

## Chapter IV

# Ensuring food and nutrition security

### Summary

- The persistence of malnutrition reflects deep inequalities in the distribution of and access to food at national and global levels. Ensuring that everyone in the world has access to enough nutritious food should be at the forefront of the post-2015 development discussions.
- Increasing food production in parallel with population growth, urbanization and a change in consumption patterns will require an integrated approach that takes into consideration the nexus of food, water, energy, environment and climate, while reorienting food production, distribution and consumption.
- Increasing agricultural productivity will be required, in particular in developing countries where the agriculture sector accounts for an important share of gross domestic product and where large productivity gaps still exist.
- Access of poor households to food and of isolated producers and smallholders to markets will need to be improved, in particular given that hunger can exist even in countries where there is enough food produced.
- Food consumption will need to be oriented towards diets that are less resource-intensive and more nutritious, which will be crucial for the sustainability of the food system and for better health outcomes.
- The transformation and development of the agricultural sector will require investments on a significant scale. The public sector should typically finance infrastructural needs as well as research and development, while introducing adequate incentives for private investments, such as risk protection and better access to credit markets. In addition, Governments need to design a regulatory framework that ensures inclusive and sustainable private investments.

### Introduction

Ensuring that everyone in the world has access to enough nutritious food should be at the forefront of the post-2015 development discussions, as recently emphasized by the Secretary-General through the launch of the Zero Hunger Challenge.<sup>1</sup> The present chapter highlights the changes needed in the food system to ensure food and nutrition security by 2050 and the challenges involved, given that malnutrition is only partly an issue of food availability. The persistence of malnutrition reflects the deep inequalities in

<sup>1</sup> Secretary-General Ban Ki-moon launched the Zero Hunger Challenge on June 20, 2012, at the Rio+20 United Nations Conference on Sustainable Development. For further information see <http://www.un.org/en/zerohunger/challenge.shtml>.

the distribution and access to food, knowing that one third of the food produced is not eaten—a missed opportunity to feed the growing world population (Food and Agriculture Organization of the United Nations, 2012b).

Recent studies have found that the challenge of malnutrition is broader than the issue of hunger or undernourishment, as highlighted by the United Nations Millennium Declaration.<sup>2</sup> Low quality and low diversity of food are other major sources of malnutrition. Individuals may have an intake of enough calories for daily subsistence, and still suffer from “hidden hunger”, with low levels of micronutrients due to low diversification of diets. This is a problem in both developing and developed countries, affecting 30 per cent of the world’s population. The excess intake of calories is another major global public-health concern, as overweight and obesity cause more than 2.8 million deaths per year among adults.

In addition to the multiple burdens of malnutrition, other problems are on the horizon. On the demand side, population growth, rapid urbanization and consequent changes in consumption patterns will require additional food. The Food and Agriculture Organization of the United Nations (FAO) estimates that food production will have to increase 70 per cent globally to feed an additional 2.3 billion people by 2050. At the same time, food demand has been shifting towards more resource-intensive agricultural products, such as livestock and dairy products, thereby exerting additional pressure on land, water and biodiversity resources.

An increase in food production will also require integrating sustainable practices, particularly regarding the use of natural resources. Many of the current agricultural practices have relied on cheap energy and abundant water and land, and are a leading source of greenhouse gas emissions (The Hague Conference, 2010). These practices are now proving unsustainable for the environment and health, due to contamination of air, land and water sources. At the same time, they have led to substantial productivity losses, thereby posing risks to food security.

Thus, increasing food production and improving distribution to respond to population growth, urbanization and a change in consumption patterns will require an integrated approach to addressing several challenges simultaneously along the entire food chain. Such an integrated approach to food security and environmental sustainability should also take into consideration the nexus of food, water, energy, environment and climate, while reorienting food production, distribution and consumption.

The first challenge is to increase food production, while minimizing the environmental impact and increasing natural resource efficiency. This will require increasing agricultural productivity, in particular in developing countries where the agricultural sector contributes an important share of gross domestic product (GDP) and where large productivity gaps still exist. The introduction of improved agronomical practices and advanced technologies will be central. Information and communications technologies (ICT), for instance, can be used to inform smallholders about new farming techniques and market prices (World Bank, 2008a), as well as to improve livestock traceability (Deloitte, 2012), maximizing output, while minimizing negative impacts on the environment. Additional investments in research and development (R&D) will be crucial in increasing productivity, but better dissemination and adaptation of existing technology in different agroecological regions will also need to be part of the solution. A broader rural development strategy is also required, including infrastructural investments to better connect producers and smallholders to output markets, including rural-urban linkages.

<sup>2</sup> See General Assembly resolution 55/2.

The second major challenge will be to improve the access to food and markets, as hunger often occurs in countries where there is enough food produced. Income poverty is a major factor preventing access to food. Therefore, increasing the income level of poor households will help them obtain food that is adequate in quantity and quality, thereby reducing the prevalence of undernourishment. However, high inequality in the rural sector, in particular in the distribution of assets—such as land, water, capital, education and health—is an obstacle that needs to be addressed in order to enhance food security. The underlying issue of discrimination in the rural sector, including against women, also calls for concrete action. In addition, social protection mechanisms, including safety nets, must also be part of a broader strategy to facilitate access of lower-income groups to food, in particular during economic shocks.

The third challenge is to orient food consumption towards “sustainable diets”, that is, diets that are less resource-intensive and more nutritious, which will be crucial for the sustainability of the food system. Such changes would also improve health conditions related to low diversification of diets, including obesity. Reducing food wastage will also contribute significantly to the sustainability of the food system. Currently, it is estimated that 32 per cent of the total food produced globally is wasted (Food and Agriculture Organization, 2012b). In order to substantially reduce the quantity of food lost and wasted, changes have to occur at different points along the food chain: production, storage, transportation and consumption. Strategies to reduce food waste will vary among countries according to their structural conditions.

Finally, in an increasingly interconnected world, improving agricultural productivity and the allocation of food within and across countries requires well-coordinated actions at local, national and global levels. At the local and national levels, in particular in food-insecure countries, institutions should promote transparency and accountability, as well as the participation of all individuals in the decisions that affect them. At the global level, the international community can help developing countries in their efforts to design and implement policies that increase resilience to food price volatility and to climatic shocks, as well as provide safety nets, especially for smallholders. Wealthier countries will also be required to change their production and consumption patterns through actions that should include reviewing trade policies to ensure that they are pro-food and pro-nutrition security, establishing regional and international strategic reserves, and addressing the issue of speculation in land, as well as enabling the adoption of sustainable diets.

### **Multiple dimensions of malnutrition: undernourishment, micronutrient deficiencies and over-nutrition**

Malnutrition is a broad term encompassing conditions that hinder good health, including both under-nutrition and over-nutrition. Under-nutrition can be the result of undernourishment (energy deficiency) or micronutrient (vitamin and mineral) deficiencies. Undernourishment continues to affect the world's population (12.5 per cent), mainly in developing countries (Food and Agriculture Organization of the United Nations, 2012a), despite remarkable progress in reducing hunger during the last decade, while stunting and micronutrient deficiencies affect a significant number of people. Obesity, on the other hand, has been increasing rapidly in all countries, although its prevalence is still

The health risks associated with undernourishment and inadequate diets in many developing countries are running parallel to a rapid rise in non-communicable diseases in many developed and middle-income countries due to over-nutrition

considerably higher in developed countries. Thus, today, the world as a whole is facing multiple burdens of malnutrition. The health risks associated with undernourishment and inadequate diets in many developing countries are running parallel to a rapid rise of non-communicable diseases in many developed and middle-income countries, owing to the rampant increase in over-nutrition.

## Under-nutrition

### *Food insecurity<sup>3</sup> persists*

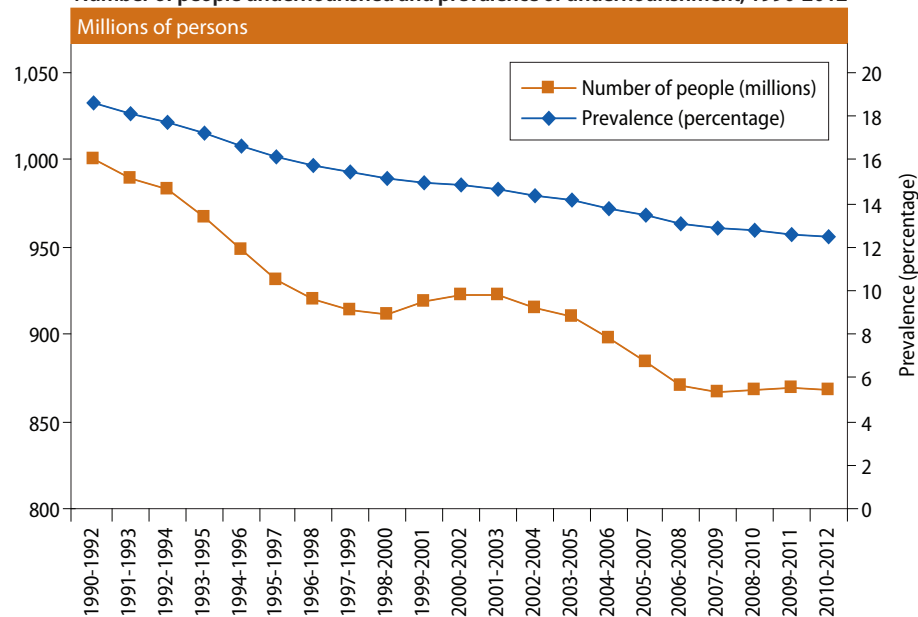
Sub-Saharan Africa and Western Asia are facing the most serious challenges to reaching the Millennium Development Goal 1 hunger target by 2015

According to recent estimations, in 2010-2012, about 868 million people were chronically undernourished (Food and Agriculture Organization of the United Nations, 2012b). Despite the fact that this figure is still particularly high and represents, as noted above, 12.5 per cent of world population, it also indicates that there has clearly been progress in reducing hunger at the global level (figure IV.1).

In several regions, however, the food and financial crisis slowed down that progress, mainly owing to higher food prices, reflecting different levels of vulnerability to external shocks and different country capacities to increase food supply when needed. Sub-Saharan Africa and Western Asia are facing the most serious challenges to reaching the

Figure IV.1

#### Number of people undernourished and prevalence of undernourishment, 1990-2012



3

Food security has been defined as access by all people at all times to the food needed for a healthy life.

Millennium Development Goal 1 hunger target by 2015.<sup>4</sup> Western Asia, in particular, has experienced a significant increase in the number of people that are undernourished, from 8 million in 1990-1992 to 21 million in 2010-2012 (Food and Agriculture Organization of the United Nations, 2012b), increasing the prevalence of undernourishment over that period.

The distribution of undernourished people in the world has also been altered in line with different progression rates in hunger reduction during the past two decades (figure IV.2). In the past 20 years, the share of the world's undernourished people decreased in East Asia and the Pacific, from 41 per cent in 1990-1992 to 28 per cent in 2010-2012, whereas the proportion increased significantly in sub-Saharan Africa, from 17 per cent in 1990-1992 to 27 per cent in 2010-2012, as well as in Northern Africa and Western Asia, from 1 per cent in 1990-1992 to 3 per cent in 2010-2012.

Periods of high food prices in the past few years have affected countries and regions differently, according to their different levels of vulnerability to external shocks. For instance, many African countries, such as the Democratic Republic of the Congo, were fully exposed to price hikes and the global recession. Over the long run, the differences in hunger reduction across regions and countries are attributable to several factors. Inclusive economic growth, generating demand for the assets controlled by the extreme poor, has a much higher impact on hunger reduction. In addition, when poor households invest part of their increased income in health, sanitation and education, the impact of economic growth on hunger reduction is also stronger. In parallel, as seen in the case of Bangladesh, which is on track to reach the hunger target of Millennium Development Goal 1, higher public spending on health and education with targeted interventions increases nutritional success (Food and Agriculture Organization of the United Nations, 2012b).

### *Impacts of under-nutrition: undernourishment and micronutrient deficiencies*

Undernourishment is the result of food intake that is inadequate as regards providing sufficient calories to meet people's physiological requirements on a continuing basis. Micronutrient deficiencies are also a result of under-nutrition, but in this case they are related to insufficient intake of vitamins and minerals.<sup>5</sup> An individual may take in enough or even too many calories for daily subsistence; however, if his or her diet is not diversified enough, the result may be low levels of micronutrients, a condition referred to as "hidden hunger". This is an issue in both developing and developed countries, affecting 30 per cent of the world's population (ibid.).

The relation between poor nutrition and poor health—including the existence of a vicious cycle of poor nutrition, poor health and low income—is well documented. For instance, iron deficiency anaemia impacts negatively on cognitive development and

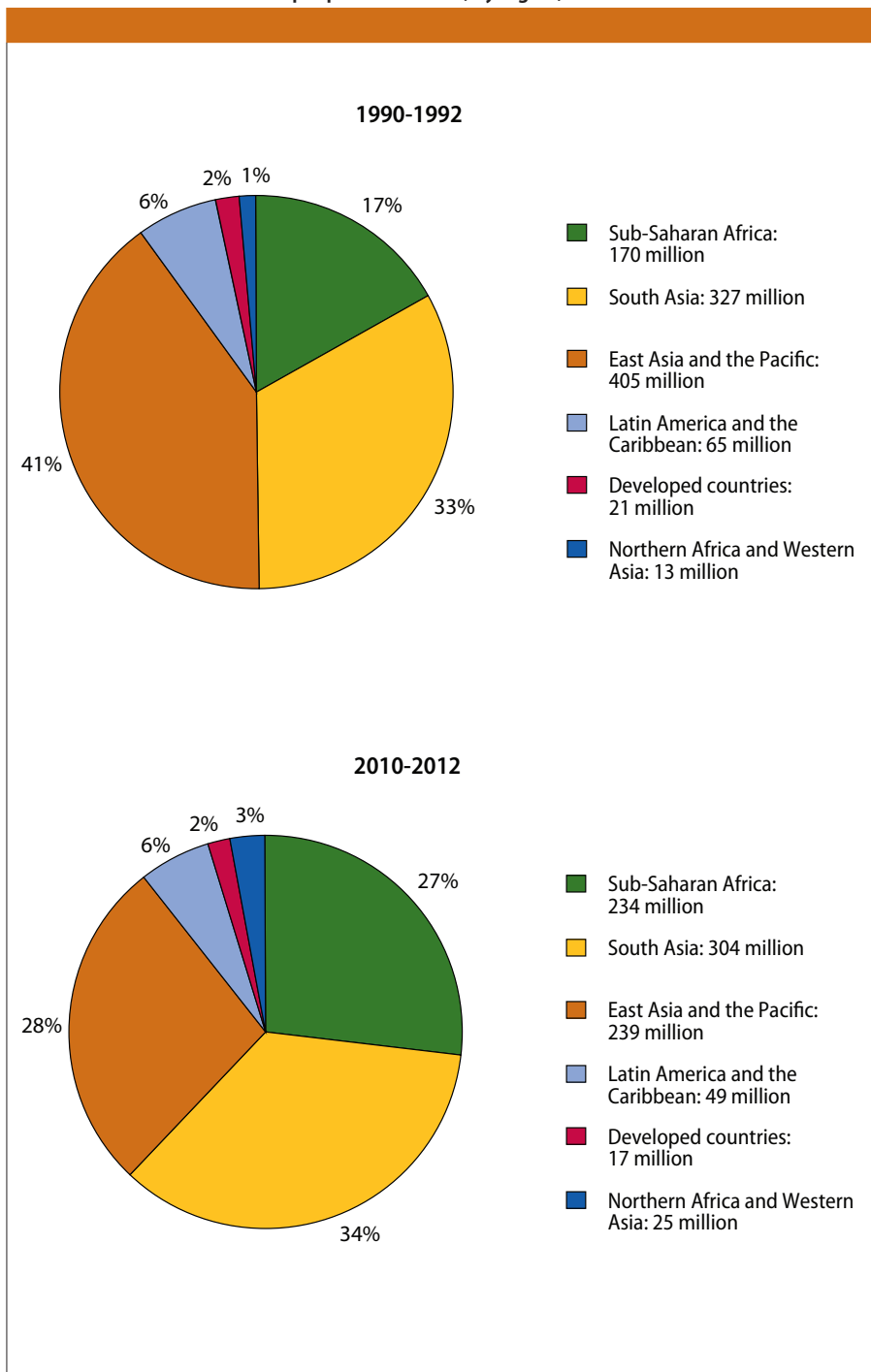
An individual may take in enough or even too many calories for daily subsistence, but cases where diet is not diversified enough may lead to low levels of micronutrients

<sup>4</sup> The impact of the food price and economic crises during the period 2007-2010 in undernourishment prevalence was less severe than previously estimated. According to FAO, there are two main reasons. First, the impact of economic shocks on developing economies was less severe than previously estimated. Many developing economies, in particular the largest ones, continued to grow at a relatively fast pace, albeit more slowly than in the pre-crisis period. Second, the methodology used by FAO estimates chronic undernourishment, which does not capture the effects of short-term shocks, such as price spikes. Therefore, the undernourishment indicator does not fully reflect the impact of price spikes and other short-term shocks.

<sup>5</sup> Vitamin A, iron and iodine deficiencies are the most commonly measured micronutrient deficiencies because they are well known and have long been associated with specific health consequences (Food and Agriculture Organization of the United Nations, 2013).

Figure IV.2

Distribution of undernourished people in the world, by region, 1990-1992 and 2010-2012



academic performance in school-age children (Food and Agriculture Organization of the United Nations, 2013). Short-term consequences in terms of learning disability, as well as long-term economic consequences, can be expected, since lower education levels lead to lower income opportunities.

Vitamin A deficiency, for instance, is a leading cause of blindness and corneal damage. In developing countries, 163 million children were estimated to be vitamin A-deficient, with a prevalence of more than 30 per cent in 2007, down from approximately 36 per cent in 1990 (United Nations System Standing Committee on Nutrition, 2010).

From a longer-term perspective, there is also the risk of intergenerational transmission of poor nutritional status. Women who suffer from undernourishment are more likely to give birth to underweight babies, whose development will then be affected throughout their life. Undernourishment may also lead to irreversible consequences, such as physical stunting, excluding individuals from better-rewarded tasks which demand greater physical strength. Ultimately, undernourishment affects individuals' freedom and well-being (Drèze and Sen, 1991).

Not only does undernourishment have microlevel negative consequences, but it affects the whole economy, reducing its rate of growth. For instance in India, stunting and iron and iodine deficiencies result in productivity losses equivalent to 2.95 per cent of GDP annually (World Bank, 2006). Despite the evidence of negative outcomes from poor nutrition in the short and long terms, nutritional health has not received sufficient priority in the development agenda (United Nations, 2012c). In particular, a good nutritional status for the whole population would have a positive impact on economic development.<sup>6</sup>

## Over-nutrition

### *Obesity on the rise*

Malnutrition has been traditionally associated with undernourishment; but in recent years, greater attention has been given to overweight (body mass index equal or superior to 25) and obesity (body mass index equal or superior to 30), as a major global public-health concern and a cause of death of at least 2.8 million adults per year (World Health Organization, 2012b). Overweight and obesity are often perceived as higher income economy issues, but in fact they have been on the rise, and at a fast pace, in low- and middle-income countries.

Globally, in 2008, the number of overweight adults reached more than 1.4 billion, surpassing the number of undernourished people worldwide.<sup>7</sup> Almost 13 per cent of the world's population are obese.

The prevalence of overweight and obese individuals varies across the world. Breaking down by World Health Organization (WHO) regions, in the Americas, overweight and obesity affect 62 per cent and 26 per cent of the population, respectively. On the opposite side of the spectrum, in South-East Asia, only 14 per cent of the population are overweight. In Organization for Economic Cooperation and Development (OECD)

Overweight and obesity are often perceived as higher income economy issues, but in fact they have been on the rise, and at a fast pace, in low- and middle-income countries

<sup>6</sup> See FAO, "Incorporating nutrition considerations into development policies and programmes: brief for policy-makers and programme planners in developing countries" (Rome, 2004). Available from <http://www.fao.org/docrep/007/y5343e/y5343e04.htm>.

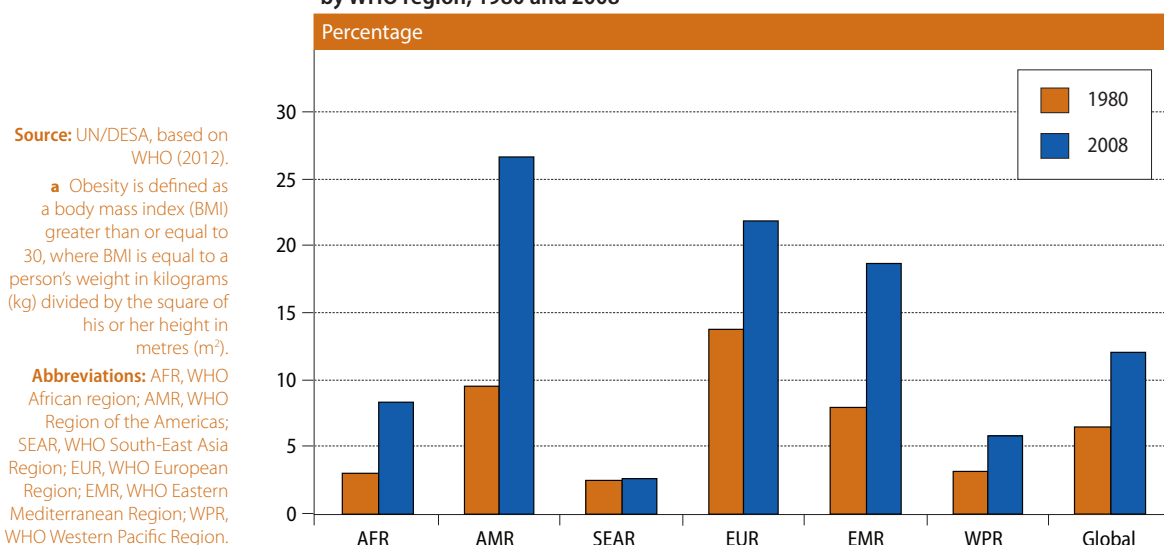
<sup>7</sup> WHO (2013).

countries for which data exist, the prevalence of obesity varies from 4 per cent in Japan and the Republic of Korea, to 30 per cent or more in the United States of America and Mexico.

Worldwide obesity almost doubled between 1980 and 2008 (figure IV.3). In OECD countries, until 1980, obesity affected less than 10 per cent of the population. Since then, that rate has doubled or tripled in many countries. In 2012, in 19 countries out of 34 OECD countries, the majority of the population was overweight. OECD projections suggest that more than 2 people out of 3 will be overweight or obese in some OECD countries by 2020.

Figure IV.3

**Age-standardized prevalence of obesity<sup>a</sup> among adults aged 20 years or over, by WHO region, 1980 and 2008**



In low- and middle-income countries, the number of overweight children has been increasing. Out of 40 million overweight children worldwide, close to 35 million were living in developing countries in 2010 (Organization for Economic Cooperation and Development, 2012a). Thus, it is not surprising to see health challenges associated with over-nutrition in countries that are still facing the issue of undernourishment. These two dimensions of malnutrition are sometimes experienced within the same household. This is the result of the greater susceptibility to obesity of adults that have suffered from undernourishment during their childhood (Hoffman and others, 2000).

### *Impacts of over-nutrition*

The health consequences of over-nutrition and obesity are quite different from those of hunger. There is an increase in non-communicable diseases instead of infectious and communicable diseases in those affected by over-nutrition and obesity. For instance, excessive consumption of meat (especially red meat), dairy products and eggs by older children and adults can have detrimental health effects and increase the risk of chronic non-communicable diseases such as heart disease, cancer, diabetes and obesity. Excessive consumption



of refined sugars and carbohydrates has also been found to be associated with health issues such as diabetes, overweight and obesity.

According to WHO, overweight and obesity are the fifth leading risk factors for global deaths, posing a greater risk than underweight. At least 2.8 million adults die each year as a result of being overweight or obese. Compared with people of normal weight, severely obese people die 8-10 years sooner. Every 15 extra kilograms (kg) increase the risk of early death by approximately 30 per cent. In addition, 44 per cent of the diabetes burden, 23 per cent of the heart disease burden and 7-41 per cent of certain cancer burdens are attributable to overweight and obesity.

Obesity also represents an important source of health expenditure at the individual and macro levels. For instance, in any given year, an obese person incurs 25 per cent higher health expenditures than a person of normal weight. At the macrolevel, obesity accounts for 5-10 per cent of total health expenditures in the United States of America. At the same time, obesity negatively affects personal income. Obese people earn 18 per cent less than people who are not obese (Organization for Economic Cooperation and Development, 2012a).

According to the World Health Organization, overweight and obesity are the fifth leading risk factors for global deaths, posing a greater risk than underweight

## Increasing food availability

In developing countries, where the prevalence of undernourishment is higher and the population is growing faster, food production will need to almost double (Food and Agriculture Organization of the United Nations, 2009c). Therefore, the first concern will be increasing agricultural productivity, in particular in countries where the prevalence of hunger is higher and where large productivity gaps still exist. The main challenge, however, is to increase food production while minimizing the environmental impact and increasing natural resource use efficiency. Finally, food production requires additional investments in rural infrastructure, including in harvest technologies designed to reduce wastage at the production level.

In order to improve food availability, the first concern will be increasing agricultural productivity, in particular in countries where the prevalence of hunger is higher and where large productivity gaps still exist

## Increasing agricultural productivity

Low productivity and slow growth in the agricultural sector, including in small farms, raise specific concerns. Despite some improvements in total factor productivity in the agricultural sector (Fuglie, 2012), growth in yield, an indicator of land productivity, for most cereals has been declining since the 1980s (FAOSTAT). Today, important gaps between farmers' yields and technical potential yields still exist in many developing countries. In 2005, such gaps varied from 11 per cent in countries of East Asia to 76 per cent in sub-Saharan Africa (Food and Agriculture Organization of the United Nations, 2011b). Reducing these gaps would increase agricultural output, and consequently, food security, as well as nutrition outcomes, in many developing countries.

### Extension services

The extensive menu of technologies and sustainable practices that are already available can, in part, reduce existing productivity gaps in agriculture. In sub-Saharan Africa for instance, where the prevalence of undernourishment is high, important productivity gains—on the order of a two- to threefold increase in average yields—can be achieved

The extensive menu of technologies and sustainable practices that are already available can, in part, reduce existing productivity gaps in agriculture

through better use of existing knowledge and technology (Foresight, 2011). Dissemination of information and technical assistance will be an effective strategy for improving access to knowledge and technology. Further, agricultural extension services are a useful tool for helping farmers increase their productivity, and collaborate with a broader network of farmers and researchers. In the current context, a large number of actors (civil society organizations, the private sector, farmers and multilateral organizations) need to contribute towards this end.

A survey conducted by the Global Conference on Agricultural Research for Development (GCARD) 2010 points to the importance of official agricultural extension workers.<sup>8</sup> The general perception is that their number is inadequate, especially when measured against the needs of small-scale farm holders, who have limited access to the services they offer, services that represent an important vehicle for the transmission of knowledge, information and training (Lele and others, 2010).

Thus, a longer-term commitment to training and a new approach to technical education are required. Training and education have to be more practical in nature and oriented towards problem-solving and decision-making. At the same time, they must involve farmers and civil society organizations in finding interdisciplinary and creative solutions to new problems.

Focusing more on building capacity among farmers, in particular smallholders, is a better strategy than prescribing technological practices. The former approach, considered to embody the empowerment model, would help farmers to identify and take advantage of available opportunities (World Bank, 2008a). The exclusion of women from technical support also needs to be explicitly addressed. In Africa, women receive 7 per cent of agricultural extension services and less than 10 per cent of credit offered to small-scale farm holders. Gender analysis and targeted initiatives must be incorporated in agricultural education, research and extension services (Davis and others, 2007).

### *Increasing investment in R&D*

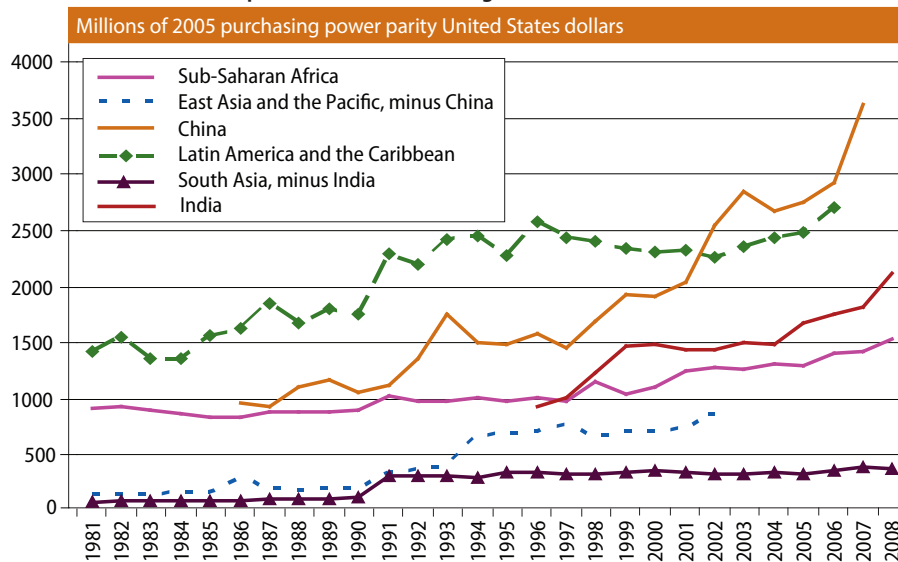
In addition to existing technology and agricultural knowledge which already provide a range of alternatives for achieving better outcomes, continuous research and development in respect of new technologies are needed. In this regard, an important lesson from the previous green revolution is that the development of new technology requires long-term financial support for R&D, in parallel with wide and effective dissemination of information and know-how (United Nations, 2011b).

However, public expenditure for agricultural R&D remains low in many developing regions (figure IV.4), the main reason being that since the 1980s, international support for agriculture research has decreased and many national agricultural research centres have scaled back their programmes for the production and distribution of seeds (Dubin and Brennan, 2009). Thus, national initiatives must be designed to address the lack of investment in R&D, including through partnerships with the private sector.

<sup>8</sup> While the main function of agricultural extension workers is to provide and transfer knowledge for increasing productivity, they are now increasingly being expected to fulfil a number of new functions, such as linking smallholder farmers to high-value and export markets, promoting environmental outcomes (involving, for example, watersheds, forests and irrigation water), supporting microcredit groups, and coping with the effects of HIV/AIDS and other health challenges (Lele and others, 2010).

Figure IV.4

## Public research expenditure on food and agriculture, 1981-2008



Source: Agricultural Science and Technology Indicators database (<http://www.asti.cgiar.org/data/>).

In developing countries, where agricultural R&D remains relatively weak, the main focus of the public research institutions should be the adaptation of technology to particular farming conditions and agroecological settings. However, the main challenge in developing countries is their national research institutions' lack of adequate resources. For instance, the development of a new variety of wheat, rice or corn, requires 7-10 years of breeding (Pardey and Beintema, 2001). The resulting discontinuity in funding compromises their independence and capacity to operate efficiently, while poor documentation of processes increases the risk of permanent loss of knowledge.

In addition to securing stable financial resources, national public research centres have to change their organizational culture. They need to improve their responsiveness to the needs of farmers, including through joint experimentation and learning. This requires that research institutions work more closely with farmers and other actors such as non-governmental organizations, farmers organizations and innovation brokers, which can make farmers' needs known to the research and government communities, using innovations made possible by ICT. In this field, participation of women, especially in sub-Saharan Africa where women constitute a large proportion of the agricultural labour force, will also be critical to enhancing their decision-making in agricultural research and extension services and to addressing their specific needs.

Research institutions also need to expand their traditional disciplinary approach to encompass an interdisciplinary focus in response to wide-ranging farmer demands. For instance, transformation of diverse agroecological rural economies requires the expertise of biologists, agronomists, water engineers, nutritionists, economists and social and political scientists (Lipton, 2010).

The private sector has become a more active player in agricultural R&D, but its involvement has not been sufficient to compensate for the reduction in public expenditure. In developing countries, public funding remains the main source of finance for agricultural

In developing countries, where agricultural research and development remains relatively weak, the main focus of the public research institutions should be the adaptation of technology to particular farming conditions and agroecological settings

Biotechnology could be an effective instrument for facilitating the transformation of agriculture in agroecological regions affected by harsher conditions

research. Moreover, the private sector tends to invest mainly in profitable research, including agricultural chemical inputs, machinery and biotechnology, targeting wealthier economies and larger farmers. The involvement of private research in managing natural resources and maintaining biodiversity also remains limited (Biodiversity International and others, 2012).

The private sector also can play an important role in promoting rapid technological innovation for achieving food security and tackling climate change. Biotechnology and innovative market access for smallholders constitute one of the areas where the private sector can play a major role in expanding research. Despite the fact that biotechnology remains a controversial issue, it nevertheless holds great potential for increasing agriculture productivity (United Nations, 2011b).

Today, one third of the rural population in developing countries lives in rain-fed regions, characterized by frequent moisture stress, which limits their agricultural output. Biotechnology could be an effective instrument for facilitating the transformation of agriculture in these agroecological regions affected by harsher conditions. It has a significant potential to increase yield gains by making crops herbicide-resistant, less dependent on chemical pesticides and more resilient to water stress, while conferring on them a greater nutritional value.

So far, private research in biotechnology has concentrated on the development of products that can be easily protected by patents and has focused mainly on the demand from large-scale farmers. The cost of seeds and inputs may discourage use of this technology by small farm holders, especially if the market continues to be dominated by a few large companies which exert influence over prices. The potential of genetically modified organisms to increase food production is limited not only by their excessive costs, but also by their unknown possible risks, including long-term environmental and health impacts. Independent assessments of the larger impacts of this technology are urgently needed.

Moving forward, the structure of incentives and the governance of innovation in this area require radical changes. New mechanisms for engaging the private sector need to be explored: results-based performance contracts granted on a competitive basis—for the development, for example, of improved seed or crop varieties with higher water-stress tolerance and greater responsiveness to fertilizers—may be one means of stimulating private research. Patent buyouts and prizes may be other means of doing so (Elliot, 2010; Bhagwati, 2005). Use of more traditional subsidies, co-financing arrangements and joint ventures, within a framework of appropriate protocols for maintaining the public-good nature of research products, could also be explored (Pardey and Beintema, 2001).

Many countries face serious challenges to addressing these complex technological changes. Overcoming these challenges will require the cooperation of the public, private and civil society organization sectors within countries, as well as between countries, towards adapting know-how to specific agricultural conditions (Biodiversity International and others, 2012). CGIAR (formerly the Consultative Group on International Agricultural Research) has a positive record in developing technology well suited for smallholders, although diffusion of these technologies has been a challenge. In 2008, CGIAR was reformed to refocus its research and develop partnerships with the capacity to increase the diffusion of results.

Yet, given the need to adapt technologies to different agroecological systems, CGIAR and other international research institutions must work more closely with national agricultural research centres so that they can adapt internationally developed technologies

to their various national contexts and “share back” their innovations with other countries. The growing capacity of large national agricultural systems in Brazil, China, India and South Africa, for instance, has generated South-South cooperation aimed at benefiting countries with limited resources, by allowing them to adopt or adapt the technologies of the countries with large agriculture systems, which are typically less capital-intensive and have less intellectual property rights protection.

## Sustainable management of natural resources

An increase in food production will also require integrating sustainable practices, in particular in the use of natural resources. Many of the current agricultural practices have relied on cheap energy and abundant water and land, and are a leading source of greenhouse gas emissions. These practices are now proving unsustainable for the environment and health. At the same time, they have led to substantial productivity losses, thereby posing risks to food security. Thus, agricultural productivity and an efficient use of natural resources, as well as climate-related adaptation and resilience-building, should be part of an integrated policy approach.

Agricultural productivity and an efficient use of natural resources, as well as climate-related adaptation and resilience-building, should be part of an integrated policy approach

### Current unsustainable practices

Even if 90 per cent of the growth in crops will come from higher yields, land availability will continue to be crucial for agriculture. Arable land would need to expand by 12 per cent in developing countries by 2050 (Food and Agriculture Organization of the United Nations, 2009a). However, available land for food cultivation has been shrinking, owing to land degradation and competition from other uses, such as urban development and production of non-food crops, like biofuels. In many regions, available agrarian land is constrained, especially when biodiversity and soil degradation are taken into account. Every year, about 12 million hectares of agricultural land are lost owing to land degradation, adding to the billions of hectares that are already degraded (Beddington and others, 2012). Soil degradation not only affects its fertility, reducing agricultural production opportunities, but also has negative effects on the hydrologic cycle, and climate, biodiversity, landscape and other ecosystem services.

Available land for food cultivation has been shrinking, owing to land degradation and competition from other uses, such as urban development and production of non-food crops

There are many factors leading to soil degradation which should be prevented. The excessive use of chemical fertilizers and pesticides is considered the major factor affecting the resilience of land. For instance, in the past 50 years, global fertilizer use increased by 500 per cent, causing widespread pollution (Earth Security Initiative, 2012). Managing the use of fertilizers will be crucial for long-term land development; for example, in the United States, it has been demonstrated that in the long term, organic agricultural methods can outperform conventional chemical farming in terms of crop yield, sustainability and profit (ibid.). While large-scale farming is, in general, identified as the main source of excessive use of fertilizers and soil degradation, land fragmentation and limited farm size can also be a source of soil degradation. In the *minifundias* of the Andean highlands of Latin America for instance, poor small-scale farm holders over-exploit natural resources, owing to population pressure and scarcity of suitable land (United Nations, 2011b).

The urbanization process is also increasing competition for arable land and wetlands. So far, urban areas occupy about 1 per cent of the total land surface (United Nations Environment Programme, 2012a), but urbanization is projected to continue at

It is expected that the increasing and competing demands for water will aggravate the serious depletion of surface-water resources

a fast pace in the next decades (see chap. III). Between 2012 and 2050, the world urban population is expected to increase by 69 per cent. At the same time, renewable energy strategies, such as use of biofuels, are increasing demand for land resources. Hence, developing the potential to create more sustainable land management systems, in order to reverse current trends in food insecurity and unsustainable land degradation, is desirable—and possible (United Nations Environment Programme, 2012a).

More recently, the purchase (or long-term lease) of large extensions of land is subjecting use of land for cultivation and local food consumption to pressure (box IV.1). These transactions have raised concern about their implications for rural communities and for the food security of countries already vulnerable to insecure food supplies.<sup>9</sup> Improved national and international oversight mechanisms may be needed to prevent the unintended negative impacts of leasing arrangements for large extensions of land on the food and nutrition security of poor communities.

#### Box IV.1

##### Purchase of large extensions of land

The demand for agricultural land intensified at the peak of the food price crisis in 2007-2008. Estimates about the extension of land involved in large-scale acquisitions vary wildly, from 120 million acres, as reported by the World Bank in 2010, to 560 million acres, as reported by Oxfam in 2012.<sup>a</sup> There are many factors explaining the accelerated interest in foreign land. Reportedly, over 60 per cent of foreign investment in land is for food exports and around two thirds of land deals in the last 10 years were made with a view to producing crops for biofuels (Oxfam, 2012, p. 6). In addition, land is also becoming an asset that offers portfolio diversification for international investors, such as large pension funds and financial institutions (Earth Security Initiative, 2012).

There is a large controversy about the recent interest of foreigners in purchasing or leasing large landholdings: some see an opportunity to leverage foreign investment for agriculture and rural development, while others warn against the risk of displacing traditional rural communities and pastoralists from their land, thereby increasing food insecurity in countries already at risk. In countries like Ethiopia, Mali, Mozambique and the Sudan, this development has raised widespread concerns over forced evictions, social vulnerability and dwindling water resources (Earth Security Initiative, 2012). Pearce (2012) found that in countries selling (or leasing) large extensions of land, in the largest majority of cases, local communities lose access to forests, pastures and water resources, with no major gains in employment, owing to the use of capital-intensive technology in large farms.

In the absence of policies and institutions that provide secure tenure and adequate safeguards to domestic smallholders and their communities, large-scale purchases of land may have unintended negative consequences for rural communities and small-scale farmers. Countries such as Argentina and Brazil have already erected legal barriers in relation to the amount of farmland that can be owned by foreigners (Earth Security Initiative, 2012). More recently, United Nations entities (such as the United Nations Conference on Trade and Development, the Food and Agriculture Organization of the United Nations, the International Fund for Agricultural Development and the World Bank) adopted the Principles for Responsible Agricultural Investment with the intention of providing some form of protection to rural dwellers. Globally agreed safeguards to protect the rights of traditional communities, often lacking legal recognition of their rights to land, water and forests, are particularly relevant for countries in sub-Saharan Africa and Latin America where, according to the World Bank, most of the 450 million hectares of “available land”<sup>b</sup> are located.

<sup>a</sup> Oxfam (2012) recently reported an area of 203 million hectares under consideration or negotiation in 2001-2010 (Oxfam, 2012).

<sup>b</sup> “Available land” in the World Bank estimates is defined as land that is uncultivated, unforested and productive (World Bank, 2011).

<sup>9</sup> By some accounts, two thirds of land purchases occur in countries already facing hunger (Oxfam, 2012).



Water is another essential natural resource for agriculture, whose limit of sustainability may have already been reached in many regions. Global water withdrawals have tripled over the last 50 years and water withdrawals for irrigation are expected to increase by almost 11 per cent by 2050 (Food and Agriculture Organization of the United Nations, 2009d). Yet, today, 80 per cent of the world's population lives in areas with high levels of threat to water security, particularly in developing countries (United Nations Environment Programme, 2012b). In addition, it is expected that the increasing and competing demands for water will aggravate the serious depletion of surface-water resources. Water scarcity represents an important challenge for agriculture, which uses 70 per cent of global freshwater.<sup>10</sup>

There are several causes of water scarcity. Intensive agriculture, including livestock production, has become a major factor in water quality degradation (United Nations, 2011b). Excessive use of agrochemicals (pesticides and fertilizers) contaminates waterways. Energy production and climate change are also main causes of water scarcity. For instance, use of traditional sources for energy production results in increased greenhouse gas emissions and climate change, increasing the frequency and intensity of extreme climatic events such as flood and droughts, sea-level rise, and the loss of glacial and polar sea ice, all of which contribute to water scarcity. Alternative solutions, such as utilization of energy sources with lower carbon footprints, can also have implications for the water environment. Hydropower production can contribute to fragmentation of river systems, while the construction of some solar-energy infrastructure consumes significant quantities of water (United Nations Environment Programme, 2012a).

Finally, climate has been changing, mainly owing to the levels of greenhouse gases in the atmosphere, presenting a serious threat to agriculture. Extreme weather events such as droughts and floods, have been affecting food production, with dramatic consequences for various agroecosystems. In the coming decades, it is expected that climate change will continue to have adverse effects on agricultural production. Even a modest climate change of about 2° Celsius can change rainfall patterns, resulting in a shorter growing season and lower agricultural production, particularly in areas that are already hot and dry, for example, in Africa and South Asia (Beddington and others, 2012). Communities already plagued with high levels of food insecurity and environmental degradation are disproportionally affected. In particular, smallholders relying on rain-fed agriculture are more vulnerable to climate change.

There are several factors contributing to the problem of climate change. Current agriculture practices, including land clearing for cultivation and inefficient use of fertilizers and organic residues, constitute one such factor, being responsible for 25-33 per cent of greenhouse gas emissions (Beddington and others, 2012). While agriculture is a major contributor to global greenhouse gas emissions, it can also be part of the solution to the problem of climate change. There is ample room for lowering emissions throughout the food system, through more efficient productive techniques and better demand management. On the production side, climate change can be mitigated through carbon sequestration in both vegetation (forests, for example) and soil. On the demand side, reducing wastage, for instance, will be important (see the sect., entitled "Diets and consumption patterns", below), as well as increasing demand for organic and eco-certified products, which should encourage producers to pay more attention to sustainable practices. Despite international and national awareness of the risks related to climate change, there has so far been limited financial and political support for implementing more sustainable practices.

Extreme weather events such as droughts and floods have been affecting food production, with dramatic consequences for various agroecosystems

Adaptation measures involving organic soil nutrient enhancement and other ecologically sound methods—an approach popularly known as climate-smart agriculture—can contribute to reducing greenhouse gas emissions

<sup>10</sup> See Food and Agriculture Organization of the United Nations (2009b).

## Improving management of natural resources

Improving agricultural outcomes will therefore require an integrated approach which promotes the resource efficiency of the whole agriculture and food system, while mitigating its environmental impacts. In this regard, government policies can foster an agricultural innovation system approach to developing a comprehensive policy framework for innovation, which can respond to the double challenge of increasing agricultural productivity and achieving environmental sustainability (United Nations, 2011b).

The Southern Agricultural Growth Corridor of the United Republic of Tanzania (SAGCOT) exemplifies such an integrated approach. The Growth Corridor brings together the capabilities and resources of businesses, government and civil society within a common platform in order to overcome the country's various ecosystems barriers to achieving the triple objective of agricultural productivity, food security and livelihoods creation in a sustainable manner. By encompassing the entire agricultural value chain, the SAGCOT approach attempts not just to raise agricultural productivity but to ensure the necessary infrastructure, policy environment and access to knowledge required to create an efficient, well-functioning agricultural value chain.

Traditional practices have recently also gained in importance within the context of adaptation to climate change. For instance, local farmers and communities have shown a great capacity to innovate in response to weather and other shocks. There are thousands of successful experiences of localized enhanced pest and weed management, water efficiency and biodiversity, including stories of highly successful innovation in the most challenging circumstances characterized by a poor natural resource base and widespread poverty.<sup>11</sup> Traditional practices, such as low-tillage farming, crop rotation and interplanting, water harvesting and recycling, water-efficient cropping, and integrated pest management, have also proved their relevance to increasing productivity and ensuring environmental sustainability.

Agricultural research should also consider the climatic, soil and water conditions of the relevant agroecological region. Adaptation measures involving organic soil nutrient enhancement and other ecologically sound methods—an approach popularly known as climate-smart agriculture—can contribute to reducing greenhouse gas emissions. As noted above, there is much interest in the climate change mitigation potential of carbon sequestration, in both vegetation (forests in particular) and soil (United Nations, 2011b). The use of ICT and better access to information facilitate the transition to precision agriculture adapted to different agroecological regions. For instance, using satellite-based remote monitoring and in-field sensing technologies is of great help in the global and regional monitoring of crop productivity and weather-related impacts.

## Investments in rural infrastructures

Addressing the structural constraints on food production and distribution within a wider framework of sustainable natural resource management will require investments in infrastructure in rural areas

In respect of addressing the structural constraints on food production and distribution within a wider framework of sustainable natural resource management, investments in infrastructure in rural areas will also be determinant. In particular, small farm holders in developing countries face limited access to output markets, which affects the efficiency of their farming. As a result of the existence of such inefficiencies, an opportunity is missed to increase agricultural output. This is especially regrettable since most of the findings

<sup>11</sup> See United Nations (2011b) for a more elaborate discussion of this topic.



presented in the literature dealing with agricultural development in low-income countries indicate that small farm units tend to show higher productivity than large-scale farms.<sup>12</sup>

In agriculture-based countries, in sub-Saharan Africa and South Asia in particular, the priority should be expansions of basic infrastructure such as roads, electricity supply and potable water. In many African countries, for instance, transportation can account for 50-60 per cent of total marketing costs. Improving road connections is thus crucial for bringing marketing costs down and stimulating local economies (World Bank, 2008a).

By addressing long-term structural constraints on food production, investments in physical infrastructure can be a catalyst of productivity growth. In poor agriculture-based countries, public investment will also play an important role in leveraging private investment, which will otherwise not flow in sufficient amounts to meet needs, owing to the perception that agricultural production is high-risk. Larger public investment in infrastructure will provide greater incentives to increase private investment within a wider framework of sustainable natural resource management.

The case of Uganda (box IV.2) not only provides a good illustration of the potentially large impact that public infrastructure can have in increasing productivity, but also raises important questions about the larger macroeconomic impacts of increasing government expenditures and the need to take into account the trade-offs involved in this decision. Carefully crafted strategies for achieving food security will require national consensus and the political will to prioritize investments, as well as greater government capacities to stimulate large productivity gains through sustainable finance. Development cooperation would have an important role in at least two areas: (a) support for development of capacity, especially within least developed countries, to conduct policy assessments, and (b) provision of additional resources for infrastructure development. Enhancing the outreach and volume of resources in the Aid for Trade initiative for infrastructure development would make an outstanding contribution to achieving the objective of sustainable food security.

In some countries, the focus should also be on crop harvesting technologies, as significant wastage occurs at the producer end and before reaching the market, owing to inadequate harvesting techniques (Institution of Mechanical Engineers, 2013). The amount of food wasted represents not only an economic cost but, more importantly, a waste of energy and natural resources. As mechanized harvested systems are implemented, food distribution and storage systems will need to be improved in parallel. Access to affordable energy and cooling systems, for instance, could provide storage options and also facilitate their installation by smaller scale farmers, isolated from markets, which would ultimately increase food availability throughout the whole year.

Many developing countries, especially those with an agriculture-based economy, will need external support to increase their investments in infrastructure. In 2010, the international community launched the Global Agriculture and Food Security Programme (GAFSP), which, among several activities, has been channelling long-term investments in food and nutrition security. However, this Programme is costly and has required a high level of funding that has not become available. Of the \$1.2 billion pledged, \$752 million have already been received, of which \$658 million have been allocated to country-led programmes in 18 countries. More funds should be provided, however, to help implement these strategies and support the development of new ones so as to reinforce the resilience of the food production system.

In some countries, the focus should also be on crop harvesting technologies, as significant wastage occurs at the producer end and before reaching the market

<sup>12</sup> These advantages may disappear for certain crops whose cultivation benefits from significant economies of scale and input-intensive technologies.

## Box IV.2

### Infrastructure's potential to drive productivity and sustainable food production: the case of Uganda

Uganda is a low-income country with severe deficits in physical infrastructure, where agriculture still generates about 23 per cent of GDP, which is relatively high compared with an average of 12 per cent in sub-Saharan Africa. Several policy scenarios illustrate the potential of Government investments in physical infrastructure to drive productivity growth and enhance food production capacity. These scenarios are compared with a baseline that delineates a continuation of currently expected economic growth and public spending interventions up to 2030.<sup>a</sup>

Public spending in agriculture infrastructure, mostly for irrigation projects, represents only 0.7 per cent of Uganda's GDP under the baseline. The first scenario assumes an increase of public investment in agriculture by the Government equivalent to 2 percentage points of GDP over the period 2016-2030. As a result, factor productivity growth in agriculture—of about 2.4 per cent per year under the baseline—is pushed up by an additional 1.3 percentage points per year during the period 2016-2030. Consequently, agricultural output growth increases by about 1.5 percentage points per year. In a second round of effects, public spending spurs export growth and a higher level of household consumption, especially of agricultural goods, but the results are also favourable at the national level (see table).

These results support the idea that public investment in agriculture infrastructure contributes to productivity gains. While investments in other public infrastructure, mainly roads and electricity supply, also yield positive results, they are relatively less significant in magnitude, particularly for agriculture, compared with the results under the first three scenarios.

The main concern for policymakers is how to finance the new investments in infrastructure. The financing requirements could create undesirable macroeconomic hardships and may be politically unattainable. In the case of Uganda, for example, the scenarios show that financing new infrastructures through higher direct-tax revenues spurs GDP growth and household consumption relatively less than does, for example, financing them through foreign resources. However, the use of foreign resources affects export growth negatively, owing to real exchange rate appreciation. In addition to these macroeconomic hardships, other factors, like debt sustainability, (declining) support from foreign donors and the issue of the real feasibility of raising tax burdens, need to be taken into consideration as well when defining a financing strategy.

According to these simulations, the ideal scenario entails the creation of fiscal space by reducing other government expenditures, which avoids the said macroeconomic trade-offs. The feasibility of this scenario will depend, however, on the political conditions for improving the efficiency of government spending and/or reallocating resources towards the agricultural sector.

<sup>a</sup> The scenarios have been generated using a dynamic economy-wide modelling framework known as the Maquette for MDG Simulations (MAMS) (Lofgren, Cicowiez and Díaz-Bonilla, 2013), which involves, inter alia, a microeconomic analysis of determinants of productivity growth where the stock of public infrastructure is one of the key drivers at underlying country-specific elasticity values. Uganda's baseline scenario was first generated for the period 2007-2015 by national researchers and Government experts, with technical support from UN/DESA and the World Bank (Matovu and others, 2013). UN/DESA extended this scenario up to 2030 for the analysis presented here.

### Improving access to food

Investments in food production systems need to be complemented by programmes designed to increase the incomes of the poor, as well as by social protection and safety nets

Although crucial to improving nutrition outcomes, improving food availability is not sufficient to ensure access to food. Food insecurity is more often the result of limited access to food. As explained by A. Sen (1981), "starvation is a matter of some people not having enough food to eat, and not a matter of there being not enough food to eat". Thus, investments in food production systems need to be complemented by programmes designed to increase the incomes of the poor, as well as social protection and safety nets. At the international level, measures also have to be taken to prevent excessive food price volatility and to ensure that a pro-food security trade system is in place.

## Box IV.2 (cont'd)

## Uganda: selected real macro indicators under simulation scenarios, 2016-2030

## Annual average growth rate

	Baseline	Direct-tax revenue	Foreign transfers	Allocative efficiency
<i>Irrigation systems</i>				
<i>Agriculture</i>				
GDP	5.3	6.6	6.5	6.7
Exports of agricultural goods	3.5	7.3	6.2	7.0
Household consumption of agricultural goods	5.0	5.4	5.8	5.8
<i>National</i>				
GDP	7.0	7.2	7.6	7.4
Exports of goods and services	7.0	7.8	7.0	8.0
Household consumption	6.5	6.2	7.0	6.9
<i>Roads and electricity supply</i>				
<i>Agriculture</i>				
GDP	5.3	5.5	5.5	5.6
Exports of agricultural goods	3.5	4.1	3.6	3.7
Household consumption of agricultural goods	5.0	5.0	5.2	5.2
<i>National</i>				
GDP	7.0	7.1	7.4	7.2
Exports of goods and services	7.0	7.3	6.9	7.6
Household consumption	6.5	6.2	6.8	6.7

**Source:** UN/DESA, based on an updated version of MAMS for Uganda, presented initially in Matovu and others (2013).

**Note:** In non-baseline scenarios, the Government generates the fiscal space needed to expand investments in infrastructure by 2 percentage points of GDP above the baseline in 2016-2030. The new investments are financed through higher direct-tax revenues, foreign transfers or allocative efficiency of government spending achieved by reducing "wasteful" spending or "overlapping" government functions.

## Limited access to food

Income poverty is obviously a main underlying factor preventing access to food. For instance, when comparing the highest and the lowest income quintiles of the population in developing countries, the poorer children are almost 3 times more likely to be underweight than children in the wealthiest 20 per cent of households (United Nations, 2012c). Hence, increasing the income level of poor households will help ensure adequate food quantity and quality, and reduce the prevalence of undernourishment. However, in many regions and countries, economic growth has not been inclusive enough to provide employment and income-earning opportunities for the poor.

Increasing the income level of poor households will help ensure adequate food quantity and quality, and reduce the prevalence of undernourishment

As many poor people live in rural areas, it is not surprising that it is in those areas that the prevalence of undernourishment is also higher. For instance, in developing regions, children living in rural areas are almost twice as likely to be underweight than children in urban households (ibid.). Therefore, economic growth should generate demand for the assets controlled by the poor (Food and Agriculture Organization of the United Nations, 2012b), in particular the rural poor.

Among the rural poor, the situation of small farm holders is at the heart of the food security challenge. Small farmers face limited resources and assets, either for purchasing or for producing the quantity of food that is adequate to their needs. Empirically, it has been observed that the majority of the extremely poor and about half of the undernourished people in the world, which includes 1.5 billion people in least developed countries, live on small farms of less than two hectares, representing 90 per cent of farms worldwide (United Nations, 2011b). Further, according to the most recent data, average farm sizes are still declining in many countries, for example, in Africa, and in India (World Bank, 2008a).

High inequality in the distribution of assets—such as land, water, capital, education and healthcare—is a main obstacle which needs to be addressed so as to enhance food security

Thus, addressing the issue of food availability and undernourishment in rural areas necessarily implies responding to the challenges faced by smallholders. In particular, high inequality in distribution of assets—such as land, water, capital, education and health care—is a main obstacle which needs to be addressed so as to enhance food security. This is particularly evident in countries where large farms have been controlling a larger proportion of the land, while exacerbating the asset squeeze on smallholders (ibid.).

Discrimination against women in the rural sector also has a negative impact on the outcomes of efforts to secure access to food and nutrition. Women make up over 40 per cent of the agricultural workforce in Africa and East and South Asia, but they constitute only 5 per cent of landholders in Northern and West Africa, 15 per cent in sub-Saharan Africa and 25 per cent in several countries in Latin America. Women have restricted access not only to land but also to credit and technology, which increases their economic vulnerability and the instability of their situation with respect to nutrition. These restrictions imposed on women exacerbate gender discrepancies with regard to nutrition, with serious intergenerational effects, as nutrition in children under age 5 depends critically on the nutrition of their mothers during pregnancy and lactation (Horton, 2008; Copenhagen Consensus, 2008).

## Generating income in rural areas

The ability to generate income for the rural poor will be a main determinant of food security. Generating an increase in agricultural productivity is an important strategy for increasing food availability, but it may not improve access to food of a large portion of the population, including vulnerable social groups.

### *Improving agricultural income*

A successful strategy for increasing rural households' income entails promoting the diversification of their farming activities

A successful strategy for increasing rural households' income entails promoting the diversification of their farming activities. When comparing households relying on more diversified farming activities with those that remain engaged in more traditional farming, it is evident that the former are more successful in moving out of poverty. In Uganda, for instance, the combination of higher productivity of land and diversification of crops, in particular cash crops, has led to lower rural poverty (World Bank, 2008a).

In addition, a diversified farming system, integrating, for instance, horticulture and livestock, can enhance nutritional outcomes, as it improves rural households' access to foods from animal sources, fruits and vegetables. In Viet Nam, for example, the vegetation, aquaculture, and cages for animal Husbandry (VAC) system, which includes a diversified farming system at the household level, has contributed to improvements in both incomes and nutritional outcomes, in terms of consumption of foods from animal sources and fruits and vegetables (Food and Agriculture Organization of the United Nations, 2013). This experience shows that integrated farming projects can be particularly successful in raising micronutrient intake, in addition to improving income stability.

However, a main challenge is the unequal access to rural assets, which prevent many households from adopting market-oriented strategies and moving out of poverty. There are gaps in the institutional structure required for the operation of land markets, financial services, input markets and producer organizations. An appropriate institutional setting is also crucial for supporting small-scale farming, so as to increase agricultural investment and productivity, while preserving natural resources. Improving women's access, for instance, to several assets, such as land, input markets and technology, could increase agricultural production by as much as 2.5-4.0 per cent, thereby reducing the number of undernourished people by 12-17 per cent, equivalent to freeing 100 million-150 million people from hunger (Food and Agriculture Organization of the United Nations, 2011b).

Moreover, flexible land management and the capacity to innovate in production, storage and marketing practices and techniques require the appropriate use of information and technology, as part of a continuous learning process (Davis and others, 2007). Therefore, rapid expansion of quality education in rural areas, including adult literacy and training, should receive the highest priority in any strategy aimed at strengthening farmers' capacity for response to rapidly changing market conditions. Innovative mechanisms for the transmission of knowledge and training also need to be strengthened. The experience of the Farmer Field Schools—operating in 87 countries—shows that innovation and flexible natural resource management can be advanced through farmer-to-farmer learning, including participation in formal and informal research institutions. In-service and on-the-job training and distance education have also proved effective and are increasingly complementing extension services (United Nations, 2011b).

Adult literacy and training should be a priority in any strategy aimed at strengthening farmers' capacity for response to rapidly changing market conditions

### *Non-farm economy*

As has been extensively documented, many rural households complement their own agricultural activity with non-farm sources of income. In agriculture-based economies, the share of rural income derived from non-agricultural sources may be only 20-30 per cent, but in urbanizing economies, it can be as high as 60-70 per cent (Food and Agriculture Organization of the United Nations, 2012b). That is to say, many rural households diversify their source of income by dividing their time and labour units between farming and non-farm activities.

Thus, in agriculture-based countries, growth in the agriculture sector can be complemented by non-farm activities, creating a virtuous cycle of rural growth and employment generation (ibid.). However, as noted above (see the previous sect. on increasing food availability), developing rural infrastructure and improving rural-urban linkages will also be important for promoting additional sources of revenue. For instance, stimulating rural-urban migration will help in diversifying the income sources of the household and reducing poverty, particularly in urbanizing economies. In China, for instance, the

Rural development strategies should enhance opportunities for smallholders to diversify their agricultural as well as non-farm activities

existence of areas of high population density combined with lower transport costs has stimulated labour-intensive manufacturing for export markets using the labour force from rural areas (ibid.).

Moving forward, rural development strategies should enhance opportunities for smallholders to diversify their agricultural as well as non-farm activities. These strategies can at the same time reduce rural poverty and under-nutrition. First, they can enable households to both diversify their sources of income, by incorporating more cash crops in their agricultural production, and secure higher-productivity jobs outside the agricultural sector. Second, they can lead to direct improvement of nutritional conditions through enhanced access to a more diversified source of nutrients.

However, access to assets, individuals' skills and migration opportunities will all be determining factors in the process of moving out of rural poverty. Infrastructural as well as institutional changes will be necessary to ensure access to rural assets, such as land and water. Access to education will also be crucial to ensuring that the rural poor and specific social groups, such as women, can take advantage of new income opportunities.

### Social security and safety nets

As discussed above, one of the main obstacles to achieving food security is the lack of access to food, in particular among lower-income groups which lack the necessary purchasing power. The 2007-2008 food price crisis exacerbated the problem of food accessibility and nutrition outcomes, in particular for poor people, who spend 50-70 per cent of their income on food. A social protection system, including safety nets, can protect the most vulnerable against short-term economic and food price shocks. Several large countries were able to protect consumers by insulating their markets from international price shocks with additional safety net programmes. Social protection can also contribute to long-term resilience by facilitating access to food and by strengthening the ability of smallholders to manage risks and adopt new technologies with higher productivity (Food and Agriculture Organization of the United Nations, 2012a). The types of social protection instruments will vary depending on national social needs, development objectives and fiscal space.

#### *Safety nets in the short term*

In the short term, emergency food assistance and safety nets are effective tools for meeting urgent food needs and protecting the most vulnerable against price and climatic shocks

As regards short-term relevance, emergency food assistance and safety nets are effective tools for meeting urgent food needs and protecting the poor and the most vulnerable against price or climatic shocks. Safety nets include community support systems, transfers (direct and indirect), subsidies, public works and microcredit. For instance, in the aftermath of the 2007-2008 food price crisis, 23 countries introduced or expanded cash transfer programmes, 19 countries introduced food assistance programmes and 16 countries increased disposable income measures (Food and Agriculture Organization of the United Nations, 2009c). Multiple solutions are possible, but, in general, scaling up existing social protection interventions has proved to be the best strategy for facing urgent challenges.

An adequate safety net can also ensure a basic level of consumption, which enables poorer farmers to assume the higher risks associated with higher-return strategies, which, potentially, could break the vicious circle of poverty and hunger. Public works (or cash for work) programmes, such as India's National Employment Guarantee Scheme, represent typical employment-based safety nets which entitle individuals to a minimal

amount of work and income, while they contribute to labour-intensive infrastructure development projects (Food and Agriculture Organization of the United Nations, 2009c). These employment programmes can also incorporate training components, thereby enhancing human capital at the local level.

### *Social security in the long term*

Long-term resilience and food security will require a more comprehensive social security system. The main goal should be to establish systematic and predictable programmes, targeting specific social groups, including the poor and smallholders, which can enhance human capital and stimulate the adoption of new technologies. For instance, nutrition intervention in early childhood, especially in the first thousand days, can lead to higher adult economic productivity. In Guatemala, a study showed that children who had received nutritional supplements before reaching the age of 3 earned hourly wages as adults that were 46 per cent higher (Food and Agriculture Organization of the United Nations, 2012b).

Much has been learned about how best to design social protection floors, how to determine which combinations of plans work and where, and how to target them. The international community can provide assistance to developing countries in designing such plans in a cost-effective time-bound manner so as to realize the right to food, as well as stimulate rural development, agricultural production and poverty alleviation. Support should also be offered to help integrate the social protection floor plan within the national agricultural strategies. The leaders of the G20, at their 2012 Summit, recognized the importance of establishing nationally determined social protection floors. They are being endorsed within International Labour Organization conference processes, which could support national efforts. The international community may also need to help the least developed countries finance their own social protection programmes.

Long-term resilience and food security will require a more comprehensive social security system

### *A pro-food security international trade system*

In today's interdependent world, the implementation of national strategies to improve access to food also requires concrete actions at the global level. As observed during the 2007-2008 food price crisis, higher food prices deeply affected nutrition and macroeconomic conditions of net food importing countries, especially in sub-Saharan Africa (Food and Agriculture Organization of the United Nations, 2011d), in part owing to a shortage of the foreign currency required to increase food imports. Conditions promoting trade and food market transparency needed to reduce price distortions and volatility will be crucial to stimulating staple food production at the local level and ensuring access to food at the same time.

Conditions promoting trade and food market transparency needed to reduce price distortions and volatility will be crucial to stimulating staple food production at the local level and ensuring access to food at the same time

### *The trade system*

Agricultural trade is potentially a pathway for GDP growth, lower rural poverty and food security. However, global markets have been working in favour of major production companies and some food exporting countries, often to the detriment of small landholders. The main challenge for the international trade system is to become more food security-oriented, in particular as regards food importing countries. For instance, the export subsidies and import protection granted by developed countries continue to create price distortions



in global food markets, with large negative consequences for developing countries. As a result, several countries have reduced investment in their agriculture sector. In this regard, as suggested in the specific proposals for the review of World Trade Organization rules, the trade system should be flexible in order to protect non-traded agricultural sectors that are vital to food security.

In food exporting countries, export restrictions must be disciplined, as agreed at the G20 Cannes Summit in 2011 within the context of food crisis situations. Export restrictions provide a disincentive to farmers to invest in food production and undermine progress towards multilateral trade reforms and freer trade in the agriculture sector. At the same time, in food importing countries, import and domestic taxes on food must be temporarily reduced, especially when taxes constitute a significant proportion of the final price. For instance, tax reductions could be a better option than a subsidy programme, despite some of the negative effects on public revenue.

In the longer run, a fairer international trading system, taking into account the food security, livelihood security and rural development needs of developing countries, will be crucial. For instance, in higher-income countries, agricultural trade distortions need to be eliminated, in particular subsidies and market restrictions, which have devastating consequences for farmers in lower-income countries. In this regard, the Doha Round of World Trade Organization negotiations should be completed, with the Marrakesh Ministerial Decision on Measures Concerning the Possible Negative Effects of the Reform Programme on Least Developed and Net Food-importing Developing Countries<sup>13</sup> assisting countries in the implementation process.

### *Food security stocks and information transparency*

Maintaining food stocks at the global and regional levels is an additional useful mechanism for improving emergency access to food and stabilizing food prices

Maintaining food stocks at the global and regional levels is an additional useful mechanism not only for improving emergency access to food, but also for stabilizing food prices. A certain level of world stock could be a sufficient condition for price stability (Committee on World Food Security, High-level Panel of Experts on Food Security and Nutrition, 2011). Supporting and improving access to these stocks can enhance food security and prevent humanitarian crises in countries under emergency conditions. These stocks should, however, target lower-income countries and be released strategically to support programmes that facilitate food access to the most vulnerable populations. In this regard, the High-level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security made two important recommendations on how to maintain a minimum level of world stocks and ultimately reduce food insecurity.

There is need for better information, with the creation of a transparent and coordinated food market information system

Pursuant to those recommendations, first, there is need for better information, with the creation of a transparent and coordinated food market information system. The elimination of most public stocks in OECD countries and the privatization of most State-trading enterprises have concentrated knowledge concerning agricultural commodity availability in the hands of a small number of companies which maintain this information as proprietary. One of the most important elements of the Action Plan on Food Price Volatility, agreed by the G20 Agriculture Ministers at their meeting held in Paris on 22 and 23 June 2011, was the launching of the Agricultural Market Information System (AMIS) to improve market information and transparency of data on current stocks, and promote coordination of policy responses (see Ministerial declaration, para. 26). The High-level Panel of Experts at the same time recommended that given the importance of

<sup>13</sup> See *Legal Instruments Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations, done at Marrakesh on 15 April 1994* (GATT secretariat publication, Sales No. GATT/1994-7).



food insecurity, trading firms should be mandated to report on stocks instead of being allowed to do so voluntarily. AMIS market information should also be extended to include food crops other than the usual global cereals, including livestock and fish. Second, assuming the role traditionally played by the United States of America and China as stock holders, the international community should maintain a minimum level of world food stock. The objective would not be to defend a price band but rather to avert price spikes through the release of stock when prices started to boom.

In addition, increasing food reserves managed by the World Food Programme (WFP) could reduce delivery time and costs when a situation reaches crisis level. Since WFP usually relies on cash to purchase food for its work, upward price spikes limit the quantity of food it can purchase and its ability to respond to human needs. In order to fill these gaps, including delivery time, WFP initiated a regional stocking programme in 2008—the Forward Purchase Facility—in Eastern and Southern Africa. This system offered several advantages, such as more accurate provision due to reduced time lags between requests and provision, and could be expanded to other regions. However, the lack of funding, and of available advance financing in particular, constitutes a major constraint on expanding this pilot project.

## Diets and consumption patterns

Nutrition outcomes are largely determined not only by food production and accessibility but also by food quality and diversity. A considerable potential for increasing the nutritional status of people and the efficiency of the whole food chain lies in encouraging changes in diet and consumption patterns, as well as designing pro-nutrition policies in other sectors, such as health and education. In addition, reducing food losses is a cost-effective means of increasing the availability of safe and nutritious food for all. Preventing food wastage would also reduce the challenge of how to increase production in a world with limited natural resources.

### Sustainable diets

The challenge of feeding a rising and increasingly affluent population also requires behavioural changes in terms of consumption, including dietary patterns. In particular, the livestock sector, which has grown rapidly to meet the increasing demand for meat, is a prime contribution to water scarcity, pollution, land degradation and greenhouse gas emissions. This has prompted calls for support of more sustainable diets with a more balanced content of calories derived from animal food. While the caloric content of meat is, on average, not substantially higher than that of cereals, meat production is much more demanding in terms of natural resources. On average, grain-meat conversion ratios, i.e., the number of kilograms of cereals needed to produce one kilogram of poultry or beef ranges from 2 to 1 for poultry all the way up to 7 to 1 for beef (United Nations Convention to Combat Desertification, 2012).

Consumption by an increasingly affluent population in 2050 will exacerbate pressures on the use of land and water and increase greenhouse gas emissions from agriculture (see previous sect. on increasing food availability). A decrease in the consumption of meat through adoption of more sustainable diets can lead to a substantial reduction in the use of land and other natural resources, thus improving the prospects of sustainable development, as illustrated in box IV.3.

A decrease in the consumption of meat can lead to a substantial reduction in the use of land and other natural resources, thus improving the prospects for sustainable development

### *Health and education policies to enhance nutrition security*

There is a strong consensus that better nutrition will also require pro-nutrition policies in other, related sectors. Public policies and programmes designed to improve health, water and sanitation services will be particularly important. Increasing individuals' awareness of the benefits of healthier diets, through information campaigns and educational programmes, is also relevant. A multifaceted approach to improving the nutritional status of people,

#### Box IV.3

#### **Sustainable diets and reduced food waste**

The Food and Agriculture Organization of the United Nations (FAO) has estimated that meat consumption in 2050 will amount approximately to 4.65 billion tons. Poultry meat consumption level is expected to be 2.3 times higher than in 2010, while consumption of other livestock products is expected to be between 1.4 and 1.8 times higher (Food and Agriculture Organization of the United Nations, 2009d). The world's average daily calorie availability is projected to rise from an average of 2,789 kilocalories per person in 2000 to 3,130 kilocalories per person in 2050, a 12 per cent increase. Further, current food waste is around 30-50 per cent of total production (Food and Agriculture Organization of the United Nations, 2011d; Institution of Mechanical Engineers, 2013).

Using the T21 model,<sup>a</sup> the Millennium Institute simulated the impact of reducing meat consumption and food waste on the demand for land.<sup>b</sup> The simulation assumes an overall reduction in the consumption of meat to provide 500 calories per capita per day in 2050 (down from the 620 projected by FAO). In addition, food waste and loss are assumed to decrease slightly from the current 32 per cent of total production to 30 per cent. These two assumptions result in a substantial reduction in harvested area, from an estimated 1.31 billion hectares required in 2050 to 1.065 billion hectares, a savings of almost 20 per cent in respect of the demand for harvested land.

While the changes projected do not seem ambitious, much larger changes will have to occur in each country, according to their starting point. For meat consumption, it is assumed that there is a global convergence towards the current world average of 500 calories per capita per day from animal food, which would require an increase in the consumption of animal food in low-income countries in Africa, the Caribbean and Asia and a reduction in the consumption of animal food in high-income countries in Europe, North America and Oceania of 30-35 per cent.

Similarly, the projected decrease of food waste and loss, from the current 32 per cent to approximately 30 per cent by 2050 is based on the assumption of a global convergence towards a level of about 200 kilograms per capita per year. This allows for some slight increase in food waste and loss in low-income countries (mainly driven by an expected substantial increase in production), a gradual decrease of food waste and loss in middle-income countries, and a more drastic reduction in high-income countries.

While these results demonstrate that even a conservative change in global consumption patterns will yield significant reductions in the demand for harvested land, with consequent lower pressure on the use of water, soil nutrients and energy, they also indicate that even small steps towards improving the use of available resources require major changes at country level, in the way that food is produced, transported and consumed.

The available policy options for inducing these changes are largely country-specific and require a large degree of coordination and consistency across multiple policy areas, with agriculture, health and education being the most obvious. Achieving an understanding of the policy instruments available to countries for inducing a change in diets within different contexts requires further research and policy experimentation. Policy instruments such as taxing meat products or refined sugars and carbohydrates to discourage unhealthy diets, educational programmes, mandating corporate social responsibility and labelling standards, production disincentives for meats and production incentives for whole grain cereals, vegetables and fruits, etc., need to be tested against the overall objective of promoting (and enabling) the adoption of sustainable diets.

**Source:** UN/DESA, based on Millennium Institute, "Global food and nutrition scenarios", background paper prepared for the *World Economic and Social Survey 2013* (2013).

<sup>a</sup> The T21 model is a dynamic simulation tool designed to support comprehensive, integrated long-term national development planning.

<sup>b</sup> In addition to the simulation presented in this box, the Millennium Institute designed three more simulation scenarios with different assumptions on changes in consumption and waste patterns. For a full discussion of the results, see Millennium Institute, "Global food and nutrition scenarios", background paper prepared for the *World Economic and Social Survey 2013* (2013).

including in preventing overconsumption and obesity, is essential. Hence, health and educational policies need to incorporate nutrition-related considerations in their programmes.

### Health

Nutrition and health are inextricable, as a good nutritional status can be achieved only within the context of overall conditions of good health. For instance, in developing countries, access to basic health services is often inadequate owing to an insufficient number of health centres and qualified personnel. The resulting poor health conditions and illnesses, such as measles and gastroenteritis, will then have a negative impact on nutritional status. Similarly, the lack of safe water and of adequate sanitation leads to many diseases and illnesses, while compromising the nutritional status of people.

Thus, health policies should include preventive health and hygiene measures, which are essential for good nutrition, as well as ensure that nutrition components are part of their programme. In developing countries, access to health-care facilities and services for the poor, particularly women and children, has positive impacts on the nutritional status of individuals (Food and Agriculture Organization of the United Nations, 2004). In particular, as has been emphasized on many occasions, the first thousand days of life are crucial for children's survival, as well as being a determinant for their nutrition and health status as adults. For instance, infants and small children should be breastfed exclusively up to the age of six months. After those first six months and for up to two years, breastfeeding should be complemented with safe and nutritious foods for infants (Food and Agriculture Organization of the United Nations, 2013).

Considering the negative effects of both under- and over-nutrition on health throughout life stages (see previous sect. on the multiple dimensions of malnutrition), health and nutrition must be part of a life-course approach, in particular for the prevention of chronic diseases. First, healthier diets and physical activity should be part of preventive measures to reduce negative health consequences in the long term. Second, national health policies need to strengthen health systems, enabling them to respond more effectively and equitably to health-care needs (World Health Organization, 2008).

### Information campaigns and educational programmes

In the case of lower-income groups in developing countries, the income elasticity of demand for dietary energy is positive and greater than for other income groups (Food and Agriculture Organization of the United Nations, 2012a). However, as income increases, there is a tendency to purchase more expensive foods, based on taste preferences, which may not improve nutrition outcomes. In many cases, individuals are unaware of the health problems associated with consuming certain types of foods, as well as of the importance of certain micronutrients. In developed countries, people may be unaware of the health problems associated with a less diversified diet and consumption of specific foods. In countries where overweight and obesity have increased, diets have typically shifted towards higher intake of energy-dense foods which are high in fat, salt and sugars but low in vitamins, minerals and other micronutrients.

Thus, education programmes can improve the health and nutritional status of the population in general, and of women and children in particular. Women with better education are more aware of the importance of adequate diets and can secure access to better-paying jobs. Several studies have shown that women with higher income

A multisectoral approach to improving the nutritional status of people, including in preventing overconsumption and obesity, is essential

Health systems need to be strengthened to respond more effectively and equitably to the health-care needs of people throughout the life course and prevent negative health consequences

In developed countries, it has been observed that poorly educated women are 2-3 times more likely to be overweight than those with high levels of education

and greater bargaining power within the family exert a more positive influence on child nutrition, health and education outcomes (Food and Agriculture Organization of the United Nations, 2013). In developed countries, it has been observed that poorly educated women are 2-3 times more likely to be overweight than those with high levels of education (Organization for Economic Cooperation and Development, 2012a). Although the link between education, knowledge and dietary intake is not clear, the impact of education and knowledge is most evident when those at highest risk are considered (Food and Agriculture Organization of the United Nations, 2013).

Inculcating basic knowledge of good nutrition, including family nutrition practices, in primary and secondary schools, can help individuals make informed dietary choices. Nutrition education could be included in the school curriculum and offered in community centres targeting adults. Recent evaluations of various school-based nutrition education programmes in Italy and Portugal showed that those programmes had positive impacts in terms of both attitudes and consumption and health outcomes (ibid.). In particular, nutritional education for women has a positive impact in terms of dietary intake and malnutrition (ibid.). Yet, in many developing countries, gender discrimination preventing school enrolment of girls is still a challenge, which ultimately has negative impacts on nutrition outcomes.

Dietary guidelines constitute one example of the public information tools used in many countries which should be encouraged

In addition to education, information and nutrition advocacy can also have positive impacts on population conditions related to nutrition. Strategies aimed at influencing consumer choice based on enhanced consumer awareness and knowledge should also be considered, as they may lead to a change in consumption habits. Dietary guidelines constitute one example of the public information tools used in many countries which should be encouraged. Information and communications measures are particularly relevant to preventing obesity. However, nutrition-related messages must be appropriate in order to be effective. They should be delivered by health professionals, among others, through a variety of channels and over an extended period of time.

### Consumption patterns: reducing waste

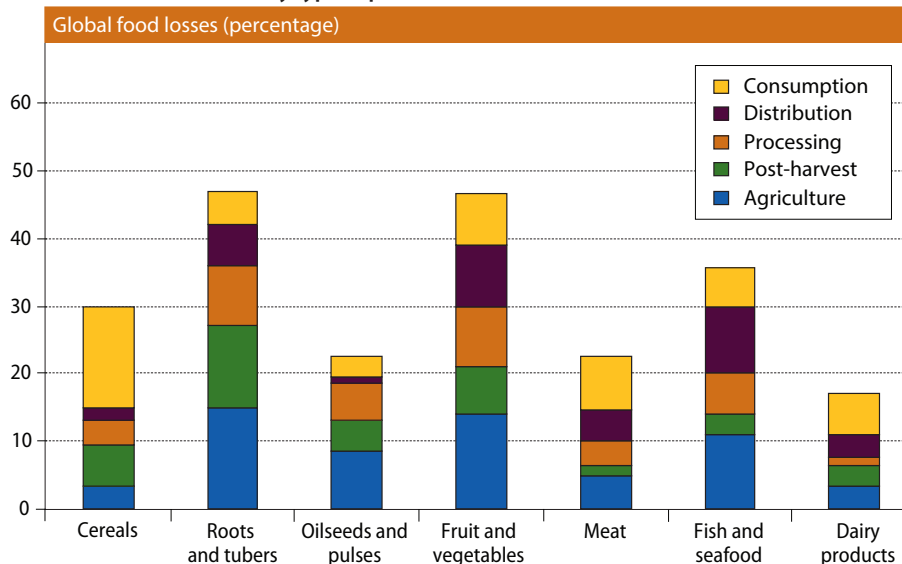
Globally, approximately one third of the total food produced for consumption, amounting to 1.3 billion tons per year, is lost or wasted (Food and Agriculture Organization of the United Nations, 2012c). Because of food waste, an opportunity is lost to reduce malnutrition and significant unnecessary pressure is imposed on natural resources, including through greenhouse gas emissions caused by production of food. There are several sources of food wastage throughout the supply chain, from initial agricultural production down to final household consumption (figure IV.5). This section examines food wastage occurring at the consumption end is examined, along with the underlying factors associated with different socioeconomic and agricultural development conditions.

The amount of food wasted in developed countries is higher than that in developing countries. Recent estimations show that the weight of food wasted per capita by consumers in Europe and North America amounts to 95-115 kg/year, compared with the figure for sub-Saharan Africa and South and South-East Asia, which is only 6-11 kg/year (Food and Agriculture Organization of the United Nations, 2012c).

In developed countries, food wastage occurs more frequently at the retail and consumer end, owing, in part, to management practices and consumption habits

In developed countries, food wastage occurs more frequently at the retail and consumer end, owing, in part, to management practices and consumption habits. In wealthier countries, sales agreements between producers and distributors may contribute

Figure IV.5  
Lost and wasted food, by type of product



Source: Food and Agriculture Organization of the United Nations (2012c).

to the wastage of quantities of food due to the application of quality standards. As much as 30 per cent of total harvested food does not reach the marketplace as a result of quality selection and cosmetic considerations (Institution of Mechanical Engineers, 2013). Also, food production tends to exceed demand in developed countries as a precautionary measure, in order to ensure delivery of agreed quantities. This situation entails a financial loss for producers and additional pressure on natural resources.

In industrialized countries, once food production reaches the market, perishable products are displayed for a minimum period of time in supermarkets, reducing in-store wastage. However, of the 70 per cent of harvested food that reaches the marketplace, 30-50 per cent is wasted at home by the final consumer (Institution of Mechanical Engineers, 2013). Insufficient purchase planning and conservative expiration dates on labelling, as well as significant discounts when food is purchased in higher quantities, are the main factors explaining the large degree of waste at the consumer level.

In developing countries, the situation is relatively different, as waste may occur primarily at the producer level, owing to inadequate harvesting methods and at the marketplace, owing to inappropriate storage, rather than at home. At the producer level, premature harvesting of crops usually causes a loss in nutritional value and, as a result, a significant portion is wasted as it is not suitable for consumption. At the marketplace, waste also occurs when vendors keep food displayed in stalls for a long period of time, using unhealthy preservation methods. However, urban households keep wastage at minimum levels by buying small portions each time they purchase food.

In developed countries, retail and consumption patterns will require profound cultural changes, particularly regarding preferences and rejection of food based on cosmetic characteristics. As surveys show, consumers are willing to buy such food as long as the taste is not affected (Food and Agriculture Organization of the United Nations, 2011e). Raising awareness in food industries, and among retailers and consumers, is a key

In developing countries, the situation is relatively different, as waste may occur primarily at the producer level, owing to inadequate harvesting methods, and at the marketplace, owing to inappropriate storage

In developed countries, retail and consumption patterns will require profound cultural changes

element in ensuring that consumers are offered a broader range of quality products in retail stores. Further, a significant proportion of the food that is currently discarded but still suitable for consumption could be sold or donated to commercial or charity organizations.

Governments may have to implement policies designed to stimulate different marketing and food management practices which can modify retailer and consumer decisions, and ultimately reduce the amount of food wasted at the marketplace and at home. Such policies are particularly applicable to consumable fresh food products that do not reach the market owing to cosmetic considerations. Publicity, advocacy, education and even legislation can also be used to bring about ideological, cultural and behavioural changes so as to reduce high levels of retail and domestic food waste in the developed world. In addition, in wealthier countries, price incentives in retail spaces lead to over-consumption, which ultimately increases food waste and health issues linked to excessive caloric intake. As long as food market prices remain relatively low, there will be no incentives to alter behavioural practices.

In developing countries, investments in infrastructure will be crucial to reducing food wastage

In developing countries, as discussed previously (see sect. on increasing food availability), investments in infrastructure will be crucial to reducing food wastage. Public investments should focus on main infrastructures, such as roads and energy production. In parallel, private sector investments could concentrate efforts on storage and cooling systems. At the same time, it is important that food chain operators be trained to improve production, handling and storage methods, in line with food safety standards.

### Increasing financing for the agricultural sector

The transformation and development of the agricultural sector discussed in previous sections will require investments on a significant scale. There have been several studies on and estimations of the financing requirements for agricultural development. Considered within a long-term perspective, investment needs for primary agriculture and its downstream industries in developing countries were estimated at US\$ 9.2 trillion (2009 dollars) over the 44-year period from 2005-2007 to 2050 (Food and Agriculture Organization of the United Nations, 2009a). This level of investments will have to be sourced from both the public and the private sector. The public sector should typically finance infrastructural needs as well as research and development. These investments would improve productivity in the agricultural sector and attract private investment, which will benefit from positive externalities. Yet, the policy environment must provide the right incentives for private investments. Risk protection and better access to credit markets, for example, can stimulate private investments, from smallholders in particular.

#### *The importance of increasing public investment in agriculture*

The public sector needs to take the lead in those areas that offer little incentive for private investments—such as rural infrastructure, and research and development, as well as extension services—to increase agricultural productivity

In many developing countries, the share of agriculture in public expenditure has to increase in order to improve the agricultural system, as emphasized by the Secretary-General's High-level Task Force on the Global Food Security Crisis (United Nations, 2008). The public sector needs to take the lead in those areas that offer little incentive for private investments—such as rural infrastructure, and research and development, as well as extension services—to increase agricultural productivity. Scaling up investment in these agricultural public goods and services has the potential not only to improve agricultural productivity, but also to crowd in private investment. In addition, greater public



investment in community capacity development and social infrastructure has been considered indispensable to improving the management of natural resources and the livelihoods of small-scale farms (Food and Agriculture Organization of the United Nations, 2012a).

The main challenge, however, lies in the fact that public resources allocated to the agricultural sector have been falling short of the required levels, including in developing countries where food insecurity is higher and where smallholders need more support in order to engage with the market. Government spending on agriculture has decreased from the 1980s to the mid-2000s, representing only 6 per cent of total public expenditures (United Nations, Department of Economic and Social Affairs, 2008). In Africa, for instance, despite the landmark decision of Heads of State and Government of the African Union, at the second ordinary session of the Union Assembly, held in July 2003, to adopt the Maputo Declaration on Agriculture and Food Security,<sup>14</sup> Governments have not increased their allocation of resources to the agricultural sector as expected. Heads of State and Government had committed to the allocation of at least 10 per cent of budgetary resources to agriculture and rural development within five years. The commitment to allocate the same percentage by 2015 to coincide with the deadline for reaching the Millennium Development Goal 1 target of halving hunger was renewed in 2009. However, in 2008, only 8 countries out of 45 allocated 10 per cent or more of their total budgetary resources to agriculture and rural development (figure IV.6). These countries were Burkina Faso, Ethiopia, Ghana, Guinea, Malawi, Mali, the Niger and Senegal (Omilola and others, 2010). Six of these countries are least developed countries, and were at the same time the larger beneficiaries of official development assistance (ODA) and characterized by less favourable agriculture conditions (Benin and others, 2010).

Major national emergencies, lack of peace and stability, HIV/AIDS and natural disasters were among the major challenges faced by Governments during the last decade, leading to fewer resources for agriculture. However, there are also several governance issues preventing more and better allocation of public resources to agriculture which need to be addressed. The lack of transparency and political will is an underlying factor leading to low levels of public spending in agriculture. Contrary to the common perception, low economic growth and low aggregate wealth in a country are not necessarily an impediment to allocating higher public spending to agriculture. For instance, in Africa, a small economy such as Malawi had already complied with the Maputo Declaration, allocating more than 13 per cent of the total public budget to agriculture (te Lintelo and others, 2013).

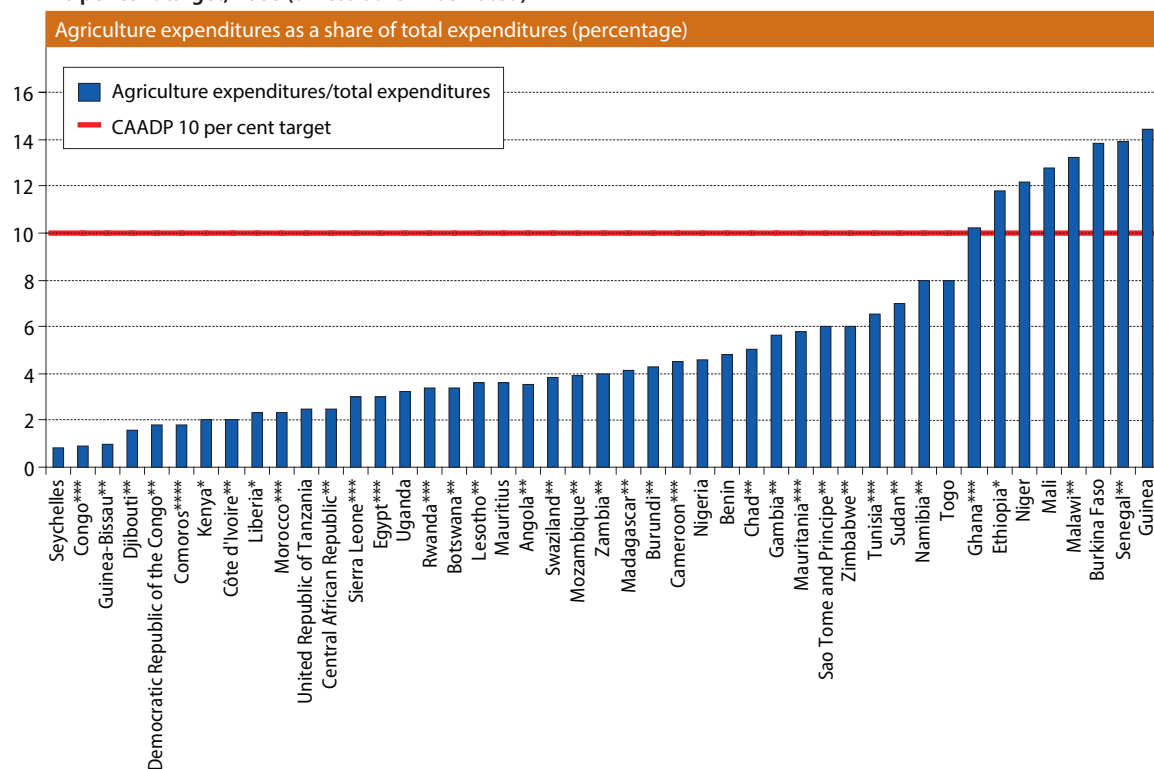
Another major challenge is the inadequacy of agricultural sector policy strategies, including diversion of public spending from long-term investment to agricultural subsidies. While subsidies, such as for energy, or fertilizer subsidies for agriculture, can help overcoming short-term market failures, they tend to remain in effect much beyond the original planned time frame, leading to inefficient use of resources. For instance, in Zambia more than half of the agriculture budget during fiscal year 2005 was spent on subsidies for fertilizers and crop marketing, while investment in infrastructure represented only 3 per cent of the budget. Moreover, only 29 per cent of farmers were buying fertilizers, namely, those who were wealthier and closer to roads (World Bank, 2008a).

Contrary to the common perception, low economic growth and low aggregate wealth in a country are not necessarily an impediment to higher public spending on agriculture

<sup>14</sup> See document A/58/626, annex I.

Figure IV.6

### Agricultural expenditures and the Comprehensive Africa Agriculture Development Programme (CAADP) 10 per cent target, 2008 (unless otherwise noted)



Sources: Based on Regional Strategic Analysis and Knowledge Support System (ReSAKSS) data collected from various national Government sources; and International Monetary Fund (2009).

\* = 2009

\*\* = 2007

\*\*\* = 2006

\*\*\*\* = 2005

### Incentives for private investment

Creating the right incentives and regulations is a major influence in encouraging both large- and small-scale private investments, while improving smallholders' livelihoods

Insufficient public investment in agriculture is an important barrier to improving and ensuring food and nutrition security. At the same time, low private investment, including from smallholders in their own farming activities, constitutes another major constraint on improving food production. Creating the right incentives and regulations is a main determinant for encouraging both large- and small-scale private investments, while improving smallholders' livelihoods.

There is scope for increasing production, food security and rural incomes with greater investments in small farms. In particular, if investment focuses on the production of food staples, rather than high-value products or export-oriented crops, there will be better opportunities to increase food security in highly food insecure countries. In Africa, for instance, it is estimated that the value of domestic and regional markets can amount to more than 50 billion dollars annually, more than the value of total international agricultural exports from the region (World Bank, 2008a; Sahan and Mikhail, 2012). Furthermore, diversifying small farms' food production is the best strategy for improving rural households' income and nutrition conditions.



There are numerous obstacles preventing higher investment in small farms. The above-mentioned insufficiency of public goods and services limits potential returns to farmers' investments. The second issue is related to the lack of price incentives for small-scale producers, in particular when there are price controls on food products which reduce their potential net revenue. A third issue is the lack of access by smallholders to formal insurance protection against risks, which, typically, include natural disasters, pest infestations and price volatility, leading to lower investments in small farms, as a safeguarding measure.

An additional obstacle—and, arguably, the most important—is the lack of access to credit markets. In many developing countries, agricultural financial services remain underdeveloped, in particular the supply of seasonal credit for small farms, preventing farm-level investments. In many cases, when credit is available, banks increase risk premiums and interest rates to prohibitive levels, as they perceive small-scale production as particularly risky. Thus, expanding rural financial institutions and creating specific financial products for small-scale farms will be a key determinant as regards boosting productivity in the agricultural sector. The public sector can not only supply specific insurance and financing products to farmers, but also stimulate the development of insurance and credit markets for smallholders (Organization for Economic Cooperation and Development, 2010). Specific products could include leasing, matching grants, warehouse receipt systems, commodity-based financial products, and overdraft facilities for input dealers (United Nations, 2008).

Private investments in agriculture, particularly international private investments, are needed and can play an important role in boosting productivity and ensuring food security, when directed towards strategic needs (Hallam, 2009). However, in order to increase the positive impact of these investments, Governments need to design policies and legislation that can create a more conducive climate for inclusive and sustainable investments. Direct incentives, for instance, such as tax incentives, can encourage investments that directly support local smallholders. Contract farming can also lead to positive investment, when small-scale farmers are assisted in contract negotiation and dispute resolution (Sahan and Mikhail, 2012).

The onus of increasing the positive impact of private investment is on recipient countries, even if a regulatory framework is often missing in developing countries. While international standards and voluntary actions can partly bridge the gap, it is still essential that national Governments create regulations and incentives to ensure a positive impact. For instance, as observed above, large-scale land acquisitions from foreign private investors must be regulated in order to maximize benefits for local communities. In relation to land, several mechanisms can be used, such as legal protection of all land rights and the inclusion of local communities in political decision-making processes (Sahan and Mikhail, 2012). Similarly, sustainable farming investments can also be encouraged with adequate incentives and regulations for protecting the environment.

### *International support for agriculture*

The support of the international community—bilateral and multilateral organizations, international non-governmental organizations and other development partners—will be crucial for the allocation of more resources to long-term investments in agriculture. In the last few decades, agriculture has been considerably neglected by donors and development partners. In the 1980s and 1990s, total ODA to agriculture exhibited a declining trend, as a consequence of structural adjustment programmes that favoured industrial sectors

Expanding rural financial institutions and creating specific financial products for small-scale farms will be a key determinant in boosting productivity in the agricultural sector

It is still essential that national Governments create regulations and incentives to ensure the positive impact of private investments, particularly international private investments

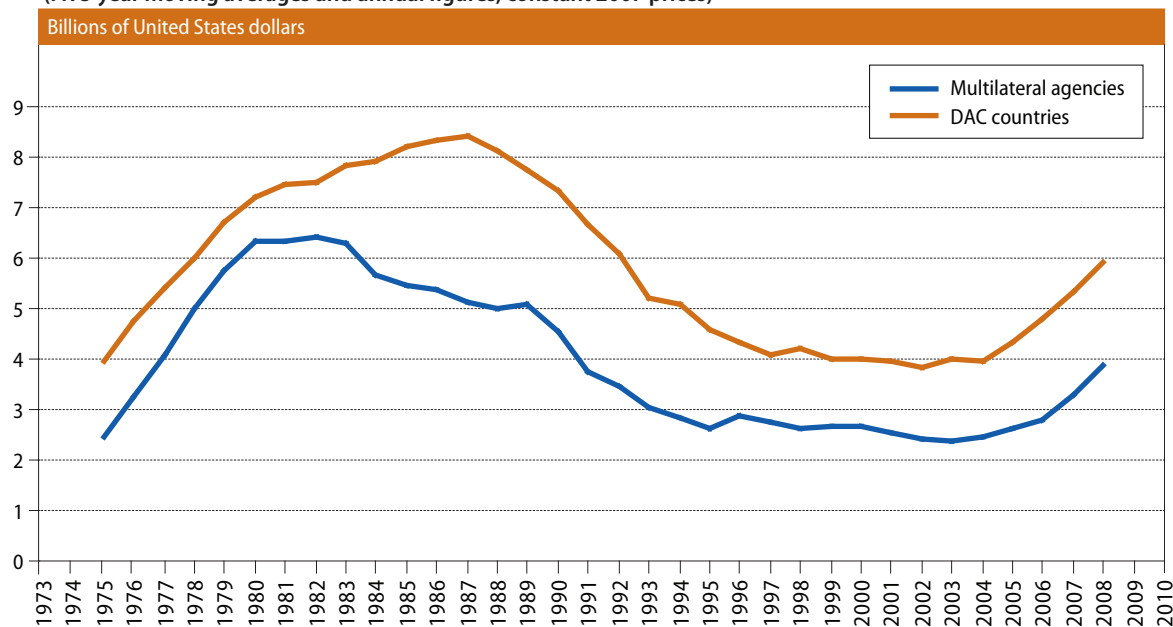
Developing countries will need additional financial support from the international community in order to increase the allocation of resources to long-term investments in agriculture

in developing countries. From the 1980s to 2008, aid to agriculture fell by 43 per cent (figure IV.7). In terms of total aid programmes, the share of aid to agriculture declined even more sharply, from 17 per cent in the 1980s to 6 per cent in 2008.

Despite the long-term decline, bilateral aid to agriculture showed an upward trend in recent years, during the period 2003-2008. This recent trend coincided with the onset of the new millennium and commitments made by the donor community, in particular to Africa. In addition, in 2007-2008, the total annual average aid commitments to agriculture amounted to US\$ 7.2 billion (Organization for Economic Cooperation and Development, 2010), which represented a positive step towards increasing financing for agriculture in developing countries. Still, in 2008, the High-level Task Force on the Global Food Security Crisis urged donor countries to double ODA for food assistance, other types of nutritional support and safety net programmes, and to increase the proportion of ODA to be invested in food security and agricultural development from the current 3 to 10 per cent within five years (and beyond if needed) so as to reverse the historic underinvestment in agriculture (United Nations, 2008). Further, global support of US\$ 20 billion for agriculture over a three-year period was promised at the Group of Eight (G8) Summit, held in L'Aquila, Italy, from 8 to 10 July 2009 (see L'Aquila joint statement on global food security, para. 12). By the time of the 2012 Camp David G8 meeting, 48 per cent of the L'Aquila pledge had been disbursed. Some countries such as Canada, Italy, the Netherlands and the UK had already fully disbursed their pledges (Organization for Economic Cooperation and Development, 2012b).

Figure IV.7

**Trends in aid to agriculture: commitments, 1973-2008**  
(Five-year moving averages and annual figures, constant 2007 prices)



Source: Organization for Economic Cooperation and Development (2012b).

In order to maximize the positive impact of external aid on agriculture, countries that face food insecurity and small-scale farms should be prioritized. In line with this perspective, sub-Saharan Africa and South and Central Asia have received, respectively, 31 per cent and 22 per cent of the total aid flows to agriculture in 2007-2008 (Organization for Economic Cooperation and Development, 2010). However, continuity and coherence of ODA for agriculture are also crucial for its effectiveness.

In addition, new mechanisms in global governance of agriculture are needed to provide political support, coordinate across sectors and, in particular, ensure continuous and appropriate funding (World Bank, 2008a). Concerted action is needed by the international community in addressing the issues of trade and global public goods (research and technology), as well as helping developing countries confront climate change challenges. In the case of climate change, for instance, it is accepted that wealthier countries bear the major responsibility for its emergence, while vulnerable farmers in developing countries suffer most of its consequences. Thus, within the context of the United Nations Framework Convention on Climate Change, several funds were created to finance adaptation in vulnerable developing countries. In 2010, aid for climate change mitigation was estimated at US\$ 17.6 billion, and climate change adaptation at US\$8.9 billion (Organization for Economic Cooperation and Development, 2012b). However, as observed earlier, the international community is underinvesting in global public goods for food and agriculture, as these have only long-term pay-offs. Nevertheless, greater and better allocation of financial resources is possible, once the international community acknowledges that investing in sustainable agriculture is a means of ensuring global equity and stability.

New mechanisms in global governance of agriculture will also be important for better coordination across sectors and for ensuring continuous and appropriate funding