

FOOD AND AGRICULTURE GLOBAL PRACTICE

AN OVERVIEW OF LINKS BETWEEN OBESITY  
AND FOOD SYSTEMS

IMPLICATIONS FOR THE FOOD AND AGRICULTURE  
GLOBAL PRACTICE AGENDA



**THE WORLD BANK**  
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## IMPLICATIONS FOR THE FOOD AND AGRICULTURE GLOBAL PRACTICE AGENDA

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# ABBREVIATIONS AND ACRONYMS

Agriculture GP	Food and Agriculture Global Practice	IARC	International Agency for Research on Cancer
ASA	Advisory Services and Analytics	IFC	International Finance Corporation
ASF	Animal Source Foods	IFPRI	International Food Policy Research Institute
ATNI	Access to Nutrition Index	KP	Knowledge Product
BMI	Body Mass Index	LAC	Latin America and the Caribbean
CGIAR	Consortium of International Agricultural Research Centers	MENA	Middle East and North Africa
EAP	East Asia and the Pacific	NCDs	Noncommunicable Diseases
ECA	Europe and Central Asia	NGO	Nongovernmental Organization
FAO	Food and Agriculture Organization (of the United Nations)	OECD	Organisation for Economic Co-operation and Development
FBGDs	Food-Based Dietary Guidelines	OFSP	Orange Flesh Sweet Potatoes
FDA	Food and Drug Administration	SAFANSI	South Asia Food and Nutrition Security Initiative
GBD	Global Burden of Diseases	SAR	South Asia
GDP	Gross Domestic Product	SSA	Sub-Saharan Africa
GNI	Gross National Income	SUN	Scaling Up Nutrition
GNP	Gross National Product	TTL	Task Team Leader
GAIN	Global Alliance for Improved Nutrition	UNICEF	United Nations Children's Fund
Glopan	Global Panel on Agriculture and Food Systems for Nutrition	WBG	World Bank Group
HFCS	High Fructose Corn Syrup	WHO	World Health Organization
HNP GP	Health, Nutrition, and Population Global Practice	WTO	World Trade Organization



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# EXECUTIVE SUMMARY



Obesity has emerged as a global challenge, affecting developed and developing countries alike. Globally, overweight and obesity cost an estimated US\$2 trillion per year, and 68 percent of all deaths are caused by noncommunicable diseases (NCDs), of which three of the four most common are diet related (namely cardiovascular diseases, cancers, and diabetes). Moreover, two-thirds of deaths from NCDs take place in developing countries, where also two-thirds of overweight or obese people live, casting obesity no longer as only a developed country challenge.

While the World Bank Group (WBG) has embraced the global nutrition challenge since the launch of the Scaling Up Nutrition movement in 2010, the Food and Agriculture Global Practice's (Agriculture GP) efforts to date have focused largely on one dimension of the malnutrition spectrum, undernutrition and micronutrient deficiencies, leaving a role for the GP in addressing the challenges associated with the other dimension of the spectrum, overweight and obesity.

This Knowledge Product (KP) is an initial attempt to better understand how agriculture and food systems can contribute to and mitigate against the rising incidence of overweight and obesity in WBG client countries, and to do so by presenting evidence-based interventions (policies and actions) in the agriculture and food systems domain. This report is based on literature review, and not primary research. It is intended primarily to inform World Bank staff in related operational and analytical work.

Obesity is a multi-sectoral and multidisciplinary challenge that requires a collaborative effort; any successful intervention strategy and actions would need to be multifaceted. This report has been undertaken at the request of the World Bank's Health, Nutrition and Population GP and to complement their ongoing analytical work on preventing and controlling overweight and obesity: approaches and policy options that examines overweight and obesity through the lens of many other sectors, including and beyond agriculture and food systems.

As the world faces an evolving malnutrition crisis, with countries moving from the challenges of undernutrition and micronutrient deficiency to a crisis that also includes

overweight and obesity, one thing remains constant: agriculture and the food system have an important role to play in ensuring access to a high quality diet that includes diversity of foods that are safe, and provides levels of energy appropriate to age, sex, disease state and physical activity as well as micronutrients (Glopan, 2016). While there is no available quantification of the share or importance of agriculture and the food system within the set of factors that contribute to rising obesity (and that share, even if quantifiable, would likely differ from country to country), most studies indicate that a comprehensive portfolio of interventions “targeting a broad set of variables and different levels within the obesity system” is necessary to tackle the crisis.

This report discusses direct and indirect policies, as well as program and project actions affecting diets with a focus on overweight and obesity, but not exclusively so. This is couched upon the realization that many of the suggested actions for reducing overweight and obesity also serve the purpose of reducing undernutrition and/or micronutrient deficiency. Thus, policies and actions that support the provision of and access to a safe, diversified, and healthy diet should be supported continuously across the entire food system as countries transition from focusing on undernutrition to overlapping malnutrition problems increasingly including overweight and obesity. While evidence of impact is still being generated based on experience within the agriculture and food systems domain, there is ample evidence of impact for interventions to control and prevent obesity in areas outside the domain of this report.

This report uses the Global Panel on Agriculture and Food Systems for Nutrition (Glopan) conceptual framework that illustrates the link between diet quality and the four subsystems of the food system: *agricultural production*; *food storage, transport and trade*; *food transformation*; and *food retail and provisioning*. The remainder of this KP is organized based upon Glopan’s conceptual framework—with a slight modification to include the significant impact made by agricultural research on agricultural/food production—beginning with the ‘farm’ or agricultural production subsystem and continuing onto the ‘fork’ or food retail and provisioning subsystem. All suggested interventions, most of which have been tested and their

outcomes documented, are arranged under their respective subsystems.

This work emphasizes the overt need for context-specific piloting of suites of interventions, paired with vigorous monitoring and assessment, given both the strong cultural/behavioral context of the obesity problem and the unknown universality of intervention success within the agriculture and food systems domain. This report’s recommended entry points for action—intended to support the goal of improving diet quality with a focus on overweight—have been developed, with respect to each subsystem, accordingly.

## AGRICULTURAL PRODUCTION SUBSYSTEM

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- a. **Role of Agricultural Research**—Agricultural research greatly affects relative profitability of different crop choices, farmer decision making, and consequently affects relative prices of raw material supply to the food system, which likely influences the processed food produced. While over 7,000 different crops have been historically harvested for consumption, today, 50 percent of all plant sourced calories come from just three crops: rice, wheat and maize. These three are also amongst the crops that have received the most attention by the agricultural research community, most notably starting with the Green Revolution, and continuing today under the Consortium of International Agricultural Research Centers (CGIAR), and private sector research efforts. Surplus production of staple grains since the 1970s has not been matched by productivity gains in other cereals, such as pearl millet, as well as in fruits and vegetables, where a global production deficit currently exists. Based on current WHO recommendations, production of fruits and vegetables is 22 percent below global population requirements, and 58 percent below consumption needs in low-income countries. Based on medium population forecasts and assuming business as usual, this situation will worsen with the supply to needs ratio falling to 0.35 in 2025 and 0.33 in 2050. In turn, without a change in the agricultural research and

technology domain, by 2050 the production of fruits and vegetables will be 67 percent below that required in low-income countries, which will lead to increased prices, and thus compromise access to diversified and healthy diets.

**b. Role of Agricultural Production—**

Agricultural production generates the foods and ingredients that form the basis of the quantity, diversity and relative prices of foods available for human consumption. Although diet diversity has long been recognized as important for adequate nutrient intake and human health, the concept of nutritional diversity is typically not integrated into planning and assessments of agricultural and food systems and policies. In fact, in the context of global agricultural development, ‘nutrition sensitive agriculture’ has gained traction only recently as part of a 2010 movement to focus attention on a multi-sectoral approach to improving nutrition. Success of agricultural systems, rather than based on the providing of diverse, required nutrients, is more often evaluated by metrics of crop yields, economic output and cost-benefit ratios. And, while agriculture’s contribution to food security has traditionally focused on supply issues with, perhaps, its greatest achievement enshrined in the Green Revolution—one unintended consequence was a shift in prices of staple grains relative to other foods, such as legumes, fruits and vegetables that did not experience such yield increases, resulting in a loss of dietary diversity toward more cereal-based diets. This consequently led to lower intake of micronutrients (e.g., iron, vitamin A, and zinc) as relative prices of cereals decreased dramatically and became more accessible to the poor. The phenomenal success of the Green Revolution in the 1960s and 1970s led to an overemphasis on raising yields of a few select cereals as the central focus of agriculture in developing countries—a trend which continues today.

Self production and trade are two ways to increase diversity of the food supply. Irrespective of the strategy employed to drive the development of a more diverse food supply, evidence clearly shows that a diversified and healthy diet that is rich in fruits and vegetables can lower blood pressure,

## ENTRY POINTS FOR POSSIBLE ACTION

### **Agricultural Research Subsystem**

1. Incentivize more public sector research on high quality and underserved foods (legumes, fruits, vegetables) to increase productivity and shift relative prices.
2. Ensure that cereal research and provision on inputs include a nutrition focus, and not just a yield focus, and that results are communicated to producers.
3. Encourage private sector advances in research favoring high quality and underserved foods.

### **Production Subsystem**

1. Ensure that bio-fortified cereals are the norm, where they are available and agronomically competitive, rather than the exception.
2. Eliminate subsidies and other production/price support measures for production of unhealthy ingredients for food processing.
3. Encourage production (and consumption) of fruits, vegetables, and pulses.

reduce the risk of heart disease and stroke, contribute to prevention of some types of cancer, lower risk of eye and digestive problems and have a positive effect on blood sugar that can help keep appetite in check thereby being an effective tool in weight control. Therefore, preventing overweight and reducing micronutrient deficiency share a common goal of a high quality diet rich in fruits and vegetables.

## FOOD STORAGE, TRANSPORT, AND TRADE SUBSYSTEM (POSTHARVEST LEVEL)

When food is not consumed by the farmers themselves, immediately after food is harvested it is handled, treated, stored, packed, moved, transported and traded. Interventions adopted in the food storage, transport and trade subsystem to improve diet quality are also interventions that are undertaken for more conventional objectives of raising profitability of the value chain. Actions include investments to reduce food losses and waste, address food safety and comply with export requirements. The fact that the objectives of improving diet quality and profitability can be achieved through the same measures is an advantageous situation because no new or customized actions

are needed, unlike in the production subsystem where actions aligned to conventional profitability maximizing objectives do not necessarily deliver for the objective of improving diet quality.

### ENTRY POINTS FOR POSSIBLE ACTION

#### **Food Storage, Transport and Trade Subsystem**

1. Reduce food loss and waste of underserved nutritious food groups (especially fruits, vegetables, pulses, poultry, fish).
2. Use trade to improve the quality of the local diet.

## FOOD TRANSFORMATION SUBSYSTEM (AGROPROCESSING LEVEL)

Food processing combines raw food ingredients to produce marketable food products that can be easily prepared and served by the consumer. It ranges from simple forms of transformation such as slicing, drying, or freezing to highly extractive forms where the nutrients of the original ingredients are highly depleted through the various processes. “Ultra-processed” foods, or products characterized as “*durable, accessible, convenient, attractive, ready-to-eat, or ready-to-heat,*” are considered to be problematic for public health in two ways: first, their principal ingredients (oils, solid fats, sugars, salt, flours, starches) make them excessive in total fat, saturated or trans fats, sugar and sodium, and short of micronutrients and other bioactive compounds, and of dietary fiber. Taken together this increases the risk of various serious diseases. Secondly, their high energy density, hyper-palatability, their marketing in large and supersizes, and aggressive and sophisticated advertising all undermine the normal processes of appetite control, leading to overconsumption, and therefore obesity, and diseases associated with obesity.

Consumption of ultra-processed foods is increasing globally. Many experts believe that the rapid expansion of ultra-processed foods, more so than any other subsystem with the agriculture and food system, is the major factor in the obesity epidemic. Studies that examine the impact of ultra-processed products on obesity and chronic noncommunicable diseases show consistent results. In several countries, the level of consumption of

ultra-processed products is tightly correlated with overall diet quality.

### ENTRY POINTS FOR POSSIBLE ACTION

#### **Food Transformation Subsystem**

1. Increase market supply of fortified foods with adequate micronutrients.
2. Build more awareness toward unhealthy ingredients for food processing, food, and products.
3. Incentivize product reformulation to reduce unhealthy ingredients in the processing stage (sugar/sweetener, sodium, trans fats, etc.).

## FOOD RETAIL AND PROVISIONING SUBSYSTEM (RETAIL LEVEL)

Most food is purchased at market-based formal and informal retail outlets such as markets (traditional wet markets and modern supermarkets), street vendors or restaurants. Another channel for food provision is the public procurement system where the government purchases food and provides meals for institutions such as state-run schools, hospitals or prisons. Retailers and governments (in the case of public procurement of food) can play a role in promoting safe, diversified, and healthy diets by what they sell and how they position certain foods. This subsystem is closer to the actual consumption point, and thus is arguably the most effective in changing the food environment and consumption behavior that lead to obesity.

### ENTRY POINTS FOR POSSIBLE ACTION

#### **Food Retail and Provisioning Subsystem**

1. Build more awareness toward healthy eating.
2. Disincentivize the consumption of unhealthy foods through taxes.
3. Regulate or limit access to unhealthy foods.

Some of the interventions listed above can be discussed with and undertaken by the ministry of agriculture in client countries, while others require multi- and cross-sectoral cooperation among ministries and agencies responsible for health, gender, trade, transport, and more. The need for collaboration across boundaries is further reinforced by the impact on overall diet quality, obesity, and chronic

noncommunicable diseases of the level of consumption of ultra-processed products. Partnerships with the WBG's International Finance Corporation (IFC), the private sector, and civil society are just a few that need to be pursued in order to influence that part of the food system.

In recent years, the Agriculture GP has made concerted efforts to broaden its focus from ending poverty by delivering primarily on yields, profits, and jobs, toward also addressing the nutrition dimensions which underpin health and human development. The process is not over. The nutrition-sensitive agriculture agenda needs to evolve to address overweight and obesity as agriculture and food systems can and should play a role in delivering

safe, diversified, and healthy diets for all. In contrast to other domains affecting obesity where there is ample evidence for interventions that control and prevent obesity, evidence of impact in the agriculture and food systems domain is still being generated. This report and the peer review process have identified possible topics for further examination, such as the changing economic determinants of food choices, including agriculture policy and food policy biases; the role of food processing industries (i.e., industries that purchase raw farm commodities); the role of retail structures (e.g., supermarkets etc.); and identification of locations where households do not have access to diverse foods, both in terms of quantity and relative prices.



# INTRODUCTION AND RELEVANCE OF THIS WORK

In order to permanently end poverty and hunger by 2030, the world needs a food system that can feed every person, every day, everywhere; that can raise real incomes of the poorest people; that can provide safe food and adequate nutrition; and that can better steward the world's natural resources. In this context, the World Bank Group's Food and Agriculture Global Practice (Agriculture GP) work is aligned around four strategic pillars: (i) ensuring a more climate-smart agriculture, (ii) improving nutritional outcomes, (iii) strengthening value chains and improving market access, and (iv) promoting rural livelihoods and agriculture employment—as illustrated in the GP's 2015 *Ending Poverty and Hunger by 2030: An Agenda for the Global Food System* publication (Townsend, 2015). The GP's 2016 *The Future of Food: Shaping the Global Food System to Deliver Improved Nutrition and Health* (World Bank Group, 2016) publication focuses on how food systems can contribute to improved nutrition and health and lays out a spectrum of food system interventions to address different forms of malnutrition, which include reducing energy deficiency (hunger), reducing micronutrient deficiency (hidden hunger), reducing excessive net energy intake (overweight/obesity), and improving food safety.

The World Bank Group has embraced the nutrition challenge as a multi-sectoral agenda. Since the launch of the Scaling Up Nutrition (SUN) movement at the Bank's Spring Meetings in 2010, the Bank has worked across internal silos to address nutrition, and to set in practice the understanding that addressing underlying causes of malnutrition requires broader, nutrition-sensitive approaches implemented through multiple sectors in addition to health, including agriculture.

Efforts in the Agriculture GP have largely focused on undernourishment (hunger) and one dimension of the malnutrition spectrum (undernutrition) and micronutrient deficiencies, leaving a role for the GP in addressing the challenges associated with the other dimension of the spectrum, overweight and obesity. Undernutrition and micronutrient deficiencies have been at the core of policies and operations because, despite significant progress, 795 million people are still not meeting their minimum dietary

energy needs, more than 2 billion people are not getting all the vitamins and minerals necessary for growth and healthy development, and 165 million children under five are stunted. Meanwhile, though, the prevalence of overweight and obesity is increasing, leading to much higher incidence of diet-related noncommunicable diseases (NCDs),<sup>1</sup> and resulting in the coexistence of different forms of malnutrition as the “new normal” (Global Nutrition Report, 2014). Globally, overweight and obesity cost an estimated US\$2 trillion per year, and 68 percent of all deaths are caused by NCDs, of which three of the four most common are diet related (namely, cardiovascular diseases, cancers, and diabetes) (McKinsey Global Institute, 2014; WHO, 2015). Moreover, two-thirds of deaths from NCDs take place in developing countries, where also two-thirds of overweight or obese people live, casting obesity no longer as only a developed country challenge (World Bank Group, 2016).

In light of the above, the role of agriculture and food systems in nutrition is being re-examined. Good nutritional outcomes require good consumer and caregiver knowledge, good health, safe water and hygiene practices, and most importantly a safe, diversified and healthy diet (Box 1). As such, agriculture has an essential role in nutrition as it directly influences the availability and accessibility of nutrient rich foods such as fruits, vegetables, pulses, dairy and fish. And this is so regardless of the specific nutrition objective: a safe, diversified and healthy diet is a goal across the nutrition challenge spectrum. Agricultural

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<sup>1</sup> The four main types of NCDs comprise cardiovascular diseases (like heart attacks and stroke); cancers; chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma); and diabetes. Source: WHO Fact Sheet on Noncommunicable Diseases, 2015 (<http://www.who.int/mediacentre/factsheets/fs355/en/>).

research determines the relative productivity and economic returns of crop choices for farmers, which in turn partly determines the relative prices of different dietary elements emanating from the agricultural production systems by virtue of the balance of production and availability relative to needs.

Agriculture is part of the food system which refers to the set of institutions, resources, stakeholders, and behaviors involved in the production, transformation, delivery, sale, and consumption of food. As a driver of food availability, affordability, access, and acceptability, it is responsible for providing diet options (Global Nutrition Report, 2016). Studies have linked low quality diets (Global Panel, 2016) or unhealthy diets (The Chicago Council on Global Affairs, 2011) to different malnutrition and health outcomes, such as stunting, wasting, overweight and obesity, micronutrient deficiencies, high blood pressure and NCDs. The World Health Organization (WHO) identifies unhealthy diets as one of the behavioral risk factors that can cause overweight and obesity, which in turn increases the risk of NCDs. An increasing amount of research is focusing on food environment/food system factors such as production, marketing, affordability, and accessibility of foods that affect diet choices, to more systematically prevent and control diet-related diseases and overweight and obesity.

There is a need to revisit an approach to nutrition that is almost exclusively focused on hunger and undernutrition, and embrace a more significant focus on agriculture’s role in delivering safe, diversified, and healthy diets that not only address undernutrition and micronutrient deficiencies, but also address the growing challenge of overweight and obesity in our client countries.

## BOX 1. WHAT IS A HEALTHY DIET?

There is no universal definition of what constitutes a healthy, or high quality diet, as the exact composition of it depends on individual characteristics and needs (e.g., age, gender, lifestyle, etc.), but also on culture and availability of food. Nevertheless, the World Health Organization (WHO) advises that for adults a healthy diet comprises:

- » fruits, vegetables, legumes (e.g., lentils, beans), nuts and whole grains (e.g., unprocessed maize, millet, oats, wheat, brown rice).
- » at least five portions of fruits and vegetables a day (note: potatoes, sweet potatoes, cassava and other starchy roots are not considered fruits or vegetables) to reduce the risk of NCDs and help ensure an adequate daily intake of dietary fiber.
- » less than 30 percent of total energy intake from fats helps prevent unhealthy weight gain. Also the risk of developing NCDs is lowered by reducing saturated fats to less than ten percent of total energy intake, and trans fats to less than one percent, and replacing both with unsaturated fats. Unsaturated fats (e.g., fats found in fish, avocados, nuts, and sunflower, canola and olive oils) are preferable to saturated fats (e.g., found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard). Industrial trans fats (found in processed food, fast food, snack food, fried food, frozen pizza, pies, cookies, margarines and spreads) are not part of a healthy diet.
- » less than ten percent of total energy intake from free sugars, which is about 12 level teaspoons for a person of healthy body weight consuming around 2,000 calories per day. WHO guidelines suggest ideally less than five percent of total energy intake for additional health benefits. Free sugars are all sugars added to foods or drinks by the manufacturer, cook or consumer, and sugars found naturally present in honey, syrups, fruit juices and fruit juice concentrates. Excess consumption of free sugars contributes to unhealthy weight gain, which can lead to overweight and obesity.
- » less than one teaspoon of salt per day, and use iodized salt. The majority of people consume too much sodium through salt, and not enough potassium that can mitigate the negative effects of elevated sodium consumption. This combination contributes to high blood pressure, which in turn increases the risk of heart disease and stroke.

In 2015, the International Agency for Research on Cancer (IARC), the cancer agency of the WHO, advised people to moderate consumption of red meat and processed meat to reduce the risk of cancer. Red meat refers to all mammalian muscle meat, including, beef, veal, pork, lamb, mutton, horse, and goat. Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavor or improve preservation. Most processed meats contain pork or beef, but processed meats may also contain other red meats, poultry, offal, or meat by-products such as blood. The risk of cancer increases with the amount of meat consumed, but the data available for IARC's evaluation did not allow for a conclusion about whether a safe consumption level exists.

*Sources:* WHO. Healthy Diet. Fact Sheet No. 394. Updated September 2015. <http://www.who.int/mediacentre/factsheets/fs394/en/>

WHO Statement. Links between processed meat and colorectal cancer. 29 October 2015. <http://www.who.int/mediacentre/news/statements/2015/processed-meat-cancer/en/>

International Agency for Research on Cancer (IARC); WHO. IARC Monographs evaluate consumption of red meat and processed meat. Press Release No. 240. 26 October 2015. [http://www.iarc.fr/en/media-centre/pr/2015/pdfs/pr240\\_E.pdf](http://www.iarc.fr/en/media-centre/pr/2015/pdfs/pr240_E.pdf)



# OBJECTIVES



This Knowledge Product (KP) is anchored within the framework outlined in the Agenda for the Global Food System (Townsend, 2015), and the 2016 *Future of Food* publication (World Bank Group, 2016). Given that energy/food supply and availability are a recognized contributing factor to overweight and obesity, this report is an initial attempt to better understand how agriculture and food systems can contribute to and mitigate against the rising incidence of overweight and obesity, and to do so by presenting evidence-based interventions (policies and actions) in the agriculture and food systems domain. This work is based on literature review, and not primary research. Obesity is a multi-sectoral and multidisciplinary challenge that requires a collaborative effort; any successful intervention strategy and actions would need to be multifaceted. This report is undertaken at the request of the Health, Nutrition and Population Global Practice (HNP GP) of the World Bank Group and in order to complement their currently ongoing Advisory Services and Analytics (ASA) *on preventing and controlling overweight and obesity: approaches and policy options* that examines overweight and obesity through the lens of many other sectors, including and beyond agriculture and food systems.



# NUTRITION TRANSITION: THE CHANGING DIMENSION OF THE “MALNUTRITION CHALLENGE”

According to the WHO, nutrition is defined as the intake of food considered in relation to the body’s dietary needs. Good nutrition—an adequate, well-balanced diet combined with regular physical activity—is a cornerstone of good health. Poor nutrition can lead to reduced immune response, increased susceptibility to disease, impaired physical and mental development, and reduced productivity.<sup>2</sup> Poor nutrition comes in multiple forms: undernourishment (hunger), undernutrition (poor nutritional status due to nutritional deficiencies), micronutrient deficiencies (when a person does not get enough important vitamins and minerals in their diet), and overweight and obesity (when a person eats too many calories and/or lacks sufficient exercise).

Past data have shown that as poverty levels fall, undernutrition and micronutrient deficiency rates also fall. That is, as poverty levels fall, less people suffer from widespread and chronic undernutrition or hunger challenges. As incomes rise, people choose to eat better quality staple grains,<sup>3</sup> as well as more diversified diets, including more animal source foods (ASF), fruits and vegetables. Studies show that undernutrition (defined as low weight-for-age) declines at about 50 percent of the rate that Gross National Product (GNP) per capita increases. Cross-country results resemble those coming from household surveys of individuals (Alderman, 2012). This is illustrated in the global decline of people suffering from undernourishment and children who are stunted. In 1990 more than a billion people worldwide suffered from undernourishment, whereas currently the numbers are less than 800 million. In terms of child stunting, 250 million children under the age of five were stunted in 1990 compared to about 156 million in 2015. About 40 percent of them live in South Asia (Aguayo and Menon, 2016), while more than one-third live in Sub-Saharan Africa. Progress on reducing stunting is particularly slow in Sub-Saharan Africa. Both Asia and Latin America and the Caribbean have cut stunting rates by over one-third

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<sup>2</sup><http://www.who.int/topics/nutrition/en/>

<sup>3</sup>Consumers choose more expensive staple grains, e.g., rice with less grit, and the average cost of a calorie increases.

since 2000 while Sub-Saharan Africa saw a reduction of only one-sixth during the same period (UNICEF, 2016).

Micronutrient deficiency is more difficult to recognize, with the exception of anemia, since laboratory assessments are expensive and intrusive.<sup>4</sup> Thus, large-scale representative data are lacking even though effects on disease incidence, cognitive and physical growth are well established. This has led some to label micronutrient deficiency as *'hidden hunger'* as opposed to the more visible form of undernutrition (*'hunger'*). However, existing data indicates that as poverty levels fall, micronutrient deficiency rates also fall owing to improved access to diverse diets, adequate maternal and child care, as well as access to fortified foods.<sup>5</sup> In fact, out of the three most prevalent micronutrient deficiencies worldwide (vitamin A, iron, and iodine), only iron deficiency persists in high-income countries. Vitamin A deficiency, a leading cause of preventable blindness in children and which increases the risk of disease and death from severe infections, has been almost eliminated globally except for in Sub-Saharan Africa and South Asia (Stevens et al., 2015). The number of countries where iodine deficiency is a public health problem decreased dramatically over the past decade leaving only 54 countries considered to be iodine deficient by the WHO.<sup>6</sup> Even for iron deficiency, which is the most common and widespread nutritional disorder in the world affecting over 2 billion people, global trends are promising. WHO estimates show that globally the prevalence of anemia (caused by various factors of which about half is estimated to be iron deficiency) fell by 12 percent between 1995 and 2011—from 33 percent to 29 percent in nonpregnant women and from 43 percent to 38 percent in pregnant women.<sup>7</sup>

Overweight, and its extreme form, obesity,<sup>8</sup> show the opposite trend. Globally, approximately 2 billion people

are overweight (Body Mass Index (BMI)  $\geq 25$ ), of which about 641 million are obese (BMI  $\geq 30$ ).<sup>9</sup> This means that about one-third of the entire global population is obese, and the number of overweight is more than double the number of undernourished people globally (Figure 1). The same trend can be observed for data on children under 5 which shows declining rates of stunting and an increase in the prevalence of overweight children (Figure 2). Until very recently no country had reversed the increasing trend of overweight, although some high-income countries such as the United Kingdom (UK), and Italy have been showing signs of stabilizing (OECD, 2014). Nauru has achieved a small decline in adult male obesity from 39.9 percent in 2010 to 39.7 percent in 2014 (Global Nutrition Report, 2015), and in the U.S. the prevalence of obesity increased to 13.9 percent by 2003–2004 and then decreased to 9.4 percent in children aged 2 to 5 years by 2013–2014 (Ogden et al., 2016). In both cases, however, the decline is very slight, and beyond the scope of this paper to explain.

Until quite recently the overweight and obesity epidemic was considered a problem for only high-income countries. This is no longer the case as the number of overweight is exploding in developing countries, and this increase is affecting all regions. Figure 3 shows that since 1990 childhood overweight prevalence has been rising globally, and most rapidly in Europe and Central Asia (ECA) followed by Latin America and the Caribbean (LAC). Prevalence rates were high to begin with, and continue to rise in Middle East and North Africa (MENA). Growth rates seem to be flat in Sub-Saharan Africa (SSA) and East Asia and the Pacific (EAP). Child overweight prevalence remains the lowest in South Asia (SAR) compared to other regions, but is rising. It is beyond the scope of this KP to explore regional differences in overweight prevalence.

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<sup>4</sup> Anemia is not expensive to monitor and can be done with portable screening tools (like hemocue). This assessment is however generic and further tests are needed to determine iron deficiency anemia from infections.

<sup>5</sup> Anemia, defined as hemoglobin levels below 10.9 g/dl, declines at about 25 percent of the rate of income growth (Alderman, 2012).

<sup>6</sup> <http://www.who.int/nutrition/topics/idd/en/>

<sup>7</sup> [http://www.who.int/nutrition/topics/globaltargets\\_anaemia\\_policybrief.pdf?ua=1](http://www.who.int/nutrition/topics/globaltargets_anaemia_policybrief.pdf?ua=1)

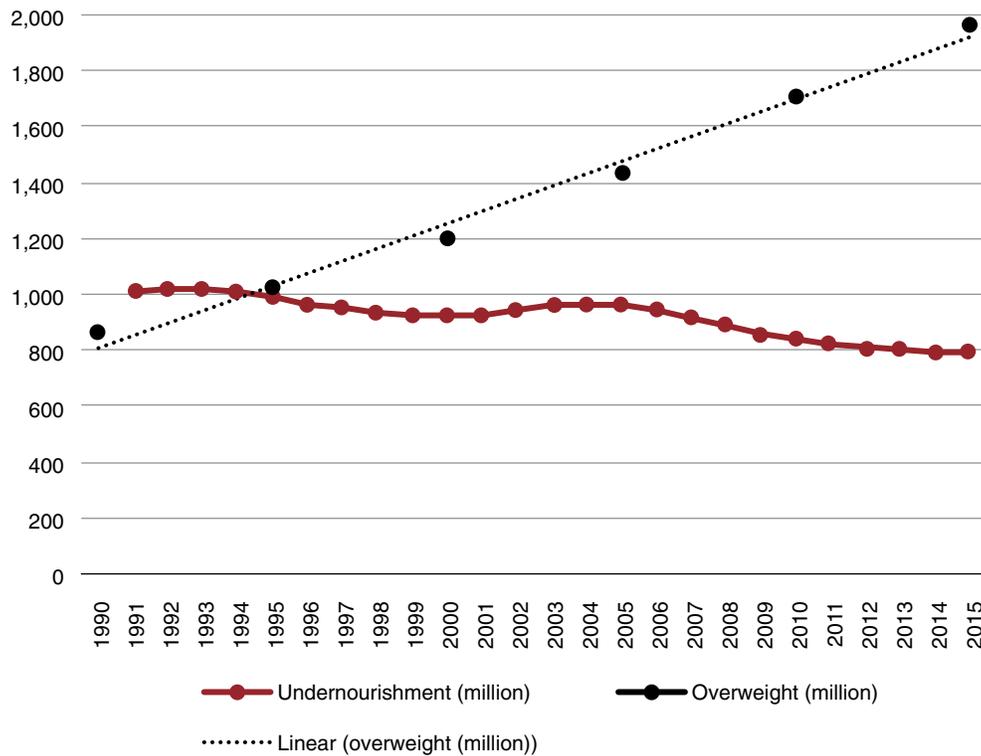
<sup>8</sup> A condition characterized by excess body fat, typically defined for children on the basis of weight-for-height, and for adults by Body Mass Index (BMI). A normal range of BMI is between 18.50 and 24.99. A BMI of 25 or above is

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overweight; 30 and above is obese. Cutoffs were established by a WHO expert consultation in 2000 ([http://www.who.int/nutrition/publications/obesity/WHO\\_TRS\\_894/en/](http://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/)) to intentionally be linked to the risk of NCDs. BMI of 25 and above indicates that the risk of NCDs is increased, and the risk increases as the BMI gets higher. There is an existing discussion that BMI cutoffs should be different for people depending on origin or occupation.

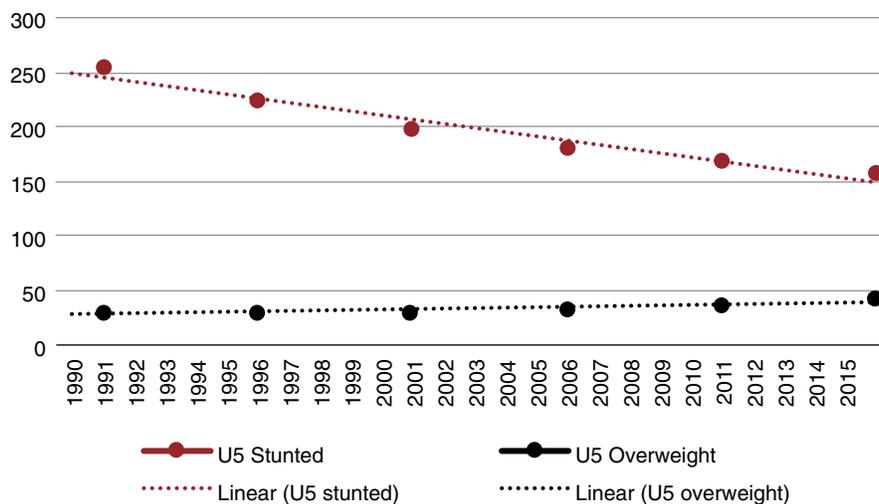
<sup>9</sup> The most comprehensive estimate for global overweight showed about 2.1 billion people are overweight (Ng et al., 2014). WHO estimates put the global overweight figure in 2014 as 1.9 billion (WHO Global Health Observatory data). The most recent estimate for obesity in 2014 was 641 million (NCD Risk Factor Collaboration, 2016).

**FIGURE 1. OVERALL TREND (TOTAL POPULATION FOR ADULTS 18+): DECLINING UNDERNOURISHMENT AND EXPLODING OVERWEIGHT**



Source: Undernourishment data—FAOSTAT; Overweight data—Overweight prevalence from WHO Global Health Observatory Data (overweight for adults 18+ (body mass index  $\geq 25$ ), age-standardized (%)) and UN World Population Prospects, 2015 Revision (total population for adults 18+).

**FIGURE 2. OVERALL TREND (CHILDREN UNDER 5 (U5)): DECLINING STUNTING AND INCREASING OVERWEIGHT**

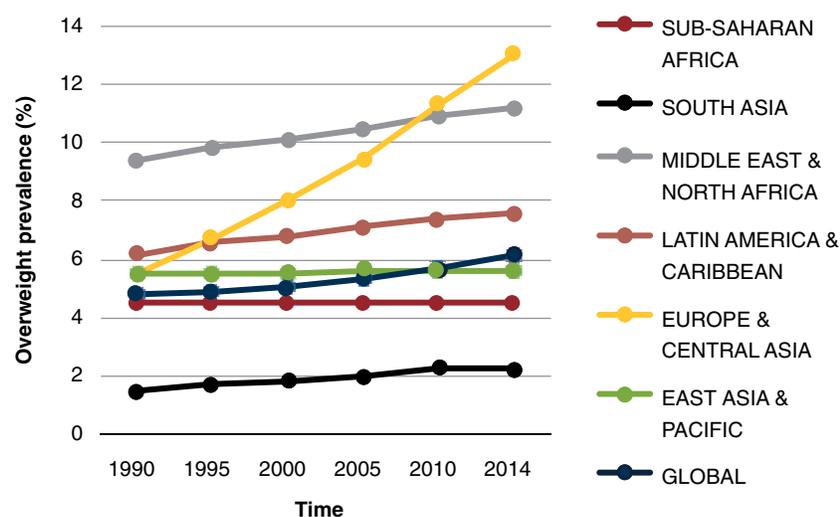


Source: Joint Malnutrition Estimates (WHO/UNICEF/World Bank), 2016.

According to the risk analysis of the Global Burden of Diseases study in 2015, which studied preventable causes of disease and premature deaths, having a high BMI was found to be the fourth largest risk globally, and it was the risk factor that increased the most between 1990 and 2015

(Table 1). High BMI is known to be amongst the causes of other leading risk factors such as high blood pressure and diabetes (identified by high fasting plasma glucose levels) that are also leading risk factors in all regions of the world except for Sub-Saharan Africa. High BMI was the second

**FIGURE 3. GLOBAL AND REGIONAL TRENDS OF CHILD OVERWEIGHT PREVALENCE, 1990–2013 (CHILDREN < 5 YEARS)**



Source: UNICEF, WHO, and World Bank, 2014; cross-reference with HNP ASA on global obesity.

**TABLE 1. LEADING RISK FACTORS FOR HUMAN-CAUSED DISEASES AND DEATH (MEASURED BY REDUCTION IN DISABILITY ADJUSTED LIFE YEARS)**

Leading Three Risk Factors for Human-Caus ed Diseases and Death				
	1	2	3	Rank of High BMI
Global	Blood pressure	Smoking	Fasting plasma glucose	4
High income	Smoking	Blood pressure	BMI	3
ECA	Blood pressure	Smoking	BMI	3
LAC	Fasting plasma glucose	Blood pressure	BMI	3
EAP	Blood pressure	Smoking	Sodium	5
MENA	Blood pressure	BMI	Fasting plasma glucose	2
SAR	Blood pressure	Fasting plasma glucose	Particulate matter	10
SSA	Childhood undernutrition	Unsafe sex	Unsafe water	10+

Source: GBD Risk factors collaborators, 2016.

Note 1: Dark shaded box = high BMI, light shaded boxes = risk factors that are known to be partially caused by high BMI.

Note 2:

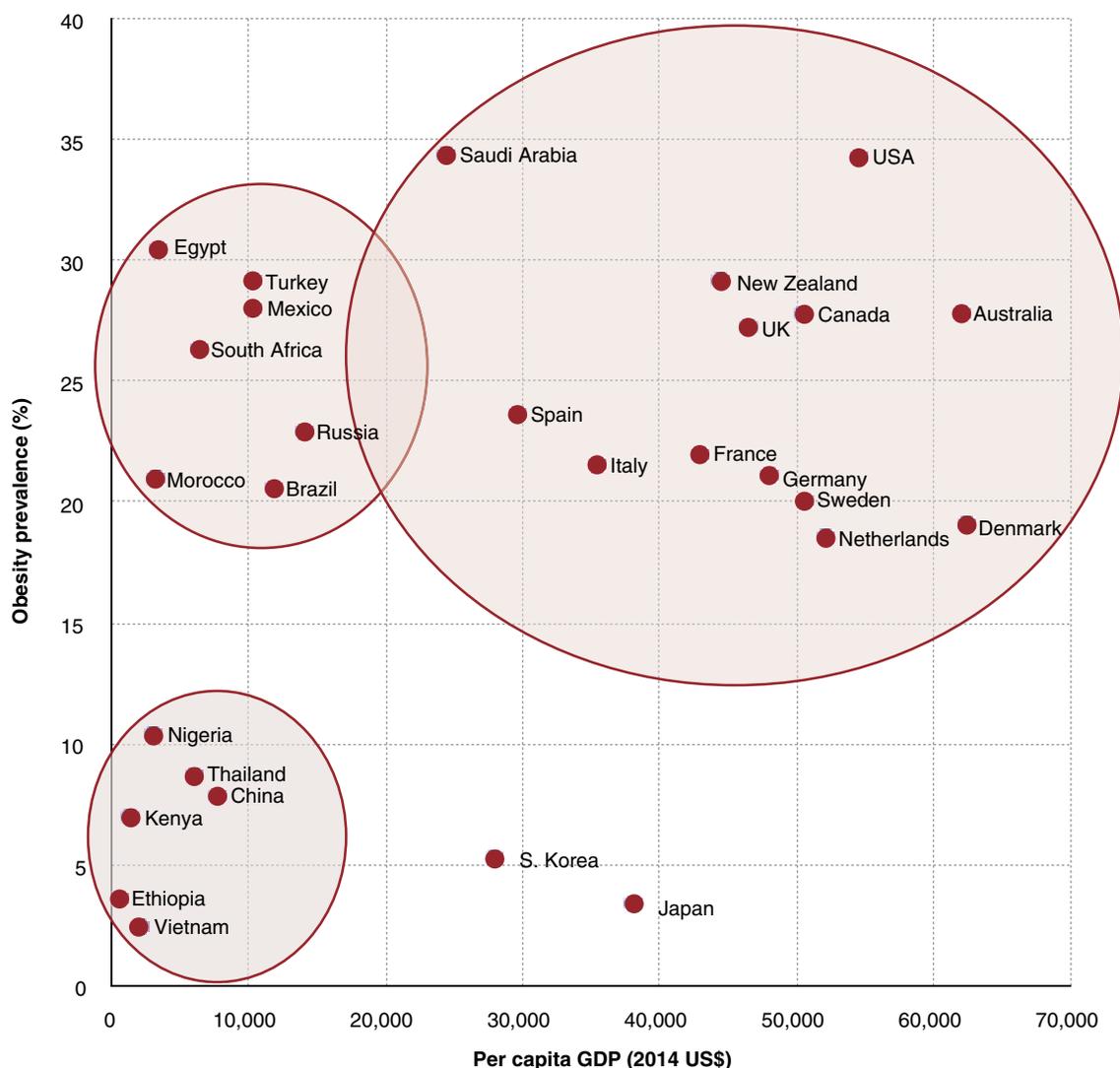
- Blood pressure = high systolic blood pressure (over 110–115mm Hg)
- High fasting plasma glucose (over 4.8–5.4 mmol/L). A fasting plasma glucose test, or fasting glucose test (FGT), is a blood test used to help diagnose diabetes or prediabetes
- High BMI (over 25 kg/m<sup>2</sup>)
- Particulate matter = ambient particulate matter pollution (Annual average daily exposure to outdoor air concentrations of PM with an aerodynamic diameter smaller than 2.5 μm, measured in μg/m<sup>3</sup> over 2.4–5.9 μg/m<sup>3</sup>)
- Sodium = diet high in sodium (24-hour urinary sodium over 1–5g per day)
- Unsafe water = unsafe water source measured by the proportion of households with access to different water sources (unimproved, improved except piped, piped water supply) and reported use of household water treatment methods (boiling or filtering; chlorinating or solar filtering; no treatment)
- Smoking measured by the proportion of the population with cumulative exposure to tobacco smoking; proportion of the population who currently smoke
- Childhood undernutrition measured by childhood (under 5) underweight, wasting and stunting
- Unsafe sex measured by the proportion of the population with exposure to sexual encounters that convey the risk of disease

largest risk in the Middle East and North Africa; the third largest risk in high-income countries, Eastern and Central Europe, and Latin America and the Caribbean; and the fifth largest in East Asia and the Pacific. Only in Sub-Saharan Africa was high BMI (or high blood pressure or high fasting plasma glucose) outside of the top 10 risks for diseases and death.

Initially, the obesity epidemic was considered a problem only in the U.S. and in some Western European countries. Overall obesity prevalence does appear to be correlated with a country's wealth. Figure 4 clearly shows countries categorized in three groups: (i) high-income countries with high obesity prevalence rates (>18 percent);

(ii) middle-income countries with similarly high obesity prevalence (> 20 percent); and (iii) low-income countries with low obesity prevalence rates (< 11 percent). Japan and South Korea are the only clear outliers with obesity prevalence rates much lower than what would be inferred according to their income levels (< 6 percent). Another study indicates that the relationship between GDP and mean BMI is positive and linear up to about US\$5,000 per capita per year; at greater GDP, the relation between GDP and BMI is almost flat (Swinburn et al., 2011), indicating almost zero effect of one to the other. In the U.S., more than half of adults in some age/gender/race/ethnic specific subpopulations were overweight or obese, and key factors included worsening diet quality (higher

**FIGURE 4. OBESITY RISES WITH INCOME—WITH A FEW EXCEPTIONS**



Source: Original figure with 2008 values found in McKinsey Global Institute (2014). Figure updated for this report by Yurie Tanimichi-Hoberg. Obesity prevalence (BMI > 30): WHO Global Health Observatory, 2014 data, average of male and female prevalence rates. Per capita GDP: World Bank, 2014 current US\$.

consumption of processed foods, eating out especially at fast-food restaurants) as well as reduced physical activity.

In developing countries, overweight and obesity was initially closely associated with high socioeconomic status in urban areas. As early as 2000, the WHO was already indicating that *“obesity prevalence is increasing worldwide at an alarming rate in both developed and developing countries. It is still relatively uncommon in African and Asian countries, but is more prevalent in urban than in rural populations. In economically advanced regions, prevalence rates may be as high as in industrialized countries”* (WHO, 2000). However, in the early 2000s evidence began to emerge showing shifts to low socioeconomic status groups and rural areas as a country’s GDP increased. In Brazil, one of the few middle-income countries with repeated cross-sectional surveys of BMI, this shift was particularly evident for women, with obesity rates increasing rapidly in the lowest income groups (Monteiro et al., 2007). A 2014 study in low- and middle-income countries found that the prevalence of overweight is increasing in nearly all countries, and in about half of all countries (33 percent), overweight in rural areas is increasing at a rate greater than that in urban areas (Jaacks et al., 2014).<sup>10</sup>

Thus, the reality on the ground in most developing countries is that they are faced with the costs and challenges stemming from overweight and obesity while still also managing the residual risks stemming from other forms of malnutrition,

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<sup>10</sup> KP team exchanges with the ASA team have confirmed that obesity rates are not reported by urban/rural status. The Global Burden of Disease (GBD) reports overweight (and obesity) prevalence by sex and by age.

namely undernutrition and micronutrient deficiencies. This increased burden is often referred to as the ‘double burden of malnutrition’. This double burden of malnutrition can exist at the individual level (for example, children who are stunted, by height for age, and are also obese, by weight for height, at the same time), at the household level (when a mother may be overweight or anemic and a child or grandparent is underweight) and at the population level (where there is a prevalence of both undernutrition and overweight in the same community, nation or region).

Medical evidence also shows complex biological relationships between being overweight and factors that are beyond the individual’s control. For example, nutritional deficiencies or an excessive rate of weight gain (such as through exposure to interventions to promote compensatory growth following a period of faltering growth) during gestation, as well as not being exposed to breastfeeding for an adequate period, contribute to a predisposition to overweight and an increased risk of noncommunicable diseases later in life (Popkin et al., 2012). This means that early stage undernutrition, including in utero, relates to increased risk of overweight later in life. This is particularly relevant to developing countries undergoing rapid social and economic changes where large groups of infants and young children are exposed to a mismatched environment of nutritional deficiencies very early in life followed by excesses. For example, children’s anthropometric indicators may show low weight for age (underweight), but high weight for height, potentially overweight, due to the child being stunted (height for age), which is determined between conception and two years of age.

# OVERWEIGHT/OBESITY: A COMPLEX CHALLENGE OF HIGH COST TO SOCIETY

Being overweight harms health in many ways. High BMI is a known risk factor for diseases such as diabetes, heart disease, osteoarthritis, and some cancers, to name just a few, and reduces the life span by about three (3) years for overweight people and up to eight (8) years for the obese (Grover et al., 2014). Treating obesity and obesity related conditions costs billions of dollars a year. There is wide variance in estimates of the economic cost of obesity since different studies include different costs. Direct costs typically include all or some of costs related to health service delivery to treat obesity related health problems such as the cost of hospitalization, medical consultations in outpatient clinics and the consumption of medications. Indirect costs typically include all or some of the costs associated with lost productivity when individuals must temporarily (absenteeism) or permanently leave work for health reasons (disability or premature mortality). Reduction in the productivity of workers in the workplace whose performance is impaired by their illness is also sometimes included. Some studies also include changes in insurance premiums since employers pay higher life insurance premiums and pay out more for workers' compensation for employees who are obese than for employees who are not.

McKinsey Global Institute estimates the global economic impact of obesity as roughly US\$2 trillion per year or equivalent to 2.8 percent of global GDP. This includes the cost of lost economic productivity through the loss of productive years, direct costs to health care systems, and the investment required to mitigate the impact of obesity. The McKinsey Global Institute's estimates put obesity as the third most costly human caused social burden behind only smoking (US\$2.1 trillion per year) and 'armed violence, war and terrorism' (US\$2.1 trillion per year) (McKinsey Global Institute, 2014). In the U.S., the medical care costs to treat obesity were estimated to be US\$147 billion dollars in 2008, and the annual nationwide productive costs of obesity related absenteeism ranged between US\$3.38 billion to US\$6.38 billion.<sup>11</sup> Combined, this roughly equates to about 1 percent of GDP in the U.S. In the U.K., another high-income

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<sup>11</sup> <https://www.cdc.gov/obesity/adult/causes.html>

country with a high prevalence of obesity, the cost to the economy of overweight and obesity was estimated at £15.8 billion per year in 2007, including £4.2 billion in costs to its National Health Service.<sup>12</sup> This roughly equates to 4 percent of GDP in 2007.

Overweight and obesity are complex challenges with multiple contributing factors. Although immediate causes of overweight and obesity are relatively simple, namely an imbalance of energy intake and energy expenditure resulting in a positive energy balance, there are many other factors that directly or indirectly affect energy balance, and combine to contribute to the causes of obesity. Child undernutrition is a similarly complex issue, which benefited from the development of a conceptual framework with strong buy-in from a wide range of stakeholders: the UNICEF causes of malnutrition framework that was developed as part of its Nutrition Strategy in 1990. Obesity is a newer epidemic compared to child undernutrition, and thus, there is not yet a singular conceptual framework for global stakeholders to rally around.

A complex system map, the Foresight Obesity System Map (Annex 1), developed by the U.K. Government, is comprehensive and the most commonly referenced obesity framework. It identifies 108 separate factors (variables) in seven (7) individual and population-level clusters (physiology, individual activity, physical activity environment, food consumption, food production, individual psychology, and social psychology) that directly and indirectly affect the core equation of energy balance (energy intake vs. energy expenditure)<sup>13</sup> (Butland et al., 2007). Variables in each cluster interact with each other, and with variables in other clusters through a web of causal relationships. There are four key variables affecting the core system engine. The “force of dietary habits” is the key variable associated with the food production and consumption clusters (Annex 2) collectively referred to as the food environment in the System Map.<sup>14</sup> It is affected by sets of variables characterizing the food industry’s business model,

and food market prices in the food production cluster, and the variety and availability of food in markets, the nutritional quality of available food, and the rate of eating (speed at which people take their meals) in the food consumption cluster (Vandenbroeck et al., 2007).

Another commonly used framework that categorizes obesity drivers/determinants,<sup>15</sup> moderators/modulators and solutions is by Swinburn (Figure 5, Swinburn et al., 2011). The framework is again complex with different levels of determinants that affect energy (im)balance from systemic drivers, such as taxation and regulatory regimes, to environmental drivers on food and physical activity. The framework recognizes that energy balance is affected by behaviors and environments. Accordingly, food appears as an environmental driver, specifically as “food supply and marketing environments that promote high energy intake,” and as a behavior pattern, namely “high food and energy consumption with associated low physical activity levels.” Moreover, the authors locate “obvious possible drivers” of obesity in the food system, and specifically the rise in the supply of cheap, tasty, and energy dense food; improvement of distribution that renders food convenient and accessible; and food marketing. The additional contribution of the framework is the insight it provides to possible solutions to obesity. The left-hand side refers to policy and system-wide interventions that hold the greatest potential impact and have the widest population reach, but are also politically the most difficult to implement. The right-hand side of the table lists the individual-based interventions, like drugs and surgery, that are relatively easy to implement and come with low or no political cost (but with high medical/health care cost). To add to the complexity of the matter, these medical and individual-based interventions have a stronger evidence base of success in curbing obesity. They, however, do not represent a financially viable and sustainable way to treat entire

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<sup>12</sup> [https://www.noo.org.uk/NOO\\_about\\_obesity/economics](https://www.noo.org.uk/NOO_about_obesity/economics)

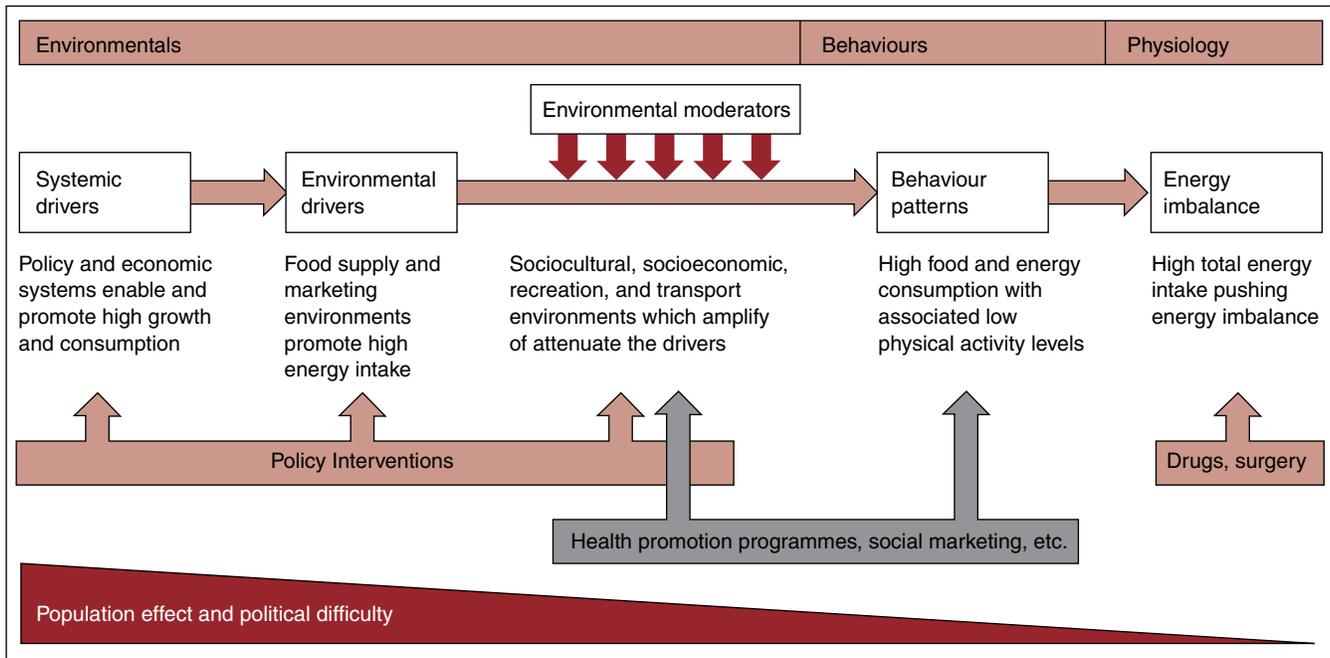
<sup>13</sup> At the core of the Obesity System Map is “energy balance” (energy intake vs. energy expenditure), also referred to as the engine, or core engine.

<sup>14</sup> The other three are: psychological ambivalence (under the psychology cluster); degree of primary appetite control (physiology cluster), and level of physical activity (physical activity cluster).

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<sup>15</sup> According to the framework, a driver/determinant of obesity is an “environmental factor that has changed substantially during the past 40 years (coinciding with the upswing of the [global obesity] epidemic), is global in nature (affecting almost all countries with enabling economic conditions), and is rapidly transmissible (in view of the near simultaneous nature of the epidemic across countries).” Moderators/modulators are defined as “environmental conditions that operate on a population to accentuate or attenuate the effect that the drivers have on the trajectory of changes in obesity prevalence.” These can be cultural body-size preferences, levels of active or car transport in a country, etc.

**FIGURE 5. FRAMEWORK TO CATEGORIZE OBESITY DETERMINANTS, MODERATORS AND SOLUTIONS**



Source: Swinburn et al., 2011.

populations. Thus, emphasis is placed on the left-hand side of interventions despite the sparse evidence on how they operate and how successful they are.

The complexity of the Obesity System Map and the Swinburn et al. (2011) framework explain why, at an individual level, it is so difficult for people to ‘just eat less, and move more to lose weight’, and why at a population level no country has fully succeeded in reversing the obesity trend. The complexity further illustrates how a successful

intervention strategy would need to be multifaceted and tailored to a heterogeneous population. All these frameworks show that agriculture and the food system play a key role in such a strategy, especially pertaining to the clusters of food production and consumption, and that changes in the way we think and operate are needed. Some of these changes are highly synergistic with efforts already undertaken to address the other forms of malnutrition, and they all fall under the common goal of promoting safe, diversified and healthy diets.



# ROLE OF AGRICULTURE AND THE FOOD SYSTEM IN PROMOTING SAFE, DIVERSIFIED AND HEALTHY DIETS WITH A FOCUS ON OVERWEIGHT/OBESITY



As the world faces an evolving malnutrition crisis, with countries moving from the challenges of undernutrition and micronutrient deficiency to a crisis that encompasses also overweight and obesity, one thing remains constant: agriculture and the food system have an important role to play in ensuring access to a high quality diet that includes a diversity of foods that are safe, and provides levels of energy appropriate to age, sex, disease state and physical activity as well as micronutrients (Glopan, 2016). Obviously, given the complexity of malnutrition as evidenced in the UNICEF framework for child malnutrition as well as the UK Foresight Report Obesity System Map and the Swinburn framework of obesity, agriculture and food systems are only part of the solution, since the set of associated factors that cause the problem is far reaching and amounts to a tightly knit obesogenic environment that sustains people to eat more and exercise less.

There is no available quantification of the share or importance of agriculture and the food system within the set of factors that contributes to rising obesity, and that share, even if quantifiable would likely differ from country to country. Most studies take the approach that while research generates more evidence, “as many interventions as possible must be delivered to have significant impact” because almost all interventions that are commonly discussed in obesity prevention/mitigation are highly cost effective from a societal viewpoint (McKinsey Global Institute, 2014), and that “a strategy to tackle obesity needs a comprehensive portfolio of interventions targeting a broad set of variables and different levels within the obesity system. Although, alone, each component part of the strategy may not create significant impact, their complementary and reinforcing action is critical to achieving the significant shift required in population obesity trends.” (Butland et al., 2007).

## BOX 2. NOURISHING FRAMEWORK POLICY ACTIONS

Each letter in the word NOURISHING represents one of ten actions that governments can take:

**N** = Nutrition label standards and regulations on the use of claims and implied claims on food

**O** = Offer healthy food and set standards in public institutions and other specific settings

**U** = Use economic tools to address food affordability and purchase incentives

**R** = Restrict food advertising and other forms of commercial promotion

**I** = Improve nutritional quality of the whole food supply

**S** = Set incentives and rules to create a healthy retail and food service environment

**H** = Harness food supply chain and actions across sectors to ensure coherence with health

**I** = Inform people about food and nutrition through public awareness

**N** = Nutrition advice and counseling in health care settings

**G** = Give nutrition education and skills

Letters in the word NOURISHING, and associated actions, fall within one of the three domains, as follows: NOURIS actions fall under the domain of the food environment; H represents the food system; and ING falls under behavior change communication.

Source: <http://www.wcrf.org/int/policy/nourishing-framework/about-nourishing>

It is possible to identify interventions through both policies and programs/projects in agriculture and the food system that can contribute to preventing overweight and obesity. There are some policies that affect diets indirectly, such as policies on agricultural development and investments in infrastructure, and others that have specific dietary objectives (Keats and Wiggins, 2014). The NOURISHING framework (Box 2), developed by the World Cancer Research Fund International, provides an often cited list of the latter type of policy actions that governments can take to promote healthy diets and reduce overweight and obesity. The framework highlights ten policy actions in three domains: food environment, food system and behavior change communication.<sup>16</sup> Actions broadly fall under the food system in that they affect both supply and demand of food.

This report will discuss direct and indirect policies, as well as program and project actions affecting diets with a focus on overweight and obesity, but not exclusively so. This is couched upon the realization that many of the suggested actions for reducing overweight and obesity also serve the purpose of reducing undernutrition and/or micronutrient deficiency. Thus, policies and actions that

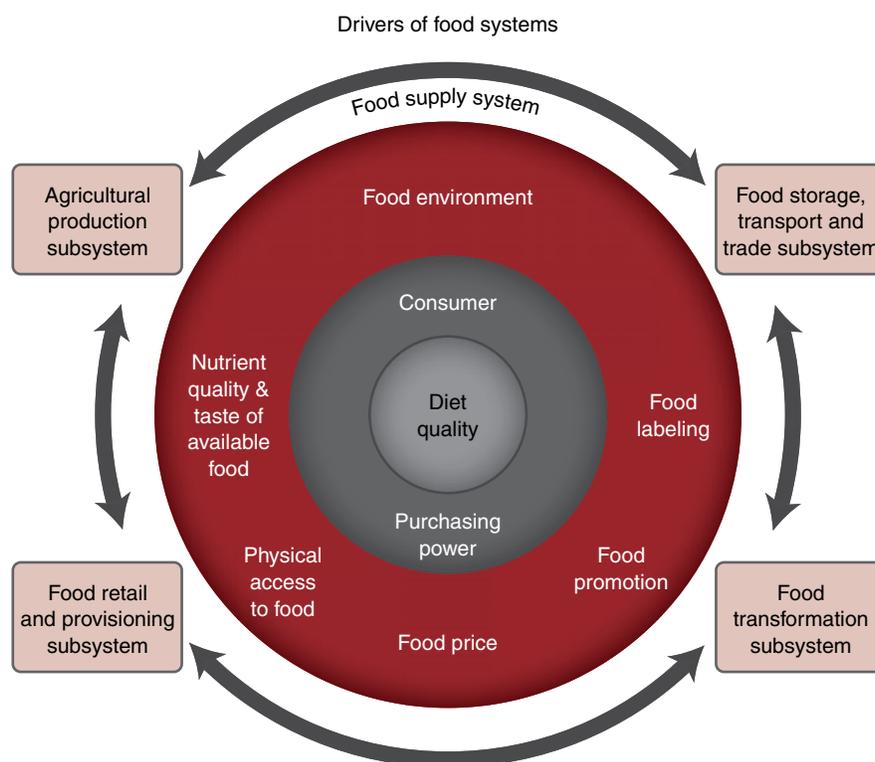
support the provision of and access to a safe, diversified and healthy diet should be supported continuously across the entire food system as countries transition from focusing on undernutrition to overlapping malnutrition problems increasingly including overweight and obesity. While evidence of impact is still being generated based on experience within the agriculture and food systems domain, there is ample evidence of impact for interventions to control and prevent obesity in areas outside this domain.

This report uses the Global Panel on Agriculture and Food Systems for Nutrition's (Glopan) conceptual framework that shows the link between diet quality and the four subsystems of the food system: agricultural production; food storage, transport and trade; food transformation; and food retail and provisioning (Figure 6). The remainder of this document will organize itself using this conceptual framework, starting with the 'farm' or agricultural production subsystem and continuing onto the 'fork' or food retail and provisioning subsystem. The only modification introduced is the consideration of agricultural research as an important and separate aspect of the agricultural production subsystem given its outsized role in affecting the agricultural/food production system.

Under each subsystem examples of suggested interventions are listed. Most of these suggested actions have been tested and their outcomes documented. However, even

<sup>16</sup> The framework is accompanied by a regularly updated database listing implemented government policy actions accessible here: <http://www.wcrf.org/int/policy/nourishing-framework>

**FIGURE 6.** CONCEPTUAL FRAMEWORK SHOWING LINK BETWEEN DIET QUALITY AND THE FOOD SYSTEM



Source: Glopan (Global Panel on Agriculture and Food Systems for Nutrition), 2016.

when an intervention works well in a particular setting, the universality of its success is unknown. In fact, given the strong cultural and behavioral context of the obesity problem, it is likely that any successful intervention must be customized to the local context. Context-specific piloting of suites of interventions, paired with vigorous monitoring and assessment, would be important to discover the best mix of actions and policies to undertake. The suggested actions in the rest of the report do not include those that are only available in a high-income context or pertain to clusters not associated with food, such as reducing screen time for children, or offering business tax incentives for establishing exercise and outdoor recreational facilities.

## ROLE OF THE AGRICULTURAL PRODUCTION SUBSYSTEM

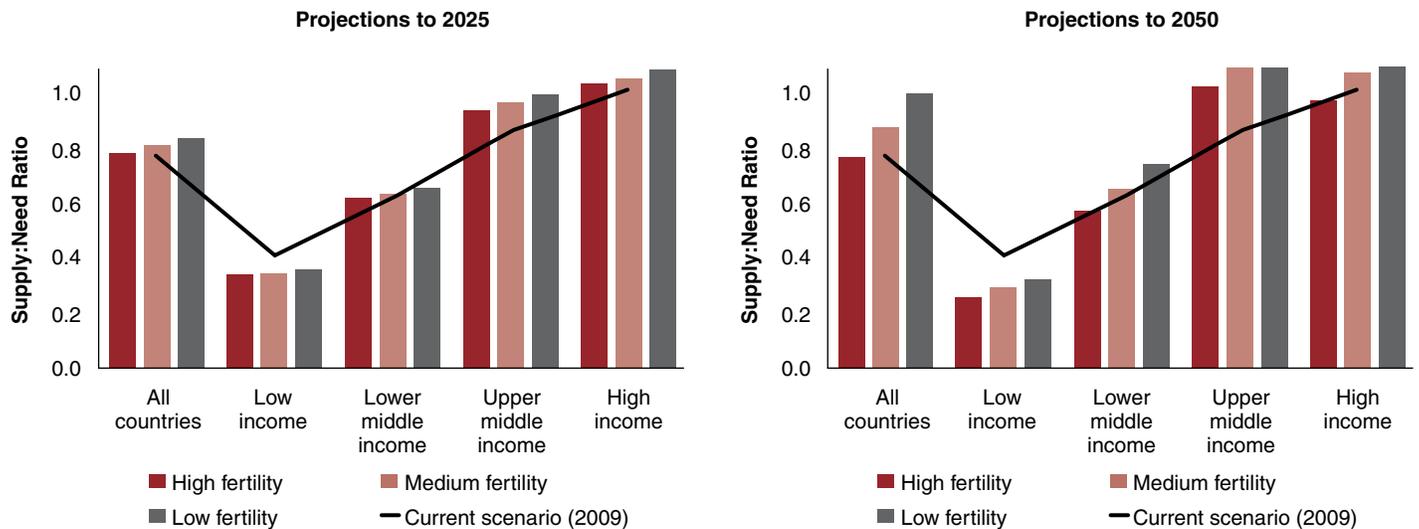
### (A) ROLE OF AGRICULTURAL RESEARCH

**Background:** Agricultural research greatly affects relative profitability of different crop choices, farmer decision making, and consequently affects relative prices of raw material

supply to the food system, which likely influences the processed food produced. Throughout history, 7,000 crops have been used for food, but today just 12 crops and five (5) animal species provide 75 percent of the world's food. Fifty percent of plant-sourced calories come from just three crops: rice, wheat and maize (Kennedy, 2015). These three are also amongst the crops that have received the most attention by the agricultural research community, most notably starting with the Green Revolution, and continuing today under the Consortium of International Agricultural Research Centers (CGIAR), and private sector research efforts. South Asia illustrates the impacts of the Green Revolution. In 1969–1971, the surplus production of staple grains over consumption requirements was just 10 million metric tons. By 2009–2011 the surplus was more than 60 million metric tons, and more than 89 percent of the staple grain surplus was made up of rice, wheat and maize and just 11 percent related to other cereals, reflecting the lower productivity gains in other cereals, such as pearl millet (Pingali, 2015).

Global performance in staple grain production has not been matched by performance in fruits and vegetables

**FIGURE 7. PROJECTIONS OF FRUIT AND VEGETABLE ADEQUACY TO 2025 AND 2050**



Source: Siegel et al., 2014.

where there is a global production deficit. An analysis of global data (Figure 7) reveals that, based on current WHO recommendations, global production of fruits and vegetables is 22 percent below the global population needs, with a supply to needs ratio of 0.78. The situation for low-income countries is worse, with a median supply to needs ratio of just 0.42, indicating that fruit and vegetable production is 58 percent below the consumption needs of people in low-income countries (Siegel et al., 2014). Inadequate production levels result in higher prices, particularly given the short shelf life and fragility of these products in transportation, compromising access by the poor to a healthy diet. Based on medium population forecasts and assuming business as usual, this situation will worsen with the supply to needs ratio falling to 0.35 in 2025 and 0.33 in 2050. Without a change in the agricultural research and technology domain, by 2050 the production of fruits and vegetables will be 67 percent below that required in low-income countries, which will lead to increased prices, and thus compromise access to healthy diets for the poorest.

**Pathways to influence diet quality (with a focus on overweight):** In the agricultural research subsystem the three main pathways to improve diet quality are through: (1) incentivizing more public sector research on high quality foods (legumes, fruits, vegetables) to increase productivity and shift relative prices; (2) ensuring that cereal research includes a nutrition focus, such as

bio-fortification, and not just a yield focus; and (3) encouraging private sector advances in research and technology favoring high quality and underserved foods.

1. **Incentivizing more public sector research on high quality and underserved foods (legumes, fruits, vegetables) to increase productivity and shift relative prices:** The Consortium of International Agricultural Research Centers (CGIAR) allocated half of its research funding in 2012 to rice and maize. While livestock, fish and some pulses received some allocation, research for fruits and vegetables (except for bananas) was minimal (Glopan, 2016). CGIAR is a donor to the World Vegetable Center, that focuses on vegetable research and development.<sup>17</sup> In 2005, the Center cofounded the Global Horticultural Initiative to increase awareness amongst international policy makers of the value of fruit and vegetables in combatting global malnutrition and poverty. Efforts could be expanded to reinforce the Center’s work even further.
2. **Ensuring that cereal research and provision on inputs include a nutrition focus, and not just a yield focus, and that results are communicated to producers:** Increasing

<sup>17</sup> Founded in 1971 as the Asian Vegetable Research and Development Center (AVRDC) with a focus on tropical Asia, today the work of the World Vegetable Center spans the globe. <https://avrdc.org/>

supply of cereals is a traditional objective of agricultural development in most countries, and even more so in developing countries where food security and the maintenance of livelihood for the majority of the rural poor is often the primary objective of the sector. Toward this objective, farm policies in many developing countries are geared toward improving the productivity of basic cereals by increasing access to modern inputs such as high yield seeds, agrochemicals and improved water management infrastructure. This type of intervention, while effective in addressing widespread hunger, has no positive effect on addressing micronutrient deficiency or overweight. In fact, a singular focus on this approach has been shown to be detrimental to it. A parallel action could include developing new metrics in agriculture that measure aspects related to nutrition, such as an alternative to standard yields (nutrient content per unit of land or labor), and minimum cost of a quality diet.

These research results will need to be disseminated to farmers through channels including an effective extension system capable of taking on knowledge related to nutrition. Agriculture extension workers have direct and ongoing contact with smallholder farmers, and therefore have a unique opportunity to strengthen messages regarding consumption of nutritious foods based on WHO recommendations of what constitutes a healthy diet. Extension services are delivered by public and private entities via extension agents, such as national ministries of agriculture, and large agribusinesses. Farmers, nevertheless, may not receive an extension agents' visit for years due to poor logistics and resource constraints. In order to overcome these limitations, and to also convey messages more easily, a variety of channels are increasingly used including radio, print media, and information and communication technology (ICT)-enabled tools, such as cell phones and videos, the enabling role of which is well documented.<sup>18</sup> Agriculture extension systems have been used to disseminate

messages related to undernutrition and micronutrient deficiencies, and often in collaboration with the health community. They have not been used to convey messages related to overweight/obesity, but presumably they could.

3. **Encouraging private sector advances in research favoring high quality and underserved foods:** Glopán (2016) reports that approximately 45 percent of private sector research investments focus only on maize. Notably this exceeds the maize seed share (25 percent) of the seed industry, but it is illustrative of the industry's experience that maize seed production is profitable. Other crops have not received such investments. In situations where there is a growing private sector capacity for agricultural research, governments can promote research on high quality and underserved foods through the private sector with competitive research grants or other services.

## (B) ROLE OF AGRICULTURAL PRODUCTION SUBSYSTEM (FARM LEVEL)

**Background:** Agricultural production generates the foods and ingredients that form the basis of the quantity, diversity and relative prices of foods available for human consumption. Despite the fact that diet diversity has long been recognized as important for adequate nutrient intake and human health, the concept of nutritional diversity is typically not integrated into planning and assessments of agricultural and food systems and policies. Success of agricultural systems is more often evaluated by metrics of crop yields, economic output and cost-benefit ratios, and does not reflect the diversity of nutrients provided by the system and required for a healthy diet. In the context of global agricultural development, 'nutrition-sensitive agriculture' has gained traction only recently as part of a movement to focus attention on a multi-sectoral approach for improving nutrition as espoused by the Scaling Up Nutrition movement that began in 2010.

Agriculture's contribution to food security has traditionally focused on supply issues with, perhaps, its greatest achievement enshrined in the Green Revolution. Thanks largely to the Green Revolution, the developing world

<sup>18</sup> World Bank. (2017). *ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions*. Updated Edition. Washington, DC: World Bank.

tripled its production of cereal crops despite a doubling of population, with only a 30 percent increase in land area cultivated (Wik et al., 2008). Agricultural output per person grew by 61 percent from US\$209 per person in 1961 (2004–06 international prices), to US\$336 per person in 2010. Consequently, between 1961 and 2010, real prices of cereals fell by roughly 60 percent (Alston and Pardey, 2014). This phenomenal feat was accomplished by intensifying the use of modern inputs—in particular machinery, fertilizers and irrigation, combined with improved genetic material and methods of production derived from organized scientific research, mainly from CGIAR centers.

The Green Revolution focused on basic food staples such as rice, wheat and maize, because of their importance in the diets of the poor as primary sources of calories, and because there was significant research already conducted in developed countries for these crops. One unintended consequence of the Green Revolution was a shift in prices of staple grains relative to other foods, such as legumes, fruits and vegetables that did not experience such yield increases, resulting in a loss of dietary diversity toward more cereal-based diets. This consequently led to lower intake of micronutrients as relative prices of cereals decreased dramatically and became more accessible to the poor. In some cases, traditional crops that were important sources of critical micronutrients (such as iron, vitamin A, and zinc) were displaced by staples promoted by the Green Revolution. The Green Revolution was one of, if not the most important advance in modern agriculture, and thus its influence on agriculture practitioners and policy makers alike has been profound. The phenomenal success in dramatically raising the yields of three major crops (rice, wheat and maize) in the 1960s and early 70s, and the much delayed and less publicized gradual release of high yield varieties in other crops such as pulses and root crops till the 1980s, led to an overemphasis on raising yields of a few select cereals as the central focus of agriculture in developing countries. This continues today. The response to the 2007–08 food price crisis was a call to increase production and productivity of staple grains. Similarly, the focus of climate smart agriculture has largely been on staple grains; yet arguably fruits and vegetables are far more sensitive to temperature changes and water stress.

**Pathways to influence diet quality (with a focus on overweight):** Self production and trade are two

ways to increase diversity of the food supply. A recent cross-country study<sup>19</sup> cited in the Glopian Foresight Report (2016) found that while food imports (and income) are associated with a more diverse food supply in high- and middle-income countries, the diversity of agricultural goods produced by a country is the stronger predictor in low-income countries. Regardless of what drives the development of a more diverse food supply, evidence clearly shows that a diet rich in fruits and vegetables can lower blood pressure, reduce risk of heart disease and stroke, contribute to prevention of some types of cancer,<sup>20</sup> lower risk of eye and digestive problems, and have a positive effect upon blood sugar that can help keep appetite in check thereby being an effective tool in weight control. Therefore, preventing overweight and reducing micronutrient deficiency share a common goal of a high quality diet rich in fruits and vegetables. But while there is consensus among the health community regarding the benefits of a diet rich in fruits and vegetables, advice varies on the health benefits and risks associated with the consumption of certain meats.

Evidence shows that while meat consumption, in general, is an important source of protein and some micronutrients like iron and vitamin B12, high intake of red meat and processed meat is associated with an increased risk of heart disease, diabetes, and colon cancer, as well as weight gain. Thus, many in the health community advise replacing red and processed meat with nuts, beans, fish, or poultry to lower the risk of heart disease and diabetes and to aid in weight control (Bernstein et al., 2010 and Mozaffarian et al., 2011). Therefore, a nuanced message needs to be developed for the promotion of livestock production (beef and pork) since the recommendation does differ by the type of malnutrition challenge being addressed, unlike with fruits, vegetables, and pulses, where the message remains consistent. In the agricultural production subsystem at the farm level the three main pathways to

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<sup>19</sup>Remans, R., Wood, S. A., Saha, N., Anderman, T. L., and Defries, S. A. 2014. Measuring nutritional diversity of national food supplies. *Global Food Security*, 3, 174–182, <http://dx.doi.org/10.1016/j.gfs.2014.07.001>

<sup>20</sup>High consumption of non-starchy vegetables—such as lettuce and other leafy greens, broccoli, bok choy, cabbage, as well as garlic and onions—and fruits “probably” protect against several types of cancers, including those of the mouth, throat, voice box, esophagus, and stomach; fruit probably also protects against lung cancer (Wiseman, 2008).

improve diet quality are through: (1) ensuring that bio-fortified cereals are the norm, where they are available and agronomically competitive, rather than the exception; (2) eliminating subsidies and other production/price support measures for production of unhealthy ingredients for food processing (sugar, corn [where there is established local capacity to develop high fructose corn syrup (HFCS)], palm oil etc.); and (3) encouraging production (and consumption) of fruits, vegetables, and legumes.

One aspect to consider is that because not all of what is produced is consumed by humans, it is more efficient to subsidize/tax the consumption of underserved nutritious and less healthy food groups closer to the retail/consumption point to alter consumption patterns as opposed to the production of these same food groups. Similarly, raw food ingredients are only a small part of the full content of a highly processed food that may or may not be healthy. Thus, taxing or subsidizing an ingredient into processed foods is a highly indirect and inefficient way to affect its prices or consumption behavior. Despite the popular belief, for example, that the vast U.S. farm subsidy programs are fueling the U.S. obesity epidemic, a careful analysis does not support this claim. Alston, Sumner, and Vosti (2008) assessed the effects of U.S. farm programs (not just the crop support portion), and found that even if the entire farm subsidy were removed in the U.S., the effects on commodity production and subsequently their prices are much smaller than expected from a textbook understanding of how subsidies work (reduction of 3–12 percent of output level, and reduction of 0–4 percent in price for soybean, wheat, maize and rice), because the price depressing effects of the subsidy are contained (or even reversed) by other policies, such as set-aside requirements, and also because subsidy rates in the U.S. are determined according to past acreage and yield information, and not current levels. Therefore, theoretically, measures under this pathway will not be as cost efficient as subsidizing/taxing closer to retail/consumption in its final form of consumption. This does not necessarily mean that there is no effect on production diversification and dietary diversity. But it does point to the need for further research. Another aspect to take into account when considering taxing or subsidizing foods is the welfare effect on low-income consumers. Since food comprises a larger proportion of expenditure among low-income consumers,

a subsidy to encourage consumption of certain foods may be preferred to taxing certain unhealthy foods.

1. **Ensuring that bio-fortified cereals are the norm, where they are available and agronomically competitive, rather than the exception:** Bio-fortification is a method of breeding crops to increase their nutritional value focusing on making plant foods more nutritious as the plants are growing. Some of the bio-fortified crops use traditional plant breeding techniques (non-transgenic), such as the crops being developed by HarvestPlus with other CGIAR centers. Others use genetic, or transgenic modification techniques such as the Golden Rice being developed by the International Rice Research Institute. Bio-fortified crops have been demonstrated to improve vitamin A and iron intakes—alleviating two micronutrient deficiencies that cause a large number of deaths and disabilities. While increased production of nutritious foods may have some independent impact on dietary consumption and micronutrient status, the evidence shows that nutrition education around those foods strongly enhances the effect. A review of food-based approaches to reduce iron and vitamin A deficiency found that only those food-based interventions with education, social marketing, or mass media demonstrated an impact on nutritional outcomes (Alderman et al., 2013).
2. **Eliminating subsidies and other production/price support measures for production of unhealthy ingredients for food processing:** These ingredients may include sugar, corn (if there is capacity to process into high fructose corn syrup (HFCS)), and palm oil. As mentioned earlier, this pathway will likely not be as efficient in changing consumption patterns as a tax near retail/consumption (e.g., taxing sugar sweetened beverages or snacks that use these food ingredients). Furthermore, a country may be promoting the production of certain crops, such as maize or palm oil, as part of its biofuel policy. In such a case, taxation near retail/consumption of the processed good would make more sense to curb its consumption.
3. **Encouraging production (and consumption) of fruits, vegetables, and pulses:**

Interventions in this category are effective in addressing malnutrition across the spectrum from undernutrition to overweight/obesity. The Glopian Foresight Report (2016) found that current consumption of fruits and vegetables is below WHO recommended levels in all regions of the world except for East Asia. It is not very clear to what extent this trend is due primarily to low production, or low trade, or high prices, but difficulty in production and distribution due to their highly perishable nature is the most cited reason for low availability. Studies, although with limitations, seem to converge on a call to increase availability and affordability of fruits and vegetables (Miller et al. 2016; Siegel et al. 2014; WHO Nutrition Topics, n.d.). In order to achieve this, public sector investments in research, technology, extension, and in infrastructure to produce, store, transport, distribute, as well as trade fruits and vegetables could go a long way (this possibility is examined under other subsystems). For pulses, production at the global level has sharply increased since 2005, and between the 1980s and 2011 there was a fourfold increase in the pulses trade. Nevertheless, pulse prices continue to be high. A comprehensive 2016 study by the International Food Policy Research Institute (IFPRI) concluded that there are “low yields in developing countries since pulses are mainly grown in marginal areas under low input conditions, small-scale production, weak institutional arrangements, and low research priorities and government support compared to cereals.” These challenges need to be overcome. Examples of actions at the farm level include: small-scale household production models such as kitchen gardens or community plots; and bio-fortification (for cassava, beans and orange flesh sweet potatoes (OFSPs)). Nutrition education and behavior change communication are needed to increase demand for diversified and high-quality foods.

## ROLE OF THE FOOD STORAGE, TRANSPORT, AND TRADE SUBSYSTEM (POSTHARVEST LEVEL)

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**Background:** When food is not consumed by the farmers themselves, immediately after food is harvested it is handled, treated, stored, packed, moved, transported and traded. Interventions adopted in this subsystem to improve diet quality are also interventions that are undertaken for more conventional objectives of raising profitability of the value chain. Actions include investments to reduce food losses and waste, address food safety and comply with export requirements. The fact that the objectives of improving diet quality and profitability can be achieved through the same measures is an advantageous situation because no new or customized actions are needed, unlike in the production subsystem where actions aligned to conventional profitability maximizing objectives do not necessarily deliver for the objective of improving diet quality.

**Pathways to influence diet quality (with a focus on overweight):** As in the previous production subsystem, one key goal is to maintain the supply of underserved nutritious foods (fruits, vegetables, pulses, poultry, fish) into the market, and also to minimize the supply of undesirable ingredients for food processing from the market (sugar, corn where there is established local capacity to develop HFCS, and palm oil, etc.) To maintain the supply of underserved nutritious food groups, key entry points that pertain to the food storage, transport, and trade subsystem are: (1) reducing food loss and waste; and (2) using trade to improve the quality of the local diet, including measures to reduce the imports of ingredients for food processing and unhealthy foods and conversely increase the import of underserved nutritious food ingredients.

1. **Reducing food loss and waste:** Food loss and waste is particularly important when dealing with overweight because food losses in industrialized countries are as high as in developing countries, but in developing countries more than 40 percent of the food losses occur at postharvest and

processing levels, while in industrialized countries, more than 40 percent of the food losses occur at retail and consumer levels. Loss and waste is especially high, reaching about 50 percent of produced amounts, for fruits and vegetables, many of which are highly perishable and where retailers set standards in size and aesthetics in many developed country markets (FAO, 2011). Additionally, adapting new agricultural technologies (such as aeroponics and hydroponics for vegetable production) in developing countries enables production in urban centers reducing the need for cold chains and transportation, where losses appear.

- 2. Using trade to improve the quality of the local diet:** In theory, trade can increase availability and affordability of healthy food. Nevertheless, as mentioned under the role of the agricultural production sub-system, a recent cross-country study<sup>21</sup> cited in the Glopan Foresight Report (2016) found that food imports are associated with a more diverse food supply only in high- and middle-income countries, and not in low-income countries. Moreover, traded foodstuff can be used in the food processing industry to produce food of low nutrient quality. In terms of minimizing the supply of undesirable ingredients for food processing and unhealthy foods, the Pacific Island countries, which have one of the world's highest prevalence of overweight and obesity and also rely heavily on food imports, have imposed restrictions and tariffs on processed foods high in fats, sugar and salt. Fiji, a World Trade Organization (WTO) member since 1996, began in 2012 to tax ingredients for food processing, such as a 32 percent import duty on palm oil and monosodium glutamate, as well as to remove existing 5–32 percent import duties on fruits and vegetables. In the past, Samoa banned imports of fatty meats such as turkey tails, which was replaced with

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<sup>21</sup> Remans, R., Wood, S. A., Saha, N., Anderman, T. L., and Defries, S. A. 2014. Measuring nutritional diversity of national food supplies. *Global Food Security*, 3, 174–182, <http://dx.doi.org/10.1016/j.gfs.2014.07.001>

a high sales tax following its accession to WTO in 2012. Fiji still bans the import of fatty mutton flaps (Snowdon and Thow, 2013). As of 2013, no formal objections to Fiji's ban had been raised to the WTO (Snowdon and Thow, 2013). As import bans are forbidden by WTO rules, countries are advised to seek alternative measures.<sup>22</sup>

A different story emerges in the U.S. for sugar, a commodity that has been historically kept out of the domestic market. The historical import restriction of sugar in the U.S. has helped maintain higher than global sugar prices, thereby dampening its demand. However, this has also aided in the explosion of producing and consuming another sweetener, high fructose corn syrup (HFCS), after it was developed in the 1970s. Despite some initial evidence that HFCS led to more weight gain compared to sugar (Bray, Nielsen, and Popkin, 2004), more recent studies refute this indicating that there is no additional adversarial effect of consuming HFCS on obesity or other diseases beyond the effects for sugar. Leading major American agencies<sup>23</sup> such as the Mayo Clinic, American Heart Association, and the Department of Agriculture's guideline for healthy diets recommend reducing the consumption of all sugars, including HFCS, without singling it out as presenting extra concerns.

## ROLE OF THE FOOD TRANSFORMATION SUBSYSTEM (AGROPROCESSING LEVEL)

**Background:** Food processing combines raw food ingredients to produce marketable food products that can be easily prepared and served by the consumer. It ranges from

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<sup>22</sup> Suggestions include to involve health professionals in negotiations of trade agreements (Snowdon and Thow, 2013), and/or seek a collective approach through international institutions/organizations instead of undertaking unilateral country actions.

<sup>23</sup> The U.S. is the leading producer of high fructose corn syrup and has the highest level of per capita consumption at 55 pounds per year.

simple forms of transformation such as slicing, drying, or freezing to highly extractive forms where the nutrients of the original ingredients are highly depleted through the various processes. Monteiro (2010) categorizes processed foods into three groups: (1) Type 1—unprocessed or minimally processed foods (e.g., dried fruits, frozen meats, unsalted nuts), (2) Type 2—processed culinary ingredients (e.g., oils, sugar, flour), and (3) Type 3—ultra-processed foods (e.g., white bread, cookies, frozen pizza, hot dogs, canned soup, instant noodles).<sup>24</sup>

The characteristics of the ultra-processed foods according to Monteiro are “*durable, accessible, convenient, attractive, ready-to-eat or ready-to-heat products. Such ultra-processed products are formulated to reduce microbial deterioration (‘long shelf life’), to be transportable for long distances, to be extremely palatable (‘high organoleptic quality’), and often to be habit forming. Typically, they are designed to be consumed anywhere—in fast-food establishments, at home in place of domestically prepared and cooked food, and while watching television, at a desk or elsewhere at work, in the street, and while driving*” (Monteiro, 2010). As such, he concludes that these foods are problematic for the public health in two ways: first, their principal ingredients (oils, solid fats, sugars, salt, flours, starches) make them excessive in total

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<sup>24</sup> (1) Type 1: Unprocessed or minimally processed foods that do not change the nutritional properties of the food. Examples include, fresh, chilled, frozen, vacuum packed fruits, vegetables, fungi, roots and tubers; cereals (grains) in general; fresh, frozen and dried beans and other pulses (legumes); dried fruits and 100 percent unsweetened fruit juices; unsalted nuts and seeds; fresh, dried, chilled, frozen meats, poultry and fish; fresh and pasteurized milk, fermented milk such as plain yogurt; eggs; teas, coffee, herb infusions, tap water, bottled spring water.

(2) Type 2: Processes that extract and ‘purify’ specific substances from unprocessed foods. Examples are vegetable oils, margarine, butter, milk, cream, lard; sugar, sweeteners in general; salt; starches, flours, ‘raw’ pastas and noodles, as well as food industry ingredients usually not sold to consumers as such, including high fructose corn syrup, lactose, milk and soy proteins, gums and similar products. Most end products of type 2 food processing are depleted or devoid of nutrients and essentially provide energy.

(3) Type 3: Ultra-processed products that combine Type 2 ingredients (and, rarely, traces of Type 1). Examples are white breads, biscuits (cookies), cakes and pastries; ice cream; jams (preserves); fruits canned in syrup; chocolates, confectionery (candies), cereal bars, breakfast cereals with added sugar; chips (French fries), crisps (chips), sauces; savory and sweet snack products; cheeses; sugared fruit and milk drinks and sugared and ‘no-cal’ cola and other soft drinks; frozen pasta and pizza dishes; pre-prepared meat, poultry, fish, vegetable and other ‘recipe’ dishes; processed meat including chicken nuggets, hot dogs, sausages, burgers, fish sticks; canned or dehydrated soups, stews and pot noodle; salted, pickled, smoked or cured meat and fish; vegetables bottled or canned in brine, fish canned in oil; infant formulas, follow-on milks, baby food.

fat, saturated or trans fats, sugar and sodium, and short of micronutrients and other bioactive compounds, and of dietary fiber. Taken together this increases the risk of various serious diseases. Secondly, their high energy density, hyper-palatability, their marketing in large and supersizes, and aggressive and sophisticated advertising, all undermine the normal processes of appetite control, cause overconsumption, and therefore obesity, and diseases associated with obesity.

Consumption of ultra-processed foods is increasing globally. According to a study using the nationally representative National Health and Nutrition Examination Survey of 2009–10 of American citizens aged one year old and higher, ultra-processed foods comprised 57.9 percent of total energy intake, and almost 90 percent of the average U.S. daily intake of added sugars<sup>25</sup> (292.2 kcal) came from ultra-processed foods (Martinez et. al., 2015). In another study, the share of ultra-processed foods of total energy intake in Canada showed an increase from 24.4 percent in 1938 to 54.9 percent in 2001. In Brazil, it rose from 18.7 percent in 1987 to 26.1 percent in 2003. In the most recent surveys, the share of ultra-processed products is almost twice as high in Canada than in Brazil, but relative growth has been higher in Brazil (2.1 percent per year) than in Canada (1.3 percent per year). The same study looked at consumption patterns of a smaller subset of ultra-processed foods (frozen processed foods,<sup>26</sup> snacks,<sup>27</sup> and soft drinks<sup>28</sup>) for 79 middle- and high-income countries (with a minimum 2012 per capita GNI of US\$1,036). The results showed greatest consumption in high-income countries, but greater relative and sometimes absolute

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<sup>25</sup> Added sugars are defined as “sugars that are added to foods as an ingredient during preparation, processing, or at the table. Added sugars do not include naturally occurring sugars (e.g., lactose in milk, fructose in fruits). Examples of added sugars include brown sugar, cane sugar, confectioners’ sugar, granulated sugar, dextrose, white sugar, corn syrup and corn syrup solids, molasses, honey, and all types of syrups such as maple syrup, table syrups, and pancake syrup.

<sup>26</sup> Frozen processed foods: Bakery products; potatoes; desserts; meat, poultry, fish, seafood, meat substitutes, red meat, processed poultry, processed fish/sea food, meat substitutes; dishes such as pizza, ready meals, others.

<sup>27</sup> Snacks: Sweet and savory snacks (chips/crisps, corn chips, pretzels, sweet snacks, salted nuts), confectionery (chocolates, sweets, gums, pastilles, jellies), ice creams (including frozen yogurt).

<sup>28</sup> Soft drinks: Carbonated drinks, fruit and vegetable juices (sweetened juices, nectars, fruit drinks, fruit-flavored drinks), ready-to-drink tea or coffee, sports and energy drinks, Asian specialty drinks.

increases in middle-income countries. The data suggest that in high-income countries intake of ready-to-consume snacks may remain static and that consumption of soft drinks may be past peak levels (Monteiro et al., 2013).

Many experts believe that the rapid expansion of ultra-processed foods, more so than any other subsystem with the agriculture and food system, is the major factor in the obesity epidemic. Studies that examine the impact of ultra-processed products on obesity and chronic non-communicable diseases show consistent results. In several countries, the level of consumption of ultra-processed products is tightly correlated with overall diet quality. Evidence from the U.S. shows that consumption of various ultra-processed products such as cookies, white bread, candy and desserts; sugar-sweetened drinks; processed meats; and French fries and potato chips is associated with weight gain in adults (Mozaffarian et al., 2011). Increase in fast-food sales predicts an increase in body mass in high income European, North American, and other countries of the Organisation for Economic Co-operation and Development (OECD) (De Vogli et al., 2014). An analysis covering 14 countries in Latin America showed a positive, strong, and significant association between prevalence of adult obesity and higher sales per capita of ultra-processed products (PAHO, 2015).

**Pathways to influence diet quality (with a focus on overweight):** There are three main avenues to address the adverse health effects prevalent in the food transformation subsystem: (1) increase market supply of fortified foods with adequate micronutrients; (2) build more awareness toward unhealthy ingredients for food processing, food, and products; and (3) incentivize product reformulation to reduce unhealthy ingredients in the processing stage.

1. **Increase market supply of fortified foods with adequate micronutrients:** Food fortification such as enriched flours or vegetable oil, iodized salt, or fortified complementary foods for infants is a targeted, convenient, and effective intervention to address micronutrient deficiency. A successful food fortification program requires cooperation between private companies and public food regulation agencies and ministries of health. The establishment of such a structure

could be beneficial for other nutrition interventions, for example for obesity prevention. Food fortification is complementary to bio-fortification. Food fortification is less effective at reaching rural populations who may process and consume more of their own production rather than purchasing from the marketplace, making bio-fortification particularly effective for the rural poor. However, neither food- nor bio-fortification itself has a direct link in addressing overweight.

2. **Build more awareness toward unhealthy ingredients for food processing, food, and products:** In the U.S., only 50 percent of adults always or most of the time look at nutrition labels. For those that rarely or never check the labels, the primary reason is because ‘they do not know what to look for even if they did look at it’ (Food and Drug Administration, FDA, 2016). Experts advise that nutrition labels can be an important tool in raising awareness among consumers as long as they are easy to understand. Examples of innovative and user-friendly labelling include the traffic signal labelling system developed by the U.K. Food Standards Agency. The system uses green, amber and red signals to show consumers whether a product is high, medium or low in fat, saturated fat, salt, sugar and, ideally, energy (in calories). In 2016, Chile implemented a new food labeling law that requires packaged foods to display a black stop sign label with large letters warning, such as “High in fats,” when products exceed the following per 100 grams: 275 calories, 400 milligrams of salt, 10 grams of sugar, or 4 grams of saturated fats. Commercial hooks such as toys, accessories, stickers or similar incentives are also banned.

Another important tool that can be improved to increase its efficacy is the national dietary guidelines. Dietary guidelines provide advice on foods, food groups and dietary patterns to provide the required nutrients to the general public to promote overall health and prevent chronic diseases. Development of these guidelines has been expanding to more than 100 countries although progress is still lagging in Africa (only five countries have guidelines: Benin, Namibia, Nigeria, Seychelles, and

South Africa).<sup>29</sup> Although the guidelines reflect locally available and consumed foods, they typically offer guidance in terms of raw food ingredients (food groups such as vegetables, fruits, grains, and protein) and do not provide ample guidance on how to choose among the wide array of processed foods. Guidelines need to reflect the reality of heightened consumption of ultra-processed foods. Brazil's dietary guideline is an anomaly in that it clearly advises to 'avoid ultra-processed foods', and instead advises to 'make natural or minimally processed foods the basis of your diet.' (Brazil Ministry of Health, 2014).

- 3. Incentivize product reformulation to reduce unhealthy ingredients in the processing stage:** Food processing actions target mainly industrially produced trans fats and sodium. There are two main approaches: legislative limits (or bans) of these ingredients allowed in food, or voluntary self-regulation. Product reformulation is usually led by voluntary self-regulation by the food industry (typically framed as a socially responsible industry practice) to reformulate their products, within a framework established by national strategies or health guidelines established by the government. Often, they are implemented as a compromise or substitute to outright regulations that the food industry opposes. There are examples of product reformulation, mainly in the U.S. and Europe, most commonly to reduce sodium content and trans fats. Less common initiatives involve reducing sugar content or reducing portion size of processed foods. Typically, these initiatives are led by private companies within a framework established by governments. For example, in the case of salt a high majority (81 percent) of national salt reduction strategies include industry engagement to reduce the salt content of products. Globally, bread is the most targeted food for reformulation followed by foods such as bakery products, processed meats, dairy products, sauces and convenience meals. Thirty-six countries have

taken the next step to establish voluntary sodium content targets for foods and meals. Furthermore, nine countries have mandated maximum sodium content limits for products. Whilst these are mostly for bread, Argentina, Bulgaria, Greece and South Africa have additional limits for other foods (Trieu et al., 2015). Reducing sugar has seen less progress given the technical challenges of simply reducing sugar in processed foods. Sugar plays a wider role than just providing the sweet taste; it provides bulk, density, and viscosity (thickness) in food products, and with a reduced amount of sugar, products often lack the taste, mouth feel, bulk, shelf life, and other attributes of the original product. Very recently Nestlé announced that it has developed a way of restructuring sugar, allowing the company to reduce the amount of sugar in its candy products, and that the new sugar could be introduced in their products starting in 2018.<sup>30</sup>

## ROLE OF THE FOOD RETAIL AND PROVISIONING SUBSYSTEM (RETAIL LEVEL)

**Background:** Most food is purchased at market-based formal and informal retail outlets such as markets (traditional wet markets and modern supermarkets), street vendors or restaurants. Another channel for food provision is the public procurement system where the government purchases food and provides meals for institutions such as state-run schools, hospitals or prisons. Retailers and governments (in the case of public procurement of food) can play a role in promoting quality diets by what they sell and how they position certain foods. This subsystem is closer to the actual consumption point, and thus is arguably the most effective in changing the food environment and consumption behavior that lead to obesity.

The three basic thrusts for improving diet quality at the retail level are: (1) build more awareness toward healthy eating in general; (2) disincentivize the consumption of unhealthy food; and (3) regulate or limit access to

<sup>29</sup> <http://www.fao.org/nutrition/education/food-dietary-guidelines/en/>

<sup>30</sup> [https://www.nytimes.com/2016/11/30/business/nestle-reformulates-sugar-so-it-can-use-less.html?\\_r=0](https://www.nytimes.com/2016/11/30/business/nestle-reformulates-sugar-so-it-can-use-less.html?_r=0)

unhealthy foods through voluntary industry measures or government regulations.

1. **Build more awareness toward healthy eating:**

Governments should lead efforts to build community-wide awareness toward healthy eating. Developing a standardized nutrition labeling system that is easy to understand is one important tool (discussed in the previous section on the transformation subsystem). WHO (2017) recommends implementing mass media campaigns on healthy diets, including social marketing to reduce the intake of total fat, saturated fats, sugars and salt, and promote the intake of fruits and vegetables. Documented success tends to be in those targeted at children whose behaviors can be modified easier than adults (Walls et al., 2011). The innovative Brazilian dietary guidelines include a suggestion that people develop culinary skills because not having them causes people to rely on super processed foods and increase eating away from home (Brazil Ministry of Health, 2014), which has been shown to be positively correlated with high caloric intake (Mancino et al., 2009). A systematic review of cooking classes on children's food related preferences, attitudes, and behaviors showed significant improvements in at least one criteria such as willingness to try fruits and vegetables, and fruit and vegetable consumption, as reported by their parents (Hersch, 2014). A similar review of cooking classes for adults also showed positive outcomes in terms of improved dietary intake in key nutrients and health outcomes such as reductions in serum cholesterol levels (Reicks et al., 2014).

2. **Disincentivize the consumption of unhealthy foods through taxes:**

Although designing a tax on unhealthy foods is highly complicated and could incur unintended consequences, the most common case of disincentivizing the consumption of unhealthy foods through market measures is the taxation of sugar sweetened beverages. This is included as a recommendation in the 2016 final report of the WHO Commission on Ending Childhood Obesity (WHO, 2016) and is implemented in many countries beginning in France in

2012. Despite oppositions by the beverage industry, it has since spread to many European countries, major cities in the U.S.,<sup>31</sup> as well as some middle-income countries like Mexico and South Africa and some Pacific Island countries. Numerous studies have found that such taxes reduce the consumption of sugar sweetened beverages.<sup>32</sup> Other less common taxes on a broader category of unhealthy food is the example of taxing 'junk foods', such as taxing foods that have high levels of fats or added sugar. In 2011, Denmark instituted the world's first 'fat tax' on any food item with more than 2.3 percent saturated fat. However, this tax was repealed within a year since consumers simply circumvented the tax by purchasing the products across the border in Germany and Sweden. Hungary currently has a tax on packaged foods high in fat, salt or sugar. Although the effect of a tax depends on its design, taxing junk food is more difficult than taxing soda because not all fats are unhealthy, and taxing foods according to fat content would lead to items such as nuts incurring very high taxes. Also since manufacturers regularly update and modify the production processes of certain foods, taxing junk food would create a perpetual situation of governmental catch-up, reevaluation and alteration of tax rates in an attempt to keep up with production changes (Franck et al., 2013).

Some countries are known to have extensive untargeted food subsidy programs as part of their social safety nets. The Middle East and North Africa region has historically maintained such food subsidies where they cost an average of 1 percent of GDP. In some countries, like Egypt, the cost is even higher at about 2.5 percent of their GDP (Sdrulevich et al., 2014). The program provides Baladi bread, vegetable oil, and sugar at

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<sup>31</sup> In 2009, the Obama Administration explored levying an excise tax on sweetened beverages as part of health care reform efforts, but the proposal was abandoned after heavy lobbying by the beverage industry (<http://articles.latimes.com/2010/feb/07/nation/la-na-soda-tax7-2010feb07>).

<sup>32</sup> In 2016, a study of the Mexico case found that annual sales of sodas in Mexico declined 6 percent in 2014 after the introduction of the soda tax and monthly sales figures for December 2014 were down 12 percent on the previous two years (Colchero et al., 2016)

subsidized prices to the vast majority of the population. Although this program was never designed to improve the nutrition status of its beneficiaries, it has actually been found to lead to higher rates of overweight among recipients. Egypt today has one of the highest female overweight rates in the world, affecting 85 percent of all (nonpregnant) ever-married women 15–49 years of age, while almost 40 percent are obese. A 2016 IFPRI study found that the probability of child overweight and the probability of maternal overweight increase with the subsidy levels that the families acquire from the program, and shows clearly that incentivizing overconsumption of cheap, calorie-rich foods and unbalanced diets creates an incentive for excess consumption that leads to overweight (Ecker et al., 2016). Many attempts have been made to reform the food subsidy programs in countries mainly with the objective of decreasing the government’s fiscal burden, and not for its negative nutritional effects. Such reform attempts have rarely been successful due to the fact that they are part of the social safety net and hugely popular with the public.

In instances where the government provides food in public institutions, it has more control over nutritional aspects such as content, menu formulation, pricing, and portion size. For example, adjusting school meal guidelines to ensure optimal nutrition practices are in place is a good entry point. However, in reality political pressure can be strong to adjust large procurement programs such as national school meals. In the U.S., for example, the Department of Agriculture recently finalized comprehensive new school meal guidelines that increased vegetables, fruit, and whole grains and curbed sodium, saturated fat, and trans fat. But due to political pressures, the agency was not able to fully implement the meal guidelines recommended by an expert panel at the Institute of Medicine (Lagarde, 2008). Also, even when appropriate guidelines are in place challenges for implementation still exist such as budgeting for the higher costs of purchasing and preparing more healthful foods and coaxing children to accept the more healthful options that they may not be familiar with.

**3. Regulate or limit access to unhealthy foods:** Evidence is weak on the efficacy of existing self-regulation in the food industry (sometimes under corporate social responsibility), which is mainly targeted at children (Sharma et al., 2010; Huizinga and Kruse, 2016).<sup>33</sup> Many of the existing regulations have been criticized as being intentionally vague and permissive, making their implementation difficult to monitor and lacking in credible complaint, adjudication, investigation and sanctions mechanisms, and some caution against repeating the disastrous experience of industry self-regulation by tobacco companies to prevent smoking to youths.<sup>34</sup> Thus, evidence to date shows that voluntary measures by the food industry itself is a highly risky approach and should be accompanied by other measures including regulatory actions by the government to enforce certain restrictions.

Given the inherent conflict of interest that resides with food industry companies regulating themselves, governments should foster a collaborative working relationship that includes not only the food industry but also third party civil society groups. A key player would be consumer organizations, which are advocacy groups that seek to protect people from corporate abuse such as unsafe products, predatory lending, and false advertising. They exist in many countries around the world. Consumers International is an international nongovernmental organization (NGO) that represents 240 organizations in 120 countries and already does work in the food arena.<sup>35</sup> Other key players include

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<sup>33</sup> Examples include the 2006 Alliance for a Healthier Generation by Coca-Cola, PepsiCo, and Cadbury Schweppes that adopted School Beverage Guidelines, which regulates the size and contents of beverages sold at schools; the 2007 Children’s Food and Beverage Advertising Initiative by 15 leading food and beverage companies to devote no less than 50 percent of their child-directed advertising to the promotion of “healthier dietary choices and/or to messages that encourage good nutrition or healthy lifestyles”; the 2009 initiative by Disney and Nickelodeon to discontinue the use of their names and licensed characters on packaging for foods that do not meet their self-defined criteria for healthier food (Sharma et al., 2010).

<sup>34</sup> Brownell and Warner, 2009 lay out similarities between self-regulatory actions taken by the tobacco industry and those taken by the food industry today.

<sup>35</sup> Consumers International has a recommendation towards a Global Convention to protect and promote healthy diets. The suggested actions include: establishing and implementing national evidence-based nutrient recommendations and food-based dietary guidelines (FBDGs); food and nutrition knowledge and skills training in primary and secondary school education programs; clear infor-

### BOX 3. TOP COMPANIES INCORPORATING NUTRITION CONSIDERATIONS IN THEIR BUSINESS MODELS

The Access to Nutrition Index rates food and beverage manufacturers' nutrition related policies, practices and disclosures worldwide on a recurring basis, and publishes results every year. The first Global Index was launched in 2013, and the second Global Index in January 2016.

The top three companies in the 2016 Index are Unilever, Nestlé and Danone, which also led the Index in 2013. The report states: "Although all companies still have a long way to go, Unilever, Nestlé and Danone have clearly embedded a commitment to addressing global nutrition challenges into their core business models; commitments are translated into practice and reported on publicly. This is commendable. It should be regarded as an example of best practice and as a guide to improvement for other companies. Unilever leads with regards to providing healthier products to consumers worldwide. The company has a strong Nutrient Profiling System (NPS) against which the global product portfolio is checked for levels of key nutrients. Nestlé stands out with a clear corporate nutrition strategy that is approved at the highest levels of the company and includes a comprehensive set of objectives that cover the reformulation of products to make them healthier, access to healthy foods and responsible marketing. Danone remains relatively strong in including nutrition in its business strategies as well as its processes. It leads for including affordability considerations in its product Research & Development (R&D) programs, and for stakeholder engagement. However, Danone dropped in the overall rankings mostly because the company's nutrition targets for the next few years had not yet been published at the time of the research for this report."

Source: <https://www.accesstonutrition.org/sites/in16.atnindex.org/files/resources/atni-global-index-2016.pdf>

health policy organizations such as the Access to Nutrition Index (ATNI) that compiles objective ranking of large food and beverage companies on their policies and practices towards nutrition<sup>36</sup> (Box 3). This approach also models success in other sectors with wider public/private participation in governance like the Forest Stewardship Council or the Marine Stewardship Council (Sharma et al., 2010).

Governments have traditionally been granted authority to reduce risks posed by unsafe foods, for example in connection to foodborne diseases. As the obesity epidemic continues, and the cost of obesity prevention and care rises, more governments are expanding this authority to target foods that are closely linked to obesity and associated diseases. One such example is the restriction on trans fats, which began in 2003 in Denmark. Trans fats are formed through an industrial process that adds

hydrogen to vegetable oil, which causes the oil to become solid at room temperature.<sup>37</sup> It is less likely to spoil, so foods made with it have a longer shelf life. Trans fats are now virtually banned in several European countries, the U.S. (starting in 2018), and in some middle-income countries like Argentina, Brazil, Chile, and South Africa. In these countries, the bans were typically preceded by an earlier regulation requiring manufacturers to clearly label the existence of trans fats on their packaging, which helps to raise public awareness as well as give manufacturers time to adjust their product formulations. Other examples include the active role of governments in reducing salt intake. An area where government regulation could play an important role, yet has not to date, except for the new law implemented in Chile from 2016, is on regulating marketing of unhealthy food to children (advertisements, product placements, etc.).

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mation about the nutritional quality of a food or beverage product at the point of choice; restricting advertising, promotion and sponsorship in order to protect children from exposure to the promotion of unhealthy food and beverage products; and removing all artificial trans fats from food and beverage products sold within their jurisdiction (Consumers International, 2014).

<sup>36</sup> The ATNI global index was founded by The Global Alliance for Improved Nutrition in 2009, and subsequently launched as an independent nonprofit organization in 2013. It is funded by the Bill & Melinda Gates Foundation, the Wellcome Trust and the Children's Investment Fund Foundation. The index ranks the world's largest 20 food and beverage companies' nutrition related policies, procedures and disclosures. <https://www.accesstonutrition.org/global-index/homepage-global-index>

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<sup>37</sup> Trans fats are contained in: **Baked goods:** Most cakes, cookies, pie crusts and crackers contain shortening, which is usually made from partially hydrogenated vegetable oil. Ready-made frosting is another source of trans fat. **Snacks:** Potato, corn and tortilla chips often contain trans fat. And while popcorn can be a healthy snack, many types of packaged or microwave popcorn use trans fat to help cook or flavor the popcorn. **Fried food:** Foods that require deep frying—french fries, doughnuts and fried chicken—can contain trans fat from the oil used in the cooking process. **Refrigerator dough:** Products such as canned biscuits and cinnamon rolls often contain trans fat, as do frozen pizza crusts. **Creamer and margarine:** Nondairy coffee creamer and stick margarines also may contain partially hydrogenated vegetable oils. (Mayo Clinic)



## CONCLUSIONS



The Agriculture GP has made great strides in internalizing and acting on the nutrition sensitive agriculture agenda designed to address the undernutrition and micronutrient deficiency challenges. Embracing the challenge of overweight and obesity is a natural next step given that the role and responsibility of agriculture and food systems is to deliver safe, diversified, and healthy diets for all.

Preventing obesity and improving other forms of malnutrition can best be achieved by one common approach—the promotion of a high quality diversified diet. Actions and policies that support the provision of and access to a safe, diversified and healthy diet should be supported continuously across the entire food system as countries transition from focusing on undernutrition to overlapping malnutrition problems increasingly including overweight and obesity.

As demonstrated, actions adopted in the food storage, transport and trade subsystem to improve diet quality are also interventions that are undertaken for more conventional objectives of raising profitability of the value chain. In other subsystems new or customized actions are needed, as for instance in the agricultural research and production subsystem where actions to maximize profitability are not aligned with improving diet quality, and in the food retail and provisioning subsystem, where traditionally the Agriculture GP has been less active.

The remainder of this section will list entry points for actions, discuss what is needed to translate them into policy dialogue between the Agriculture GP teams and country clients to enable future action, and list areas for possible future research. Some of the listed interventions can be discussed with and undertaken by the ministry of agriculture in client countries, while others require multi- and cross-sectoral cooperation among ministries and agencies responsible for health, gender, trade, transport, and more. The need for collaboration across boundaries is further reinforced by the impact on overall diet quality, obesity, and chronic noncommunicable diseases of the level of consumption of ultra-processed products. Partnerships between the Agriculture GP and the WBG's International Finance Corporation (IFC), the private sector, and civil society are just a few that need to be pursued in order to influence that part of the food system.

## ENTRY POINTS FOR POSSIBLE ACTION

Evidence-based interventions in the different sub-systems examined in this report that support the goal of improving diet quality, with a focus on overweight, but not exclusively so are presented in the following tables. This choice of presentation is couched upon the realization that many of the suggested actions for reducing overweight and obesity also serve the purpose of reducing undernutrition and/or micronutrient deficiency. The tables indicate what

interventions are already being undertaken against undernutrition and micronutrient deficiencies to illustrate the interventions that generate the greatest joint benefits; and they also show what policy action of the NOURISHING Framework they correspond to. It is also important to note that in contrast to experience within the agriculture and food systems domain, where evidence of impact is still being generated, there is ample evidence for interventions to control and prevent obesity outside this domain that this report is not covering.

### ACTIONS IN THE PRODUCTION SUBSYSTEM THAT SUPPORT THE GOAL OF IMPROVING DIET QUALITY (with a focus on overweight)

Goal	Examples of Actions	Main Nutrition Challenges	NOURISHING Framework	Notes indicate association, if any, with overweight/obesity
<b>(a) Actions in the agricultural research subsystem that support the goal of improving diet quality</b>				
Incentivize more public sector research on high quality and underserved foods (legumes, fruits, vegetables) to increase productivity and shift relative prices	Increase targeted public research	M, O	I, H, G	Half of CGIAR research funding in 2012 was allocated to rice and maize. While livestock, fish and some pulses received some allocation, research for fruits and vegetables (except for bananas) was minimal (Glopan, 2016). Further support work of World Vegetable Center and Global Horticultural Initiative.
	Develop new metrics in agriculture that measure aspects related to nutrition	U, M, O	I, H	Examples include (1) an alternative to standard yields (nutrient content per unit of land or labor) and (2) minimum cost of a quality diet.
Ensure that cereal research and provision on inputs includes a nutrition focus, and not just a yield focus; and that results are communicated to producers		U, M	S, I, G	This type of intervention is effective in addressing widespread hunger and micronutrient deficiency. A singular focus on yield only can be detrimental as it can contribute to overweight.
	Disseminate research results to farmers through agriculture extension workers, and utilize ICT, where needed	U, M	I, G, H	Agriculture extension systems have been used to disseminate messages related to undernutrition and micronutrient deficiencies, and often in collaboration with the health community. They have not been used to convey messages related to overweight/obesity. Presumably, that could happen.

Goal	Examples of Actions	Main Nutrition Challenges	NOURISHING Framework	Notes indicate association, if any, with overweight/obesity
Encourage private sector advances in research favoring high quality and underserved foods.	Governments can promote research on high quality and underserved foods through the private sector through competitive research grants or other services	M, O	I, S	Glopan (2016) reports that approximately 45 percent of private sector research investment focuses only on maize, while other crops receive relatively little.
<b>(b) Actions in the production subsystem that support the goal of improving diet quality</b>				
Ensure that bio-fortified cereals are the norm, where they are available and agronomically competitive, rather than the exception	Bio-fortification	M	I	This involves breeding micronutrients into commonly consumed staples such as corn, wheat, and rice. Some target crops are within the underserved nutritious food groups that affect overweight, like beans, cassava, OFSP, and pearl millet but most the efforts are for staples.
Eliminate subsidies and other production/price support measures for production of unhealthy ingredients for food processing		O	U, I, S	In the U.S., corn is the most heavily subsidized crop (US\$94 billion over 2005–14). <sup>38</sup> This coupled with high U.S. sugar prices (due to import tariffs and producer support) has boosted production of HFCS.
Encourage production (and consumption) of fruits, vegetables and pulses	Increase targeted production subsidy	M, O	I	Given the high heterogeneity of fruits and vegetables, designing a targeted production subsidy could be difficult. However, pulses could be included in commodity crop support programs that exist in many countries. <sup>39</sup>
	Increase public sector investments in research and technology, and in infrastructure to produce, store, transport, and distribute, as well as trade	M, O	I, S	(Examined under other subsystems); Self production and trade are two ways to increase diversity of food supply.  A recent cross-country study <sup>40</sup> cited in the Glopan Foresight Report (2016) found that while food imports are associated with a more diverse food supply in high- and middle-income countries, the diversity of agricultural goods produced by a country is the stronger variable in low-income countries.

(continued)

<sup>38</sup> <https://farm.ewg.org/region.php?fips=0000>

<sup>39</sup> In the U.S., selected pulse crops (dry peas, lentils, and small and large chickpeas) became eligible for some commodity programs under the 2002 Farm Bill, and coverage for these pulse crops continues under the 2014 Farm Bill through the Agricultural Risk Coverage (ARC) and Price Loss Coverage (PLC) programs as well as through the marketing loan program (<https://www.ers.usda.gov/topics/crops/vegetables-pulses/policy/>).

<sup>40</sup> Remans, R., Wood, S. A., Saha, N., Anderman, T. L., and Defries, S. A. 2014. Measuring nutritional diversity of national food supplies. *Global Food Security*, 3, 174–182, <http://dx.doi.org/10.1016/j.gfs.2014.07.001>

Goal	Examples of Actions	Main Nutrition Challenges	NOURISHING Framework	Notes indicate association, if any, with overweight/obesity
	Increase demand for diversified and high-quality foods through nutrition education, including through agricultural extension, (importance of vitamins and minerals, food preparation, preservation, etc.)	M, O	I, G	A commonly promoted intervention to address undernutrition, and micronutrient deficiencies which will also have benefits for overweight. Tends to focus on women.

Note 1: U = undernutrition, M = micronutrient deficiency, O = overweight/obesity.

Note 2: Each letter in the word NOURISHING represents one of ten actions that governments can take:

N = Nutrition label standards and regulations on the use of claims and implied claims on food

O = Offer healthy food and set standards in public institutions and other specific settings

U = Use economic tools to address food affordability and purchase incentives

R = Restrict food advertising and other forms of commercial promotion

I = Improve nutritional quality of the whole food supply

S = Set incentives and rules to create a healthy retail and food service environment

H = Harness food supply chain and actions across sectors to ensure coherence with health

I = Inform people about food and nutrition through public awareness

N = Nutrition advice and counseling in health care settings

G = Give nutrition education and skills

## ACTIONS IN THE FOOD STORAGE, TRANSPORT AND TRADE SUBSYSTEM THAT SUPPORT THE GOAL OF IMPROVING DIET QUALITY (with a focus on overweight)

Goal	Examples of Actions	Main Nutrition Challenges	NOURISHING Framework	Notes indicate association, if any, with overweight/obesity
Reduce food loss and waste of underserved nutritious food groups (especially fruits, vegetables, pulses, poultry, fish)	Improve rural roads and rural energy development (grid and off-grid sources)	U, M, O	Not applicable	This is a broad-stroke action that will support a wide range of rural development objectives, including, but not limited to reducing overweight.
	Implement logistical upgrades, including cold chain infrastructure (cold storage, refrigerated transport, freezing facilities, etc.), and preservation technology such as drying, packaging, etc.	M, O	Not applicable	A commonly promoted intervention to address horticultural development thereby increasing the supply of fruits and vegetables.

Goal	Examples of Actions	Main Nutrition Challenges	NOURISHING Framework	Notes indicate association, if any, with overweight/obesity
	Adapt new agricultural technologies, such as aeroponics and hydroponics for vegetable production, in developing countries enabling production in urban centers and reducing the need for cold chains and transportation, where losses appear	M, O	Not applicable	
Use trade to improve the quality of the local diet	<p>Raise import duties for ingredients for food processing</p> <p>Remove import duties from ‘underserved nutritious food groups’</p>	O	U, S	<p>Evidence seems to suggest trade is a strong predictor for diversity of food supply only in middle- and high-income countries.</p> <p>As import bans are forbidden by WTO rules, countries are advised to seek alternative measures. Suggestions include involving health professionals in negotiations of trade agreements (Snowdon and Thow, 2013), and/or seeking a collective approach through international institutions/organizations instead of undertaking unilateral country actions.</p>

Note 1: U = undernutrition, M = micronutrient deficiency, O = overweight/obesity.

Note 2: Each letter in the word NOURISHING represents one of ten actions that governments can take:

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G = Give nutrition education and skills

ACTIONS IN THE FOOD TRANSFORMATION SUBSYSTEM THAT SUPPORT THE GOAL OF IMPROVING DIET QUALITY (with a focus on overweight)

Goal	Examples of Actions	Main Nutrition Challenges	NOURISHING Framework	Notes indicate association, if any, with overweight/obesity
Increase market supply of fortified foods with adequate micronutrients	Food fortification	M	Not applicable	Not a direct tool for addressing overweight.
Build more awareness toward unhealthy ingredients for food processing, food, and products	Clear official nutrition labelling that is easy to understand	M, O	N	Nutrition labels must be easy to understand to help consumers choose.
	Dietary guidelines that go beyond raw ingredient food groups	M, O	I, G	Guidance should not just be in serving size of the various food groups. They should provide sufficient and easy to implement guidance that reflects the reality of high consumption of processed foods.
Incentivize product reformulation to reduce unhealthy ingredients in the processing stage (sugar/sweetener, sodium, trans fats, etc.)	Coordination with the food industry to foster voluntary product reformulation	O	O, U, S	Initiatives are primarily limited to the U.S. and Europe. Success has been reported in reducing salt and trans fat in product formulation. Reducing sugar has been more challenging due to technical difficulties.
	Activities to support food industry reformulation efforts (developing national strategies, public health campaigns to influence consumer demand, data collection, regulatory and legislative actions)	O	O, U, S, I	Successful private sector initiatives rely on a strong and coherent legislative framework.

Note 1: U = undernutrition, M = micronutrient deficiency, O = overweight/obesity.

Note 2: Each letter in the word NOURISHING represents one of ten actions that governments can take:

N = Nutrition label standards and regulations on the use of claims and implied claims on food

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G = Give nutrition education and skills

## ACTIONS IN THE FOOD RETAIL AND PROVISIONING SUBSYSTEM THAT SUPPORT THE GOAL OF IMPROVING DIET QUALITY (with a focus on overweight)

Goal	Examples of Actions	Main Nutrition Challenges	NOURISHING Framework	Notes indicate association, if any, with overweight/obesity
Build more awareness towards healthy eating	Comprehensive nutrient labelling	M, O	N	See discussion in the food transformation subsystem.
	Public health campaigns for healthy eating	M, O	I	Evidence is weak on its efficacy.
	Culinary education for children and adults	M, O	G	There are positive results that show that participation in cooking classes leads to changes in food consumption behavior (and some health changes).
Disincentivize consumption of unhealthy foods through taxes	(Market based measure) Implement tax on unhealthy foods such as sugar-sweetened beverages	O	U	Taxing sugar sweetened beverages is one of the recommendations by the WHO Commission on Ending Childhood Obesity (2016).
	(Market based measure) Remove distortive food subsidy policies		U, S	Food subsidies, where they exist, are part of a social safety net. Subsidized food items are typically staples or imported food items such as oils and sugar. Nutrition considerations are usually not taken into account.
	(Public procurement) Adjust school meals	O	O	Adjustment should be to increase content of healthy underserved nutritious food groups while limiting unhealthy goods.
Regulate consumption or limit access of unhealthy foods	Coordination with the food industry as they develop voluntary measures	O	I, S	The track record of successful self-regulation by the food industry is poor.
	Foster engagement with third-party civil organizations to monitor private sector activities	O	S, I	Government should foster a collaborative platform that includes the food industry and third-party civil society groups such as consumer protection organizations and food policy research organizations.
	Regulatory and legislative actions	O	S	Trans fat bans are spreading globally as are salt reduction mandates. Other areas show little progress, such as limits on advertisement of unhealthy foods and beverages toward children in media outlets.

*Note 1:* U = undernutrition, M = micronutrient deficiency, O = overweight/obesity.

*Note 2:* Each letter in the word NOURISHING represents one of ten actions that governments can take:

N = Nutrition label standards and regulations on the use of claims and implied claims on food

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## FUTURE RESEARCH

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In contrast to other domains affecting obesity where there is ample evidence for interventions that control and prevent obesity, evidence of impact in the agriculture and food systems domain is still being generated. This report and the peer review process have identified possible topics for further examination. These are:

- » Research the changing economic determinants of food choices (increasing price of unhealthy foods and beverages, decreasing the price of healthy foods) to address high prevalence of obesity in specific population groups. This may include research into agriculture policy and food policy biases which have contributed to a large growth in available low-cost, energy-dense food ingredients. Such policy biases as well as other factors (e.g., the state of physical infrastructure, strength of logistical services, value addition and profit considerations by food companies) have, in many countries, resulted in a pattern of relative consumer food prices which tilts purchasing behavior toward high energy foods and away from higher nutrient foods.
- » Assess role of food processing industries (i.e., industries that purchase raw farm commodities). Saturated high-income country markets, combined with urbanization/income growth/lifestyle changes in low-/middle-income countries have led to a geographic redistribution of food/beverage processing and processed food distribution activities among major international companies. Precisely the same factors, and trade liberalization processes, have driven a geographical redistribution of fast-food operations by global/regional players—through

franchising and other means. In middle-income countries the most dynamic, fast growing segment of the consumer food market has become that for snacks, beverages and confectionary.

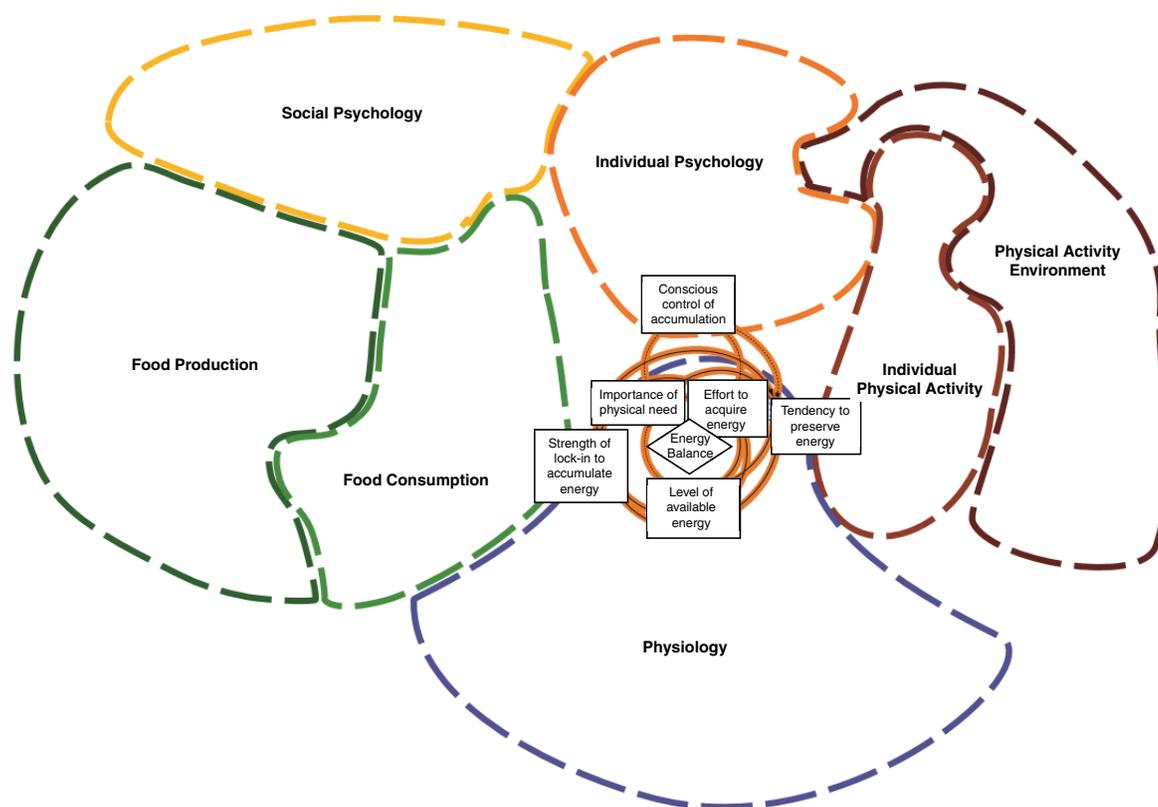
- » Assess role of retail structures (e.g., supermarkets etc.). The spread of super/hypermarket development in the urban areas of developing countries has provided an improved vehicle for the mass distribution of locally produced or imported processed foods. There has been a growth in the commercialization of work and school canteen food distribution systems which often has not resulted in improved dietary offerings. The increased connectivity of populations—via cell phones, television, radio, etc., has increased the range of means by which branded foods have been advertised.
- » Identify where households do not have access to diverse foods, mainly fruits/vegetables, both in terms of quantity and relative prices. These areas are where opportunities may exist for promoting food production in order to bring prices down, and/or supply markets (jointly with efforts to increase demand). This could be done through analysis of relative prices of food products across different countries/regions to see where the imbalances are in food availability costs according to a balanced diet.

While the contribution of energy/food supply and availability to overweight and obesity is not disputed, preventing overweight and obesity through interventions in the agriculture and food systems is a new challenge. Any contributions to the evidence base are valuable and will help to shape our engagement.

## ANNEX 1

# THE FULL OBESITY SYSTEM MAP FROM THE UK GOVERNMENT FORESIGHT REPORT

The Foresight Obesity System Map identifies 108 separate factors (variables) in seven (7) individual and population-level clusters (physiology, individual activity, physical activity environment, food consumption, food production, individual psychology, and social psychology) that directly and indirectly affect the core equation of energy balance (energy intake vs. energy expenditure)<sup>41</sup> (Butland et al., 2007).



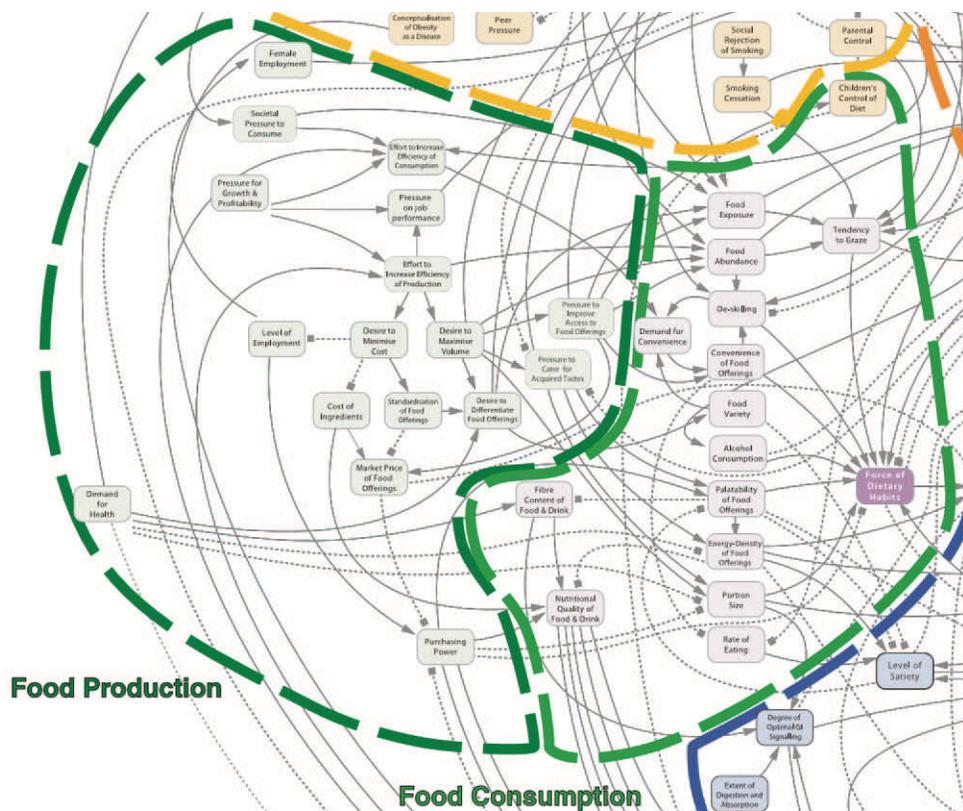
<sup>41</sup> At the core of the Obesity System Map is “energy balance” (energy intake vs. energy expenditure), also referred to as the engine, or core engine.



# ANNEX 2

## FOOD PRODUCTION AND FOOD CONSUMPTION CLUSTERS OF THE OBESITY SYSTEM MAP

Variables in each cluster interact with each other, and with variables in other clusters through a web of causal relationships referred to as “feedback loops,” and are represented by arrows in the visual below.



Source: Full Generic Map (p. 12). [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/295153/07-1177-obesity-system-atlas.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/295153/07-1177-obesity-system-atlas.pdf)

There are four key variables affecting the core system engine, i.e., energy intake vs. energy expenditure. The “force of dietary habits” is the key factor associated with the food production and consumption clusters collectively referred to as the food environment in the System Map.<sup>42</sup> The authors identify the “pressure for growth and profitability” of the food industry as the contextual anchor for the food production cluster, driving a set of variables that make up the industry’s business model. Specifically, these aspects are: (level of) effort to increase efficiency of production; desire to minimize cost; desire to maximize volume (sold); pressure to improve access to food offerings; pressure to cater for acquired tastes; cost of ingredients; (level of) standardization of food offerings; and desire to differentiate offerings. These aspects affect the “market price of food offerings,” which according to the Obesity System Map, act as the defining link between the food production cluster and the System’s core equation of energy balance.

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<sup>42</sup>The other three are: psychological ambivalence (under the psychology cluster); degree of primary appetite control (physiology cluster), and level of physical activity (physical activity cluster).

In other words, if the market price of food decreases, this reinforces the ingrained human mechanism to acquire and preserve energy in what the System Map’s authors describe as a (negative) “lock-in” (Vandenbroeck et al., 2007). Three sets of variables are at play in the food consumption cluster, at the center of which rests the “force of dietary habits” which feeds into the System’s core energy balance. One set relates to the food market, and comprises the (level of) food abundance in the market, (level of) food exposure (or pervasiveness of food products), and (level of) food variety. These variables are influenced from forces at play in the food production cluster. The (level of) fiber content of food and drink, nutritional quality of food and drink, palatability of food offerings, energy density of food offerings, and portion size constitute the second set of variables collectively known as “(health) characteristics of food products.” This set affects the “force of dietary habits” and the level of satiety (found in the physiology cluster). A final variable on its own is the rate of eating (speed at which people take their meals) constitutes the third set, and positively affects the level of satiety (Vandenbroeck et al., 2007).

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1818 H Street, NW  
Washington, D.C. 20433 USA  
Telephone: 202-473-1000  
Internet: [www.worldbank.org/agriculture](http://www.worldbank.org/agriculture)  
Twitter: @WBG\_agriculture