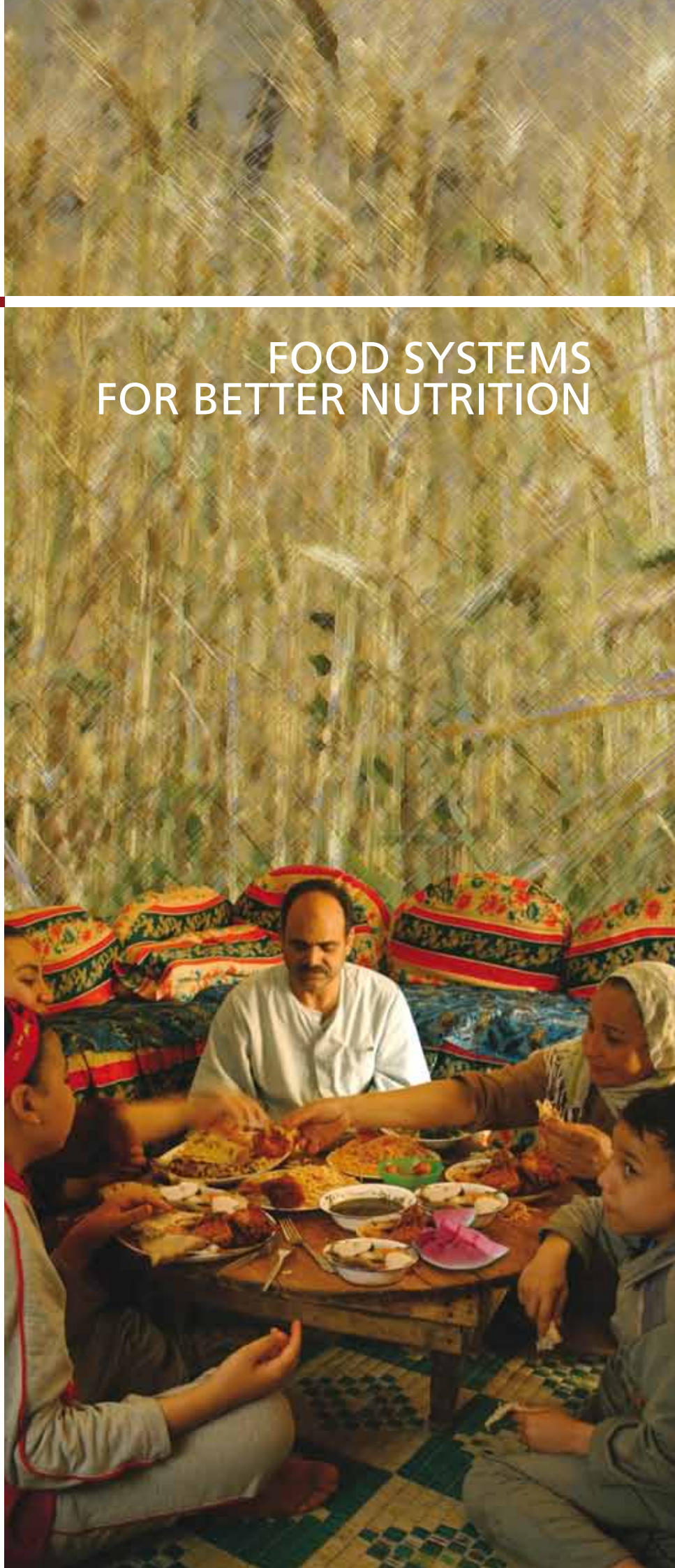
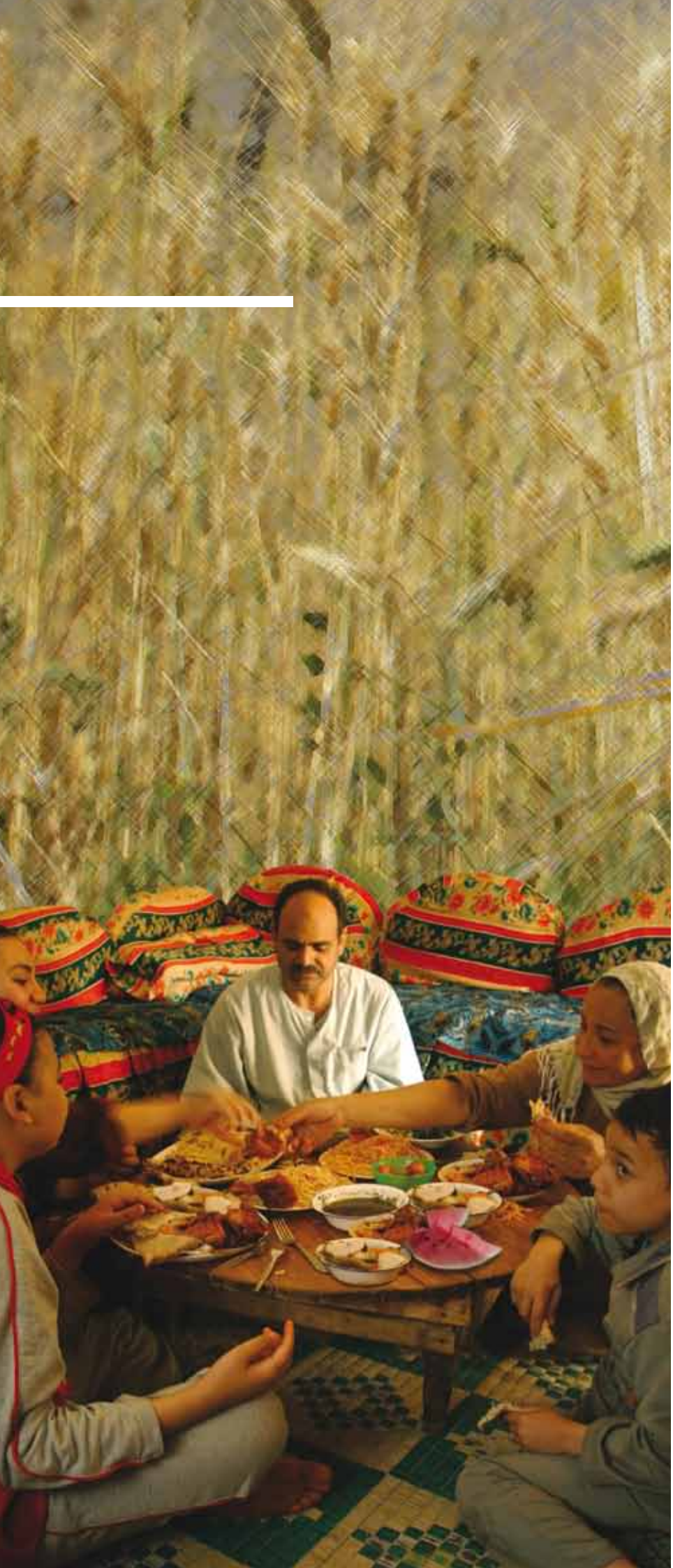
FOOD SYSTEMS FOR BETTER NUTRITION





1. The role of food systems in nutrition

Malnutrition in all its forms[1] – undernutrition, micronutrient deficiencies, and overweight and obesity – imposes high economic and social costs on countries at all income levels. This edition of *The State of Food and Agriculture* makes the case that food systems[2] – from agricultural inputs and production; through processing, marketing and retailing, to consumption – can promote more nutritious and sustainable diets for everyone.

The first edition of *The State of Food and Agriculture*, published in 1947, reported that about half of the world's population was chronically malnourished, considered at that time primarily in terms of inadequate energy consumption. FAO's latest estimates indicate that the proportion of the world's population suffering from undernourishment has declined to 12.5 percent; this is a remarkable achievement, yet 868 million people remain undernourished in terms of energy consumption and an estimated 2 billion people suffer from one or more micronutrient deficiencies (FAO, IFAD and WFP, 2012). Twenty-six percent of all children under the age of five are stunted and 31 percent suffer from vitamin A deficiency, while an estimated 1.4 billion people are overweight, of whom 500 million are obese (WHO, 2013a).

Food systems around the world are diverse and changing rapidly, with profound implications for diets and nutritional outcomes. Since 1947, food systems have become more industrial, commercial and global. The substitution of mechanical, chemical and biological technologies for land and labour in agricultural production has unleashed processes of productivity growth, economic development and social transformation that are being felt around the world. Commercialization and specialization in agricultural production, processing and retailing have enhanced efficiency throughout the food system and increased the year-round availability and affordability of a diverse range of foods for most consumers in the world. At the same time, concerns are mounting about the sustainability of current consumption and production patterns, and their implications for nutritional outcomes (Box 1).

While the nature and causes of malnutrition are complex, the common denominator among all types of malnutrition is a nutritionally inappropriate diet. The potential of food systems to contribute to the eradication of malnutrition goes beyond the fundamental role of agriculture in producing food and generating income. Of course, addressing malnutrition requires interventions not only in the food system, but also in the health, sanitation, education and other sectors. Integrated actions are needed across the health, education and agriculture sectors.

[1] Malnutrition is defined in detail at the start of Chapter 2.

[2] Food systems encompass the entire range of activities involved in the production, processing, marketing, consumption and disposal of goods that originate from agriculture, forestry or fisheries, including the inputs needed and the outputs generated at each of these steps. Food systems also involve the people and institutions that initiate or inhibit change in the system as well as the socio-political, economic and technological environment in which these activities take place. Adapted from FAO (2012a).

BOX 1
Sustainable production and consumption

The importance of managing agricultural systems in a way that ensures the sustainability of natural resource use is already well established. Most of the focus has been on the production side, where the emphasis is on sustainable intensification that can close yield and productivity gaps in underperforming systems while reducing the negative and enhancing the positive environmental impacts of agriculture (FAO, 2011a). This focus on sustainable production continues to be of great importance for people whose consumption levels are insufficient to sustain a healthy and active life. But it is also recognized that the costs and benefits of a sustainable system must also be reflected in decisions made by consumers and producers, as well as policy-makers (FAO, 2012b).

Sustainable consumption is captured by the concept of sustainable diets, that is: "those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (Burlingame and Dernini, 2012, p. 7).

Sustainable diets imply a change in dietary preferences to reduce overconsumption and a shift to nutritious diets with lower environmental footprints. They also mean a reduction of losses and waste throughout the food system. Ultimately, the aim of a successful transition to healthier and sustainable diets is for people and the ecosystem to be healthier. Such profound changes are likely to require significant changes in the food systems themselves.

For the full values of natural resources and the environment to be paid by consumers and producers, these values should be embedded in the planning, institutions, technologies and value chains. There is a need to build consumer awareness through information and education, to remove subsidies that encourage unsustainable resource use and to use differential taxation to reflect the full value of natural resources. The many issues to be addressed include the role of livestock and fish in diets, the role of local and traded foods and the link between food and non-food agricultural products. Many of these issues are highly controversial because their implications extend beyond production and consumption to trade, and so they require dialogue and agreement among international stakeholders. Not all changes are controversial, however, for example the need to reduce losses and waste. Regardless, a transition to sustainable diets will have significant implications for producers, the food industry, consumers, land use and trade rules. These challenges require inclusive and evidence-based governance mechanisms that can address the many needs and trade-offs involved. There is currently little agreement either nationally or internationally on practical ways to implement the concept of sustainable diets (UNEP, 2012).

Why is nutrition important?

Good nutrition is the foundation for human health and well-being, physical and cognitive development, and economic productivity. Nutritional status is a critical indicator of overall human and economic development, and good nutritional status is an essential social benefit in its own right. As an input to social and economic development, good nutrition is the key to breaking intergenerational cycles of poverty, because good maternal nutrition produces healthier children, who grow into healthier adults. Good nutrition reduces disease and raises labour productivity and incomes, including of people working in agriculture.

Global losses in economic productivity due to undernutrition and micronutrient deficiencies have been estimated at more

than 10 percent of lifetime earnings and 2–3 percent of global gross domestic product (GDP) (World Bank, 2006a). The latter figure translates into a global cost of US$1.4–2.1 trillion.

At the same time, obesity is associated with lower labour productivity and higher medical costs arising from associated non-communicable chronic diseases, such as diabetes and heart disease (WHO, 2011a). A recent study estimates a cumulative output loss due to non-communicable diseases, for which overweight and obesity are key risk factors, of US$47 trillion over the next two decades; on an annual basis and assuming a 5 percent rate of inflation, this is equivalent to about US$1.4 trillion in 2010 (Bloom *et al.*, 2011).

No comprehensive global estimates exist for the productivity losses and health costs associated with all types of malnutrition and related diseases. The partial estimates reported above can be summed to provide a rough estimate of global costs. This approach suggests that malnutrition in all its forms may impose a cost of US$2.8–3.5 trillion, equivalent to 4–5 percent of global GDP, or US$400–500 per person.[3]

Investments in reducing micronutrient deficiencies would have high pay-offs. Deficiencies in micronutrients can slow intellectual and physical growth among children, reduce adult labour productivity and lead to disease, premature death and increased maternal mortality (UNICEF and The Micronutrient Initiative, 2004; Micronutrient Initiative, 2009). No global estimates of the economic costs of micronutrient deficiencies exist; however, addressing such deficiencies and their consequences is one of the most valuable investments society can make. The Copenhagen Consensus project, for example, which brings together world experts to consider the most cost-effective solutions to leading world problems, highlighted the provision of micronutrients as a cost-effective means to tackle the problem of malnutrition. Research showed that investing US$1.2 billion annually in micronutrient supplements, food fortification and biofortification of staple crops for five years would generate annual benefits of US$15.3 billion, a benefit-to-cost ratio of almost 13 to 1, and would result in better health, fewer deaths and increased future earnings (Micronutrient Initiative, 2009).

Malnutrition – whether undernutrition, micronutrient deficiencies or overweight and obesity – is caused by a complex interplay of economic, social, environmental and behavioural factors that prevent people from consuming and fully benefiting from healthy diets. The most immediate causes of undernutrition and micronutrient deficiencies are inadequate dietary intake and infectious disease. Inadequate dietary intake weakens the immune system and increases susceptibility to disease; infectious disease, in turn, increases nutrient requirements and further weakens the immune system. There are three underlying causes of this vicious cycle: (i) lack of availability or access to food (food insecurity); (ii) poor health mediated by poor water and sanitation and inadequate health services; and (iii), for children, poor maternal and child-care practices, including inadequate breastfeeding and nutritious complementary feeding and, for adults, poor food choices. Of course, deeper forces of social and economic underdevelopment and inequality often underpin these problems.

The most immediate cause of overweight and obesity is overconsumption of energy relative to physical requirements, yet nutritionists have long recognized that this does not explain why some people consume more than they need. The rapid increase in the prevalence of overweight and obesity in recent decades has prompted many explanations, including genetic predisposition, viral or bacteriological infections that alter energy requirements, endocrine disruptors, the use of certain pharmaceutical products, and social and economic factors that encourage overconsumption (Greenway, 2006; Keith *et al.*, 2006).[4] Changes in the food system since the mid-twentieth century have also been implicated, including lower real prices of food, changes in relative prices of different types of food and increased availability of highly processed, energy-dense, micronutrient-poor foods (Rosenheck, 2008; Popkin, Adair and Ng, 2012).

[3] US$1.4–2.1 trillion for undernutrition and micronutrient deficiencies plus US$1.4 trillion for non-communicable diseases equals US$2.8–3.5 trillion.

[4] Some of these are theories that have not yet been empirically substantiated.

Why focus on food systems to address malnutrition?

Nutritional outcomes depend on many factors, but food systems and the policies and institutions that shape them are a fundamental part of the equation. A common denominator across all types of malnutrition is the appropriateness of the diets consumed. At the most basic level, food systems determine the quantity, quality, diversity and nutritional content of the foods available for consumption.

Agricultural production and trade policies and public investments in research and development (R&D) and in infrastructure are some of the factors that influence the supply of different types of foods. Income, culture and education, among other factors, influence consumers' tastes and preferences, which, together with relative prices, determine the demand for different foods. Demand, in turn, influences production as well as processing and marketing decisions throughout the food system, in a continuous cycle of feed-back loops. The food system thus determines whether the food people need for good nutrition is available, affordable, acceptable and of adequate quantity and quality.

The principle of shaping food and agricultural systems to improve nutrition is founded and builds on a food-based approach. Food-based interventions recognize the central place of food and diets in improving nutrition. They are often contrasted with strategies that rely on medically based interventions such as vitamin and mineral supplements. Although food supplements can address specific dietary deficiencies, a nutritious diet (meaning consumption of a variety of safe foods of sufficient quantity and quality in the appropriate combinations) ensures that people obtain not only the specific macro- or micronutrients present in the supplement but the whole complex of energy, nutrients and fibre that they need. These components of a nutritious diet may interact in ways that are important for good nutrition and health but are not yet fully understood.

A food-based approach further recognizes the multiple benefits (nutritional, physiological, mental, social and cultural) that come from enjoying a variety of foods. Creating a strong nutrition-enhancing food system is arguably the most practical, convenient and sustainable way to address malnutrition, as food choices and consumption patterns ultimately become integrated into the lifestyle of the individual (FAO, 2010).

In addressing malnutrition, considering the entire food system provides a framework in which to determine, design and implement food-based interventions to improve nutrition. Shaping food systems so they are more likely to lead to better diets and nutritional outcomes requires an understanding of the different elements of the system, potential entry points to leverage the system for nutrition and the factors that shape the choices of the different actors in the system. In addition, in today's world, analyses and actions must also demonstrate close attention to questions of environmental sustainability.

Changes and challenges in food systems of today

Analyses and actions to shape food systems for better nutrition must take into account the fact that there is no single food system but rather a multiplicity of systems with characteristics that vary, for example, with incomes, livelihoods and urbanization. Even these multiple systems are in a process of constant change. Trends in economies and societies, from local to global level, are changing the ways that people produce, process and acquire food.

In developing countries as well as more industrialized countries, food supply chains are transforming in many ways. For some consumers and some products, the supply chain is lengthening. Most people today, even the poorest smallholders in remote rural areas, rely on markets for at least part of their consumption needs. They may buy surpluses from local producers or, in the case of processed foods like biscuits or pasta, from processors in far-away cities or countries. The distance between consumer and producer may grow for such products as transportation networks improve and trade increases.

At the same time, for people in urban areas even in developing countries, the supply chain may be shortening or lengthening depending on the product. Consumers may shop directly at farmers' markets, especially for fresh fruits and vegetables, or in traditional wet markets

for meat products. Wholesalers, often with strong links to modern retail chains, may buy staple products directly from producers, bypassing traditional local brokers (Reardon and Minten, 2011). Meanwhile, supply chains for some products may be becoming more complex, with additional transformation of products by processors and distributors.

The kinds of food being demanded are also changing. New technologies are altering modes of transportation, leisure, employment and work within the home (Popkin, Adair and Ng, 2012). Increasingly, urban lifestyles lead consumers to demand more convenience, because they have less time available or simply wish to devote less time to food production, acquisition and preparation.

Urbanization also provides economies of scale for markets, resulting in lower transport costs and markets that are generally closer to home. Combined with generally higher incomes for urban dwellers, these changes widen the selection of products available. Although the diversity of choice leads to higher consumption of animal-source foods and fruits and vegetables, increases in consumption of processed foods also lead to higher intakes of fats, sugars and salt. With higher energy intakes and lower energy expenditure, urban dwellers incur a higher risk of overweight and obesity than rural dwellers. These changes in purchasing and consumption patterns are occurring in smaller cities and towns as well as the largest cities. Through their research and marketing efforts, food companies, of course, are shaping as well as responding to these demands.

These changes in activity and dietary patterns in developing countries are part of a "nutrition transition" in which countries simultaneously face not only the emerging challenge of rising levels of overweight and obesity and related non-communicable diseases but continue to deal with problems of undernutrition and micronutrient deficiencies (Bray and Popkin, 1998). This transition corresponds closely to rises in income and the structural transformation of the food system, as seen primarily in industrialized and middle-income countries. Popkin, Adair and Ng (2012, p. 3) describe this phenomenon as "the primary mismatch between human biology and modern society". All this suggests that the nature of the nutrition problem and its solutions may differ according to location and type of engagement with the food system.

Food systems and nutrition opportunities

The structure of food systems is central to determining how those systems interact with other causal factors and influence nutritional outcomes. Awareness of these characteristics and the key actors who shape food systems will help identify where to intervene and what to do to create systems that help achieve good nutrition.

The multiple links between food systems and nutrition offer many opportunities to shape food systems in such a way that they can promote better nutrition. Figure 1 provides a schematic overview of the elements of food systems and the broader economic, social, cultural and physical environment within which they operate. It highlights opportunities for improving nutritional outcomes and identifies appropriate policy tools.

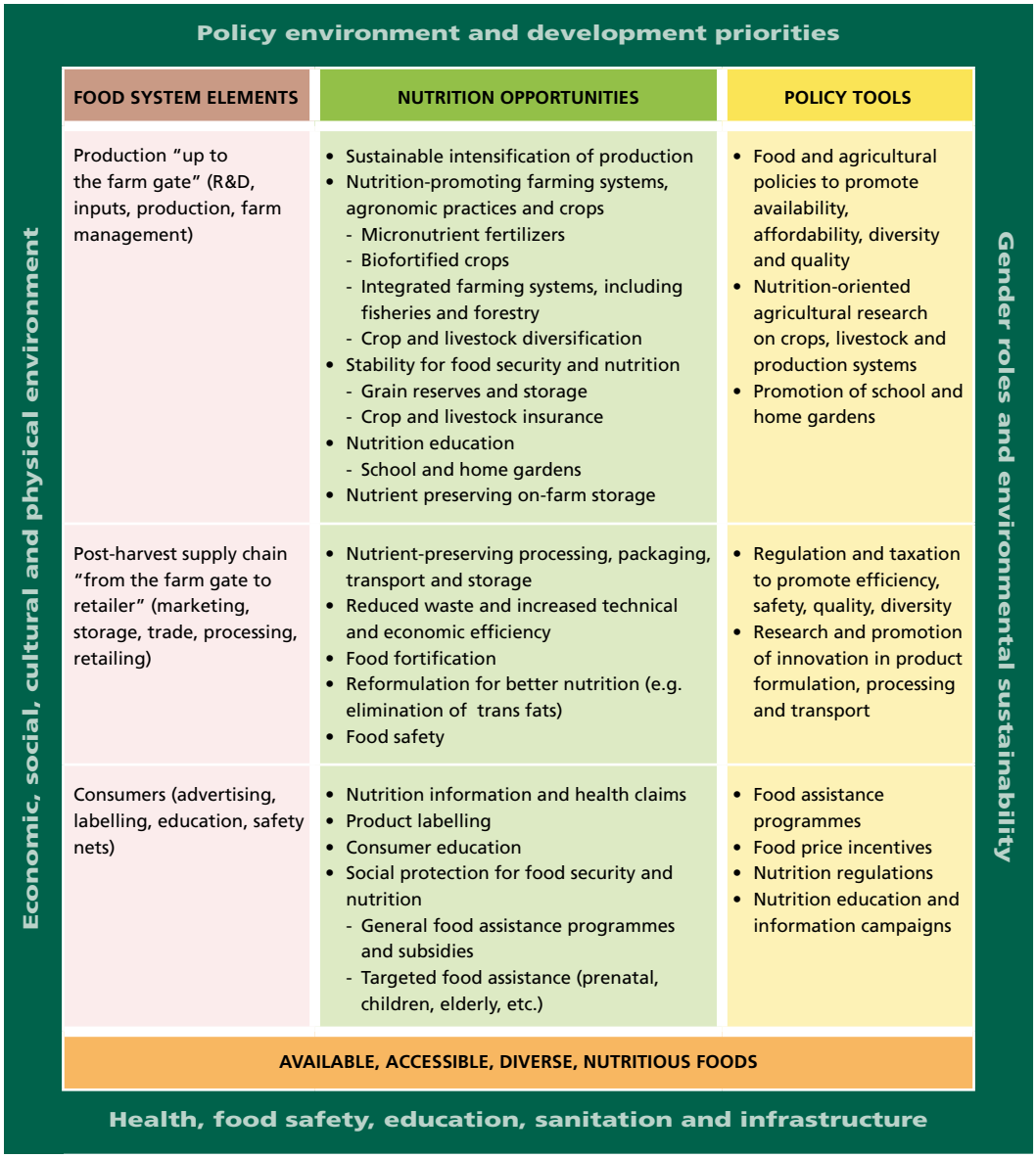
The first column outlines the elements of a food system, in three broad categories:

- production "up to the farm gate";
- post-harvest supply chain "from the farm gate to retailer";
- consumers.

The middle column lists examples of potential interventions that are targeted specifically at improving nutrition – "opportunities", that is, to shape the system. The third column notes some policy tools related primarily to food, agriculture and rural development that can influence the system. The outer ring illustrates the broader context, which can also be made more "nutrition-sensitive", for example by giving higher priority to nutrition within national development strategies and considering the nutrition implications of broader macroeconomic policies, the status of women and environmental sustainability.

The phases from production to consumption are depicted in a linear representation, but the interactions among the various actors and the flows of their influence are not. Demand by consumers or processors, for example, can affect what is produced, and multiple stakeholders can exert influences on the system and the policy context at different

FIGURE 1
Food system interventions for better nutrition



FOOD SYSTEM ELEMENTS	NUTRITION OPPORTUNITIES	POLICY TOOLS
Production "up to the farm gate" (R&D, inputs, production, farm management)	• Sustainable intensification of production • Nutrition-promoting farming systems, agronomic practices and crops - Micronutrient fertilizers - Biofortified crops - Integrated farming systems, including fisheries and forestry - Crop and livestock diversification • Stability for food security and nutrition - Grain reserves and storage - Crop and livestock insurance • Nutrition education - School and home gardens • Nutrient preserving on-farm storage	• Food and agricultural policies to promote availability, affordability, diversity and quality • Nutrition-oriented agricultural research on crops, livestock and production systems • Promotion of school and home gardens
Post-harvest supply chain "from the farm gate to retailer" (marketing, storage, trade, processing, retailing)	• Nutrient-preserving processing, packaging, transport and storage • Reduced waste and increased technical and economic efficiency • Food fortification • Reformulation for better nutrition (e.g. elimination of trans fats) • Food safety	• Regulation and taxation to promote efficiency, safety, quality, diversity • Research and promotion of innovation in product formulation, processing and transport
Consumers (advertising, labelling, education, safety nets)	• Nutrition information and health claims • Product labelling • Consumer education • Social protection for food security and nutrition - General food assistance programmes and subsidies - Targeted food assistance (prenatal, children, elderly, etc.)	• Food assistance programmes • Food price incentives • Nutrition regulations • Nutrition education and information campaigns

Source: FAO.

points and in different ways. Considering the entire food system is thus more complex and integrated than a simple commodity value-chain approach, which is likely to focus on the technical aspects of various stages of the chain and usually considers only one crop or product at a time.

Addressing the entire food system implies appreciating and working with all the different stakeholders who affect the system. These include all people – primarily private individuals and companies – who produce, store, process, market and consume food, as well as the public officials, civil society organizations, researchers and development practitioners who design the policies, regulations, programmes and projects that shape the system.

Figure 1 should be understood as a stylized representation of the many diverse and dynamic food systems that exist in the world. The nature of the food system in a given location can guide the choice of interventions to take advantage of nutrition

opportunities. For example, in a subsistence-based agricultural system, interventions aimed directly at improving the nutritional content of crops for own consumption would be promising. In urban areas where the food system is almost entirely commercial, interventions in processing and retailing could be more effective in shaping the system to support better nutrition. Many developing countries have food systems that exhibit a mix of characteristics.

Promoting nutrition-specific and nutrition-sensitive actions

Many of the nutrition opportunities highlighted in Figure 1 and in later chapters of this report are nutrition-specific. They are pursued with the primary purpose of making the system more attuned to producing good nutritional outcomes. For example, the principal impetus in developing biofortified crops is to improve nutrition. At the same time, these crops may also be more disease-resistant and better adapted to grow in micronutrient-deficient soils. They may improve nutrition but also produce higher crop yields and increase producer incomes – a win for both consumers and producers (Harvest Plus, 2011).

Other interventions, particularly those that improve the general economic, social or political environment, may not be specifically designed to improve nutrition but will almost certainly have a positive effect. Examples of these "nutrition-sensitive actions" include policies that increase agricultural productivity (which can raise producer incomes, lower the cost of food for consumers and allow producers and consumers to increase expenditures on more adequate, diverse diets) or that improve the social status of women (and so can lead to increased expenditures on health, education and food, which are all key inputs into better nutrition).

Similarly, in a nutrition-sensitive environment, governments or companies may simply take into account the potential impacts of their actions on nutrition and seek to leverage any positive effects or mitigate any negative ones. For instance, the introduction of new crops might lead to higher productivity and household incomes, but might also make higher demands on women's labour. This could lead to negative impacts on child care that a nutrition-sensitive approach would address. In sum, the difference in primary purpose (often driven by the context of the opportunity) is what distinguishes nutrition-specific interventions from ones that are nutrition-sensitive. Although the overall objective may be to create a nutrition-sensitive food system, interventions in agriculture and food systems may be both nutrition-specific and nutrition-sensitive.

Cross-cutting issues in nutrition-sensitive food systems

Many interventions are specific to a particular part of the food system, but there are some issues that nearly all interventions need to address. For example, gender issues are always relevant because men and women, who participate in every part of the food system, have different roles and therefore will be affected differently by any intervention aimed at making food systems more nutrition-sensitive. Similarly, concerns related to environmental sustainability touch every aspect of the food system and have fundamental implications for nutrition. Diets that are diverse and environmentally sustainable are the foundation for better nutritional outcomes for everyone and should be a long-term goal for all food systems.

Gender roles for better nutritional outcomes

Men and women typically play differentiated roles in food systems and within the household, although these differences vary widely by region and are changing rapidly (FAO, 2011b). Women make important and growing contributions to food production, processing, marketing and retailing, and other parts of the food system. Within the household, women traditionally bear the primary responsibility for preparing meals and caring for children and other family members, although men are assuming more responsibilities for these roles in many societies. Gender differences in the rights, resources and responsibilities – particularly resources necessary for achieving food and nutrition security for and within the household and responsibilities for food provisioning and caretaking – often impede the achievement of household food and nutrition security.

Gender-sensitive interventions can improve nutritional outcomes by recognizing women's role in nutrition through agricultural production, food provision and child care and by promoting gender equality throughout the system, including in some cases by increasing the participation of men in household maintenance, food preparation and child care. In agriculture, technologies that enhance the labour productivity of rural women (such as better farm tools, water provision, modern energy services and household food preparation) can free their time for other activities. For example, a study from India demonstrated that women who used a groundnut decorticator were able to process around 14 times more groundnuts and used significantly less physical effort than those doing so by hand. Similarly, a new hand tool designed for making ridges for vegetable crops allowed women to double the number of rows finished in one hour (Singh, Puna Ji Gite and Agarwal, 2006). Such innovations in technology may open up opportunities for women to earn higher incomes or to use their time (and increased income) for added attention to the family.

Women are also active in other parts of the food system, including food marketing and processing. For example, in Latin America and the Caribbean and in Africa, women dominate employment in many of the high-value agricultural commodity chains. Although new jobs in export-oriented agro-industries may not employ men and women on equal terms, they often provide better opportunities for women than exist within the confines of traditional agriculture (FAO, 2011b).

Raising women's incomes has important implications for nutritional outcomes, because women still play a central role in shaping household food consumption patterns. Women who earn more income have stronger bargaining power within the household. This enables them to exert more influence over decisions regarding consumption, investment and production, which results in better nutrition, health and education outcomes for children (Smith *et al.*, 2003; Quisumbing, 2003; FAO, 2011b; Duflo, 2012; World Bank, 2011).

Sustainable food systems

The importance of managing the agriculture system in a way that is conducive to the health of the ecosystem is already well established. To date, most of the focus has been on the production side, with the emphasis on sustainable intensification that can close yield and productivity gaps in underperforming systems (FAO, 2011c). This continues to be of great importance, especially for poor farmers. Yet improving the sustainability of food systems is equally important. Environmentally and economically sustainable production is important for the well-being of current and future generations. Reductions in food losses and waste throughout the system can help to maintain or improve consumption levels and at the same time alleviate pressures on production systems. The costs and benefits of a sustainable system must be reflected in decisions made by producers and consumers of food, as well as those who help shape decisions (FAO, 2012a).

Attempts to improve the sustainability of food systems face a number of challenges, such as market and non-market constraints to more diversified production and to higher levels of productivity, particularly for smallholders; unequal access to resources for women, the poor and other economically and socially marginalized groups; and increasing demands on natural resources, such as competition for water between agriculture and human settlements. In the context of weak governance, power asymmetries and the lack of clear and enforced property rights, production and consumption patterns are likely to be unsustainable. When combined with continuing inequities, the situation can have devastating consequences for nutrition, affecting both availability and accessibility of food, particularly for the poor.

Dietary diversity and nutrition

Healthy diets[5] contain a balanced and adequate combination of macronutrients (carbohydrates, fats and protein) and essential micronutrients (vitamins and minerals). Some questions remain controversial, such as whether animal-source foods are an essential part of the diet and whether all people, especially young children, can acquire adequate nutrients from food without

[5] We recognize that what constitutes a healthy diet is a matter of great debate and are therefore careful not to suggest what foods consumers should and should not consume. We do, however, report on efforts made to change consumption patterns based on others' judgements of what foods are more or less nutritious.

BOX 2
The importance of animal-source foods in diets

Animal foods are recognized as having high energy density and as good sources of high-quality protein; readily available iron and zinc; vitamins B_6, B_{12} and $B_{2;}$ and, in liver, vitamin A. They enhance the absorption of iron and zinc from plant-based foods (Gibson, 2011). Evidence from the Nutrition Collaborative Research Support Programme (NCRSP) for Egypt, Kenya and Mexico indicated strong associations between the intake of foods from animal sources and better physical and cognitive development in children (Allen *et al.*, 1992; Neuman, Bwibo and Sigman, 1992; Kirksey *et al.,* 1992).

Increasing access to affordable animal-source foods could significantly improve nutritional status and health for many poor people, especially children. However, excessive consumption of livestock products is associated with increased risk of overweight and obesity, heart disease and other non-communicable diseases (WHO and FAO, 2003). Furthermore, the rapid growth of the livestock sector means that competition for land and other productive resources puts upward pressure on prices for staple grains as well as negative pressures on the natural resource base, potentially reducing food security in the longer term. Policy-makers need to take into consideration the trade-offs inherent when designing policies and interventions to promote animal-source foods.

Fish is also an important source of many nutrients, including protein of high quality, retinol, vitamins D and E, iodine and selenium. Evidence increasingly links the consumption of fish to enhanced brain development and learning in children, improved vision and eye health, and protection from cardiovascular disease and some cancers. The fats and fatty acids from fish are highly beneficial and difficult to obtain from other food sources. Evidence from Zambia documented that children whose main staple food is cassava and whose diets regularly include fish and other foods containing high-quality protein had a significantly lower prevalence of stunting than those whose diets did not (FAO, 2000).

supplementation (see Box 2 for a discussion of animal-source foods and diets). Nutrition guidelines generally maintain that diverse diets that combine a variety of cereals, legumes, vegetables, fruits and animal-source foods will provide adequate nutrition for most people to meet energy and nutrient requirements, although supplements may be needed for certain populations.

Nutritionists consider dietary diversity, or dietary variety – defined as the number of different foods or food groups consumed over a given reference period – as a key indicator of a high-quality diet (Ruel, 2003).[6] Evidence indicates that dietary diversity is strongly and positively associated with child nutritional status and growth, even after socio-economic factors have been controlled for (Arimond and Ruel, 2004; Arimond *et al.*, 2010).

Knowledge and information gaps

A significant body of direct and indirect evidence exists about the causal and synergistic links between food, agriculture and nutrition. The available knowledge, much of which is covered in this report, supports the proposition that the food and agriculture sector can play a central role in reducing malnutrition and that decisive policy action in this sector can improve nutritional outcomes, especially when accompanied by complementary interventions in education, health and sanitation, and social protection. Food system interventions can raise producers' incomes; improve the availability, affordability, acceptability and quality of food; and help

[6] Kennedy (2004) makes the point that while dietary diversity is generally beneficial, adding foods that are high in fats (energy) will not help to reduce overweight and obesity, so the nature of the diversity also needs to be taken into account. Experts differ on how to categorize foods into different groups, so "counting the diversity" of the diet is a complex task (Arimond *et al.*, 2010).

people make better food choices (Pinstrup-Andersen and Watson, 2011; Thompson and Amoroso, 2011; Fan and Pandya-Lorch, 2012).

Knowledge about many of the issues covered in this report remains incomplete, however. Many countries lack basic data and indicators for evaluating and monitoring the nutrition landscape. Agricultural interventions are difficult to evaluate[7] and many questions remain about the effectiveness of home gardens, the role of gender, agronomic fortification, technological innovations, biodiversity and the potential of local foods in the nutrition transition. Research on supply chain interventions and their impact on nutrition is scarce, but improved efficiency along the chain, reducing waste and losses, and raising the nutritional content of foods are among the least contentious issues in the food system and nutrition debate. The roles of trade, investment and market structure in nutritional outcomes remain contentious. Knowledge gaps also exist with regard to consumer choice and nutritional outcomes, and concepts such as "dietary diversity" and "healthy diets" remain fuzzy and difficult to measure objectively. Further research is needed on nutrition education and behaviour change, the link between food system policies and nutrition, and the nexus between the food industry, healthy diets and consumers. Finally, many questions remain about how food systems can contribute to better nutritional outcomes while also adhering to sustainable production and consumption patterns.

Structure of the report

Chapter 2 frames the debate by reviewing trends in malnutrition and illustrating how the transformation of food systems worldwide has been accompanied by dramatic changes in nutritional status. This implies that the nature of food system interventions to address malnutrition will vary according to the level of agricultural and economic development of a country and the nature of the malnutrition burden it faces. In all cases, however, making the food system more nutrition-sensitive can improve nutritional outcomes.

Chapter 3 looks at opportunities to enhance nutrition in agricultural production from inputs up to the farm gate. These include making general agricultural policies and institutions more nutrition-sensitive and employing nutrition-specific interventions to enhance the nutritional quality of staple crops, diversify production and improve farm management in ways that promote more nutritious and sustainable food systems.

Chapter 4 turns to nutrition-sensitive interventions in the supply chain from the farm gate to the retailer, through storage, processing and distribution. Food supply chains are evolving rapidly in all countries, and these changes have implications for the availability and affordability of diverse, nutritious foods for consumers in different areas and at different income levels. Specific interventions to enhance efficiency, reduce nutrient losses and waste and improve the nutritional content of foods can improve nutritional outcomes by making food more available, accessible, diverse and nutritious.

Chapter 5 focuses on interventions in the food system aimed at changing consumer behaviour. While these challenges relate more to education and behaviour change, they still involve improving the nutritional performance of the food system.

Chapter 6 provides an overview of global governance of the food system for better nutritional outcomes.

[7] The recent review by Masset *et al.* (2011) finds that a range of methodological and statistical reasons account for the sparse body of evidence by which to evaluate agricultural interventions.