studies have identified digital interventions for improved nutritional health and increased physical activity in recent years, including self-administered body measurement, behaviour tracking, smartphone apps for physical activity, sleep and diet, personalized food and nutrition reporting, motivational messaging reminders, online community sessions, coaching, website interventions, text messages, digital games and emails (Fakih El Khoury et al., 2019; Kankanhalli et al., 2019; Klassen et al., 2018; Rose et al., 2017). The effectiveness of such interventions is not yet established, but this is a promising field.

2. Digital information landscape

Social media have changed how people are exposed to, use and engage with information. With traditional media, content was created externally and people were exposed to them in a passive way. With social media, however, interaction is a fundamental part of the model: users can (and are encouraged to) consume, create and share content in a variety of formats (text, photo, audio, video) (Reid Chassiakos et al., 2016). How the information is consumed has also undergone significant change. People now consume information in a planned manner (by searching for it, actively and purposively visiting sources of information), but also in what Belfrage (2018) called an incidental manner, in other words, as a consequence of other internet or social-media activities (such as visiting a social-networking site to view recent friend activity and being exposed to nutrition information or food advertising).

This new digital information landscape has implications for the quality of food and nutrition information to which people are exposed, as anyone can share their personal accounts and recommendations on diet, nutrition and physical activity without formal education or qualification to do so.

This has provided a space for popular digital influencers to market products, including food products, on social media (Coates et al., 2019), performing paid promotion activities that are often undisclosed. Even though there is professionally generated scientific content online, user-generated content is significantly more popular, despite its lack of scientific robustness or credibility (Welbourne and Grant, 2016).

Consumers do not necessarily have a high level of critical nutrition literacy, in other words, the competence and skills necessary to critically assess the food and nutrition information that reaches them every day (Guttersrud et al., 2014) and, unsurprisingly, can become overwhelmed. Colleagues have highlighted the need for increased food and media literacy so that people – in particular, youth – can better navigate this information landscape.

3. The digital behaviour of the food industry

The food industry uses numerous digital marketing techniques, including food-related game apps ("advergames"), paid partnerships with influencers, competitions and social sharing ("like, share and comment") (WHO, 2016). Recent research indicates that the exposure of young people to the digital marketing of unhealthy foods through social media is high (Potvin Kent et al., 2019). In Norway, studies suggest that the internet marketing of unhealthy foods is available around the clock, aimed directly at the user through their phone and other devices, and directed at a young audience, appealing by way of participation in promotions and competitions on social-media platforms such as Facebook, Instagram, Snapchat and YouTube (Forbrukerrådet, 2019; SIFO, 2016). New digital marketing techniques pose an additional challenge for governments already struggling to adequately regulate unhealthy food marketing.

Food retail is also affected by the digital turn. The emergence and growth of online grocery shopping could have implications for marketing and product positioning – known issues that influence consumer choice at the point of sale (Jiang et al., 2019) – as well as for food labelling. Online fast-food meal-delivery services are widespread in many countries, while online cafeterias (in schools, for example) allow parents to access school lunch menus, pre-order meals online or track children's expenditure on food. These emerging areas have been little explored in research literature so far.

4. Social engagement and community support

Digital technology has changed social dynamics and engagement, for example, with the emergence of online community and support groups and networks. Such online support networks include food-related or chronic disease-related interest groups on Facebook (for instance, diabetes management) (Abedin et al., 2017) and the use of #hashtags on Instagram and Twitter (for example, #breastfeeding and #breastisbest by new mothers for sharing experiences, raising awareness and building a supportive community for breastfeeding) (Marcon et al., 2019). Conversely, the social engagement and sense of online community created with the use of hashtags, such as #thinspiration, on social-media platforms (Twitter, Instagram and Tumblr) has been associated with more severe eating-disorder symptoms (Griffiths et al., 2018) and body-image/eating disorders (Tiggemann et al., 2018), due to the sharing of content promoting food, body guilt, dietary restrictions and weight loss (Wick and Harriger, 2018).

5. Exposure to visual cues related to food

Increasingly, people are creating, sharing and consuming images and videos of food through social media, including online cooking shows, recipes and the sharing of pictures of personal meals. This includes internet subcultures and movements such as meokbang/mukbang (Wikipedia, 2019), a global movement originated in South Korea around 2010, which consists of the video streaming (via YouTube, for example) of individuals consuming foods, usually in vast quantities, while talking and interacting with their audience (Donnar, 2017). Meokbang videos, including some featuring children as protagonists, have been viewed millions of times (Tait, 2019). They allow people to eat through the actions of others, known as vicarious consumption (Adema, 2000), and are reportedly popular among lone eaters. Scholars are already questioning what the effects of the exposure to appetizing, high-definition, heavily-edited digital images of food may be (Spence et al., 2016).

DIGITAL FOOD ENVIRONMENTS, ANALOGUE OUTCOMES

Digital food environments are likely to be accompanied by consequences (positive or negative) for health and nutrition in the analogue world. The World Health Organization (WHO) has acknowledged the existence of a digital environment that influences health (WHO, 2016; WHO, 2019), and is currently developing a global strategy on digital health, recognising the impact of the digital world on health and the potential use of digital technologies to address health challenges. This is still an emerging research area, but several links have already been suggested between the digital food environment and overweight and obesity, body image and eating disorders, such as anorexia, bulimia and orthorexia.

Exposing young people to thin and muscular bodies in the mass media and on the internet has previously been associated with an unhealthy focus on body image (Bair et al., 2012; Groesz et al., 2002; Want, 2009). Social media have been associated with body dissatisfaction and eating disorders, particularly among girls and young women (Fardouly and Vartanian, 2016). In Norway, food choices and practices are increasingly motivated by a desire for good health and thin, attractive bodies, fuelled by the activity of digital influencers (SIFO, 2014, 2015). This can have a positive impact on nutrition, by increasing attention on healthier food choices, or a negative one, by prompting excessive dieting and extreme concern over healthy eating (orthorexia). A recent randomized controlled trial showed that digital food marketing by social media influencers can significantly increase the consumption of unhealthy snacks (Coates et al., 2019).

In addition, the increased use of digital technology and screen time has been linked to physical inactivity (Bucksch et al., 2019), an important risk factor in overweight and obesity. It has also been indicated that watching food videos and TV programmes may affect energy intake, influencing what people cook or prepare and leading to a higher calorie intake (Bodenlos and Wormuth, 2013; Pope et al., 2015). This is particularly relevant amid the increasing use of on-demand online streaming services (such as Netflix), which include popular cooking, reality and other shows. In contrast, positive effects on overweight and obesity have also been observed. The use of dietary mobile apps for self-monitoring has been associated with positive health and nutrition outcomes, such as weight loss, decreased calorie intake and reduced waist circumference, suggesting that digital applications have a stronger weight-loss effect than analogue tools, such as paper-based diaries (Fakih El Khoury et al., 2019). It has also been indicated that, among adolescents, digital interventions (such as websites) can be effective in promoting positive changes in healthy eating and physical activity (Rose et al., 2017).

THE WAY FORWARD AND POTENTIAL POLICY IMPLICATIONS

The digital food environment needs to be better understood, so that it can be harnessed to ensure better nutrition and health, while at the same time protecting people from its potential harmful effects. Further research is needed to understand the exact consequences for health and nutrition in the contexts of high-, middle- and low-income countries, as well as different population groups based on socioeconomic status, geographical location (urban or rural), ethnic background, gender and other characteristics.

More research should also facilitate the identification of a clearer link between digital food environments and the broader food system, including the dimensions of food access and affordability, as well as food safety, to improve the conceptual framework proposed here.

Even so, based on current knowledge, it is possible to derive some policy implications by identifying areas where advancements can be made. These include:

- the regulation of digital marketing of unhealthy foods and beverages to children;
- guidelines and/or codes of conduct for digital influencers sharing nutrition-related information on social media and participating in digital food marketing;
- health and nutrition literacy promotion to enable people to critically assess the information to which they are exposed through digital technology;
- increased overall digital literacy, so people can better understand how their lives are impacted by the digital technology that surrounds them; and
- consideration by governments of digital technology as platforms for health-promotion efforts, including nutrition and physical activity, in their policies and strategies to achieve national and global nutrition targets and goals.

CONCLUSION

Promoting healthy food environments is a crucial measure in addressing the multiple burden of nutritional problems, from undernutrition to obesity and NCDs. The existing approach to food environments has paid little heed to the increasing role of digital technology and the internet in daily life, and to the particularities of the digital world in influencing health and nutrition, even though the attention on digital food marketing has appropriately increased in recent years. In this article, we propose that a digital food environment has been created that augments the complexity and intensity of the effects of food environments on the health and nutrition status of individuals and populations. This is an emerging field of research and the exact consequences for health and nutrition in the different contexts of high-, middle- and low-income countries and different population groups, as well as the policy implications, need to be further investigated and discussed.

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Can dietary guidelines support the transformation of food systems to foster human and planetary health?

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ABSTRACT

There is substantial evidence of the need for efforts to drastically shift the food system to enable eating patterns consistent with human and planetary health. This will have implications for food production, processing, distribution and consumption. Eating patterns low in fruit, vegetables, whole grains, nuts and seeds and omega-3 fatty acids are contributing to morbidity and mortality around the world. This highlights the need for interventions to increase accessibility to foods that are currently under-consumed relative to recommendations. However, some of those foods are not produced in sufficient quantity, while others are being consumed at an environmentally unsustainable rate. Consequently, food-based dietary guidelines, traditionally aimed at providing evidence-based recommendations for healthy eating, appear to be evolving towards a holistic approach that embraces the complexity of eating patterns, the roles they play in society and the factors that influence them, as well as environmental sustainability considerations. The recent update to Canada's Food Guide has taken such an approach, providing an opportunity to consider the extent to which such food-based dietary guidelines can support strategies to transform the food system.

INTRODUCTION

Dietary risk factors, such as inadequate intake of fruit, vegetables, nuts and seeds, whole grains and omega-3 fatty acids and excessive intake of sodium, have been shown to be responsible for more deaths than any other risk factor (Afshin et al., 2019). At the same time, there is a growing body of literature documenting the non-trivial contribution of eating patterns to climate change, biodiversity loss, water scarcity and deforestation (Friel et al., 2014; Willett et al., 2019). As we learn more about how influences in the outer rings of the social-ecological model (including foods and beverages offered in a range of settings) shape our eating patterns (Hawkes et al., 2013; Swinburn et al., 2013), the growing body of evidence has spurred efforts to transform the food system and the food environments within (Swinburn et al., 2013; Afshin et al., 2019; Willett et al., 2019).

In this context, it is relevant to consider food-based dietary guidelines (FBDGs) and the role they may play in influencing the food system. FBDGs are considered important in promoting healthy eating patterns among populations and placing nutrition concerns on national and regional agendas (WHO and FAO, 1998). We draw on Canada's recently updated FBDGs (Health Canada, 2019a; 2019b) in considering whether such guidelines may support food-system transformation to enable healthy and sustainable eating patterns, defined as "diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations" (FAO, 2010).

FBDGs: A SHIFT TOWARDS HOLISM AND RELEVANCE TO THE FOOD SYSTEM

Traditionally, FBDGs have been based predominantly on evidence on eating patterns and human health, outlining patterns of food consumption likely to meet nutrient needs and reduce risk of chronic disease (WHO and FAO, 1998). The focus on optimizing human health is consistent with a

reductionist approach that has been criticized for its "lack of attention and importance given to the broader impacts of food and nutrition systems" (Ridgway et al., 2019). Recently, there have been indications of a shift to more holistic FBDGs that embrace the complexity of eating patterns, the roles they play in society (including cultural and social, as well as their potential impacts on the environment) and the factors that influence them (such as the characteristics of food environments, including retail outlets and restaurants) (Ministry of Health of Brazil, 2015; Ridgway et al., 2019). Perhaps the most prominent example of a holistic approach are the Dietary Guidelines for the Brazilian Population, which focus on the ways in which foods are prepared and consumed (Ministry of Health of Brazil, 2015; Monteiro et al., 2015). Brazil's guidelines are unique among FBDGs in integrating physical, mental and emotional health considerations, as well as the cultural, socioeconomic, environmental, biological and behavioural dimensions of food and nutrition.

To the extent they are implemented and adopted, FBDGs can ensure that food- and nutrition-related policies are grounded in evidence (WHO and FAO, 1998). For example, FBDGs can influence policies related to foods and beverages offered in locations such as retail settings and schools. Indeed, international frameworks related to the food system have identified the value of dietary guidelines in supporting effective policy implementation (Swinburn et al., 2013). Given the changes needed to eating patterns to "optimise human, and protect planetary, health" (Forouhi and Unwin, 2019), multiple reinforcing policy strategies are critical. As they consider a range of factors influencing eating patterns and the impacts of those patterns beyond human health, FBDGs that take a holistic approach could potentially support such a suite of strategies.

FBDGs IN CANADA

In Canada, FBDGs have been in place since at least 1942, when the country introduced its Official Food Rules (Health Canada, 2007), which emphasized meeting nutrient requirements in the context of wartime rationing and were aligned with national agricultural policies of the time (Ostry, 2006). The 1944 Food Rules appear to mark the first dietary guidance in Canada accompanied by a graphical representation (Health Canada, 2007). Several food guides have been published since, with a gradual shift away from the prevention of nutrient deficiencies to the reduction of chronic disease through a focus on recommended food groups, such as fruits and vegetables, as well as dietary components to be consumed in limited amounts, such as fats and sugars. As evidence regarding eating patterns and chronic disease accumulated, FBDGs became more nuanced, incorporating details on the number of servings to consume daily from each food group, as well as messages regarding dietary components to limit (Bush and Kirkpatrick, 2003). Messages on energy balance and moderation first appeared in 1982, with recommendations to limit fat, sugar, salt and alcohol. Such messaging persisted into the 2007 Guide (Katamay et al., 2007), which specified the number of servings of each food group to consume each day based on energy needs, emphasized choosing lean options and those prepared with little fat, sugar and salt, and highlighted "other foods" to be consumed in moderation because they are high in dietary components that should be limited. There was also a version of the 2007 Food Guide that included foods traditionally consumed by indigenous peoples, acknowledging the cultural relevance of particular foods (Health Canada, 2007).

The 2019 Food Guide, intended for Canadians aged two years and older, is a departure from prior Canadian FBDGs in that it moves away from prescriptive advice in relation to food groups and servings towards an explicit recognition that, "Healthy eating is about more than the foods you eat. It is also about where, when, why and how you eat." (Health Canada, 2019b). The consumer-targeted graphical representation, consisting of a plate, presents the key message: "Eat a variety of healthy foods each day" (Health Canada, 2019b).[1] The use of a plate as opposed to other graphical representations is consistent with international trends towards a focus on proportionality (Martínez et al., 2015). Fruits and vegetables make up half of the plate, with whole grains and proteins each making up a quarter and water emphasized as the drink of choice. The 2019 edition also includes foods relevant to populations including indigenous peoples. Healthy Eating Recommendations to support the key messages note to be mindful of eating habits, cook more often, enjoy food, and eat meals with others (Box 1). Recommendations to choose protein foods that come from plants more often, as well as to limit highly processed foods and foods high in sodium, sugars and saturated fats are also presented separately from the main graphic. The use of food labelling and awareness of food marketing are encouraged. The guide does not make specific reference to environmentally sustainable eating practices, but the recommended pattern of eating bears similarity to the EAT-Lancet Commission's "planetary health diet" (The EAT-Lancet Commission, 2019; Willett et al., 2019).

1 https://food-guide.canada.ca/en/.

Box 1. KEY MESSAGES ACCOMPANYING CANADA'S FOOD GUIDE[2]

Make it a habit to eat a variety of healthy foods each day

Eat plenty of vegetables and fruits, whole grain foods and protein foods. Choose protein foods that come from plants more often

- Choose foods with healthy fats instead of saturated fat

Limit highly processed foods. If you choose these foods, eat them less often and in small amounts

- Prepare meals and snacks using ingredients that have little to no added sodium, sugars or saturated fat
- Choose healthier menu options when eating out

Make water your drink of choice

- Replace sugary drinks with water

Use food labels

Be aware that food marketing can influence your choices

Healthy eating is more than the foods you eat. It is also about where, when, why and how you eat

Be mindful of your eating habits

- Take time to eat
- Notice when you are hungry and when you are full

Cook more often

- Plan what you eat
- Involve others in planning and preparing meals

Enjoy your food

- Culture and food traditions can be a part of healthy eating

Eat meals with others

Source: *Health Canada (2019b).*

Accompanying the consumer-focused resources are Canada's Dietary Guidelines for Health Professionals and Policy Makers (Health Canada, 2019a).[3] The Guidelines outline the rationale behind the key messages presented by the Food Guide and stress the influence of the food environment in terms of foods available in varied settings, such as homes, retail outlets and restaurants, as well as the impacts of nutrition information and food marketing, including through social media. There is an emphasis on food skills and food literacy as critical elements enabling Canadians to navigate food environments and enjoy healthy eating.

Constraints on time and the availability and accessibility of resources, as well as social, cultural and gender norms are also mentioned (Health Canada, 2019a). The guidelines note unique considerations for indigenous populations, including the limited availability of foods acquired in traditional ways. They also acknowledge the impact of food production, processing, distribution and consumption on the environment, with a focus on conserving soil, water and air by choosing eating patterns higher in plant-based and lower in animal-based foods, as well as reducing food waste (Health Canada, 2019a).

Canada's Food Guide and Dietary Guidelines were informed by an evidence review that examined convincing findings on food and health (Health Canada, 2018). Dietary guidelines from other countries were considered and Health Canada undertook extensive consultation with experts from a variety of fields, including members of provincial and territorial organizations, health professional organizations and indigenous organizations. Online consultations were open to members of the public, the food industry, non-governmental organizations and experts in nutrition. A comprehensive transparency process was implemented, restricting direct dialogue between members of the food industry and governmental officials and requiring public disclosure of the content of meetings between government and other stakeholders (beyond experts) (Health Canada, 2018). The evidence review identified areas for which additional information is needed, such as environmentally sustainable eating patterns and the dietary intakes of populations such as First Nations, Inuit and Métis (Health Canada, 2018).

2 https://food-guide.canada.ca/en/food-guide-snapshot/.
3 https://food-guide.canada.ca/static/assets/pdf/CDG-EN-2018.pdf.

THE IMPLICATIONS OF CANADA'S FOOD GUIDE AND DIETARY GUIDELINES FOR CANADA'S FOOD SYSTEM

Canada's Food Guide communicates the government's official messages on recommended eating patterns. With its greater consideration of the determinants of food choice, the updated guidance may support a shift towards healthy and sustainable eating patterns. However, given the current food system and the food environments within it, as well as social determinants, following Canada's Food Guide is challenging, particularly for sub-populations, such as those affected by food insecurity (Kirkpatrick and Tarasuk, 2008) and/or those living in rural and remote regions, including indigenous peoples (Health Canada, 2019a). Indeed, prior surveillance efforts have shown that the alignment of eating patterns with dietary guidance is suboptimal (Garriguet, 2007). To some extent, the Dietary Guidelines provide the beginnings of a roadmap for action to foster the implementation of the key recommendations outlined by Canada's Food Guide. A stated objective of the Guidelines is to support improvements in the Canadian food environment and it is noted that they serve as "a resource for developing nutrition policies, programs, and educational resources for members of the Canadian population two years of age and older" (Health Canada, 2019a). As noted, there is a focus on food skills (including the use of food labelling), as well as food marketing and misinformation.

These emphases align with the federal government's broader Healthy Eating Strategy, which is aimed at "making the healthy choice the easy choice" (Health Canada, 2016). The Healthy Eating Strategy incorporates a variety of policy and regulatory approaches to support healthier food environments, including the elimination of trans fats in the food supply, guidelines for sodium reformulation in packaged and restaurant foods, restrictions on marketing foods with minimal nutritional value to children, and changes to food labelling. There is also support for greater accessibility to healthier foods in northern communities, where food environments are a major barrier to healthy eating due to the lack of availability and high prices of healthy, safe and culturally relevant foods. More recently, the Government announced A Food Policy for Canada, a multi-sectoral approach with four pillars related to health, economic growth, food security and the environment (Government of Canada, 2019). Concrete actions have not yet been clearly delineated, but Canada's Food Guide and Dietary Guidelines could serve as the foundation for identifying priorities for action. Overall, the introduction of these strategies appears to reflect a move towards a joined-up systems approach to food in Canada, with the promise of creating and implementing synergistic policies to create meaningful food-system change.

There are many considerations at play in orchestrating food-system change, including agricultural, ecological, environmental, political and social (Ridgway et al., 2019), with challenges in terms of aligning priorities and overcoming the siloed approach that has historically predominated (MacRae, 2011; Herforth et al., 2014). Comprehensive policies are needed across multiple sectors, as implementing the key recommendations within the updated FBDGs has broad implications for the food that is produced, offered and consumed.

Changes are needed to the foods and beverages offered or sold in a range of settings, including retail outlets, workplaces, schools and recreation facilities, in addition to their promotion and pricing (Swinburn et al., 2013).

Specifically, there needs to be a continued focus on reducing the prominence of foods consumed at levels that have deleterious effects on human and planetary health (with eating patterns high in these foods referred to by Willett et al. (2019) as "lose-lose diets"), including animal proteins and packaged processed foods (Friel et al., 2014). Canada's Dietary Guidelines specifically state that foods and beverages offered in publicly funded institutions should align with the Guidelines (with a focus on limiting highly processed foods and beverages) (Health Canada, 2019a), which may prove a useful, though challenging, launchpad for all levels of government to implement the updated FBDs.

Changing what is offered in institutions, as well as in homes and retail outlets, depends on larger-scale efforts to improve the alignment of the overall food supply with the FBDGs. Relevant initiatives in Canada typically focus on particular dietary components of concern, such as sodium and trans fats (Health Canada, 2016) and may be considered reductionist in nature from that perspective. There remains much to be done to shift the overall balance of the foods and beverages offered across the food stream to better align with recommendations. For example, at a global level, fruit and vegetable production levels are not sufficient to support increases in consumption to recommended levels (K.C. et al., 2018). In Canada, a significant portion of fruit and vegetables is imported and the shortfall will need to be met with increased yields, possibly by shifting from other crops (K.C. et al., 2018), through genetic engineering or other technological solutions, such as greenhouses. However, these solutions may carry

their own environmental impacts, such as the energy used for heating and refrigeration (Mercier et al., 2017; University of Michigan Center for Sustainable Systems, 2018).

Furthermore, considerations related to crop destruction by severe weather and other sources of waste at points along the food stream cannot be overlooked. Moreover, expanding the distribution and, thus, the accessibility of particular foods may have negative consequences for the environment (Friel et al., 2014). For example, resources accompanying Canada's Food Guide list fish and shellfish among the nutritious foods that should form the foundation of healthy eating, but there are environmental considerations related to overfishing and the contamination of wild fish, as well as to aquaculture (Willett et al., 2019). Within rural and remote communities, concerns associated with inequitable access to healthy foods are relevant, with implications for transportation, which also raises environmental issues. There are, thus, multiple priorities to be balanced to maximize both human and planetary health.

At the consumption level, dietary decision-making is a complex process involving taste and preferences, convenience, social and cultural factors, and socioeconomic considerations (Angus Reid Institute, 2019). Within this context, population uptake of the updated Canada's Food Guide remains to be seen. Although there were relatively high levels of self-reported awareness and use of the prior version, consumer awareness of key messages, such as the food groups and recommendations for consumption within those groups, was low (Vanderlee et al., 2015). The simplified messaging of the updated FBDGs may make it possible for consumers to better take up the key recommendations. However, to implement them, they must have the skills and self-efficacy to navigate food environments (including those that do not foster healthy and sustainable eating) to select, purchase and prepare healthy foods, and, critically, the financial and other resources to do so (Thomas et al., 2019).

Increasing food skills and food literacy may be supported by policies and programmes within a range of settings, including schools and health-care facilities. For example, some school programmes are beginning to address gardening, food preparation and composting (Stephens et al., 2016) to expand children's' exposure to the food system. Such programming must be implemented within the context of broader policies to address the social determinants of health, as more than 1 in 10 households within Canada are affected by food insecurity (Tarasuk et al., 2014).

For indigenous communities, steps towards greater food sovereignty and security must encompass policies to support equity and access to healthy foods, addressing traditional foods as well as local capacity-building (Lemke and Delormier, 2017).

As noted in Canada's Dietary Guidelines, "supporting healthy eating is a shared responsibility" (Health Canada, 2019a). Indeed, creating a food system that supports human and planetary health will require a holistic perspective that marries considerations from multiple sectors (Ridgway et al., 2019). A systems lens that considers trade-offs among priorities may be useful for balancing considerations (Herforth et al., 2014; Ridgway et al., 2019), but it has been noted that such approaches "are not yet receiving sufficient political support or attention in the face of organized and concentrated opposition" (Ridgway et al., 2019). With its broader focus compared to prior FBDGs, as well as the process used in its development, Canada's Food Guide may herald the beginning of a systems approach to food and nutrition in Canada. A question to be addressed is how to effectively engage the range of relevant stakeholders, including the food industry. In light of the barriers to incorporating planetary health into FBDGs observed in other countries (Ridgway et al., 2019), Canada's approach to developing its Food Guide, including broad consultation with limits on direct industry involvement (Health Canada, 2018) may inform efforts to develop and implement relevant policies elsewhere.

CONCLUSION

There are indications of an evolution of FBDGs away from a reductionist focus on foods to eat to promote nutritional health towards the integration of a range of considerations relevant to the food system, including those related to the food environments that influence our choices, as well as planetary health. Canada's Food Guide and Dietary Guidelines emphasize an overall pattern of healthy eating that resembles those recommended for environmental sustainability, incorporate food literacy and social aspects of eating, and highlight the need for food environments to align with the guidance. It remains to be seen to what extent Canada's Food Guide and the earlier Dietary Guidelines for the Brazilian Population, which took a similar tack, will be implemented. However, the shift towards embracing the complexity of eating patterns and the food system may hold promise in terms of supporting the identification and implementation of policies that have the potential to transform the food system to enable healthy and sustainable eating patterns. A concerted effort will be needed to ensure that policies are cohesive and go beyond a reductionist focus on specific dietary components to address multiple facets of the food system.

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FAO/ROBERT ATANASOVSKI

The future of food pricing: Monitoring and novel policy targets

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ABSTRACT

- This article aims to outline areas for future food pricing research, namely, how we can build robust food-price monitoring systems and advance the evidence base for pricing policies beyond their traditional scope – particularly in relation to price promotions and generic brands.
- Online opportunities currently offer the potential to streamline methods used to monitor food and diet pricing.
- Despite calls to restrict price promotions on unhealthy foods and beverages, it is largely unclear whether and how unhealthy food and beverage price promotions could feasibly be targeted to reduce their influence on consumer purchasing.
- Few studies have sought to understand how "everyday low prices" and generic brands could be leveraged to improve the healthiness of population diets.
- There is currently a need for more comprehensive legislation on food and beverage pricing. Public health pricing policies are integral to effectively and equitably improving population nutrition and preventing diet-related diseases.

THE IMPORTANCE OF FOOD AND BEVERAGE PRICES AND PRICING POLICIES

Across the entire food system, from procurement to consumption, price matters. Price is recognized globally as a key leverage point in reducing unhealthy dietary behaviours and the associated burdens of non-communicable diseases (WHO, 2013). This is because price is a leading determinant of food choice and widely documented to promote unhealthy (rather than healthy) food and beverage purchases in the current food environment (Zorbas et al., 2018).

Food and beverage pricing also has considerable implications for health equity (Darmon and Drewnowski, 2015), whereby those who experience greater disadvantage, most notably, as a result of lower incomes, are more price sensitive (Zorbas et al., 2018; Andreyeva et al., 2010). This notion is underpinned by traditional economic theory (of price demand), which stipulates that as price changes, so too does consumer behaviour (typically in an inverse fashion), and that this varies by socioeconomic position (Jensen and Miller, 2008). Consequently, regulating the price and affordability of food and beverages is likely to be an essential, and powerful, component of any comprehensive strategy seeking to improve population nutrition across the socioeconomic gradient.

The importance of regulatory policies that address the price of food and beverages has been widely recognized by leading health organizations and public health groups, including the World Health Organization (WHO, 2013, 2015, 2016). Such public health policies that address the structural barriers to healthy food and beverage choices (which are often greater for those with a lower socioeconomic position) have been recognized as fundamental to enabling and promoting healthy diets and reducing socioeconomic inequalities in terms of poor dietary intake and diet-related ill health (Swinburn et al., 2011; Backholer et al., 2014).

Indeed, Sustainable Development Goal (SDG) 2 to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" and SDG 3 to "ensure healthy lives and promote well-being for all at all ages" rely on structural changes being made to the nutrition environment (United Nations, 2015). As the food environment has been identified as a major cause of current obesity, undernutrition and climate-change syndemics, the justification for regulating multiple aspects of the food environment is clear (Swinburn et al., 2019). In particular, it is well established that one of the most problematic changes to the food environment has been the cheap manufacturing of and relative reduction in retail prices of energy-dense, nutrient-poor foods and beverages (Finkelstein et al., 2005).

Despite this knowledge and countless calls to action, global policy action on food environments has been slow. Of particular concern is the reluctance of governments to intervene in one of the most influential and promising leverage points in the food environment – food and beverage pricing. A recent review of nutrition policies adopted by countries around the world found that pricing policies are among the least prevalent nutrition policies: only 27 percent of 143 countries had implemented nutrition-related fiscal policies prior to fiscal year 2016/17 (WHO, 2018a). This was considerably lower than policies for nutrition labelling (81 percent), dietary guidelines (77 percent) and media campaigns (72 percent) (WHO, 2018a). While we acknowledge that a comprehensive approach to promoting healthy eating across populations requires a broad array of policies that simultaneously act on all "four Ps" of the marketing mix (price, promotion, place and product) (McCarthy, 1964) and the overall availability of healthy and unhealthy foods (Zorbas et al., 2018), here, we focus on pricing policies as under-utilized, yet highly important, approaches to achieving public health nutrition objectives.

Thus, this article is primarily applicable to high-income countries with the price-related infrastructure needed to carry out the recommendations described and where supermarket retail models (and their pricing strategies) are highly prevalent. While aspects of the article may be relevant to low- and middle-income nations experiencing transitions in their nutrition and food environments (for example, in Asia and Latin America) (Bishwajit, 2015; Rivera et al., 2004), it will be less relevant, as food pricing policies in these regions, such as food and farming subsidies, are more commonly designed in response to poverty, limited economic opportunities, hunger and undernutrition (IFPRI, 2019).

The complex nature of the food environment means that many stakeholders are impacted by pricing interventions, including consumers, retailers, manufacturers and policymakers. Many social, economic and political barriers thus prevent pricing policies from being adopted (Mozaffarian et al., 2018). Firstly, fiscal intervention is known to be unpalatable to and subject to strong push-back by the food and beverage industry (Somerville et al., 2015; Diepeveen et al., 2013; Backholer and Martin, 2017), rendering it an unfavourable policy option for governments. The strong industry pushback and lobbying in response to policy proposals targeting food and beverage prices is because they directly impact the bottom line (i.e. profit) for retailers and manufacturers (Backholer and Martin, 2017).

This traditional value system, which prioritizes business profits (also known as the commercial determinants of health) over the health and well-being of society has been a considerable obstacle to progress (Swinburn et al., 2019). The recent Lancet Commission report on obesity collectively identified political inertia (due to the large conflicts of interest that arise from industry partnerships) and inadequate engagement by civil society as key barriers to food-system policy progress (Swinburn et al., 2019). Hence, the Commissioners called for a radical reshaping of this business-focused ideology – of which traditional pricing structures are a fundamental component – to address some of the biggest health threats of the twenty-first century.

THE FUTURE OF FOOD AND BEVERAGE PRICING

To date, there have been many examples of pricing policies that have the capacity to improve population nutrition. While there has been notable implementation and increasing evidence of the effectiveness of some pricing interventions (such as taxes on unhealthy foods and beverages and subsidies for healthy foods and beverages) (WHO, 2018a), there are significant research gaps, limiting a complete understanding of the different types of potential policy targeting food and beverage pricing.

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Foremost, few countries regularly and comprehensively monitor this fundamental determinant of health (food and beverage prices), largely owing to the resource-intensive nature of in-store data collection (Lee et al., 2013). Monitoring food pricing is an essential first step in ensuring that food environments consist of healthy foods and beverages that are affordable for and accessible to everyone (Peeters, 2018). For this reason, food pricing has been recognized as a core module by the International Network for Food and Obesity Research, Monitoring and Action Support (INFORMAS), which is committed to the continued development of methods to monitor food environments (Lee et al., 2013; Swinburn et al., 2013).

Interventional and modelling studies support the use of fiscal policies, usually by way of taxes and subsidies, to rebalance the price and affordability of foods towards healthier options (Eyles et al., 2012; Gittelsohn et al., 2017). Alternative food pricing policy targets, including price promotions and generic brands, have been comparatively understudied (Table 1)(Eyles et al., 2012; Gittelsohn et al., 2017). This is despite the pervasive use of price-promotion tactics (Smithson et al., 2015; Powell et al., 2016; Zeviani, 2018) and cheap generic (or retail-owned) brands (Nielsen, 2018a) by retailers and manufacturers.

Such price-lowering strategies seek to satisfy consumer expectations as to food prices and to maximize business profitability. However, they also have the potential to undermine food-system policies, notably fiscal policies, which are increasingly being implemented around the world (Backholer et al., 2017). For example, increases in the price of unhealthy foods and beverages may be counteracted by temporary price reductions that are ubiquitous in the retail environment today. Nevertheless, only very recently have governments in England (UK DHSC, 2018) and Scotland (Scottish Government, 2018), made recommendations to reduce the influence of unhealthy price promotions as part of a broader suite of national policies to address population diets and obesity. Moreover, retailers have the power to set everyday low prices through their generic brands – options that are intended to be affordable for everyday citizens. Only recently has the need to better understand the public health implications of generic brands and their everyday low prices been recognized (Pulker et al., 2017; Sacks et al., 2018).

Currently, opportunities exist to bolster traditional food pricing research through technological advancements that incorporate online platforms, which are being used more and more by retailers. Food retailers now provide unprecedented amounts of publicly available data online, which can be used to both monitor food and diet prices and to inform policies for healthier population diets.

In this article, we outline areas for future food pricing research, specifically, how we can build robust food-price monitoring systems and advance the evidence base for pricing policies beyond their traditional scope, particularly in relation to price promotions and generic brands. Our aim is to highlight the need for more comprehensive legislation on food and beverage pricing. Acknowledging the substantial evidence underpinning food and beverage taxes and subsidies (Eyles et al., 2012; Gittelsohn et al., 2017), we reviewed recent literature (from around the last five years) to identify new research areas relating to food and beverage pricing policies, drawing on key systematic and scoping reviews examining food-price monitoring (Lee et al., 2013), price promotions (Bennett et al., 2019, forthcoming); Chandon and Wansink, 2012) and supermarkets (Pulker et al., 2018a), along with the limited evidence exploring the impact of generic brands on public health. This evidence base, and the actions proposed within, are summarized alongside the identified research gaps (see Table 1).

Table 1. EXISTING EVIDENCE AND FUTURE RESEARCH OPPORTUNITIES TO INFORM MORE COMPREHENSIVE FOOD AND BEVERAGE PRICING POLICIES

	Existing research findings and actions	Future research and actions
Monitoring	• Diet price and affordability analyses (optimal approach) rely on in-store data collection from retailers and are infrequently conducted due to resource limitations (Lee et al., 2013). • Few robust monitoring systems exist globally.	• Capitalize on the growth of the e-commerce sector by developing online monitoring methods (Cavallo and Rigobon, 2016). • There is potential to conduct diet, price and affordability analyses online, undertake international price and affordability comparisons, and monitor real-world policy impacts over time (Zorbas et al., 2019a, forthcoming).
Price promotions	• Temporary price discounts or multi-buy offers are used by retailers to influence purchasing behaviour and increase sales (Chandon and Wansink, 2012). • Emerging evidence suggests price promotions are more available for sales of unhealthy (than healthy) foods and beverages (Bennett et al., 2019). • While some evidence suggests that raising the affordability of healthy foods through the use of coupons can promote their purchase, price promotions on unhealthy foods may undermine such interventions, as shoppers tend to be more sensitive to price-lowering strategies for unhealthy rather than healthy foods (Guan et al., 2018). • Government-led price-promotion restrictions on unhealthy foods and beverages should be included in national obesity prevention strategies (UK DHSC, 2018; Scottish Government, 2018).	• It is unclear whether and how price promotions should be targeted to improve population nutrition (Bennett et al., 2019a, forthcoming). • Additional evidence is required to understand the real-world impacts of price-promotion restrictions on unhealthy foods and beverages (in terms of feasibility as well as consumer and industry responses) (Bennett et al., 2019, forthcoming). • Further consideration of the likely equity implications of a policy to restrict price promotions is required (36). • Clarify whether healthy food coupons improve the nutritional quality of overall diets (and not just increase purchases of targeted foods), especially in the presence of unhealthy food promotions (Guan et al., 2018).
Generic brands	• Generic brands constitute more than 20 percent of global market share and are expected to become more prevalent in many countries (Pulker et al., 2018a; Nielsen, 2014). • Very few studies have examined the relationship between generic brands and health, or recognized their potential as a policy lever (Pulker et al., 2018a).	• Evidence is required to understand how pricing strategies, reformulation and nutrition labelling could be implemented to improve the healthiness of food and beverage purchases through generic brands (Pulker et al., 2018a).

MONITORING FOOD AND DIET PRICES

Traditionally, food and diet prices have been monitored by surveying in-store prices across a relatively small number of products and a limited variety of regions and retail outlets. More recently, INFORMAS identified standardized diet price and affordability methods (that estimate the price, price differential and affordability of healthy and less healthy diets) as the optimal approach to monitoring food and diet prices globally, with a view to informing pricing policies (Lee et al., 2013).

While the current tools examine the price and affordability of a complete diet (rather than individual foods or beverages) at the household level and consider purchases made at various food retailers, trained data collectors are required to travel large distances to collect these data. These resource-intensive methods have precluded regular and comprehensive national and international monitoring. To address these limitations and transform traditional food-price monitoring methods, the opportunity now exists to capitalize on the growth of the e-commerce (online) food and grocery retail sector. This growth is exemplified by recent estimates that this sector has grown by 15 percent since 2016 (Nielsen, 2018b).

While the collection and use of online food and beverage prices may be relatively novel in public health, the multiple benefits of using online techniques to monitor pricing have been recognized in economic literature (Cavallo and Rigobon, 2016). The first of these benefits includes reduced resources in terms of time, personnel and travel for data collection. Data can also be collected more accurately and verified in real time (through direct data entry). Furthermore, the use of online data collection can facilitate regular and longitudinal monitoring to inform food pricing policies that ensure the affordability of healthy diets for current and future generations.

Access to big data also raises the possibility of monitoring a larger and more varied range of foods and diets (than the relatively limited number and type of products studied to date), bringing the flexibility to consider price-related marketing strategies (such as what happens to diet affordability when we consider price promotions and generic brands?) and the ability to more easily benchmark within and between countries.

Moreover, such online methods also hold promise in facilitating long-term evaluations of real-world nutrition policies. For example, longitudinal monitoring of how taxes are passed on to the consumer by retailers and manufacturers could be readily undertaken. We have demonstrated the validity and benefits of these methods in urban Australia (Zorbas et al., 2019a, forthcoming), but acknowledge the limitations of using an online approach in remote areas or in lower-income countries, where an online retail presence is limited or absent.

REDUCING THE INFLUENCE OF UNHEALTHY FOOD AND BEVERAGE PRICE PROMOTIONS

Price promotions are defined as temporary price discounts, multi-buy offers or coupons that are used by retailers to influence short-term purchasing practices (Familmaleki et al., 2015). Evidence suggests that price promotions can account for between 17 percent and 59 percent of all grocery sales (Zeviani, 2018) and tend to be more prevalent for unhealthy, rather than healthy, foods and beverages – rendering their use a public health concern (Powell et al., 2016; Pollock et al., 2009). The available marketing literature further suggests that price promotions drive stockpiling and influence consumption behaviours, leading to increased energy intake (Chandon and Wansink, 2012; Chan et al., 2008).

Nonetheless, studies that aim to understand the influence of price promotions on consumer purchasing behaviour from a public health perspective are surprisingly limited and conflicting. Studies differ on whether unhealthy food and beverages are more commonly purchased with a price promotion than healthier options (Smithson et al., 2015; Taillie et al., 2017; Nakamura et al., 2015). As a result, whether and how unhealthy food and beverage price promotions could be targeted to reduce their influence on consumer purchasing decisions is currently unclear.

Conversely, researchers have also sought to understand whether coupons for healthy foods and beverages (usually fruit and vegetables) could be used to promote healthy food and beverage purchases (Guan et al., 2018; Afshin et al., 2017). While both coupons and price promotions for healthy foods have been shown to significantly increase purchases of healthy items (Afshin et al., 2017), they do not necessarily reduce unhealthy purchases. In fact, some evidence suggests that the savings made from healthy food and beverage coupons are used to purchase a greater quantity of less healthy foods than would otherwise have been purchased (Ball et al., 2015). Consequently, there is a need to better understand whether healthy food coupons improve the nutritional quality of overall diets, particularly in the presence of unhealthy food promotions (Guan et al., 2018; Afshin et al., 2017).

Additional research is also required to identify whether and how a policy response to unhealthy food and beverage price promotions could be implemented, including the feasibility of different policy options (in the face of industry opposition, pricing competition and complex inter-relationships between retailers and manufacturers) and how industries are likely to respond if such regulation were adopted. Such issues have been extensively reported in relation to the WHO's International Code of Marketing of Breast-milk Substitutes (1981), which recommends comprehensive country-level restrictions on all forms of advertising and promotion (including price promotions) of breast-milk substitutes (WHO, 1981; WHO, 2018b; Lutter, 2013). Reported barriers to policy action on breast-milk substitutes have included limited resource allocations by governments and non-governmental organizations to promote breast-feeding, coupled with the seemingly unlimited marketing budgets of the infant-formula industries (Lutter, 2013). Importantly, infant-formula sales have not increased in certain countries where comprehensive marketing and promotional legislation exists (Rollins et al., 2016).

In contrast, an analysis of the 2011 Scottish legislation restricting multi-buy price promotions on alcohol found no

significant year-on-year reduction in the volume of alcohol purchased (in total or separately for beer and cider, wine, spirits and flavoured alcoholic beverages) in the one-year period after the restriction was implemented (Nakamura et al., 2014). With similar legislative plans to restrict the unhealthy influence of price promotions on foods and beverages in England and Scotland (UK DHSC, 2018; Scottish Government, 2018), there may be emerging opportunities to conduct natural experiments to determine the real-world effectiveness of these policies.

Further consideration of how food and beverage price-promotion sensitivity differs by socioeconomic position is also required, as tobacco research has shown low-income consumers to be more sensitive to price promotions than high-income earners (Xu et al., 2016). This relationship is less clear in relation to food and beverage price promotions, with some panel-data analyses suggesting that high-income groups purchase more price-promoted products (in relative and absolute terms) than their low-income counterparts (Taillie et al., 2017; Nakamura et al., 2015) and other studies suggesting the converse or minimal differences according to socioeconomic position (Zorbas et al., 2019b (forthcoming); Revoredo-Giha et al., 2018). Additional analyses are required to further understand this relationship, and how and why it varies across different contexts. Qualitative modes of inquiry will further aid efforts to better understand how consumers of different socioeconomic positions value and use price promotions. From a global equity perspective, the extent to which unhealthy food and beverage price promotions are used for purchases in low and middle-income countries (and the associated effectiveness of policies targeting price promotions) also remains largely unexplored.

REGULATING GENERIC BRANDS – A CAUSE FOR CONCERN?

A holistic exploration of food and beverage pricing would be incomplete without considering one of the lowest-priced elements of the modern food environment: generic brands (Chapman et al., 2013). Not only are generic brands increasingly contributing to the global grocery market share (for example, in many high-income countries, generic brands account for more than 20 percent of the market share (Nielsen, 2014)), they are also gaining traction in terms of favourable public perception (Nielsen, 2014). From a public health perspective, generic food and beverage products in the retail environment present a large market segment that can be targeted through one retailer. That is, retailer power can be leveraged to widely promote healthy eating through adequate nutrition labelling and healthier reformulation of their generic products, while ensuring that food and diet prices favour healthy options (Pulker et al., 2017; Sacks et al., 2018; Pulker et al., 2018b). Yet, only a few studies have sought to improve our understanding of the relationship between generic brands and public health (Chapman et al., 2013; Pulker et al., 2018b; Vandevijvere et al., 2018). Consequently, it is largely unclear whether and how acting on generic brands could provide an avenue for promoting healthy diets.

Monitoring of these lower-priced items will be essential to future evidence-based policymaking. This includes countries in Asia, Latin America and Africa, where a lack of generic brand penetration may reflect ongoing brand loyalty and low investment by retailers due to economic (and consequently food-manufacturing) instability (Nielsen, 2014).

IMPLICATIONS FOR POLICY AND RESEARCH

To optimize the way food and diet pricing is monitored and thereby inform pricing policies that can improve population health, we recommend the following:

- While rebalancing the price of food and beverages to favour healthy options will probably require fiscal intervention, these policies may be undermined unless alternative pricing strategies, including the targeting of price promotions and generic brands, are also considered.
- Governments and research institutions should explore the online collection of food and beverage prices to inform analyses of diet prices and affordability. Nevertheless, traditional methods remain important in many parts of the world (such as remote areas and middle- and low-income countries).
- Policymakers should consider actions to reduce the unhealthy influence of food and beverage price promotions and how generic branded products can better favour public health imperatives.

CONCLUSION

There is a clear need for high-level policy action to improve diet-related health globally, of which comprehensive food and beverage pricing legislation is an integral part. We have highlighted the need for research to keep up with the constantly evolving online retail world, to improve the way we monitor a fundamental economic driver of health – food and beverage pricing. This is pivotal if we are to inform the development of policies that can effectively regulate the food environment by simultaneously disincentivizing unhealthy and incentivising healthy food and beverage purchases for all socioeconomic groups.

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Cash transfers and the food environment: Eight ways to improve diet quality

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BACKGROUND

Social protection systems are a cornerstone of national efforts to reduce poverty, as reflected by Sustainable Development Goal (SDG) 1, Target 1.3, to implement social protection systems for all. Within these systems, cash transfer programmes are particularly common. Of the 142 countries tracked by the World Bank's Atlas of Social Protection Indicators of Resilience and Equity (APSIRE) database, 70 percent now implement unconditional cash transfers and 43 percent undertake conditional cash transfers. In those countries where they are implemented, unconditional cash transfers cover an average of 23.4 percent of individuals in the poorest wealth quintile, while conditional cash transfers cover an average of 40.3 percent, though coverage gaps are larger in low-income countries (World Bank, 2018).

Cash transfer programmes have led to significant reductions in income poverty at population level and have often improved measures of equity as well; however, poverty and equity are not the only objectives they can work towards. Leveraging social protection for nutrition (nutrition-sensitive social protection) has been an ongoing concern of policymakers and researchers alike. The potential for cash transfer programmes to improve nutrition is recognized because of their ability to address multiple determinants of nutritional status – including dietary intake, access to health services, and water, sanitation and hygiene (WASH) – and their ability to reach nutritionally vulnerable populations at scale (Ruel and Alderman, 2013).

Nevertheless, cash transfers to date have not generated nutrition gains of the same magnitude as reductions in poverty, and there have been global calls for stronger commitments and partnerships to link social protection and nutrition (Spray, 2016). Specific recommendations for programmes have focused on increasing coverage among nutritionally vulnerable populations by incorporating nutrition in targeting criteria; delivering nutrition education along with transfers; improving the quality of nutrition services for example, transfers themselves or health services, where conditions are in place); and scaling up programmes in times of crisis (Alderman, 2016). Implementing and selecting from these recommendations requires nutrition-related evidence of the burden of malnutrition among different life-stage groups and the likely drivers of that malnutrition.

The purpose of this paper is to describe how evidence related to the food environment, as a systems-level determinant of diet quality and nutritional status, can also enhance decision-making around nutrition-sensitive cash transfers.

Food environments have been defined as the interface between consumers and the broader food system, which mediates their food consumption and acquisition behaviours (Turner et al., 2017). Information related to the availability of diverse, nutritious foods and affordability, among other factors, may better inform possible causes of inadequate diet and the design features that cash transfer programmes could incorporate to address these causes.

FRAMEWORK AND ORGANIZATION OF THE ARTICLE

Frameworks now emerging for research in low and middle-income countries have distinguished between the environmental and personal dimensions of the food-environment interface (Turner et al., 2017). The framework adopted by this article is depicted in Figure 1. Characterizing these dimensions separately acknowledges that while the quality of food environments can vary from one location to another, so can individuals' engagement vary from person to person within any given food environment, depending on their individual filters.

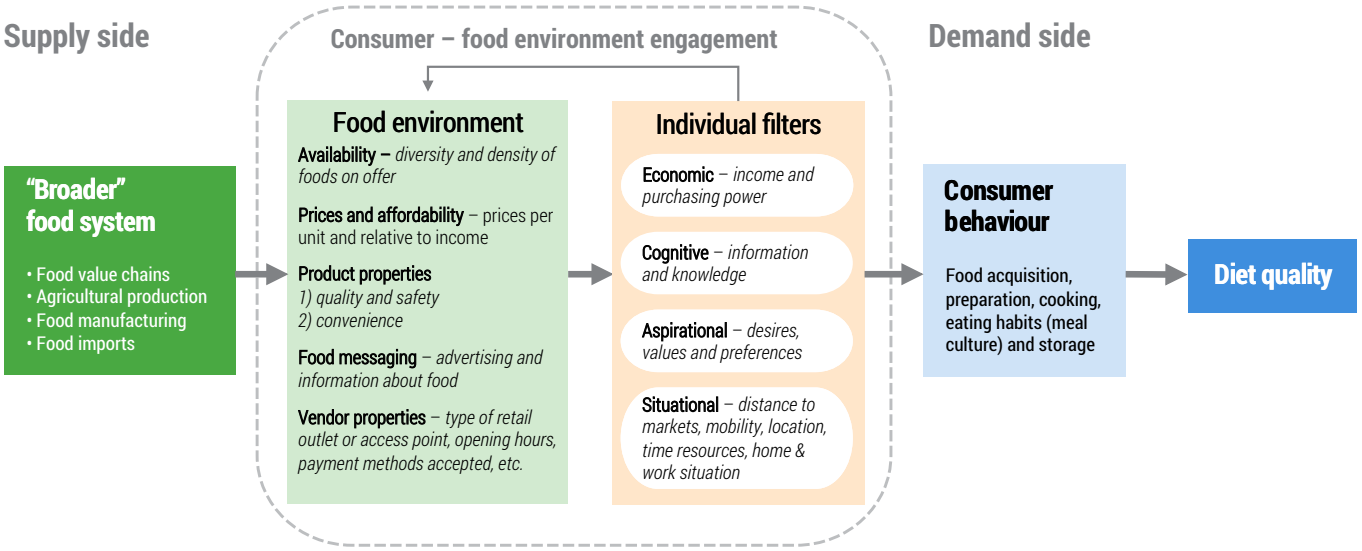
The food environment is described according to the following characteristics: the type and diversity of foods available; the prices and affordability of the foods on offer; product properties, such as quality, appeal, safety and convenience; vendor properties, such as the type of outlet (for example, supermarket or weekly wet market), payment methods accepted and hours of operation; as well as food messaging, which encompasses advertising and marketing, and nutritional information that is provided through labels, dietary guidelines or health campaigns.

Individual filters are economic, cognitive, aspirational and situational. The economic filter is determined by the income of individuals, as well as their purchasing power relative to the cost of food. Cognitive and aspirational filters are determined by what consumers know (education and nutrition literacy) and what they desire (preferences and values). The situational filter includes individuals' physical location as they go about their day, their mobility and time resources.

Food environment and individual dimensions also influence each other. For example, foods that are offered for sale by vendors may be shaped by the preferences and income level of the consumers in their area. At the same time, food advertising and certain product properties can influence consumer preferences. Whether demand is likely to exert more control over supply, or vice versa, depends on context, though low-income, marginalized consumers typically have less influence over their local supply of food, as evidenced by the overlap between food deserts and low-income neighbourhoods (Walker et al., 2012; Wrigley, 2002).

Cash transfer programmes' primary focus is on enabling consumers to meet their basic needs through increased income. Where the goal is to improve diet quality of nutritionally vulnerable populations, it is hoped that this increased income will lead to increased acquisition and consumption of nutritious foods in local markets. However, in any given context, income may not be the only constraint, which may require cash transfer policymakers and practitioners to consider additional impact pathways. The sections of this article are organized according to the main constraints that occur at the food environment and consumer level, which can lead to inadequate diets, and the design options that have been considered by cash transfer programmes to address them. Table 1 presents an overview of these design options, mapped to the constraints they may target.

Figure 1. FOOD ENVIRONMENT FRAMEWORK



Source: *Figure adapted from HLPE (2017) and Turner et al. (2017).*

Table 1. FOOD ENVIRONMENT CONSTRAINTS AND CASH TRANSFER DESIGN OPTIONS

		Cash transfer programme design options	Food environment constraints that are addressed: Food environment	Food environment constraints that are addressed: Individual filters
Demand-side interventions	1	Identify the appropriate transfer value	**Prices and affordability** – high prices for nutritious foods	**Economic** – low income levels and purchasing power
	2	Adjust transfer values according to price shocks	**Prices and affordability** – price volatility, inflation, seasonality	**Economic** – low income levels and purchasing power
	3	Top-up transfers for nutritious foods	**Prices and affordability** – high prices for nutritious foods	**Economic** – low income levels and purchasing power
	4	Cash 'plus' behaviour-change communication or nutrition education	**Food messaging** – lack of information about nutritious food (e.g. dietary guidelines), marketing of unhealthy foods	**Cognitive and aspirational** – low levels of knowledge or preferences for nutritious food and healthy diets
	5	Soft conditions or 'labelling' for nutritious food	**Food messaging** – lack of information about nutritious food (e.g. dietary guidelines), marketing of unhealthy foods	**Cognitive** – low awareness of nutrition and healthy diets
	6	Cash 'plus' supplementation	**Availability** – foods of nutritional importance to vulnerable groups are not stocked	**Situational** – markets within physical access do not offer nutritious food
Supply-side interventions	7	Improve stocking and promotion of nutritious foods in stores	**Availability and messaging** – foods of nutritional importance to vulnerable groups are not stocked or not promoted adequately.	**Cognitive and Situational** – low awareness and/or preferences for nutritious food; markets within physical access do not offer nutritious food
	8	Enhance the convenience of using cash transfers	**Vendor properties** – electronic payment systems are not in place	**Situational** – local markets do not accept preferred payment methods

Source: *Author*

It should be noted that while the focus of this article is on the food environment in markets, the on-farm food environment is also a key concern, especially in rural areas with low market access. Here, cash transfers may also play a role in helping smallholders to improve production and build resilience. Furthermore, not all of the nutrition improvements that cash transfers can achieve must involve the food environment. In addition to enhancing food acquisition and consumption, cash transfers may increase household expenditure on health services or WASH. Conditional cash transfers, which are especially common in Latin America, may also be used to more directly address health-service usage. These conditionalities have been demonstrated to significantly increase preventative health visits and reduce child underweight in Colombia (Attanasio et al., 2015). However, as has been noted elsewhere, nutrition impacts from health conditionalities are also dependent on the quality of services (Alderman, 2016).

CONSTRAINT: PRICES AND AFFORDABILITY OF NUTRITIOUS FOOD

The cost of nutritious foods[1] relative to household incomes of nutritionally vulnerable populations is a global challenge when it comes to improving dietary quality. This is especially true in low-income countries, where food can account for as much as 60 percent to 70 percent of total household income (World Bank, 2010). Even in high-income countries, there is substantial variation, with households in the lowest income quintile in the United States of America spending as much as a third of their income on food, compared with only 8 percent in the highest income quintile (USDA Economic Research Service, 2018).

The Prospective Urban Rural Epidemiology (PURE) study collected fruit and vegetable prices along with household income data from 18 countries between 2003 and 2013, finding that in low-income countries, the cost of two servings

1 Nutritious food refers to diverse as well as nutrient-dense (ratio of micronutrients to calories) foods, which contribute to the nutrient adequacy of a diet.

of fruits and three servings of vegetables per household member per day – the minimum recommended by most dietary guidelines – was equal to 52 percent of household income. Furthermore, in all regions (high-income countries included), a higher percentage of household income is required to meet fruit and vegetable intake requirements in rural areas than in urban areas (Miller et al., 2016). Animal-source foods (ASF) are another important source of nutrients, particularly for preventing undernutrition and micronutrient deficiencies in contexts where diets are dominated by cereals. ASF consumption is increasing globally, though it remains low in these contexts, where purchasing power is a constraint. In Ethiopia, where ASF consumption is lowest among the rural poor, the real prices of milk, eggs and meat increased by between 32 percent and 36 percent between 2007 and 2016, while staple foods remained constant (Bachewe et al., 2017).

The relative cost of nutritious foods to unhealthy foods has also been measured. A meta-analysis of 27 studies found that following a healthy diet pattern (for example, Mediterranean) costs on average USD 1.50 per day more than less healthy patterns. Furthermore, healthier options within the same food group (such as lean meats vs. high-fat meats or whole grains vs. refined grains) are also more expensive (Rao et al., 2013).

Cash transfer design option 1: Setting the appropriate transfer value

Cash transfers may provide a means of overcoming affordability constraints in the food environment when the level of benefits is sufficiently generous. Globally, unconditional cash transfers make up an average of 18.6 percent of beneficiary households' welfare in the lowest income quintile. However, this figure can range from less than 5 percent to close to 50 percent and, in general, low-income countries provide smaller transfers (World Bank, 2018).

Most evidence shows that size matters as far as nutrition impact is concerned. In Mexico, a doubling of the cumulative size of cash transfers received as part of the Oportunidades programme was associated with lower prevalence of both stunting and overweight among children (Fernald et al., 2008). A cross-country comparison in Latin America also found that countries providing transfers of at least 15–25 percent of household expenditure were more likely to impact linear growth, which is roughly in line with the 20 percent threshold identified by another cross-country comparison in Sub-Saharan Africa as necessary for transformative impact, including on nutrition (Leroy et al., 2009; Davis and Handa, 2015).

Transfer size varies depending on the overall objectives that programmes are designed to achieve. Where improving food security or alleviating poverty is the goal, transfer values may be set based on staple food prices (monthly or averaged over a longer time period), as in Kenya and Ghana (World Bank, 2018), or on the amount of additional income needed to bridge the food gap between a household's current consumption and a minimum nutritious food basket – for example, 2 100 kilocalories per person per day, with adequate protein, fat and micronutrients, per the World Food Programme's typical target (World Food Programme, 2018).

Examples of how the costs of diverse nutritious foods inform the benefit levels of cash transfer programmes are less common. This may be due to a variety of factors, including budget constraints, programme objectives that may not include nutrition, as well as a lack of price data for measurement. In the United States of America, Special Nutrition Assistance Program (SNAP) benefits are based on the Thrifty Food Plan, which is the United States Department of Agriculture's (USDA) estimate of the lowest-cost diet that meets national dietary guidelines. The food plan is estimated from 58 food categories that US households regularly consume using prices paid by low-income households, but the last revision of this basket was in 2006 (Carlson et al., 2007). Since then, SNAP benefits have been adjusted annually for inflation, though studies have estimated that due to geographic price differences, the true average cost of the minimum nutritious diet is 27 percent higher than maximum benefit allowed under SNAP (Waxman et al., 2018).

Estimating the cost of a nutritionally adequate basket of food may be even more challenging in contexts where systems for the regular monitoring of food prices are not in place. Many countries collect food price data for national consumer price index (CPI) estimates and as part of agricultural market information systems. However, these typically focus on a core group of aggregated staple commodities, making it difficult to estimate and compare healthy to less healthy food options (Lee et al., 2013). New metrics for measuring the cost of a nutritious diet have been tested using CPI data (in Tanzania) and an agricultural market information system data (in Ghana) (Masters et al., 2018). While limited by less extensive food lists, the results have encouraged Ghana's Ministry of Agriculture to expand data-collection to more nutritious foods (Nortey, 2017).

As efforts to better characterize the cost of a nutritious diet expand, this will provide policymakers of cash transfer programmes with a critical input necessary to better understand the nutrition gains that may be within reach, according to the benefit level.

Cash transfer design option 2: Adjusting with shocks

Even when cash transfer programmes have been informed by a market analysis of the prices of diverse, nutritious foods, these prices are subject to change over time. Volatility of prices is a major challenge for cash transfers and may lead to constrained access to food for consumers and a lowering of the real value of transfers, eroding their purchasing power. A host of different types of shock – including climate-related, economic and political – can influence food prices.

Often the poorest households are most vulnerable to the price effects of these shocks; without household savings to fall back on, food-insecure households may resort to negative coping mechanisms, including selling off productive assets, taking children out of school or limiting spending on health care (Gustafson, 2013; Nikoloski et al., 2018). Food consumption itself may also be affected, and price and income elasticities are higher for the poor, implying that they will reduce consumption of food more in response to price increases or losses of income than higher-income households (Alderman, 1986). Consumption of fruits and vegetables, dairy and meat is likely to decrease more than staple foods, due to the higher price elasticities of those food groups compared with staples (Cornelsen et al., 2015). Reducing consumption of diverse, nutritious foods in order to maintain caloric intake from cereals (in other words, reducing the nutritional quality of meals) is considered another form of coping mechanism.

To optimize nutrition impacts, cash transfer programmes must adjust to the timing of these shocks. Many countries implement seasonal safety nets to protect food consumption during the lean season, when nutritious food may be more expensive and less available. However, existing year-long programmes may also seek to scale up during shocks. Malawi, for example, index-linked its Food and Cash Transfer (FACT) and Dowa Emergency Cash Transfers (DECT) programmes to local food and non-food prices in 2006 in response to a localized drought. At a national level, though, this can require substantial administrative costs.

The case of Ethiopia's Productive Safety Net Programme in 2006–2008 paints a different picture: cash transfer values were not adjusted for seasonal inflation, which varied considerably by region, resulting in large differences in the purchasing power of beneficiaries. There was also evidence that the cash transfers themselves may have exacerbated inflation (Sabates-Wheeler and Devereux, 2010). These findings underscore that cash transfer programme design needs to be carefully considered in the presence of shocks and major disruptions to market linkages. Depending on context, alternatives to cash may need to be considered.

Cash transfer design option 3: Top-up transfers for nutritious foods

Another option for increasing vulnerable populations' purchasing power for nutritious food is to include an additional transfer (or top-up) within a programme, that is designated for purchasing nutritious food. This is similar to option 1, "identifying the appropriate transfer value", but with a couple of important differences: (a) this additional top-up can be delivered using different transfer modalities, including either cash or voucher;[2] (b) top-ups can be specifically targeted at nutritionally vulnerable groups; and (c) related to the previous discussion on timing, the top-up can be delivered in response to shocks.

The United States of America's SNAP safety net is an example of this intervention, with the Double Up Food Bucks Program now in place in 24 states (Fair Food Network, 2018). This programme doubles the value of SNAP benefits spent on fruits and vegetables in participating farmers markets and grocery stores. In addition to addressing affordability constraints related to fruits and vegetables, this programme may provide an additional incentive to consumers to shift their preferences towards fruits and vegetables (which we also address in the next section). Voucher transfer modalities can also be used to subsidize the price of specific food items that cash transfer programmes would like to encourage and that may be otherwise unaffordable for low-income households.

Humanitarian organizations may utilize top-ups during shocks as a means of covering the greater food and non-food needs of affected households. A meta-evaluation of Action Contre le Faim (ACF) fresh food voucher programmes, which were provided as complements to general food distribution during emergencies in Bolivia (the Plurinational State of), Kenya and Haiti, found that they improved dietary diversity by between 31 percent and 40 percent from baseline (ACF, 2012).

2 Where programmes seek increased consumption of nutritious foods, the choice between cash and voucher modalities may be informed by an assessment of nutrition-related knowledge, attitudes, and practices.

CONSTRAINT: NUTRITION KNOWLEDGE AND FOOD PREFERENCES

Addressing income constraints and purchasing power is not always sufficient to ensure cash transfers will improve dietary quality and nutrition. Consumer behaviour is multi-faceted and, in addition to economic, cognitive and aspirational filters – including nutrition knowledge and food preferences – may also determine the nature of an individual's engagement with their local food environment. Attitudes are an important driver of food choice and these are influenced by taste, as well as the health consequences of consuming certain foods, of which individuals with more nutrition-related knowledge may be more aware. Knowledge of one's current intake levels, nutrient requirements, and cooking and food preparation may also influence the self-efficacy an individual feels over their ability to eat healthily. Individuals are also influenced by the people around them, including their family and social networks, and television viewing and computer use (Brug et al., 2008; Epstein et al., 2008).

Dietary patterns are shifting – a systematic analysis of adult men and women in 187 countries found that from 1990 to 2010, diets based on healthy foods had increased, though not as fast as diets based on unhealthy foods. In some low-income countries, healthy dietary patterns have decreased, while middle-income countries have experienced the greatest increase in unhealthy patterns (Imamura et al., 2015). Consumption of highly processed foods has increased in all regions of the world, as have sugar-sweetened beverages (except in North America), and while consumption of red meat has increased in many regions, in Africa, already low levels of consumption decreased from 1990 to 2013 (Global Panel on Agriculture and Food Systems for Nutrition, 2016).

These shifts are the result of multiple macroeconomic drivers – including globalization, urbanization and economic growth – though preferences are also changing as consumers demand more foods with shorter preparation time, more food is consumed outside the home and food advertising has increased influence. Studies in the United States of America have found that children, adolescents and adults from low-income neighbourhoods are disproportionately targeted with obesity-promoting advertising, as are those from predominantly black or Hispanic neighbourhoods (Powell et al., 2014; Yancey et al., 2009).

Cash transfer design options 4 and 5: Cash "plus" nutrition education or behaviour change communication (BCC)

Cash transfer programmes have taken a variety of approaches to incorporating interventions aimed at impacting consumer behaviour through improved nutrition knowledge or preference. The approaches vary in the intensity of the messaging, as well as whether or not transfers are conditional on participation. The United States Special Supplemental Nutrition Program for Women, Children, and Infants (WIC) provides an example of a more intensive nutrition education approach. Beneficiaries receive messaging and counselling tailored to a nutrition assessment, individualized goals are set and followed up on, and delivery mechanisms may include face-to-face, phone or internet engagement (USDA, 2006). While not compulsory for participation in WIC, participation is strongly encouraged and WIC vouchers are often distributed at WIC centres during education sessions. Djibouti's public works programme, where households receive food assistance for participating in community asset-creation activities, in contrast, is conditional upon participation in monthly BCC sessions on nutrition (Brodmann et al., 2014).

Lighter-touch approaches are often referred to as soft conditionalities, or "labelling". In these cases, transfers are not conditional on beneficiaries taking any particular action, though they may be encouraged through messaging or social marketing to increase uptake of services available. Evidence from Lesotho's Child Grants Programme, for example, indicates that households receiving messaging that transfers were to be used for child expenditures were more likely to increase spending on children's schooling and clothing than those that did not (Pace et al., 2019). Though this programme is in the education sector, similar strategies could be used for nutrition.

A systematic review of complementary feeding interventions found that education on complementary feeding, alone, was able to improve height-for-age and weight-for-age z-scores and reduce the relative risk of stunting by 29 percent (Lassi et al., 2013). However, studies examining the combined and relative impacts of nutrition education with cash are still lacking. One study in Bangladesh found that cash plus BCC generated larger and longer-lasting improvements in infant and young child nutrition knowledge among women than cash alone (Hoddinott et al., 2018).

CONSTRAINT: LOW AVAILABILITY OF NUTRITIOUS FOODS IN MARKETS

In some cases, cash transfer programme interventions targeted at consumers' individual filters are not sufficient to overcome limitations in the external food environment. This is true where nutritious foods are not available in local markets in sufficient quantities, especially those foods that are required to meet the nutrient requirements of specific vulnerable groups. For example, children aged 6-23 months are recommended to consume ASF daily and/or fortified foods in order to meet their elevated nutrient requirements for growth (PAHO, 2003). However, daily consumption of ASF may be too expensive for many low-income households, and in food-insecure, rural areas, high-quality, affordable fortified foods may not be available in local markets. This is a particular concern in humanitarian settings, where market infrastructure and food supply chains may be disrupted.

The comparative cost of intervention options that cash transfer programmes could include is also a consideration. It may be the case, for example, that targeted nutritious foods are available in local markets, but are too expensive for the programme to sufficiently incentivize or subsidize for low-income households. In such a scenario, in-kind food supplementation, or supplementation in the form of micronutrient powders, may be a more feasible option for meeting nutrient requirements at a low cost.

Cash transfer design option 6: Cash "plus" supplementation

In the aforementioned scenarios, cash transfer programmes can consider implementing mixed-modality interventions, which combine cash and in-kind food supplementation. This is also in line with recommendations for nutrition-sensitive programmes to provide a platform for scaling up coverage of nutrient-specific interventions (Ruel and Alderman, 2013). A prospective intervention study in Niger found that households receiving cash plus a supplementary fortified food during the lean season had lower incidence of moderately acute malnutrition than households receiving either cash only or supplementary food only (Langendorf et al., 2014). Mexico has also been delivering supplements as a complementary intervention alongside its safety-net programme, Prospera (formerly known as Oportunidades), since 1997. In response to several comparative evaluations, this was switched from a fortified blended food to a micronutrient powder in more recent years, because of its ability to meet the iron requirements of children aged 6-23 months at a lower cost, with less risk of contributing to overweight and non-communicable diseases among a population that was, on average, already meeting energy requirements (Schauer et al., 2017).

Decisions related to transfer modalities and in-kind complementary nutrition supplements should be informed both by nutrition and market analysis. Policymakers and programmers must have identified the relevant malnutrition burden among target populations and the key nutrient gaps that need to be addressed. Market analysis is then necessary to determine which foods and delivery mechanisms have the best possibility of achieving cost-effective gains.

SUPPLY-SIDE CONSTRAINTS RELATED TO CONVENIENCE AND SITUATIONAL FILTERS

Cash transfer programmes focus primarily on influencing demand through consumer-level interventions that address economic, cognitive or aspirational factors that contribute to food acquisition and consumption. However, by working in partnership with food retailers and suppliers, programmes may be able to combine supply-side interventions (that is, at food-market level) with demand-side actions. These supply-side interventions are wide-ranging and can include physical improvements in the way nutritious foods are promoted and stocked in retail environments, as well as improvements in the level of convenience and ease with which beneficiaries are able to use cash transfers.

Food deserts are a key challenge for high-income countries. These are food environments that are swamped with energy-dense, nutrient-poor food options, but lacking nutritious foods, predominantly in low-income communities. Cash transfer programmes in these contexts need to consider where beneficiaries are likely to shop, based on where they live, work and their daily routines, and the likelihood that these food environments will enable them to make the best (nutritional) use of their transfers. Recipients of cash transfers may also be influenced by the methods of payment that are used by the programme and accepted by stores (e.g. paper-based value vouchers vs. electronic benefit transfer (EBT) cards). These factors, along with other vendor properties, may influence any stigma felt by beneficiaries.

Cash transfer design option 7: Partnering with retailers to improve in-store promotion and stocking of nutritious foods

In the United States of America, SNAP has used store eligibility requirements to enhance the retail food environment where SNAP beneficiaries shop, recognizing that a large percentage of SNAP benefit usage takes place in convenience stores. In 2016, regulations were amended to increase minimum stock requirements from three to seven varieties within each food category, including meat, poultry and fish, bread or cereals, vegetables or fruits, and dairy products. The B'more Healthy Corner Stores for Moms and Kids project tested several different store-level interventions for improving urban food environments to encourage WIC redemption rates in Baltimore, Maryland. These included in-person training of storeowners, point-of-purchase promotion of WIC-eligible foods, product placement (such as arranging for eligible foods to be closer to the front of the store or at eye level), and grouping WIC-eligible foods together in displays. Only the storeowner training led to increased stocking and sales of WIC-eligible foods, however, the intervention period was short and the sample size small (10 corner stores) (Wensel et al., 2019).

Cash transfer design option 8: Partnering with retailers to improve ease of use of cash transfer benefits for nutritious food

In rural areas of the United States of America, lack of access to supermarkets and grocery stores among SNAP beneficiaries has highlighted the potential for farmers markets as a strategy to increase the consumption of fruits and vegetables. However, farmers markets are not always present in low-income communities and, while SNAP as a whole has tried to move from paper vouchers to EBT systems, farmers markets, particularly in rural areas, may not always accept EBT payment methods. In response, the USDA Food and Nutrition Service has issued guidance for farmers markets on how to expand access for SNAP recipients and also provides grants to farmers markets to put in place wireless EBT payment systems (USDA FNS, 2018).

CONCLUSION

This article has attempted to link some of the newly-emerging thinking and frameworks on food environments with ongoing discussions on how to make cash transfer programmes more nutrition-sensitive. While social protection and nutrition policymakers and practitioners have been called on to adopt a nutrition-sensitive lens, taking into consideration the malnutrition burden and dietary needs of vulnerable groups, this may not be enough to operationalize nutrition-sensitive cash transfer programmes where critical information about the food environment is lacking. Without information to characterize external food-environment factors, as well as individual filters, the food environment may be a "black box" that limits the ability of policymakers to select programme design options that have the best chance of being effective. Similarly, in the evaluation of these programmes, lacking food environment information may limit our understanding of why programmes have had or not had their desired effect.

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MAGNUM PHOTOS FOR FAO/ALEX WEBB

Enabling actions to improve the food environment

The role of government in improving urban nutrition

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ABSTRACT

This paper posits the urban food environment as an extremely useful policy-making framework for developing actions to improve nutrition, as it is the point at which people and food interact. It describes the nutritional challenges of urban areas and how urban food environments influence nutrition through the affordability, physical access to, convenience and desirability of healthy foods. Consequently, governments can use a range of mechanisms to influence the urban food environment, as this paper illustrates. However, there are significant challenges to developing, applying and scaling up such food-environment interventions. Because of the complexity of governments and governance, further work is required to improve understanding of (1) how interventions can be designed and delivered in different contexts; (2) which mechanisms governments can use; (3) how existing interventions can be evaluated, in particular, the extent to which they are meeting the needs of low-income consumers; and (4) how best to develop new cities to optimize nutrition outcomes for urban communities.

INTRODUCTION

A food system comprises all the processes and people from the production of food, processing and the distribution to consumers (see, for example, FAO, 2013 and the Global Panel on Agriculture and Food Systems for Nutrition, 2016). An integral part of the food system is the food environment, which is defined as the "collective physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status" (Swinburn et al., 2013). We would argue that the urban food environment is the point of interaction between city dwellers and food, so is an extremely useful framework for policymakers in developing actions to improve nutrition. Such actions need to ensure that urban dwellers can access enough staple foods, while promoting nutritious diets and disincentivizing non-nutritious diets. This paper will outline the nutritional challenges of urban areas and how urban food environments influence nutrition through the affordability, physical access, convenience and desirability of healthy foods. It will suggest that municipal governments (through a range of relevant departments) are particularly well suited to improving urban nutrition by shaping the urban food environment, highlighting areas for action and current cases of government action.

NUTRITION IN URBAN AREAS

The global population is becoming increasingly urban. It is projected that, by 2050, a further 2.5 billion people will live in cities and their surrounding areas, implying that 68 percent of the world's population will be urban. Almost 90 percent of this growth is expected to occur in Asia and Africa (UNDESA, 2018a). The growth of urban populations can be attributed to natural population growth and an increase in the share of the world's population that live in urban areas (McGranahan and Satterthwaite, 2014). Although the reasons for migration are diverse, internal migration due to climate change is expected to increasingly influence urbanization, with those on the lowest incomes in the poorest countries hit hardest (Rigaud et al., 2018).

Malnutrition is also urbanizing, with all forms of malnutrition (concurrent undernutrition and overweight/obesity) prevalent in urban areas. While stunting rates have declined in developing countries, a review of 141 low- and middle-income countries (LMICs) suggests that this decline has mainly happened in rural areas, resulting in an increase in the share of stunted children living in urban areas (Ruel, Garrett and Yosef, 2017). Dietary changes (to more sugar, fats and oils, and processed foods) are happening fastest among those living in cities, causing a rise in overweight and obesity and diet-related diseases, such as diabetes (Hawkes, Harris and Gillespie, 2017).

The drivers of malnutrition in urban environments include a lack of time and facilities for home cooking, the pervasive marketing of unhealthy foods, greater exposure to nutrient-poor foods, more sedentary lifestyles, greater female participation in the workforce and inadequate water, sanitation and hygiene (Global Panel on Agriculture and Food Systems for Nutrition, 2017). In cities, approximately one in four people lives in inadequate housing, informal settlements, or slum areas, where conditions harm their health and limit their prosperity and opportunities (UNDESA, 2018b). The correlation between income poverty and food insecurity means that low-income households and their ability to purchase food are vulnerable to the impacts of price shocks or political instability (Maitra and Rao, 2015).

URBAN FOOD ENVIRONMENTS AND THEIR INFLUENCE ON NUTRITION

A food environment is based on an individual's perception and reality. While an urban community may be exposed to the same retail environment, transport infrastructure and services, it is their individual interactions with the food environment, the sources and types of food available that influences their food choice and, consequently, their nutrition and health outcomes.[1] A person's food environment differs depending on income, age and health status (the food choices of those who are very young, infirm or living with a disability may be managed by others); their understanding, skills and capacity (including physical space and availability of equipment) to store, prepare and eat the foods available; their cultural influences (including religious beliefs and the 'social status' of eating certain foods); the effects of rural-urban migration and immigration; gender; their position in the household or family; and language issues (especially when it comes to labelling and purchasing food).

Critical components of the urban food environment and the food choices people make relate to affordability, access, convenience and desirability. Urban food environments are continuously shaped (in both positive and negative ways) by a range of factors: from global to local actors, including government and the private sector, to changing social and cultural norms, household dynamics (such as employment changes), individual factors (changing food preferences, for example) and other factors, such as technological developments in the food industry and food-system infrastructure, and climate change. Understanding the interaction between the influences on urban food environments in different communities is critical to developing successful interventions that improve nutrition.

AFFORDABILITY

More than 97 percent of low-income urban households rely on purchased foods, so affordability is critical (Cohen and Garrett, 2010). Affordability is not just about the price of food, but also overall household income, how the purchase of food is prioritized over other household expenses and which

1 Nutritional status depends on a person's food, health, hygiene and care (Cohen and Garrett, 2010).

food types are prioritised over others. A review of 20 LMICs found that for those on the lowest incomes in urban areas, food accounted for a significant proportion of household expenditure - up to 74 percent in Tajikistan and more than 50 percent in 18 of the 20 countries (Ahmed et al., 2007). As healthier diets (those with sufficient protein, fruit and vegetables) can cost more than unhealthy diets (Darmon and Drewnowski, 2015), a smaller food budget and a larger share of the household budget spent on food by people on low incomes can restrict food choice to low-cost, low-quality diets, in contrast to those on higher incomes, who have greater food choice (Darmon, Fergusson and Briend, 2003). For those on low incomes, food price shocks can result in the adoption of coping mechanisms, such as reduced food intake and/or a switch to cheaper, often less nutritious foods, exacerbating rates of malnutrition (Cohen and Garrett, 2010). Food pricing policies or subsidies on certain foods and a range of initiatives can be used by governments to reduce the impact of price shocks on low-income communities (i.e. social safety nets).

PHYSICAL ACCESS

There are significant differences in people's physical access to healthy diets within cities. Many have diverse sources (supermarkets, markets, smaller retail outlets and food providers, such as restaurants, cafeterias and street food) and types of food available (including imported and domestically produced fresh, packaged and processed foods). However, access to food is dependent on people's mobility, access to transport and a retail environment in which they can source whatever food is affordable. This highlights the need for making food a key factor in urban planning, to ensure accessibility to nutritious food by all communities.

CONVENIENCE AND DESIRABILITY

Due to the decline in household production of food in cities, the need to engage in cash-based income-generating activities and the changing role of women in society (Tacoli, 2012), there is a greater demand for convenience, prepared or processed food (see, for example, Wang et al., 2014, and Ruel et al., 2017). There is more out-of-home consumption and eating is less family-centred (Caballero and Rubinstein, 1997), highlighting the importance of considering the role of food manufacturers, food providers and food retailers in urban food environments.

THE ROLE OF GOVERNMENT IN SHAPING THE URBAN FOOD ENVIRONMENT

Governments can utilise a range of mechanisms, such as laws, policies, taxes and subsidies, educational campaigns and the promotion of policies and initiatives through state facilities (such as schools), public procurement and services to influence nutrition (see, for example, the Partnership for Healthy Cities, 2019; FAO, 2018a; Hawkes and Halliday, 2017). The aspects of the food environment related to marketing and, for processed and packaged foods, the formulation and presentation of food are primarily driven by food manufacturers, food providers and food retailers.

Government incentives and minimum standards and/or penalties can encourage these actors to directly or indirectly promote nutritional outcomes – for example, laws to regulate marketing, especially to children (DLA Piper, 2016), packaging and labelling. Mechanisms to influence the food environment can focus on food-based issues (such as food pricing or how and where food businesses can operate), be integrated across sectors (such as the design and management of urban landscapes and services), or relate to broader economic and social development, such as international and domestic trade and labour laws and social safety nets.

The food environment, as the interface between people and food, is a useful policy-making framework for developing actions to improve nutrition. In urban food-systems planning, the integration of food-environment initiatives, particularly those that take into account affordability, physical access, convenience and desirability, can (and should) create a focus on nutrition as a policy outcome. Policymakers can assess the nutritional challenges of urban food environments, the drivers of those challenges, the appropriate scale and target groups, and identify suitable partners and a range of mechanisms that can be applied within their areas of responsibility and their mandate, to develop interventions that improve nutrition. For policymakers to be able to undertake such work requires (1) recognition of the importance of urban nutrition and the political will to prioritise such issues, (2) data and information to inform food-environment assessments and planning, and the technical knowledge to consider the complexity of cross-sectoral issues, and (3) resources to undertake the work and the capacity to effectively work across sectors, government departments and with a wide range of government, private-sector and non-governmental organisations.

Although the mechanisms that governments use to improve nutrition through food-environment interventions must be adapted to the local context and be evidence based, here are some examples to illustrate how governments can improve nutrition:

- **Urban planning:** Many areas slated for urbanization to accommodate growing populations have not yet been built. It has been estimated that by 2030, 60 percent of these areas globally will need to be urbanized (Secretariat of the Convention on Biological Diversity, 2012). There is a clear opportunity to use urban planning policies to develop and build these new areas in a way that makes them more resilient to future challenges. In existing cities, integrating food into urban planning is also critical. One example is the City of Hangzhou in eastern China, which has made a greater diversity of fresh food products safer and more accessible by developing a more efficient food distribution system, by increasing the number and capacity of wholesalers and food markets, prioritising local food production, and improving food safety standards and monitoring in food markets (Zhou, 2018).

- **Public procurement:** With countries around the world spending 10-15 percent of their gross domestic product (GDP), on average, on public procurement, according to World Trade Organization estimates, this is a tool that governments could use to achieve a range of outcomes (FAO and EU DEVCO, 2018). In 2008, New York City created the City Agency Food Standards,[2] which established nutrition criteria for more than 240 million meals and snacks served annually at schools, senior and child-care centres, homeless shelters, correctional facilities, public hospitals and other New York City agency facilities and programmes (NYC Health, 2015).

- **School food environments:** Urban governments can have sizeable mandates to regulate schools and the school food environment. In Belo Horizonte, Brazil, free meals are offered in public schools, while in the Dutch capital, Amsterdam, drinking tap water is promoted in schools (Hawkes and Halliday, 2017). The London Food Strategy, meanwhile, includes a proposal to restrict the opening of new takeaway outlets within 400 metres of schools and is aiming to introduce a range of initiatives to reduce levels of overweight and obesity in school children (Mayor of London, 2018).

- **Social safety nets:** The effects of price shocks on the affordability of nutritious food can be mitigated through government cash-based transfers and other social safety nets. For example, the Djibouti Social Safety Net programme was developed to improve child nutrition by adding to household income, with a particular focus on low-income households with pregnant women and young children (The World Bank, 2014).

- **Taxes or subsidies to change the price of food:** Depending on the jurisdiction, these are often developed at the national level, however in the United States of America some cities are taxing sugar-sweetened beverages (Center for Science in the Public Interest, 2018).[3] Taxes on such drinks are aimed at reducing sugar intake to reduce overweight, obesity and non-communicable disease rates. In Mexico, findings suggest that over two years, on average, there was an 8.2 percent decrease in purchases of sugar-sweetened drinks, with the largest decline in the lowest socioeconomic groups (Colchero et al., 2017). Awareness of the tax was found to lower consumption of sugary drinks in urban areas (Álvarez-Sánchez et al., 2018). The consumption of certain foods can be promoted through subsidies and these have been used by certain governments to improve food security. India, for example, has the Public Distribution System[4] (and other programmes) to ensure the availability of essential commodities (such as rice, wheat, edible oils and kerosene) at below-market prices through a network of outlets or fair-price shops (Marshall and Randhawa, 2017). Such efforts could be more nutrition focussed, by including fresh foods or, at a minimum, fortified staple foods.

- **Improving food safety and nutritional quality:** Shanghai has created a Food Safety Credit System, in which food business are evaluated and classified, and information is shared between all relevant municipal governments to enable enforcement (FAO, 2018b). Singapore has the Healthier Dining Programme, which encourages caterers, restaurants, cafes, hawker centres, coffee shops and other food and beverage outlets to offer healthier food options (Health Promotion Board, 2019).

2 https://www1.nyc.gov/assets/doh/downloads/pdf/cardio/cardio-meals-snacks-standards.pdf.

3 https://cspinet.org/sites/default/files/attachment/soda-taxes-passed-to-date.pdf.

4 https://dfpd.gov.in/.

- **Changing rules on marketing:** In response to growing evidence that the advertising of foods and beverages affects children's food choices and intake, some governments have implemented measures to restrict the marketing of certain foods to children (Galbraith-Emami and Lobstein, 2013). In South Korea, a review of regulations restricting the television advertising of energy-dense, nutrient-poor foods to children has shown the potential to improve children's food environment. However, some companies have merely shifted their marketing away from television to other media to bypass the regulations (Lee et al., 2013), implying that a more comprehensive approach to market oversight may be preferable.

CONCLUSION

Rapid urban population growth, coupled with the burden of urban malnutrition, has prompted some city governments to implement measures to make the urban food environment more nutrition-friendly. These interventions can include specific, targeted actions, be part of a wider food (and nutrition) strategy, or be conducted more broadly through economic development and social services. As the food environment influences an individual's food choices and, therefore, health, it is an important starting point from which to develop initiatives to improve nutrition. Governments can use the range of mechanisms to influence the food environment, as we have seen in the examples cited.

However, there are significant challenges to developing, applying and scaling up such food-environment interventions. Further work is required to improve capacity and understanding of how interventions can be applied in different contexts, to develop existing and additional mechanisms that governments can use, to evaluate existing interventions (especially the extent to which they are meeting the needs of low-income consumers) and to communicate findings and determine how best to develop new cities in a way that improves nutrition for urban communities.

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Transforming food environments through community-led action

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ABSTRACT

Insufficient attention has been paid to community-led strategies for improving the food environment in rural communities, despite the fact that this is where the vast majority of undernourished people live (FAO, 2019). This paper describes methodologies pioneered by The Hunger Project (THP) to develop the capacities of impoverished rural communities, which result in improved and sustainable outcomes in agricultural production, nutrition, health and family income. THP has brought together like-minded civil-society organizations in a Movement for Community-led Development to promote the national policies and programmes required to take these approaches to a transformative, national scale.

THE FOOD ENVIRONMENT IN IMPOVERISHED RURAL COMMUNITIES

Defining food environment: The Food Environment Working Group (FEWG) defines the food environment as "the interface that mediates one's food acquisition and consumption within the wider food system" (Turner et al., 2017, pp. 4–6). Its report analyses the "external" and "personal" environment, but THP has found that the external environment needs to be analysed carefully at each administrative level from the household up: village, district, nation, region and globe.

Gender dimensions: The personal food environment of an impoverished rural farmer – the majority of whom are women – is the distance she can walk with a baby on her back. Within that distance, there may be no public or financial services, no food-processing machinery, storage facilities or health clinics. These governance and market failures are compounded by patriarchal social structures that deny her voice in the decisions that affect her life.

Women's lives: As has been well documented, her biggest challenge may be time poverty – she spends hours each day seeking water and firewood, caring for children, farming, processing and preparing food. The evidence suggests (Buvinic and Furst-Nichols, 2014) that unless she gains access to a comprehensive array of public services, she is unlikely to ever escape poverty and its resulting cycle of hunger.

Preference for sons: In South Asia, sons are so prized over daughters that girls are breastfed less than boys in the hope that a mother may soon become pregnant again, this time with a boy (Jayachandran and Kuziemko, 2011). Women grow up being taught to eat last and least, reserving the best food for the men and boys. Girls are married too young and begin having babies before their bodies are fully developed, often launching a cycle of frequent pregnancies and an accompanying rise in the risk of death and disability to mothers and children (Rutstein, 2011).

Mindset: This harsh food environment is not only physical and economic, but also psycho-social, resulting in a mindset of dependency and resignation (Freire, 1970).

Governance: Contrary to the adage that "it takes a village", THP finds that most traditional villages – perhaps 100 households – are too small to manage public services or to interface effectively with the district administration. THP has found that 'it takes a cluster of villages' within walking distance (a 10 km radius), with a population of 5 000 or

more, to manage public services. Indian *panchayats*, for example, have been based on this principle for thousands of years. THP finds that in impoverished communities, there is often a gap between communities and the bottom tier of government administration, typically the district, that renders people powerless to exert influence (Coonrod, 2016).

APPLYING PRINCIPLES OF COMMUNITY-LED DEVELOPMENT

Developing methodologies: Since 1990, THP has worked (as have other organizations) to develop systematic approaches to build the capacity of rural women and men to build the community institutions they need to overcome hunger and lead healthy and productive lives. THP has drawn on the best practices of social movements from around the world, recent research and successful sectoral programmes, as well as its own process of trial and reflection. While these methodologies must always be adapted to the local context, they share several key elements:

1. **Start with women:** The current food environment is a reflection of entrenched and harmful gender norms and attitudes that everyone must change, beginning first and foremost with women leaders as key change agents.

2. **Mobilize everyone:** Rural communities often possess ingrained and sophisticated traditions of volunteerism for the collective good, guided by traditional leadership structures. This volunteerism is generally not systematically employed in support of basic services. Addressing the multiple interventions required to improve nutrition takes awareness, social and behavioural change, coupled with well-organized action by the entire population – and this must start with a change in mindset, from resignation to a spirit of self-reliance. THP facilitates this process through a phased series of workshops in which community members gain skills, confidence and stronger linkages with resources at district level. This can include:
   - **Vision, commitment and action (VCA) workshops:** These community-wide workshops enable communities to analyse their situation, identify priorities and launch initial confidence-building projects out of which new leadership emerges.
   - **Animators:** As mobilization begins to take hold, dynamic (and often young) leaders emerge, who participate in additional workshops to develop skills as the catalysts for mass-action campaigns.
   - **Group formation:** Citizens form committees on key sectors (nutrition, health, women's rights, water, sanitation and hygiene (WASH) and food security), building on their personal passions and strengths.
   - **Action campaigns:** Animators organize mass-action campaigns to address local priorities, leveraging local-government resources as much as possible.

3. **Get local governance to work:** Sub-district government (where it exists) is often ill-equipped to effectively deliver the public services people need (UNCTAD, 2015):
   - **A fair share of public resources:** Nations or provinces that are making rapid progress in transforming food systems are those that have devolved financial resources to these local governments, such as the recent devolution of 20 percent of public resources to Kenya's counties (World Bank, 2012). In the hungriest areas, local government has well below 10 percent of public resources.
   - **Capacity development:** Rural sub-districts are not a favoured posting for civil servants, and elected local representatives often have no training or orientation in the management of nutrition-specific or nutrition-sensitive interventions. THP has found that there are citizen-volunteers for every subject area, passionately committed and capable of providing leadership in partnership and with guidance from the scarce professional resources of the district administration.
   - **Mandatory mechanisms of social accountability:** Most development activities remain be top-down, sectoral and short term, with little or no "downward accountability". A mobilized citizenry is only going to be effective and stay engaged when there are regular opportunities to engage directly with government.
   - **Timely local data:** Most rural communities have no data on their own nutritional status and no way of knowing whether they are better or worse than local norms. The nations themselves depend on sample surveys, perhaps every five years. Community-led action greatly benefits from area-specific data that are simple enough to be tracked annually.

Building a movement for national and global change: Civil-society organizations, such as THP, are able to pioneer and demonstrate these approaches, but only national governments can enact the policy changes and budget reallocations required to take them to scale. For this reason, THP has brought together more than 60 international and local non-governmental organizations into a Movement for Community-led Development (CLD Movement) (CLD, 2015).[1]

1 https://communityleddev.org/.

REGION-SPECIFIC METHODOLOGIES FOR GENDER-FOCUSED, COMMUNITY-LED DEVELOPMENT

1. **The challenge in India:** India is home to largest number of malnourished people globally, despite ample food production. Stunting rates among children under the age of five are similar to those of Ethiopia, a much poorer country, and far worse than in Kenya or Senegal.[2] Since the 73rd amendment to India's constitution[3] was passed in 1992, responsibility for nearly all activities related to improving nutrition has been devolved to elected village councils (*gram panchayats*). At the same time, India's large-scale, nationally funded food-environment programmes, such as the Public Distribution Scheme (PDS) and the Integrated Child Development Scheme (ICDS), have been plagued by corruption and incompetent administration (Sahoo et al., 2016). Access to health care – a key component of good maternal nutrition in the critical first 1 000 days from conception to a child's second birthday (Bhutta et al., 2008) – is notoriously low. India spends only 1.2 percent of its GDP on health (Dey, 2018).

2. **Women's leadership in India:** The most revolutionary aspect of the 73rd amendment was the reservation of one-third of all seats and presidencies of *panchayats* for women (a number that has since increased to one-half in many states) (Government of India, 2011). THP has seized on this opportunity, launching a comprehensive programme to develop the leadership skills and capacity of these newly elected women representatives (EWRs) so that they can become effective agents of change for improved nutrition (THP India, 2019). The programme includes:
   - **Women's leadership workshops:** A three-day foundation course on basic rights as citizens, responsibilities as EWRs and awareness of and ties to government programmes;
   - **Women's forums:** Public forums, organized by EWRs for the women of their constituencies, to hear their priorities and provide them with information;
   - **Needs-based workshops:** On-demand workshops on how to understand, access and oversee programmes on health, education, nutrition, WASH and public safety; and
   - **Block-level federations:** Monthly meetings of EWRs at the next-highest administrative tier (the block) to engage with government administrations and collectively demand action to improve public services.

3. **Results in India:** To date, THP has implemented this programme with more than 150 000 EWRs, improving public services in terms of nutrition-specific and nutrition-sensitive interventions. EWRs have overseen and improved the quality of PDSs and ICDSs in their areas. They have secured and tracked medical referrals for wasted children, improved access to clean drinking water and launched programmes to mentor adolescent girls, so as to halt child marriage and ensure that girls stay in school.

4. **Changing and implementing new laws in Bangladesh:** Like India, Bangladesh has seen rapid economic progress, but continues to have very high rates of stunting, with over one-third of children affected.[4] The tier of government closest to the people is the union parishad (UP), each of which serves roughly 25 000 people. In 2007, THP successfully advocated for new local-government laws with progressive provisions for direct citizen engagement (THP, 2017). To demonstrate the impact of putting those laws into action, THP launched the comprehensive SDG Union Strategy in 185 of Bangladesh's 4 554 unions (THP, 2017). The programme includes:
   - **Animators:** In each union, at least 150 volunteer animators participate in a four-day workshop, developing skills to facilitate VCA workshops and encourage villages to set priorities, take self-reliant action and provide input to UP plans and budgets.
   - **UP representatives** participate in a five-day workshop aimed at giving them confidence and assertiveness in their dealings with public servants and a thorough knowledge of how to implement the new UP law.
   - **Standing committees:** The new UP law permits direct participation by citizens in 13 standing committees aimed at improving 13 devolved areas of public service. THP encourages animators to participate in these standing committees.
   - **Women leaders:** A cadre of educated women in the union receives an additional three days of workshops on gender analysis, plus monthly topical workshops. They are uniquely able to reach women and adolescent girls cloistered in conservative households and educate them on nutrition, halting child marriage and

2 https://data.unicef.org/wp-content/uploads/2019/04/UNICEF_Expanded_Global_Databases_Stunting_2019_April.xlsx.

3 https://www.gktoday.in/gk/constitution-73rd-amendment-and-panchayati-raj-in-india/.

4 https://data.unicef.org/wp-content/uploads/2019/04/UNICEF_Expanded_Global_Databases_Stunting_2019_April.xlsx.

domestic violence, improved sanitation, and vocational opportunities. Women leaders also advocate at higher tiers of government through the Unleashed Women's Network.[5]

- **Ultra-poor:** Animators facilitate group formation, group savings and group enterprise formation among the most destitute community members.
- **Peacebuilding:** As Bangladesh has been subject to pervasive political and extremist violence, a number of "peace ambassadors" participate in skills-development workshops and organize peacebuilding activities.

5. **Reclaiming food sovereignty in Latin America:** Although wealthier than South Asia or sub-Saharan Africa, Latin America is home to high rates of malnutrition, particularly among rural indigenous communities. The dominant western urban culture has dramatically altered the food environment, replacing traditional, more nutritionally rich crops with junk food and sugary soft drinks. In the remote indigenous communities of Mexico and Peru, THP has supported indigenous women's organizations in carrying out campaigns to reclaim, refine and promote traditional nutritious foods and to interface effectively with local government (THP México, 2019). In Mexico, THP has mobilized animators and held VCA workshops on bottom-up planning (also at household level), introducing safer cooking stoves and better sanitation facilities, in addition to traditional nutritious foods (THP México, 2019).

6. **Epicentres in Africa:** While the challenge in South Asia has been to transform dysfunctional local governance, in much of sub-Saharan Africa, there is virtually no local government below district level. In those areas where THP works, there is no public rural infrastructure. To address this, in eight African countries, THP has developed the Epicentre Strategy (THP, 2018). Over five to eight years, rural communities progress through four distinct phases:

    - **Initial mobilization (1 2 years):** After a baseline study, animator and VCA workshops are held, similar to those in Bangladesh. However, in Africa, teams of animators receive specialized skills in 12 sectoral programmes, including food security, WASH, nutrition, health and women's rights. Each village in the Epicentre cluster elects one man and one woman to serve on the Epicentre committee, which negotiates five acres of land for Epicentre facilities from district government or traditional leaders (TPH Malawi, 2019).
    - **Construction (1 year):** Traditional leaders and the Epicentre committee mobilize voluntary labour for the construction of buildings to house literacy training, a health clinic, housing for government-provided nurse midwives, a food bank and microfinance facility, and food-processing equipment. The Epicentre also includes a demonstration farm, at which local families are able to learn the best ways to produce nutrition-rich foods suited to their environment. This education is particularly critical, as farmers must adapt to climate change.
    - **Programme implementation (2–3 years):** The Epicentre committee and the sectoral subcommittee set their own sectoral goals and priorities and track their own progress. They also establish collective income-generating activities to sustain the facilities.
    - **Transition to sustainable self-reliance (1–2 years):** Once Epicentres demonstrate successful management of local programmes and generate sufficient income, they are incorporated as free-standing organizations, requiring no further funding from THP. Two years after self-reliance, THP conducts an ex-post evaluation for further learning.

ILLUSTRATIVE EXAMPLES OF IMPACT OF THESE PROGRAMMES

- **India:** External evaluators in the state of Odisha found that EWRs in the THP programme delivered three times as many public services as EWRs in comparable villages (Catalyst Management Services, 2017).
- **Bangladesh:** A study published in the Proceedings of the National Academy of Sciences of the United States of America showed that THP programmes increased community trust compared with control villages, empowering those in extreme poverty to make better long-term investments in their own future (Jachimowicz et al., 2017).
- **Senegal:** Epicentres were able to increase dietary diversity by 40 percent – from 3.8 to 5.3 different foods or food groups consumed the previous day – over a two-year period, according to statistically significant household surveys.[6] Epicentre volunteers established village clubs to conduct cooking demonstrations and to screen malnourished children.

5 https://join.thehungerproject.org.uk/event/unleashed/faq.

6 https://epicentertoolkit.org/study.

- **Benin:** Epicentres have launched the Moringa Project,[7] producing powdered moringa nutritional supplements. In addition to generating a valuable nutritional resource for their community, local producers have partnered with THP to scale up their operations and sell excess product to private national distributors, moving local producers from subsistence farming into social and economic entrepreneurship.
- **Upscaling and replication:** The Dutch National Postcode Lottery funded Benin's Moringa Project and, due to its success, has funded THP to extend the programme to Ethiopia, Malawi and Uganda.

SCALING IT UP: THE CLD MOVEMENT

Calling for a new paradigm of development: The era of the Millennium Development Goals (2000 to 2015) saw progress in many sectors, but ignored issues of local governance and failed to hit nutrition targets (UN, 2015a). In negotiating the Sustainable Development Goals, a group of civil-society actors[8] advocated strongly for the inclusion of community-led processes. These efforts bore some fruit: SDG 11, originally destined to have an urban focus, includes all communities, while SDG 16 calls for inclusive participatory decision-making "at all levels" (UN, 2015b). The call for investment in local capacity also features in paragraph 34 of the Addis Ababa Agenda for Financing for Development (UNCTAD, 2015), in which the international community committed to scaling up support for decentralized governance.

At the UN summit that launched the SDGs, this aforementioned group of civil-society actors launched the CLD Movement.[9]

GOALS OF THE CLD MOVEMENT

The CLD Movement believes that every person has a fundamental right to voice in the decisions that affect their life and to equal and affordable access to the fundamental public services through which they can achieve their full potential.

To this end, the CLD Movement works to bring civil society and governments together in an effective partnership to achieve the following goals:

1. **Voice and agency for women, youth and all marginalized groups:** All citizens, particularly the marginalized, need effective community-based civil-society organizations to express their collective aspirations, operating in a policy environment that guarantees their opportunity to participate in local decision-making and in their own development.
2. **Adequate community finance:** There must be policies that ensure all communities can command a fair share of public resources to achieve local goals in ways that are transparent, timely and publicly accountable. In addition, every person has a right to access affordable financial services.
3. **Good local governance:** Local governments must be democratically elected. They need to be financially autonomous and possess the requisite skills to fulfil their responsibilities to meet the basic needs of their citizens. Local governments need to work in direct partnership with active citizens through mandatory mechanisms for bottom-up planning and social accountability, including their citizen's right to information.
4. **Quality public services:** Every community must have access to affordable, effective, quality public services for health, education, water, sanitation, vocational training, food and nutrition security, natural resource management, public safety and justice – preferably through integrated strategies and co-location for improved efficiency and convenience to citizens.
5. **Resilience:** All communities must establish regularized processes for disaster preparedness and risk reduction – developing the skills and awareness to be resilient to climate change and social/political disruption.

The CLD Movement organizes national chapters to push for fiscal devolution and other reforms necessary to develop the capacity of local communities to successfully take charge of their own development. National chapters engage with government ministries and bodies, in particular, by arranging field visits for these predominantly urban leaders to see the progress being achieved by the CLD Movement in the rural areas of their own country and in neighbouring countries.

National leaders can also draw inspiration from progress achieved in countries such as South Korea, which attributes much of its remarkable economic growth to its 1970s CLD programme, known as *Saemaul Undong* (Inter Press Service, 2015). National-scale CLD programmes are also under way in the Philippines, Indonesia, Afghanistan and, most recently, in Kenya.

7 https://themoringaproject.org/.
8 https://communityleddev.org/members/.
9 https://communityleddev.org/.

African leaders took a major step when the African Union adopted the African Charter on Decentralization (African Union, 2014). Now, the Charter needs to be promoted, ratified and implemented across the continent.

The CLD Movement has government allies. For example, many local authority associations joined together to form the Global Taskforce of Local and Regional Governments[10] to advance the localization of the SDGs. The UN Secretary-General's office launched Local 2030 to support such efforts and the UN Development Programme gave itself the mandate to localize the SDGs. The Swiss Agency for Development and Cooperation sponsors the Asian Local Governance and Initiative Network (LOGIN Asia), which spans 12 countries.[11]

Business as usual will not transform the food environment for the billions of people who remain malnourished, having been bypassed by the improvements that have helped so many others. This will require profound social, behavioural, economic and political reform. All efforts must start with a change of mindset – from treating impoverished people as passive beneficiaries, to unleashing their power as the authors, owners and key change agents of their own development.

10 https://www.global-taskforce.org/.

11 http://www.loginasia.org/.

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FAO/OLIVIER ASSELIN

Food environments for a healthy and nutritious diet: The contribution of academia

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ABSTRACT

Our food systems need to undergo significant transformation if we are to ensure healthy and sustainable diets for all. This transformation needs to be multidimensional, intersectoral and interdisciplinary. The academic community must be part of this process, both as a pillar of scientific, educational and technical support and as a centre of learning. The Latin American Network for Food and Nutritional Sovereignty and Security (SSAN) is the result of a process aimed at bringing together academic actors to focus on nutrition, food sovereignty and food security policies in the region. NutriSSAN is an online platform that has enabled the organization of special interest groups focused on various themes within the SSAN Network. The Obesity Special Interest Group has been spearheaded by four Latin American universities, leading to improved, co-created academic work in the area, including nutrition and food systems, through knowledge and experience exchange. This article reports the effects of interactions within the Latin American SSAN Network and the Obesity Special Interest Group on academic achievement and on the prospects for healthier and nutritious diets, with a view to promoting healthy food environments.

INTRODUCTION

Individual, community and global health depends on the resilience of ecosystems that sustain life on Earth, and those ecosystems have been struggling. To date, steps to promote much-needed changes in lifestyle and to create a new model of sustainable development have not been sufficiently effective. The need for more coherent public policy has become increasingly evident. This can be achieved if all sectors, disciplines and stakeholders work together.

Among the consequences of a lack of human resilience are the persistence and worsening of malnutrition and an increase in overweight and obesity. Economic growth, urbanization, globalization and technology have made society more complex. We need well-developed strategies that take into account the social determinants of health to create the conditions required to develop efficient and inclusive food systems.

Food-system efficiency translates into sustainable food production and consumption, incorporating nutrition and food security. Since the turn of the century, the Specialized Agencies of the United Nations, led by the World

Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), have become increasingly outspoken on the issue, recommending the adoption of multi-level, multi-actor strategies to transform the planet's food systems.

Different areas of government, the private sector and civil society have been asked to participate in finding intersectoral solutions, based on a socio-ecological approach to health and nutrition that considers the multidimensional, holistic and systemic characteristics of the issue at hand (Ramirez and Ayala, 2013). Universities have great potential to contribute to the transformation of global food systems by generating and facilitating access to knowledge. The university's contribution lies in the theoretical or translational fields of applied research, either through the transfer of technology or through participation in the processes of social transformation.

Academic networks, such as the Latin American Network for Food and Nutrition Sovereignty and Security (SSAN), are an example of how academic collaboration can help to promote the transformation of food systems. In this essay, we will discuss the role of universities, the pragmatic aspects of that role and the contribution of the Latin American SSAN Network to the promotion of food environments for a healthy and nutritious diet.

THE THIRD FUNCTION OF UNIVERSITIES

Each university has its own particular mission, stemming from a balance or a preponderance of one or more of its three functions: teaching, research and community outreach. It is this third function that defines what, why, for whom and how subjects are taught and researched. The cosmopolitan nature of universities means they can pursue knowledge without borders and, by their very essence, contribute to the practice of sustainability, either by exchanging knowledge or by broadening horizons of understanding. However, globalization is a source of disagreement and dispute that has generated inequity and endangered local culture and customs.

In this context, there is a new university revolution under way around the globe, through which a quantitative and qualitative transformation is taking place in the form of a new social contract between universities and society, with universities playing a more active role in the process of economic development. Some believe universities' role should go beyond facilitating the interests of the current economic system and that they should position themselves as an alternative to global capitalism, actively contributing to social cohesion, democracy, a reduction in social inequity, environmental protection and the defence of cultural diversity (Morin, 1999; Santos, 2005).

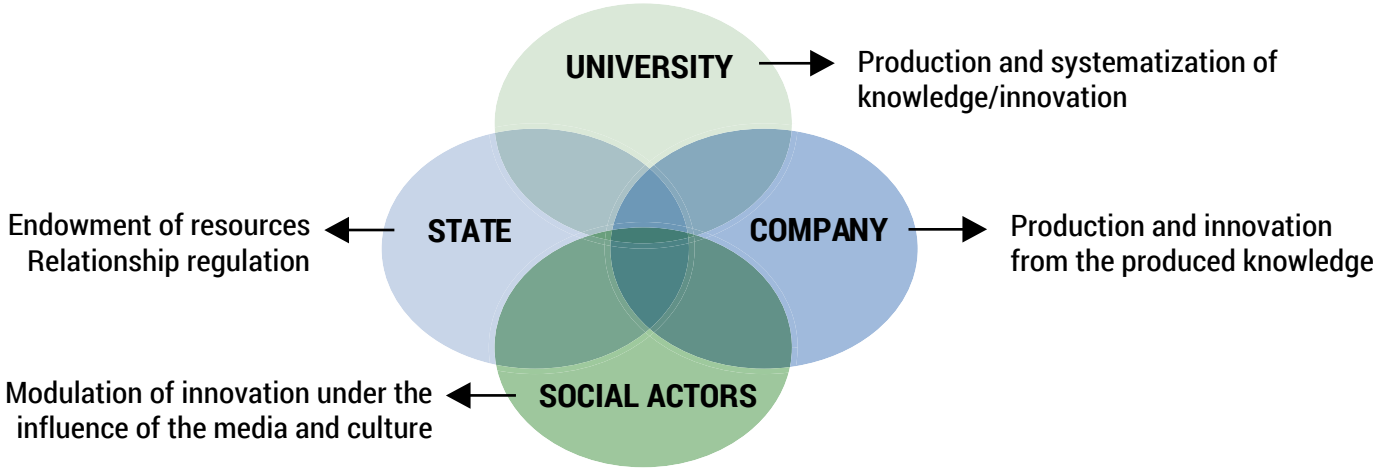
The task of universities is to mould professionals with integrity and strong social commitment who will cultivate models of healthy, ethical behaviour. In the field of science and technology, the legitimization of the social function of the university takes place through different routes, those of conventional technologies and alternative technologies. Thus, to understand the contribution of academia to the transformation of food systems (though far from exhaustive), it is essential to base our discussion in innovation theory in the knowledge-based economy and in engaged research in the context of social inequality.

THE THEORY OF INNOVATION

The triple-helix model developed by Etzkowitz and Leydesdorff (2000) is based on the interactions of government, business and universities in relation to innovation. It characterizes the latter as an active participant in social, political, economic and productive changes, highlighting its role in developing and strengthening the creation of capable and competent human resources through teaching, research and reflection (Etzkowitz, 2011; Corrales, 2014).

The model suggests that scientific activity is legitimized by its contribution to economic development. Building on the original linear model, current innovation theory understands a knowledge system to be very much determined by its ability to adapt, combine and integrate different modes of knowledge and innovation. The intersection of the model's components enables trilateral or multilateral networking interactions with other actors. A fourth driver has been introduced to the model to include civil society and the media – in other words, an ecosystem of knowledge and emerging fractal innovation – in a bid to broaden the model's impact on society (Figure 1) (Carayannis and Campbell, 2009). In this approach, the social actor is represented mainly by the consumer, who, through culture and influenced by the media, modulates the processes of innovation.

Figure 1. INNOVATION ECOSYSTEM



Source: *Adapted from Carayannis and Campbell (2009).*

INNOVATION FROM PRODUCED KNOWLEDGE

As the main regulator of the relationship between the state and the university, the market (which is subject to strong international influence) is tasked with fostering competitiveness between companies and nations. This is where the relationship between a university and its environment becomes important and finds its closest approximation to the world of work and other issues of social interest in the relationship between the helices of the innovation model.

It is through the evolution of the concept of technological innovation that the concept of social innovation has emerged. It can be defined as the result of knowledge applied to social needs through the participation and cooperation of all actors involved, generating new and lasting solutions for social groups, communities or society in general (Bignetti, 2011). This concept has been used in a number of American and European universities, though it is not very widespread in Latin America, being more closely aligned with the concept of technology transfer (Bignetti, 2011).

ENGAGED RESEARCH

Another strand lies in the engagement of researchers and students in social movements, for example, in popular education movements, the solidarity economy and other initiatives taking place in Latin America in the context of participatory or engaged research, in which the ecology of knowledge is valued. These are the environments in which social technologies are developed. A landmark development in this regard was the Argentinian university reform of 1918, which started with student activism in Córdoba, strengthening university autonomy and recognizing its role as an agent of social transformation.

It is in the quest for social transformation from a dialogical perspective that engaged research is framed, with researchers becoming involved in social causes, adopting an approach of "doing with", rather than "doing for", a social group or community.

It is through engaged research that social technologies are produced. Social technology refers to an economic strategy, based on a relationship of solidarity between production and commercialization, which implies political resistance to hegemonic logic that places a monetary value on every material thing, removing other human values from the final product. One popular concept of social technology involves replicable products, techniques and methodologies, developed through interaction with the community, which present effective solutions to the challenges of social transformation (Dagnino, 2010).

It differs from the concept of social innovation, which refers to the ethical and solidary stance of universities, companies and corporations in the production of innovation (solutions) for the common good.

FAO/JON SPAULL

The relationship between a territory and its food sovereignty depends on the power of its population to determine what and how to produce to ensure access to clean, nutritious and healthy food. It means having control over the food system. Here, engaged research has the potential to promote human development through emancipation and autonomy, based on collective construction and knowledge-sharing.

MORE EFFICIENT AND INCLUSIVE FOOD SYSTEMS

It is imperative that we – especially in the universities of Latin America and the Caribbean – explore how to construct more efficient, inclusive and sustainable food systems globally and address their impact on society.

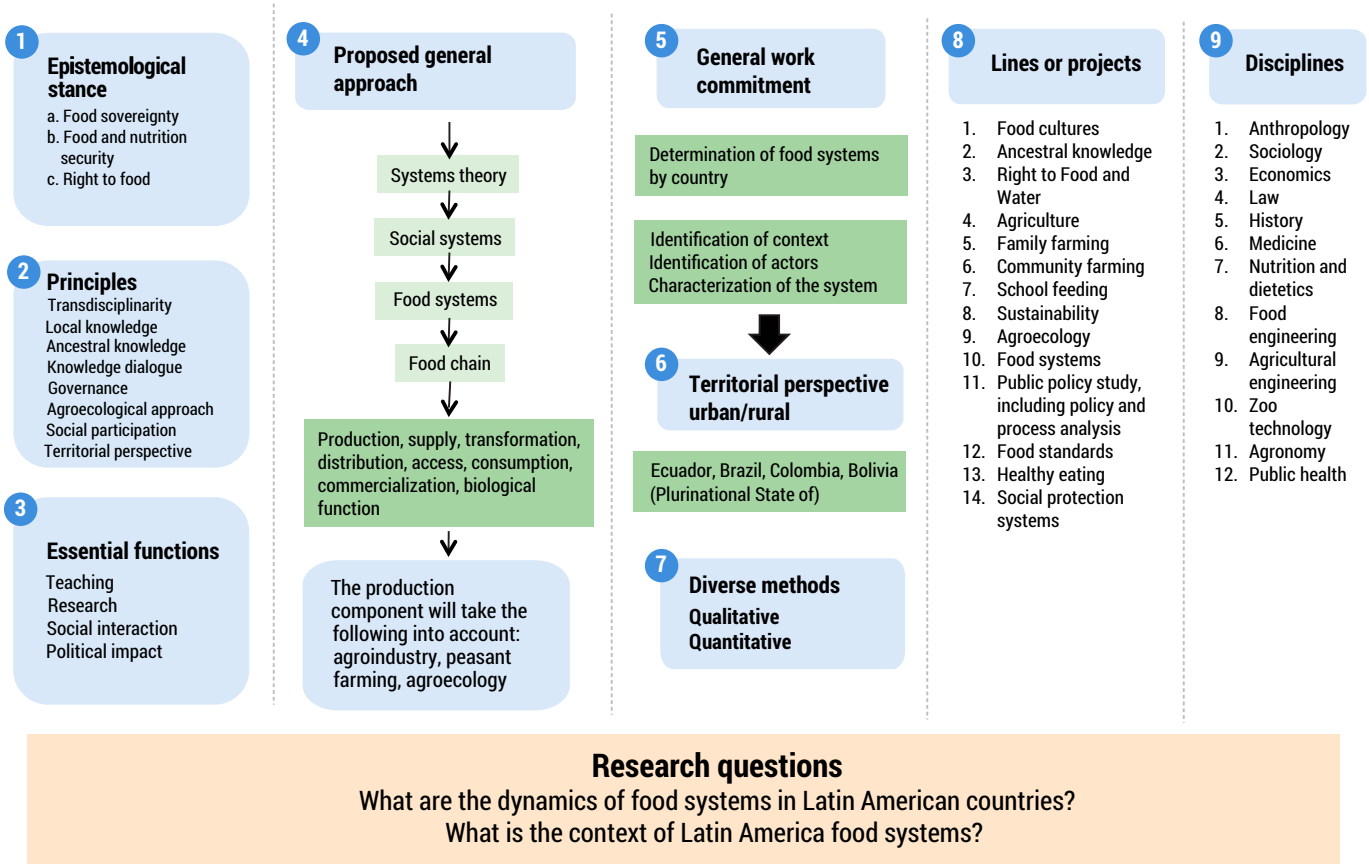
To this end, universities should:

- Promote individual, family and community responsibility for sustainable food systems.
- Dedicate university resources to supporting actions related to respect for sustainable food systems.
- Design curricula that foster the active participation of students in the promotion of sustainable food systems.
- Ensure undergraduate and graduate students have the knowledge and skills they need to make decisions about sustainable food systems.
- Provide the necessary tools for conducting research aimed at identifying, constructing and evaluating sustainable food systems.
- Engage in regional and global discussions on food systems in order to better link research gaps at the policy level with the academic research agenda.
- Invest in multidisciplinary research across study programmes, for example, linking agriculture, economics, health and social-science departments.
- Promote academic mobility, exchange of experience and cooperation between academic institutions, sectors of the economy and social organizations.
- Undertake activities that promote access to technologies for communities excluded from production and marketing systems, as well as the governance of food and nutrition security policies.
- Train people in the preservation and sustainable use of food biodiversity and water for consumption and food production.
- Study and promote market alternatives grounded in the social and solidarity economy and food sovereignty.

Rural-urban relations will need to be strengthened to create new market rules. We will need to improve food production chains and build a consensus among consumers to boost demand for sustainable products. To achieve sustainable market practices, we will need to develop techniques and market knowledge. The development of local markets has been identified as an important alternative to the development of public-sector infrastructure for the provision of healthy foods.

Collaborative work among researchers from different countries may result in more appropriate methodological approaches to the study and the transformation of food systems. We can take as an example the outcome of a meeting of researchers from the SSAN-UNASUR (Union of South American Nations) Network (now the Latin American SSAN Network) in 2016. Figure 2 summarizes the reference framework for the work of researchers affiliated with the network. It sets out the network's epistemological stance, its principles and essential functions, taking into account the Right to Food and convergent concepts and principles. The network sought a theoretical and methodological frame of reference that chimed with its conceptual assumptions and principles, including the largest possible number of themes and areas of knowledge (Figure 2).

Figure 2. GROUP DISCUSSION SUMMARY



Source: *Co-created by the representatives of Bolivia (Plurinational State of), Colombia, Ecuador, Brazil; designed by Professor Eliana María Pérez Tamayo of the University of Antioquia.*

** Now the Latin American SSAN Network*

MULTILATERAL NETWORKS AND PLATFORMS

Among the transformations in international relations since the beginning of the 2000s, there have been certain collaborative scientific relationships mediated through diplomatic channels. We have seen research on national food and nutritional sovereignty and security backed by UNASUR and the Community of Portuguese Speaking Countries (CPLP), as well as by the Brazilian Ministry of Science, Technology, Innovation and Communication (MCTIC). In general, these investments are aimed at strengthening the involvement of the academic community in shaping public policy on food sovereignty and food and nutritional security, and in the search to develop local and regional competencies.

In this kind of regional arrangement, the role of collaborative networks and institutional structuring emerges, sparking international cooperation by offering the possibility of mutual exchange and support through a relationship of interdependence, not just technology transfer or humanitarian aid (Ferreira and Fonseca, 2017). The logic of "doing for others" turns into a logic of "doing with others" (Martini and Wünsch, 2017),11 unlike the traditional model of international cooperation, which has stronger countries as its primary focus, through governmental agencies, social organizations or even the private sector (Martins et al., 2017).

THE LATIN AMERICAN SSAN NETWORK

The Latin American SSAN Network connects Latin American researchers through teaching, research and extension projects in support of countries' food and nutrition sovereignty and security. It grew from the SSAN-UNASUR programme created by the South American Council for Education, Culture, Science, Technology and Innovation of UNASUR in 2012. While the UNASUR programme has been subject to some disruption due to political developments in the

countries involved, the researchers remain active. There are currently 89 teaching, research and extension projects being led by Brazilian researchers in various territories, all of which include at least one researcher from another Latin American country. The first phase (2013 to 2016) supported 25 projects and forged partnerships that persist today. It further galvanized actions to strengthen the Latin American SSAN Network as a collaborative academic network. Online interaction, despite its limitations, has helped to improve the communication process. One of the key support tools has been the NutriSSAN electronic platform hosted by MCTIC Brazil's National Research Network.

NUTRISSAN AND SPECIAL INTEREST GROUPS

NutriSSAN[1] is a technological platform for communication, virtual interaction and cooperation, designed based on the experience of Brazil's National Research Network (RNP) and Telemedicine University Network (Rute). In addition to being a technological support, NutriSSAN is an established government system, complete with operational technical coordination and an expert advisory committee.

NutriSSAN's principles and guidelines are based on the principles of food and nutritional security, in line with the guidelines of international commitments and declarations on the Right to Food and the Right to Sustainable and Inclusive Development. NutriSSAN is split into special interest groups. These are coordinated by NutriSSAN units approved by the RNP, located in educational and research institutions. They perform diverse functions aimed at furthering education, research and extension projects.

The NutriSSAN units act as academic support structures for education, research and extension projects in food sovereignty, security and nutrition. They are linked to SSAN science and technology centres (one in each region of Brazil), as well as any educational and research institutions that have an interest in and the technical infrastructure to manage such a unit locally.

THE OBESITY SPECIAL INTEREST GROUP

The Obesity Special Interest Group came about through cooperation on food sovereignty, food security and nutrition by researchers from São Paulo State University in Brazil, the Technical University of Loja in Ecuador, the University of Bío-Bío in Chile and the University of Córdoba in Argentina. It is linked to the Latin American SSAN Network.

Public policies for obesity prevention and control top the group's agenda. Every month, it discusses the obesity status of each country, as well as developments in prevention and control, followed by an exchange of experience and methodologies. The outcomes of these discussions are collated into an online publication: eight issues based on 2017 and 2018 discussions were published in 2018 and 2019 (www.interssan.com.br).[2]

The systematization of information in propositive diagnosis can contribute to the design of local-government policies, plans and programmes to encourage the development of healthier food environments that include environmentally friendly food systems and, thus, reduce obesity, the risk factors that cause it and the non-communicable diseases associated with it.

A key strength of this process is the spread and replication of local practices based on the experience of others. Research seeks to bridge the gap between the knowledge generated and its application in products and processes within the food system to be transformed, of which obesity is a product.

REGIONAL CONNECTIONS, LOCAL ACTIONS

The Latin American SSAN Network has been both an aggregating factor and a starting point for the development of countless actions in member countries in response to the common ideal of creating and promoting environments for a healthy diet. Each of these actions illustrates the dynamic interaction of network participants in an effort to deepen our understanding of healthy environments, so as to conduct research and facilitate critical debate grounded in the realities of the participating countries. The following are some of the actions and experiences of the Obesity Special Interest Group.

1 https://nutrissan.rnp.br/web/nutrissan/contatoeguiato.

2 The first issue was published in November/December 2018. The other issues will be published in 2019.

ARGENTINA

Since 2014, collaborative work has been produced at the National University of Córdoba with a view to encouraging the creation of physical and social spaces where producers, consumers, university students and other social agents can interact to foster conditions that improve their quality of life and, in particular, democratize the relationship between production and consumption. The university's extension work in the fields of agroecological production, fair trade and the consumption of healthy foods has promoted the development of healthy food environments in relation to local food systems in agroecological transition. With public policies to support agroecological production focused on certain social sectors, there is little territorial integration and the food systems are fundamental to the economy.

The Agroecological Fair of Córdoba (AFC) was founded in 2013 as a healthy food environment offering agroecological foods through a local agricultural framework, guaranteeing the availability of fresh and healthy food. Its aim was to strengthen local markets and regional production systems and encourage the participation of family producers. It is a collective organization that includes different types of producer in various stages of transition towards an agroecological production model. It has significant social capital, with a horizontal organizational structure and is self-governed by a sovereign decision-making body. The multiple interactions of the AFC network have fuelled a creative environment and the dissemination of practices and knowledge, expanding its social capital to form an innovative territory. Its complexity is both a challenge and an opportunity to contribute strategies of empowerment and inclusion, and demands an inter-institutional and interdisciplinary team.

The university plays a fundamental role in the development of territorial capacity and as a producer of social innovation and social transformation, acting as a facilitator and convenor. This is reflected in the emergence of agroecological fairs in other territories.[3]

3 National University of Córdoba extension project: Agro-ecological territorial development and food sovereignty strengthening production, marketing and responsible consumption (http://www.nutricion.fcm.unc.edu.ar/index.php/43-asignaturas/optativas/518-politica-alimentaria).

BRAZIL

In Brazil, the Food and Nutrition Sovereignty and Security Interest Group (GISSAN) of the Centre for Science, Technology, and Innovation in Food and Nutritional Sovereignty and Security (INTERSSAN) at São Paulo State University has undertaken an array of activities. GISSAN is active across the multi-campus university and INTERSSAN has been created as a space for dialogue between the university, government institutions and civil society for the transformation of food systems. The facility conducts training courses and lends support to local leaders in the implementation of policies and the development of social technologies. Interaction with South American and African countries has led to improvements in INTERSSAN's activities, through joint and participatory educational processes (professional improvement, postgraduate courses, and short courses), as well as interactions such as web conferencing and co-produced activities, for example, through the Obesity Special Interest Group. It has become apparent that local initiatives have the power to transform and that small things can make a difference, from the quality of shared foods to attitudes towards mealtimes, and support for government actions and local communities.[4]

One example is the facility's support for local networks of farmers and consumers to ensure product quality and fair prices. Another is the inclusion of teachers, undergraduates and graduate students in state and local food and nutrition security policy, through methodologies for the preparation of food and nutrition security plans for 2019-2023, approved in 2018. The conditions were created for the broad participation of civil society in the process, both at local and state levels. In addition, studies were conducted and indicators for monitoring and evaluating the plans were established in a participatory manner, with the active involvement of municipal and state councils.

CHILE

Chilean academia has been participating in the formulation, implementation and evaluation of public policy in the area of food and nutrition for more than 50 years and has been involved in the implementation of national programmes (Ministry of Public Health, Chile, 2010; Ministry of Health, Chile, 2016a; Riumalló et al., 2004; Ministry of Education, Chile, 2018).

4 https://redelassan.wordpress.com/.

Chile's academia has helped the government to improve the population's access to healthier foods, such as milk products, increase access to important nutrients, such as iron, zinc and folic acid, and to combat malnutrition by eradicating the primary causes (Ministry of Health, Chile, 2016a; 2016b). Some of the best examples of academia's participation in the development, implementation and evaluation of public policy to address the problem of obesity are the inclusion of front-of-pack warning labels on food packaging, the prohibition of advertising aimed primarily at children under the age of 14 and the prohibition of its commercialization inside schools (Law No. 20606 (Ministry of Health, Chile, 2012) and Law No. 20869 (Ministry of Health, Chile, 2015)). Academia made methodological contributions to this process, participating in working groups and conducting targeted research.

ECUADOR

In Ecuador, actions have been focused on the education and training of various population groups in response to the need for qualified staff to effect legislation and public policy, to generate public awareness, to create a culture of healthy eating and to counter negative publicity and disinformation. There has been an emphasis on food and nutritional security courses conducted with the backing of São Paulo State University, Brazil, which trains key actors in the public sector and civil society. Other projects, such as "Nutritional support for school-age children", the "Healthy eating workshop" and the open virtual course, "Education for healthy eating", are available to university students and the general population, along with courses on food safety and healthy eating.[5]

CONCLUSION

The transformation of food systems into environments that provide healthy and inclusive diets is a highly complex task requiring coordinated action by academia, regardless of specialty, be it in the field of innovation and technology transfer, or the collective construction of social technologies in environments that foster a knowledge ecology. The regional and global connections and relationships of the scientific community allow the enhancement of academic achievement and the exchange of knowledge, experience, methodology and tools.

5 http://propgdb2.unesp.br/latosensu/upload/435-2-2.pdf.

MAGNUM PHOTOS FOR FAO/ALEX WEBB

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Last-mile nutrition: What role for the private sector?

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Authors' statement: *The authors declare this paper to be highly supportive of the approaches to nutrition and the activities of Sight and Life in which they were engaged at the time this paper was submitted.*

ABSTRACT

The 'last mile' for the nutrition community is the distance to achieving the 2030 target of ending malnutrition in all its forms (target 2.2. of the Sustainable Development Goals). In low- and middle-income countries, reaching the last mile remains an immensely challenging endeavour due to the nature of food environments, which are complex, dynamic and heavily influenced by the private sector. The food industry has long been criticized for making food environments unhealthy – its contribution to reducing malnutrition has been insufficient, with countless missed opportunities and damaging actions that have stained public and private engagement. Yet, the private sector's role in shaping local and global food systems in ways that have significant potential to influence the availability, accessibility and affordability of and demand for nutritious foods should not be ignored. With the majority of food being acquired from markets in low- and middle-income countries, it has become essential to work collaboratively with the private sector to implement innovative, market-based solutions that will contribute to improving the food environments of nutritionally vulnerable populations around the world. This article shares insights and lessons learned from four innovative partnerships in different countries, which aim to make nutritious foods more accessible, affordable, convenient and desirable. Through these case studies, we aim to highlight the potential of private-sector investment in nutrition, showcase innovative strategies for private-sector engagement and draw attention to the catalytic role non-profits can play by brokering partnerships between governments and the private sector to holistically nourish the last-mile consumer.

INTRODUCTION: WHAT IS THE "LAST MILE" IN NUTRITION?

The "last mile" refers to the "distance between where we are today, and where we aim to go for any given health indicator" (UNICEF, 2017: 2) and encompasses elements of the food environment, including affordability, accessibility and availability, which hinder or enable access to healthy diets. For the nutrition community, this distance is the current gap to achieving the Global Nutrition Targets (WHO, 2014).

Political commitment to ending malnutrition has never been greater, but despite the progress made over the past few decades, malnutrition remains a leading global challenge and a major obstacle to achieving the Sustainable Development Goals (SDGs). The recently published Global Nutrition Report (GNR) 2018 highlights the persistence, enormity and pervasiveness of malnutrition and its multiple burdens to human health and development: 88 percent of countries face a serious burden, with at least two of the three forms of malnutrition – undernutrition, micronutrient deficiencies, and overweight and obesity – while 29 percent have high levels of all three (Development Initiatives, 2018). Worldwide, 151 million children are stunted and 51 million are wasted (UNICEF, WHO and World Bank, 2018). Two billion people are micronutrient-deficient, while another 2 billion adults and 41 million children are overweight or obese (UNICEF, WHO and World Bank, 2018). Although goals and targets are clearly elucidated, the world is not on track to achieve SDG target 2.2 of ending malnutrition in all its forms. The 2018 GNR describes the recent progress to tackle all forms of malnutrition as "unacceptably slow" (Development Initiatives, 2018: 11).

It is undeniable that lifestyles, consumer choices and the food and beverage sector have contributed significantly to this growing burden. With rising incomes, urbanization and ever-increasing demand for processed foods in low- and middle-income countries (LMICs), products from the food and beverage industry account for a growing share of local diets, and this transition is progressively reaching rural areas. The ATNI Global Index 2018 reveals that less than a third of the 23,000-plus products marketed by the world's top food and beverage companies can be classified as healthy (ATNI, 2018). The industry's contribution to reducing malnutrition has simply been insufficient, with countless missed opportunities and damaging actions that have stained public and private engagement and made it harder to engage to achieve better nutrition (Milani, 2018).

Various actors have differing roles in providing solutions to the burden of malnutrition and the private sector is one key player. In LMICs, these efforts have focused on food safety or the fortification of staple foods (flour, rice, oil) and condiments with micronutrients (Milani, 2018). However, governments must remain in the driver's seat as the legislative and standard-setting body, while convening and pooling together the resources, knowledge and expertise of different stakeholders. At *Sight and Life*, we have explored various models to productively engage private sector in reaching the last mile in nutrition. One of our focus areas is to create and support successful public-private partnerships (PPPs) that lead to sustainable nutrition improvements.

WHY ARE WE LAGGING?

Central to the challenge of malnutrition are food systems – or all elements and activities that relate to the production, processing, distribution, preparation and consumption of food (Willett et al., 2019). In recent decades, the ways that food and beverages are produced, processed, distributed, marketed and consumed have changed drastically.

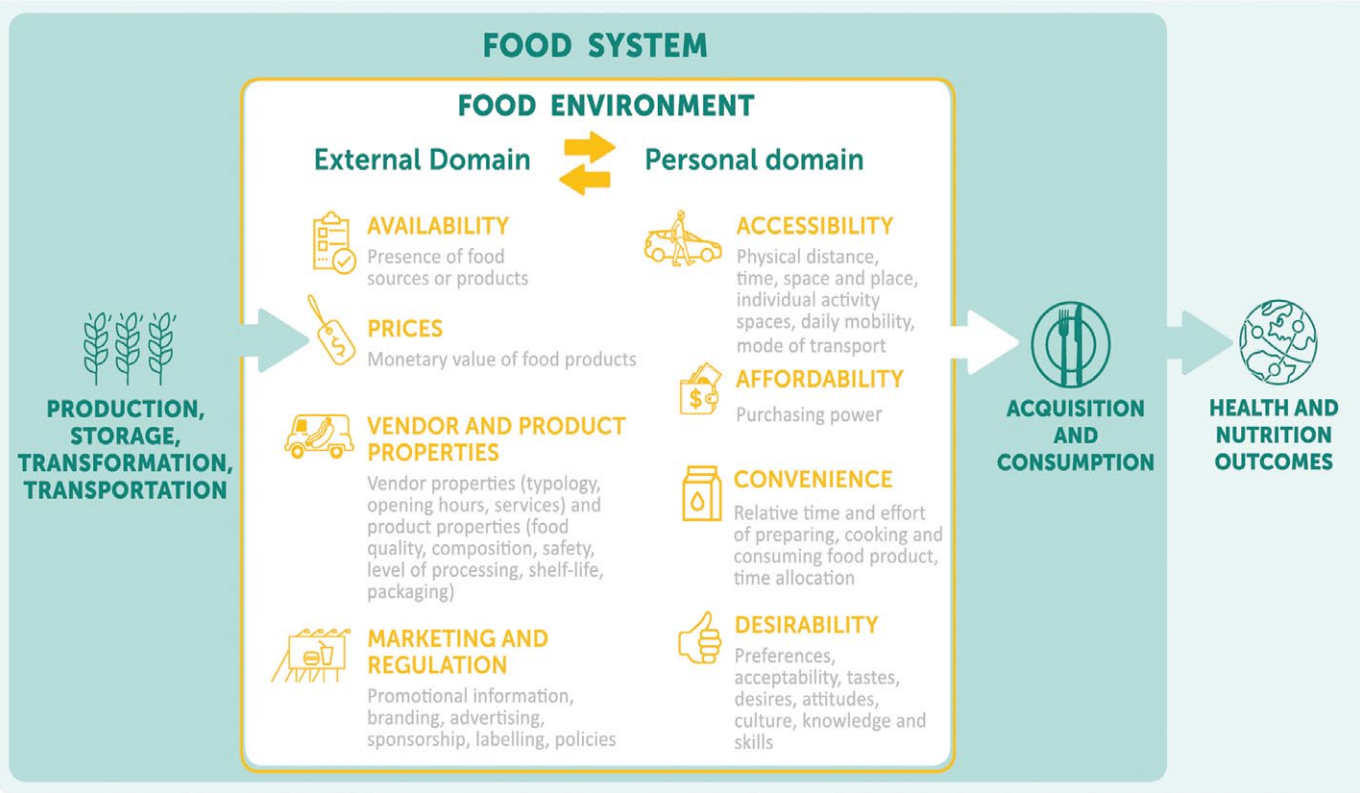
The food environment is part of the food system and refers to the physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence consumer food choices and nutritional status (HLPE, 2017). It also relates to the policies that influence the availability and accessibility of healthy foods. In simpler terms, the food environment influences how people access, prepare and consume food.

Dietary changes around the world are the result of changes in the global, national and local food environments, which are constantly challenged to support consumer choices consistent with healthy diets and good nutrition. In recent years, multiple conceptual frameworks have been put forward to demonstrate the pathways by which dietary and eating habits are influenced by food environments and their relationships with the wider food system.

An example is the Agriculture, Nutrition and Health Academy's Food Environment Working Group (ANH-FEWG) conceptual framework (Figure 1), which defines the food environment as the interface that mediates the acquisition of foods by people within the wider food system (Turner et al., 2017). Under this framework, the food environment consists of two domains, the personal and the external, which share an interrelated set of physical, economic and sociocultural dimensions.

The *personal* domain includes a set of individual-level dimensions, including food accessibility, affordability, convenience and desirability, that determine the consumption of certain foods and nutrition status (Caspi et al., 2017). For example, wealth and socioeconomic status are important in determining the ability to purchase certain foods, including packaged and processed foods, while proximity to retail outlets and/or supermarkets can determine one's access to those foods. The external domain refers to the myriad opportunities and constraints that exist in a given context and includes exogenous dimensions, such as food availability, prices, vendor and product properties, and food promotion, advertising, marketing and regulation in a given context. Within this domain, political, economic and sociocultural factors influence the food environment and wider food system (Caspi et al., 2017).

Figure 1. THE ANH-FEWG FOOD ENVIRONMENT CONCEPTUAL FRAMEWORK



Source: : *Turner et al. (2017)* .

HOW DO WE REACH THE LAST MILE?

In LMICs, reaching the last mile remains an immensely challenging endeavour due to the nature of food environments in these countries. Not only do they tend to be complex and dynamic, but they also have limitations in terms of data availability, resources and infrastructure, and consist of co-existing differing markets that include formal and informal food markets, as well as non-market-based food sources (Caspi et al., 2017). Most consumers live in obesogenic environments – environments that are rich in tasty and energy-dense, but micronutrient- and fibre-poor foods. These surroundings make it difficult to buy and eat healthier foods, because the foods that are easily accessible are highly processed from cheap agricultural inputs, containing high amounts of salt, sugar, fat and flavour additives, engineered to increase consumption.

Further fuelling the prevalence of obesogenic environments is irresponsible marketing. Foods and beverages that are usually classified in the 'eat least' category in dietary guidelines are among the most heavily marketed products. It is in the interest of the private sector to make its food desirable using sensory science and clever marketing, because this leads to repeat consumption, sales, profits and a sustainable business (Hall, 2018).

Despite these obstacles, there are innovative triple-duty solutions (whereby food-based interventions are addressing undernutrition, overnutrition and micronutrient deficiencies) to address last-mile nutrition in LMICs. This article shares four case studies in this area, with a special focus on the role of the private sector in fulfilling societal needs.

While the potential risks of engagement with the private sector are valid, there are ways to manage and mitigate them. Choosing the appropriate governance structures or forms of engagement is crucial in this regard. Due diligence, risk assessments and applying principles of engagement are essential when it comes to deciding whether to engage or not. In some cases, it may be that a more formal partnership with a certain governance structure is warranted, while in others, a looser partnership may suffice to mitigate risk. In other cases, there should be no engagement at all (Hawkes and Buse, 2011; WHO, 2016).

WHAT ARE SOME INNOVATIVE STRATEGIES FOR PRIVATE-SECTOR ENGAGEMENT FOR LAST-MILE NUTRITION?

Through a food-environment lens and with a focus on the personal and external domains, we share insights and lessons learned from four innovative partnerships, which aim to make nutritious foods more accessible, affordable, convenient and desirable. The case studies presented in this section are neither exhaustive nor prescriptive.

CASE STUDY 1: SIZANANI MZANZI

Sizanani Mzanzi (Zulu for "help each other South Africa") is a social business founded in South Africa. A social business is a non-dividend company created to address and solve a social problem (Yunus and Weber, 2009). In line with this, Sizanani Mzanzi's primary objective is to bring affordable, nutritious foods to vulnerable South African households.

The burden of malnutrition in South Africa is significant: it is a major underlying cause of death in 64 percent of children under five years of age, and one-third of women of reproductive age are anaemic (UNICEF, 2015).

It is estimated that South Africa loses more than USD 1.1 billion in GDP annually to vitamin and mineral deficiencies (World Bank, 2011). There are several factors contributing to this grim scenario. Low-income communities lack access to the goods and services they require in order to enjoy healthy and productive lives, while humanitarian and community projects, funded solely by grants, have limited reach and intervention periods. Hence, there is a need for continuity, sustainability and scale to effectively address malnutrition in South Africa. It is in this context that Sizanani Mzanzi was founded, to concurrently strengthen both the external and personal domains of the food environment in urban South Africa.

Through its partnership with Sizanani Mzanzi, *Sight and Life* has provided technical expertise and monitoring capacity to help ensure the high quality of both the food sold and the impact on nutrition and health outcomes. Over the years, a private-sector company has contributed to the partnership by leveraging its scientific excellence and large customer base to facilitate the development and supply of two fortified products – a beverage powder and an instant maize/soy porridge, under the MixMe™ trademark, which were the start-up products.

Which elements of the food environment does this case study address?

Desirability, accessibility and availability

Sizanani Mzanzi first introduced two fortified products that were developed under the MixMe™ brand – a flavoured instant porridge and a flavoured, powdered beverage for retail distribution via the microfranchizing model. In November 2016, Sizanani Mzanzi conducted consumer research through food diaries, shopping tours and in-depth interviews to understand purchasing and consumption habits for instant porridge and juice concentrate. In the townships of Ivory Park and Soweto, consumer research revealed that instant porridge and beverages were the most frequently consumed convenience foods. Consumers who bought instant porridge did so because it was a filling breakfast and saved time during the morning rush. Likewise, juices were regularly consumed and formed an integral part of their diet. Both MixMe™ products and product flavours (vanilla, orange, and pineapple) were chosen in light of these contextual dietary habits and in accordance with consumer preferences. These were the easiest vehicles through which the required nutrients could be delivered to consumers on a regular basis.

Sizanani Mzanzi then recruited community-based entrepreneurs from low-income areas and equipped these microfranchisees with basic training in nutrition and sales techniques to allow them to engage in door-to-door sales. The microfanchisees bought the products at a specified price and sold them at an agreed price that allowed them to make a small profit. Selling MixMe™ products door to door was a starting point for Sizanani Mzanzi, which needed to get a more personal feel for the market and to be able to control the products' pricing and selling methods.

Nonetheless, in 2018, this model evolved into an indirect distribution model comprising a two-level channel, consisting of a wholesaler and retailer. In response to consumer insights, the MixMe™ products are now being phased out and a new highly nutritious instant cereal product, endorsed by the South African Heart and Stroke Foundation, called Level Up™, has recently been launched (van Zutphen and Bajoria, 2018). Sizanani Mzanzi approached retailers to encourage them to carry Level Up™. It started with a few stores, but has now been introduced into 20 urban retail outlets, both corporate and franchised stores, of which one is the big retailer, SPAR Group.

Affordability and price

Low-income consumers are ready to pay more for nutritious products they value and there are two key contextual insights from South Africa that are important to pricing decisions: luxury brands are more expensive than traditional non-fortified foods and people are ready to spend up to seven times the price of local non-fortified foods on affordable fortified products. Benchmarking analysis suggested the ideal pricing for Sizanani Mzanzi's Mix Me™ instant porridges was between one and five times the cost of local non-fortified equivalents, at a point below the customer's perceived value and above the producer's cost of goods sold.

The guiding principles for price-setting that a marketer needs to follow are summarized in Figure 2. Consumer research revealed that price is a key driver of consumer purchases. This means that the health and nutritional benefits of Sizanani Mzanzi products had to be accentuated in the pricing communication for the pricing premium to be maintained. For the price-conscious consumer, Sizanani Mzanzi products have been positioned as an investment in the family's health.

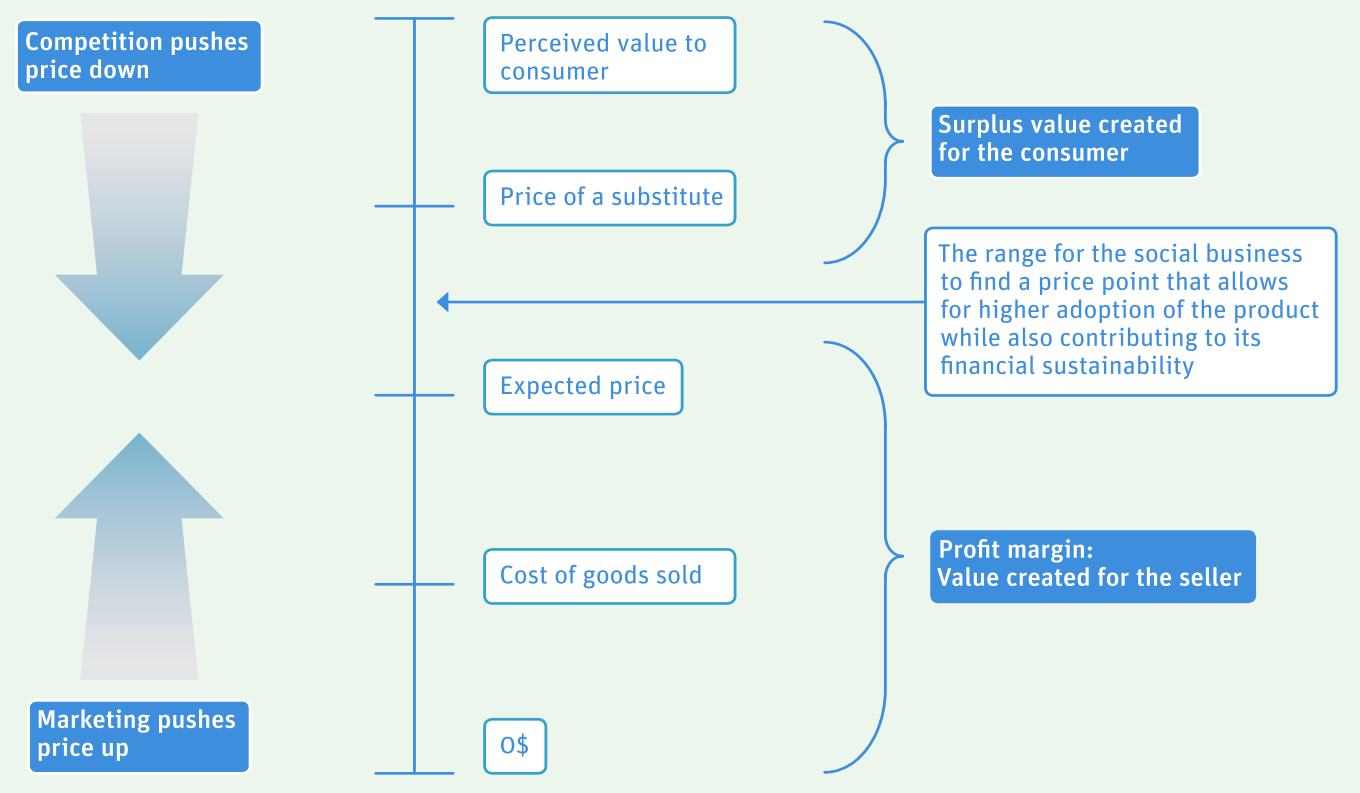
Impact

In total, it is estimated that 150 000 consumers in Johannesburg have benefited from improved health, nutrition and productivity. Furthermore, the results of consumer research show that consumers like the product despite the 'health' tag, which has helped reduce the barriers that prohibit uptake to ensure that more families include nutrient-dense products in their diets and/or purchases.

Lessons learned

As an emerging social business, Sizanani Mzanzi's aim is to be grounded in consumer research and to offer products that actively improve nutrient intakes and restrict unhealthy ingredients (sugar, salt, trans and saturated fats) of last-mile consumers. Investing in consumer research also helped this business to keep close tabs on the factors shaping the personal domain of the consumer food environment, so that it could respond appropriately with tweaks to the external domain, be it switching from a door-to-door model to a traditional retail model for accessibility, or changing the product format, formulation and branding entirely for desirability and convenience. Sizanani Mzanzi demonstrates that being responsive to changing consumer needs is key to shaping healthy food environments.

Figure 2. PRICE-SETTING GUIDELINES FOR MARKETERS



Source: *van Zutphen and Bajoria (2018)* .

CASE STUDY 2: MAKING A NUTRITION DIFFERENCE IN INDIA (MANDI)

India has 500-600 million nutrient-deficient people spread across the various income segments. Within these segments, the "aspiring" class has household income of USD 3 200 to USD 7 100 per year (Brar et al., 2014). The aspirers make up the largest income segment of the Indian population (54 percent) and nutritional deficiencies are rampant among them (IIPS, 2017). MANDI is a disruptive business-to-consumer (B2C) social enterprise, launched by Dutch life- and material-sciences multinational company DSM, with the potential to address nutrition among India's 500 million-strong aspiring class using locally relevant solutions.[1]

Which elements of the food environment does this case study address?

MANDI is built on five key principles, which specifically address both the external and personal domains of the food environment for the Indian aspirers.

Personal domain:

- MANDI started by mapping the Indian nutrition landscape and then arrived at solutions, to make sure the products were desirable to the Indian aspirer.
- MANDI kept people and their needs at the heart of thinking around a feasible portfolio of affordable products and then looked for science to solve it.
- The consumer research for MANDI looked at people holistically as a combination of socioeconomic-cultural-food-lifestyle attributes.
- The MANDI brand was built on trends and insights that are not only true today, but also relevant for the future.

External domain:

- In designing its pricing strategy, MANDI aimed to make a difference in society, while balancing DSM's commercial ambition.

With these principles in mind, MANDI launched a pure-play consumer nutrition brand called Nu-Shakti (Hindi for 'power of nutrition'), with a range of affordable, locally relevant products. The products include staple-food fortifiers, biscuits for pregnant mothers, a micronutrient powder and a fortified beverage, each costing between USD 0.03 and USD 0.14. Analysed through a food-environment lens, MANDI goes the extra mile by strengthening the components of the personal domain with strong, insight-driven communication to establish consumer connection and desirability. It has deployed direct marketing tools to build consumer awareness and retention.

To strengthen the components of the external domain, there has been a focused launch of the products in two states in India, with an extra layer of innovation to maximize availability in both urban and rural markets. In urban markets, the product is carried by a health e-tailer, coupled with retail activation, while in rural markets, MANDI has tapped into a pan-India rural women entrepreneurs' network, which also organizes community-level awareness programmes. In both rural and urban markets, more than 200 000 consumers received samples and feedback has been excellent, with indications of high product acceptance and product high relevance. As next steps, MANDI aims to build awareness at scale, track and review, and also expand to other states in India.

Impact

Through the rural women's network alone, nearly 320 000 sachets of MANDI products have been sold in two pilot Indian states. In addition, 650 women entrepreneurs have been trained to sell and generate community-level awareness of the products, generating incomes for themselves and their families.

Lessons learned

The main lesson from this case study is that simply making affordable nutritious products available with generic public-health messaging is often not enough of a trigger for consumers to purchase it. Private-sector initiatives, such as MANDI, have marketing budgets to invest in creating product desirability among consumers by employing innovative, peer-driven marketing tactics.

1 For more, please see Bajoria (2018).

CASE STUDY 3: THE MALAWI EGG HUB

In Malawi, malnutrition is a serious challenge and contributes to a significant proportion of preventable child deaths – 37 percent of children in Malawi are affected by stunting and 23 percent of all child deaths are related to undernutrition (UNICEF, 2018; SPRING, 2017). Eggs are a relatively inexpensive source of essential micronutrients and high-quality protein and an excellent food for improving nutrition. A recent trial in Ecuador has concluded that eating an egg a day for six months can reduce stunting by 47 percent and underweight by 74 percent (Iannotti, 2017). This is further substantiated by intake data, suggesting that eating one egg in addition to the recommended daily intake of breast milk will help to achieve the essential nutrient requirements of infants (Iannotti, 2014; USDA, 2018). However, eggs are scarce and rarely consumed by children in much of Africa and Asia, including Malawi, owing to unfavourable external domains of the food environment, notably high cost (8-10 times the price of cereals) and low availability.

Which elements of the food environment does this case study address?

Charles Stewart Day Old Chicks (CSDOC) is Malawi's leading private input supplier of poultry. It works to strengthen the food environment for egg consumption by ensuring the availability and affordability of eggs in the country. It helps poultry farmers to achieve commercial-scale productivity by providing them with input packages, credit, training and access to markets, as shown in Figure 3.

CSDOC organizes farmers into groups of five and assists them in setting up and developing an enterprise with a three-year breakeven period. Farmers are encouraged to buy improved feed at wholesale rates and to sell eggs primarily in their communities, thus improving local consumption. The trucks that deliver feed also buy poultry input materials, such as maize and soya, and any excess eggs from farmers, thereby creating a holistic cycle (Figure 4).

Figure 3. CSDOC'S EXPERTISE

High quality input support

- High performing point-of-lay birds
- Feed, vaccines & medicines as per specifications
- Poultry equipment

Extension services

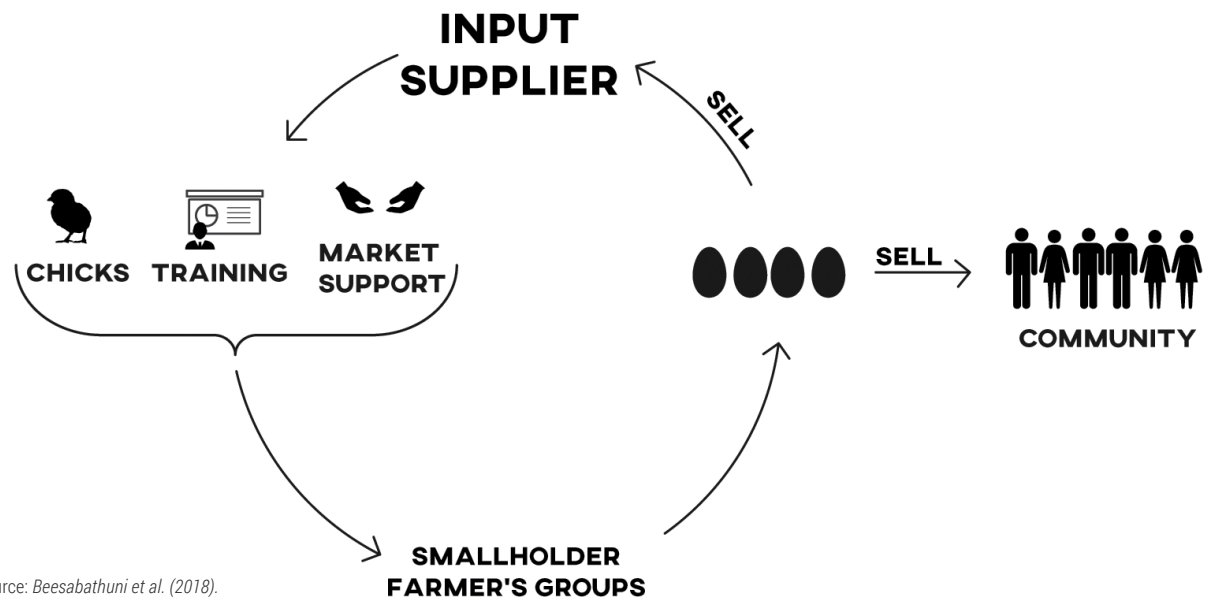
- Theory + practical lessons
- Weekly + emergency extension services
- Progress monitoring

Consistent market support

- Buy back at wholesale rates
- Demand creation

Source: *CDSOC.*

Figure 4. OPERATING MODEL OF CSDOC'S INTERVENTION TO INCREASE EGG SUPPLY IN MALAWI



Source: *Beesabathuni et al. (2018).*

Impact

CSDOC is currently supporting 70 farms with high-quality inputs, training, credit facilities and market support, helping them to produce around 25 million eggs per year collectively. Farmers are also encouraged to sell eggs at their village markets, close to the site of production, thus improving the availability of eggs in rural Malawi. In addition to providing cheaper and more accessible eggs, CSDOC is also improving farmers' ability to acquire and consume more nutritious foods by increasing their incomes: on average, farmers make a net profit of USD 1 135 per year, nearly 2.3 times more than the minimum wage.

Lessons learned

By leveraging its market access, technical know-how and on-the-ground presence, CSDOC is able to support smallholder farmers in making nutrient-dense foods, such as eggs, more widely available. What this case study demonstrates is that the private sector can shape food environments not just through packaged foods, but also whole foods, by working collaboratively with farmers to build their capacity.

CASE STUDY 4: OBAASIMA

In Ghana, despite two decades of sustained economic growth and reductions in some forms of malnutrition, progress on minimizing micronutrient deficiencies has been slow. A recent micronutrient survey conducted by the Ghana Health Service revealed deficiencies in key micronutrients, including vitamin A, iron and folate, particularly in pregnant women, concurrent with high levels of overweight and obesity (University of Ghana, 2017). While micronutrient deficiencies persist, more than 40 percent of women in Ghana are overweight or obese (University of Ghana, 2017).

In 2013, a partnership was launched between *Sight and Life*, DSM, the German Federal Ministry for Economic Cooperation and Development, the Children's Investment Fund Foundation, the Bill and Melinda Gates Foundation, the Association of Ghanaian Industries and the Ghana Standards Authority. Driven by the common objective of improving the micronutrient intake of women of reproductive age, the OBAASIMA scheme and seal were developed as a market-based approach to addressing micronutrient deficiencies across the food chain, from production to supply and demand creation.

Figure 5. THE OBAASIMA FRONT-OF-PACKAGE SEAL

Source: *OBAASIMA scheme.*

Which elements of the food environment does this case study address?

The programme is a demand-driven approach to addressing micronutrient malnutrition, aimed at increasing the number of fortified food products available in Ghana for women of reproductive age and to make them more recognizable. Using a distinctive trademark or front-of-package seal, the OBAASIMA symbol guarantees nutrition quality, while easily identifying fortified food products that provide a source or good source of 18 vitamins and minerals designed for women of reproductive age, such as iron, folic acid, calcium, iodine and zinc, as well as vitamins A, C, B12 and D.

The OBAASIMA seal not only serves double duty by providing clear assurance to consumers of a high-quality, safe and nutritious food that adheres to the minimum fortification content and restriction of sugar, salt and trans and saturated fat, but it also encourages entrepreneurial opportunities for food companies that want to capitalize on consumer growth in the area of affordable nutritious food. In this way, OBAASIMA has created demand for nutritious foods in Ghana by making products easily identifiable and recognizable, thereby reshaping the marketing and regulatory component of the food environment. It also serves as a very good model for engaging the private sector in LMICs to alleviate micronutrient deficiencies and improve food environments for the last-mile consumer.

Impact

As of May 2019, three food companies were making products with the OBAASIMA label, and an additional four new products will be launched in fourth quarter of 2019. Many of these products will be part of the World Food Programme's voucher programmes in Ghana.

The business and technical know-how provided through OBAASIMA have enticed traditional business-to-business companies to shift to a business-to-consumer focus, learning the importance of effective ways of marketing and distributing new consumer products in the marketplace. This newly learned expertise provides further opportunities for companies to expand their portfolio of affordable nutritious and safe foods. Expert guidance on the appropriate nutrients and levels necessary for women of reproductive age has resulted in companies with or without fortification experience to optimally fortify their products for this target group. Furthermore, criteria on safety, quality and nutrition, which are necessary for products to qualify for the OBAASIMA seal, have led to additional investment for two OBAASIMA-affiliated small and medium-sized enterprises, enabling them to increase production capacity, resulting in additional local employment as well as an increase in the availability and affordability of nutritious and safe foods.

Lessons learned

As much as fortified foods have been proven to help alleviate micronutrient deficiencies, they are not a panacea. In light of the double burden of malnutrition emerging in LMICs, innovative business models, such as OBAASIMA, and the development of a trademark seal, in particular, are encouraging examples of how two challenges can be addressed at once (micronutrient deficiencies and the risk of overweight and obesity). Perhaps most importantly, they are the result of thought being given to an essential nutrition intervention and redesigning it in a way that it is tailored to tackling the double burden of malnutrition.

WHAT CAN WE LEARN FROM THE CASE STUDIES ON PRIVATE-SECTOR ENGAGEMENT IN LAST-MILE NUTRITION?

Sight and Life carefully chose this set of case studies to showcase innovative models that address and strengthen all of those elements of the food environment that are required to holistically nourish the last-mile consumer. Sizanani Mzanzi is a social enterprise that bolsters the food environment by making locally desirable, nutritious and affordable products available through traditional retail channels, while MANDI is a purely commercial undertaking that is innovating in methods of delivering and marketing affordable nutritious foods to last-mile consumers. The Malawi Egg Hub highlights the catalytic role the private sector can play in supporting smallholder farmers that have the potential to address the nutrition gap with a highly nutritious product, such as eggs, while OBAASIMA is a positive model for PPPs to improve food environments through a demand-driven approach.

The four case studies underscore that aligning the private sector with better nutrition outcomes can allow us to draw on their nutritional expertise, research and development capacities and deep consumer insights to strengthen vendor and product properties, leading to greater convenience. They also show that building demand for nutritious foods by making products easily identifiable and recognizable (for example, through quality seals) can help to reshape the marketing and regulatory component of the food environment and can serve as a model for engaging the private sector in LMICs to address the double burden of malnutrition and improve food environments for the last-mile consumer. Lastly, the private sector's role in ensuring availability and accessibility is undeniable; it has the networks and supply chains not only to bring its own affordable nutritious foods to consumers, but also to empower smallholder farmers with access to markets for essential nutritious foods.

LIMITATIONS

While these initiatives show an encouraging trend, many hurdles remain to reaching the last mile, including linking agricultural policy to better nutrition and developing better metrics and incentives. Public-private engagement can remain difficult due to a lack of trust between the public sector, civil society and the private sector, conflicts of interest, different goals, objectives, working cultures, timelines and expectations. There is an urgent need to improve dialogue between all stakeholders and for learnings to be captured along the partnering process, to inform jurisdictions and encourage them to undertake an evidence-based approach to assessing partnerships. Lastly, there is a huge gap that needs to be addressed in measuring the impact of PPPs on nutrition outcomes.

CONCLUSION

There are enough statistics to highlight how the burdens of malnutrition, brought on by poor food environments, are robbing millions of people of opportunities to reach their full potential and limiting economic growth in their countries. 'Business as usual' is not an option; there is an urgent need for disruptive solutions and innovative new collaborations to facilitate cutting-edge research and development, sustainable investments and improved networks, leading to partnerships that meet the nutritional needs of marginalized communities at the last mile. The four case studies presented in this paper are neither exhaustive nor prescriptive, but they attempt to shine a light on private-sector initiatives to help guide key influencers and stakeholders towards principles of better engagement to deliver healthier diets for all.

FAO/SUE PRICE

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MAGNUM PHOTOS FOR FAO/ALEX WEBB

Speakers' corner

Actions that make food value chains nutrition-sensitive: Brazil's sodium-reduction policies

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INTRODUCTION

Food environments that limit access to healthy foods in adequate quantity are a major cause of death and disability around the world. Tackling the double burden of malnutrition, including non-communicable diseases (NCDs), depends on effective sectoral and intersectoral policies, as well as multi-stakeholder approaches to reshape the food system and the food environment, in which food choices are made. Nutrition-sensitive value chains have become a key action point in this equation.

NCDs are responsible for more than 70 percent of deaths in Brazil and are a significant cause of disability (Marinho et al., 2018). Brazilians consume more than twice the World Health Organization's (WHO) recommended levels of sodium, and the country's main dietary source of sodium is discretionary salt added to meals and industrialized foods (Sarno et al., 2013). Food reformulation is, therefore, key to reducing harmful ingredients, such as sodium, fats and sugars in Brazil's food supply. Thus, multiple strategies and stakeholders, including partnerships with the private sector, are required to revamp the country's food systems and dietary behaviours (Nilson, 2015).

BRAZIL'S VOLUNTARY AGREEMENTS ON SODIUM AND SUGAR REDUCTION

In 2008, Brazil embarked on a large-scale reformulation of food with a view to reducing trans fats with an official commitment by the country's food-related industries to the Pan American Health Organization (PAHO) (PAHO, 2008). Because of the success of this initiative and other programmes elsewhere, such as that of the United Kingdom of Great Britain and Northern Ireland (He et al., 2014; Wyness et al., 2012; Eyles et al., 2013), in 2010, Brazil decided to tackle the issue of the country's sodium intake. Following a series of multi-stakeholder discussions, the sodium content of food was included in the Strategic Action Plan to Tackle Non-communicable Diseases in Brazil 2011-2022 (Ministry of Health, 2011). Priority food targets were selected based on their contribution to the nation's sodium intake, with special emphasis on those foods most often consumed by children and adolescents, in a bid to encompass more than 90 percent of Brazil's dietary sources of sodium. Breads, instant pasta, cookies and crackers, cakes and cake mixes, breakfast cereals, potato chips, snacks, margarine, mayonnaise, soups, condiments, meat and dairy products were selected.

The mean sodium content of each category was established as a baseline, with the aim of lowering the upper limit of sodium content in each category below the baseline average within four years (Nilson et al., 2012). The baseline was established and the monitoring was conducted using food label information and laboratory analysis.

Guidelines on good production practices were compiled to support food industries and other businesses, including food services, in their sodium-cutting efforts. The first such guide focused on bread (Brazilian Health Regulatory Agency, 2012), the main culprit.

During the first round of monitoring (2011-2013), between 90 percent and 100 percent of food products met their initial targets, with an average reduction in sodium content of 5 percent to 21 percent, depending on food category (Nilson et al., 2017a). From 2011 to 2017, continuous monitoring by the Ministry of Health showed an 8 percent to 34 percent reduction in the average sodium content of more than half of the priority food categories. The monitoring process also showed that Brazil's food industries developed and shared new food reformulation technologies during the six-year period and that consumers adapted to foods with less salt (Nilson et al., 2017b).

According to food-industry estimates, there were 17 200 fewer tons of sodium on the Brazilian market from 2011 to 2014 and there will be 28 500 fewer by 2020 (ABIA, 2013). Unpublished data from the Ministry of Health estimate a decrease of 0.29g in Brazil's per capita daily salt consumption by 2017, equivalent to a 2.5 percent reduction in total salt intake. Such a decline could potentially avert or postpone as many as 2 000 deaths associated with hypertension-related cardiovascular diseases every year, according to unpublished analysis using the Preventable Risk Integrated Model - PRIME (Scarborough et al., 2014).

Hot on the heels of its success with salt reduction through voluntary agreements with industry, Brazil has taken a similar tack to reduce the country's sugar intake, selecting food categories (sugared beverages, cakes, cookies and biscuits, dairy products and powdered chocolate) and setting four-year targets for average sugar content from the baseline. The agreement also prohibits the replacement of sugar with calorie-free sweeteners or fats (Ministry of Health, 2018).

MANDATORY MEASURES (FOR WHEN VOLUNTARY INITIATIVES ARE NOT ENOUGH)

Voluntary agreements with the food industry may lose effectiveness over time (MacGregor et al., 2015). Some countries, such as Argentina, are moving from voluntary to mandatory sodium-reduction targets, while others, such as South Africa, are regulating nutritional content from the outset (Peters et al., 2017; Charlton et al., 2014). WHO's REPLACE action package has also acknowledged the need for legislation to move forward on the elimination of industrially produced trans fats (WHO, 2018). Food marketing evidence has shown that self-regulation is not effective (Kunkel et al., 2015).

Despite the positive results of voluntary sodium-reduction targets in Brazil, the companies that have signed up to the national agreements only account for around 80 percent of the country's food market, so the whole market has not been reached. Regulations establishing mandatory reductions are gaining support from consumer protection groups and academia. Mandatory targets for all foods that take part in the national agreements could avert or postpone up to 3 900 deaths annually, potentially saving a total of USD 2.5 million dollars a year to the Brazilian health system.

CONCLUSION

Nutrition is currently at the forefront of the international agenda and this is a crucial window of opportunity to strengthen multi-sector and multi-stakeholder commitments to support and expand nutrition-sensitive food value chains.

Food reformulation can be approached through voluntary and/or regulatory initiatives. Brazil's experience highlights the potential of voluntary sodium targets to reduce the consumption of excessive salt. Evidence gathered as the voluntary process evolves will determine the next steps in terms of the country's sodium-reduction policy.

It is important to stress that reducing the intake of ingredients such as sodium, fats and sugars requires multiple strategies, so dietary counselling, health-education campaigns, school interventions and regulatory policies – such as the mandatory labelling of sodium, sugars, total, saturated and trans fats, front-of-pack labels (Vyth et al., 2010) and the taxation of unhealthy foods and beverages (Zhong et al., 2018) (Grogger, 2017; Berardi et al., 2016; Kanter et al., 2017) – play important roles (Hyseni et al., 2017).

Public policies must be strengthened and national government must assume a leadership role in pinpointing potential partners and carefully managing possible conflicts of interest, shaping the food environment in order to facilitate healthy dietary choices, strengthening evidence-based policies in all fields and engaging with partners in academia, civil society and the private sector. Lastly, the participation of private sector, especially the food industry, can be helpful, but must be accompanied by clear commitments to health transparency and management of conflicts of interest so as to avoid unintended consequences and to prioritize the interests of public health (Burlandy et al., 2016).

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Communities as food environments

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The 2019 edition of *UNSCN Nutrition* focuses on "food environments to enable healthy and nutritious diets". The food environment has been broadly 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" (High Level Panel of Experts, 2017: 28). Following on from my comments in *Speakers' Corner* in UNSCN News 43 in 2018 (Kent, 2018a), I wish to highlight the importance of human relations in determining who will have nutritious and healthy diets. The quality of the community affects the quality of diet.

When dealing with health issues, the unit of analysis usually is individuals. However, we can also speak about the health of communities. The community can be viewed as a whole, as if it were a living thing, in line with those who view the Earth from a Gaia perspective, that "humanity constitutes a living system within the larger system of our Earth" (Sahtouris, 1998; Lovelock, 1995).

From a Gaia perspective, "understanding that the health of soil, water, and ecosystems is inseparable from our own health, reason no longer urges their pillage" (Eisenstein, 2018).

Communities can be viewed as organs, carrying out specific functions within a larger organism. They are small units of human social organization, embedded within other layers, such as the state or province, the country, the region and the world. Communities have many different kinds of system within them and various sorts of input and output. They interact with their surrounding world in many ways.

Communities can be more or less healthy. Their vital signs can include not only the health of the residents, but also community-level indicators, such as economic inequality, the status of the environment and measures of the quality of social functioning, such as crime rates and volunteerism. The key to the healthy functioning of communities is the way in which people care about the well-being of others and their environment. Caring can be defined as acting to benefit others. The term can refer to the action itself or the underlying motivation for it (Kent, 2016: 38).

Hunger arises when people don't have adequate control over their own life circumstances. Where people go hungry, we can be sure that others are controlling the resources around them and shaping the terms on which they live. The others are serving their own interests, not those of the hungry. People need power, individually and in community with others, to shape their own lives and live in dignity.

Even if they have little money, communities can function well. There can be serious food supply issues when geophysical hazards, such as earthquakes or floods, occur or when armed attacks suddenly disrupt local food systems and entire communities. However, in stable communities, hunger usually results from exploitation, where some people profit excessively from the fruits of other people's labour. When people have decent opportunities and can enjoy the full benefits of their own labour, they live adequately. They do that even in harsh physical environments (Jara, 2018). Where physical and social environments are too harsh to sustain life, people try to move elsewhere.

The pre-modern lifestyle is still functioning in much of the world. Caring in communities is especially important for people who have little money and therefore, are more dependent on the people around them. A poor person living among equally poor but caring people will have a much better quality of life than someone with the same income level who lives in an indifferent or exploitative community.

While there are many levels of social organization – global, national, subnational states and provinces, cities and towns, districts, villages, neighbourhoods – the focus here is on local communities, where people live and connect with neighbours. As a result of their normal day-to-day functioning, caring communities can be expected to deal more effectively with major issues, such as conflict, violence, poverty and environmental pollution and depletion. They are likely to be effective in remedying problems when they occur and do well in preventing their occurrence. Hunger and less severe forms of malnutrition are less likely to occur in caring communities, even if their members do not pay special attention to the community's food system.

Where local communities function well and are not exploited by outsiders, their people are likely to suffer fewer bad things, such as crime and conflict, and enjoy more good things, such as conviviality, clean environments and good food supplies. Well-functioning communities are likely to lead to better health among their residents (George et al., 2018). Well-functioning communities are much more than random collections of people who happen to live near one another. In caring communities, there is joint effort towards a shared goal: living well together.

Local communities can be the site of conventional nutrition interventions, but in caring communities, there will be less need for them. Just as health does not depend only on medicine, good nutrition status does not depend only on issue-specific remedies. Nutrition status depends in part on the quality of relationships between people within the community, but also on their relationships with others in and from other communities. Those relationships can be strengthened.

Caring generally diminishes in intensity over great distances, whether that distance geographical, social, religious or something else. Experts from Rome, Geneva or New York cannot be expected to care as much about malnourished people, on a sustained basis, as those who live in close proximity to those malnourished people. The strategies adopted by high-level agencies should take this reality into account.

In some community-based nutrition programmes organized by the global agencies, the community is viewed simply as a place where people live. How they live and, more specifically, how they relate to one another, gets little attention. The global experts miss the point that, to some extent, people are better nourished because they live in well-functioning communities. In caring communities, people don't let their neighbours go hungry.

Increasing attention is now being given to the functioning of community food systems (UC Davis, 2018). Community food systems are part of the larger community, contributing to and depending on the health of the larger systems in which they are embedded. Caring can be strengthened by encouraging community members to spend more time working and playing together in many different ways. Of course, the impact on nutrition is likely to be greater if the joint activity is about food. I present many examples in my essay, entitled "Nourishing Communities" (Kent, 2018b).

Community-based food systems recognize that while participants may have little cash income, they have other kinds of wealth, such as labour power, motivation and knowledge of the local culture and local environment. There is also natural wealth to be found in local land, water and sunshine, which can be used in sustainable ways. However, perhaps most importantly, in strong communities, people care about one another – an important asset.

The inputs to community-based food operations are different from those of commercial ones and their managers are likely to have different priorities when it comes to identifying the important results. With their unconventional economics, community-based food operations may be feasible even where conventional commercial operations are not.

People with little money can live together with no one going hungry, as demonstrated in countless places over thousands of years. Instead of focusing on ways to remedy hunger when it occurs, we can devise ways of living in which the issue of hunger simply does not arise (Dregger, 2016). The caring that is built up through various forms of collaboration is likely to yield many different kinds of benefits. Living in a caring community is nourishing in many ways, and a form of wealth.

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FAO/PETTERIK WIGGERS

Vertical indoor production of vegetables to reduce micronutrient deficiencies in urban areas

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If we insist on prioritizing actions to expand the production and consumption of calories while two billion people continue to suffer from micronutrient deficiency, we will not meet Sustainable Development Goal 2 (SDG2) target 2.2 "to end all forms of malnutrition" by 2030, and the oft-stated goal of a healthy and diversified diet for all will remain an illusion. Instead of achieving the SDGs, we will see an increasing number of people suffering simultaneously from nutrient deficiency and obesity. The much-heralded nutrition transition – particularly pertinent in relation to urbanization – is likely to result in more diversified, but not necessarily healthier diets. Consumer preferences, incomes and access to various kinds of food, as well as their relative prices, play important roles in determining whether the dietary transition is towards more sugar, sweeteners, fats and other empty calories, or towards diets with a higher content of fruit, vegetables, pulses and foods of animal origin.

The vertical indoor production of vegetables is one means of facilitating the latter, particularly in urban areas, where access to fresh fruit and vegetables is limited and prices are high. The prevalence of urban "food deserts" is well known, but the lack of access to and unaffordability of fresh vegetables are not limited to those extreme cases.

The rapidly decreasing cost of LED lighting, technological improvements and better management are making vertical indoor food production economical. The opportunity to reduce micronutrient deficiencies in urban populations by enhancing access to vegetables is exciting, and production in controlled environments makes vegetable production impervious to climate change. Unfortunately, while venture capitalists are showing great interest in such production methods, those of us in the food, nutrition and agricultural sectors have been slow to respond. As a result, almost all the experimentation and research has been done by production enterprises and very little evidence is publicly available. In my opinion, this has to change. We need agronomic, nutritional and economic research to provide publicly available evidence to guide further development of the sector for the nutritional and economic benefits for all.

But why do I think the vertical indoor production of vegetables is a promising area when it comes to ensuring a healthy diet for urban consumers? Here are six of the many reasons.

1. Vertical indoor production can make fresh vegetables available to urban consumers throughout the year. With the right technology, the growing cycle is shorter in controlled environments than in open fields and greenhouses, and seasonality is eliminated. Some production units report that they are producing more than 20 crops of leafy vegetables annually. Obviously, the key question is whether the current, very limited consumption of vegetables in urban areas is due to lack of physical access, high prices or consumer preference. The answer varies from location to location, but there is a good deal of evidence showing that lack of physical access is an important issue in urban areas, particularly in mega-cities. Access to fresh vegetables may also become more limited as supermarkets replace open markets in developing countries, unless supply chains are improved and the risks of supply volatility are reduced. Assured supply from vertical indoor production units may encourage the many supermarkets that do not currently carry fresh vegetables to do so. At the same time, food safety risks would be lower. This is not to say that lack of supply is the only reason consumption of fresh vegetables is low. As more vegetables become available, prices should fall and demand should increase. However, consumers may need to be educated or nudged in the right direction.

2. Nutrient yields per unit of land are high because the footprint of the building and its immediate surroundings is the only land required. As urbanization absorbs more land and as land values increase, both greenhouse and open-field production will move further away from urban areas, lengthening supply chains, boosting energy and transportation costs, and increasing CO2 emissions.

3. No soil and very little water are used in the vertical production process. Indoor vegetable production is usually aquaponic or aeroponic. In both cases the use of water is very limited, reportedly only about 5 percent of the water used in equivalent open-field production. The use of plant nutrients, be they chemical or organic fertilizer, is much lower in controlled indoor production environments. Virtually all nutrients are captured by the plants and losses are very low. This, of course, also implies little to no contamination of land or streams. It is sustainable "precision farming" in the best sense of the term.

4. Risks from biotic and abiotic factors found in open fields are all but eliminated, meaning no use of pesticides, no human and environmental health risks and no production losses. Both greenhouse and open-field vegetable production are exposed to insect attacks, plant diseases and other biotic risks that may require pesticides. Abiotic risks resulting from adverse weather or attacks by birds and other animals can ruin vegetable crops in open fields.

5. Because it is not affected by climatic fluctuations and global warming, vertical indoor production provides a constant supply of vegetables throughout the year, impervious to climate change. Climate change and related unpredictable weather events, including strong winds, flooding and drought, are fuelling ever more risks and uncertainty in open-field production, resulting in large output, price and producer income fluctuations.

6. Placing production units within or near urban or semi-urban areas makes the supply chain very short and reduces losses, transportation costs and greenhouse gas emissions. Some companies and urban-planning units are currently considering the inclusion of vertical indoor vegetable production in high-rise apartment buildings, giving new meaning to the term "locally produced". Others are remodelling old factory and office buildings, or constructing new high-rise buildings specifically for indoor vegetable production, or a combination of vegetable and fish production.

But with so many positives, why has vertical indoor food production not taken off? In actual fact, it has. There are many such production units in Japan, Singapore, Taiwan and Korea and an increasing number in the United States of America and other countries. However, as far as I know, there are none of any size in low-income countries. As with any other innovation or technological development, the risk is high, the level of knowledge related to its application is low and the cost of the resulting products may be high until they are produced at scale (recall, for example, the cost of the first computer and the first mobile phone compared with current prices). Early adopters assume large risks and expected future benefits may not materialize; a number of early US production units reportedly failed, for example. It would appear, however, that new technologies and larger scale have now made vertical indoor vegetable farming economically viable.

Still, there are many unanswered questions. Privately funded initiatives will continue to seek answers through experience, trial and error. In addition, there is an urgent need for agronomic, nutritional and economic research to steer the future development of vertical indoor production of vegetables in a way that complements other efforts to eliminate micronutrient deficiencies and achieve healthy diets for all. Two questions are particularly important from a nutritional perspective. First, can unit production costs and consumer prices be kept low enough to make the vegetables affordable for low-income consumers? And, second, is the nutritional value of vegetables produced in controlled environments different to that of vegetables produced in the open field?

We need more solid evidence. What we do not need is the unsubstantiated rejection of an idea that was but a pipedream only a few years ago and is now a promising opportunity to improve health through better diet.

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Letter to the Editor

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Author's statement: *The author declares having no conflict of interest at the time of publishing.*

Dear Editor,

When we talk about food environments, what we really ought to be talking about are the social and physical environments that damage, or promote and sustain, nutrition.

What this means is that we have to understand the superimposed layering of society that has resulted in different power dynamics associated with class, gender, ethnicity, caste and so on, not to mention the global rise of xenophobia, warmongering and intolerance. All of these contribute to inequality of access to food and nutrition services, as well as to the social determinants of undernutrition, such as food security, food sovereignty, safe water, sanitation, secure employment and decent housing. What's more, forced migration, social conflict, climate change and environmental degradation are increasingly having an impact on nutrition outcomes.

A gendered approach to health and nutrition is necessary to comprehend how women's health and nutrition are being neglected and being viewed through a patriarchal lens. The consequent inequality in access to material resources and the imbalance in power relations inform, in large measure, women's health and nutritional state and their access to services.

The aforementioned societal division-based power dynamics ultimately determine people's ability to lead healthy lives. Addressing these issues is fundamental to understanding and addressing poor nutritional conditions in communities around the world.

The current paradigm of development is based on the promotion of a culture of mindless consumption and exploitation of nature. The planet is on the brink of disaster and communities are already suffering the consequences of global warming, polluted air, water and land, and the depletion of forest-based resources, all of which have serious nutritional consequences. Polluting industries, including the extractive industries, are not just involved in polluting our natural sources of clean air, land and water, but also in grabbing vast tracts of land and displacing large populations – actions that also have significant nutritional consequences.

Food systems in most parts of the world are captive to the operations of agribusiness companies and food-and-beverage corporations. Challenging the operations of these private-sector actors remains paramount and is not given nearly enough priority.

While undernutrition rates are too high in many parts of Africa and South Asia, the growing threat of obesity afflicts many countries, including an increasing number of lower-middle-income countries. Countries and communities are struggling to build sovereign systems that ensure equitable access to nutritious food. Moreover, the impacts of neoliberalism are felt not just on the political and economic planes, but also on the social and cultural planes, with a bearing on nutrition.

We contend that only by looking at food environments through these underlying structural lenses can we hope to overcome our decades of less-than-successful attempts to tackle under- and over-nutrition.

Obituary

Elisabet Helsing

Nutritional physiologist

1940 – 2019

Elisabet Helsing, born in Oslo in 1940, began her working life as a school teacher. It was while nursing her own two children that she developed a strong interest in protecting, promoting and supporting breastfeeding. Backed by a young medical officer in the Norwegian National Directorate of Health, Gro Harlem Brundtland – later Norway's Prime Minister and Director-General of the World Health Organization (WHO) she developed official pamphlets with practical advice for mothers on how to succeed at breastfeeding. In 1968, she founded Ammehjelpen, the mother-to-mother breastfeeding support group, which rapidly expanded across the country and was credited with the dramatic rise in breastfeeding in Norway over the subsequent decade. In 1969, she enrolled in nutrition studies at the University of Oslo to bolster her scientific credentials and lend weight to her campaign for breastfeeding. Her interests grew to nutrition policy more broadly, something later reflected in her doctorate from the University of Athens in 1989 where she compared the evolving national nutrition policy in Norway and Greece.

Elisabet's international career started in Norway in 1973, through the FAO-led Freedom from Hunger Campaign, for which she organized international conferences and awareness-raising on international nutrition issues. At the 1974 World Food Conference she convinced the Norwegian Minister of Agriculture to propose breastmilk as a commodity to be accounted for in national food balance sheets, highlighting its economic value. Later, in Niger, she worked on emergency nutrition relief with the International League of Red Cross Societies and the national ministry of health. In Bangladesh, with the World Food Programme, she supervised the implementation of a feeding programme for over half a million women and children. On a private basis she started a self-help project for women (Nijera Kori, "we do it ourselves"), which developed into a well-known national activist NGO, still operating today.

Between 1978 and 1981, Elisabet coordinated a Norwegian Agency for Development Cooperation (NORAD) project to investigate the potential use of fish-protein concentrate in emergency relief worldwide (and concluded in the negative). In 1980 to 1981, she also coordinated an international multi-centre study on breastfeeding among working mothers in Brazil, Sri Lanka and Tanzania, hosted by the Institute for Nutrition Research at the University of Oslo. From 1981 to 1984, she worked as a Senior Executive

Officer in the Norwegian National Directorate of Health on international nutrition-related questions. This inclued collaboration with WHO on the implementation of the International Code of Marketing of Breast-milk Substitutes, often in the face of strong industry opposition.

In 1984, Elisabet became the first regional adviser for nutrition in the WHO Regional Office for Europe in Copenhagen. During her 12 years in the job, she raised the profile of nutrition-policy development and implementation. With the breakup of the Soviet Union in 1990, there were even more demands on her time and creativity with the addition of twenty new Europen states. She spearheaded the roll-out of the Baby-friendly Hospital Initiative (BFHI), strengthened nutrition surveillance and dietary surveys, and was an early adopter of emerging issues such as the rise in obesity. Elisabet further helped to found the World Alliance for Breastfeeding Action (WABA) in 1991, taking on a number of leadership roles. It was also while in WHO that she met her husband, Dr. Graham Dukes, a WHO medico-legal expert on the side-effects of drugs, with whom she shared the rest of her life and numerous common interests.

Back in Norway, in 1996, Elisabet remained engaged in issues relating to infant nutrition, advising Norwegian government agencies as a senior executive officer at the Norwegian Board of Health's Section for International Affairs and Public Health. She lectured and supervised students at the University of Oslo and took an interest in breastfeeding as a human right both of the mother and the child. From 1999 to 2003, she served as president of the Federation of European Nutrition Societies (FENS).

Elisabet has authored numerous books, contributions and scientific papers, training materials for health workers and practical guides for mothers. In 2003, she was awarded the Norwegian King's Medal of Merit in Gold for extraordinary services to the people through her work to promote breastfeeding. Her work is all the more impressive when one considers that it came about under the shadow of "Mr P", as she called the Parkinson's disease that afflicted her early in life. She never let "Mr P" restrict her professional life, however.

Elisabet Helsing's contributions to public health nutrition and breastfeeding, in particular, are numerous and indelible. She was always willingly to share her profound knowledge, experience and enthusiasm, to the benefit of her many colleagues, students and friends in the field of nutrition, who have been inspired and moved by her. She will be truly missed by many – in Norway and in the international nutrition community.

Authored by Kaia Engesveen and Wenche Barth Eide, with Anne Bærug, Grete Botten, Siri Damman, Gerd Holmboe-Ottesen, Isatou Jallow, Kaare R. Norum, Nanna Lien, Arne Oshaug, Jan Ivar Pedersen, Dag S. Thelle, Liv Elin Torheim and Margareta Wandel.

FAO/GIUSEPPE BIZZARRI

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A world free from hunger and all forms of malnutrition is attainable in this generation

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