TOWARDS THE FUTURE WE WANT

End hunger and make the transition to sustainable agricultural and food systems

FAO at RIO+20

FIAT PANIS

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Contents

Foreword

Rio+20 and beyond: together for a sustainable future

As stated in the 1972 United Nations Conference on the Human Environment and the 1992 Earth Summit, human beings are at the centre of sustainable development. However, even today, over 900 million people still suffer from hunger. Poor populations worldwide, especially in rural areas, are among those most vulnerable to the food, climate, financial, economic, social and energy crises and threats the world faces today.

We cannot call development sustainable while this situation persists, while nearly one out of every seven men, women and children are left behind, victims of undernourishment.

The quest for food security can be the common thread that links the different challenges we face and helps build a sustainable future. At the United Nations Conference on Sustainable Development (Rio+20) we have the golden opportunity to explore the convergence between the agendas of food security and sustainability to ensure that happens.

Both require changes towards more sustainable production and consumption models. To feed a growing population that is expected to top the nine billion mark in 2050, FAO projects the need to increase agricultural output by at least 60 percent in the next decades. To do so, we must save and grow – increasing agricultural production while preserving the environment.

But even then the pressure on our natural resources will be extreme. So we must also change the way we eat and find ways to feed the world without the need to produce as much. We can do this by changing to healthier diets in the richer segments of our population and by diminishing the food loss and waste that exist in industrialized and developing countries, and that make us throw away 1.3 billion tonnes of food every year, between production and consumption.

However, even if we do increase agricultural output by 60 percent, the world would still have 300 million people hungry in 2050 because, like the hundreds of millions today, they would still lack the means to access the food they need. For them, food security is not an issue of insufficient production; it is an issue of inadequate access. The only way to ensure their food security is by creating decent jobs, paying better wages, giving them access to productive assets and distributing income in a more equitable way.

We must bring them into society, complementing support to smallholders and income generation opportunities with the strengthening of safety nets, cash for work and cash transfer programmes that contribute to strengthening of local production and consumption circuits, in an effort that must contribute to our sustainable development goals.

The transition to a sustainable future also requires fundamental changes in the governance of food and agriculture and an equitable sharing of the transition costs and benefits. In the past, the poorer have paid a greater share of transition costs and received a smaller share of benefits. This is an unacceptable balance and one that needs to

change. The speed of change should also be our concern, so that the vulnerable population can adapt and be part of the changes instead of widening the gaps that exist today.

This document is FAO's contribution to identifying the challenges we face, the consensus we need and actions that we must undertake to reach the sustainable future we want. Sustainable development, as is the case of ending hunger, is a goal to which every one of us must contribute – citizens, companies, governments, civil society and institutions. Together, working from the local to the global level, we can build the future we want. And this future needs to start today.

José Graziano da Silva
Director-General
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Executive summary

Improving agricultural and food systems is essential for a world with healthier people and healthier ecosystems. Healthy and productive lives cannot be achieved unless "all people at all times have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). Healthy ecosystems must be resilient and productive, and provide the goods and services needed to meet current societal needs and desires without jeopardizing the options for future generations to benefit from the full range of goods and services provided by terrestrial, aquatic and marine ecosystems. There are very strong linkages between the conditions to achieve universal food security and nutrition, responsible environmental stewardship and greater fairness in food management. They intersect in agricultural and food systems at the global, national and local levels. To emphasize these links, FAO has three main messages for the Rio+20 summit:

MESSAGES

1. The Rio vision of sustainable development cannot be realized unless hunger and malnutrition are eradicated.

2. The Rio vision requires that both food consumption and production systems achieve more with less.

3. The transition to a sustainable future requires fundamental changes in the governance of food and agriculture and an equitable distribution of the transition costs and benefits.

FAO believes that the Rio vision will remain unfulfilled as long as hunger and malnutrition persist. The sustainable management of agriculture and food systems is key to a sustainable future. Sound policies are needed to create the incentives and capacities for sustainable consumption and production and to enable consumers and producers to make sustainable choices.

National governments and other stakeholders need to:

1. Establish and protect rights to resources, especially for the most vulnerable;

2. Incorporate incentives for sustainable consumption and production into food systems;

3. Promote fair and well-functioning agricultural and food markets;

4. Reduce risk and increase the resilience of the most vulnerable; and

5. Invest public resources in essential public goods, including innovation and infrastructure.

To achieve the future we want – a world without hunger and with sustainable development – FAO calls on the Rio+20 participants to make the following six commitments:

1. Accelerate the pace of reducing hunger and malnutrition with a view to eradicating these in the near future.

2. Use the *Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security* and the *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* as the overarching frameworks for achieving food security and equitable sustainable development.

3. Support the efforts of all stakeholders working in food and agriculture, especially in developing and least-developed countries, to implement technical and policy approaches to agricultural development that integrate food security and environmental objectives.

4. Ensure an equitable distribution of costs and benefits from the transition to sustainable agricultural consumption and production, and that people's livelihoods and access to resources are protected.

5. Adopt integrated approaches to managing multiple objectives and linking financing sources for achieving sustainable agricultural and food systems.

6. Implement governance reforms based on the principles of transparency, participation and accountability to ensure policies are carried out and commitments are fulfilled. The Committee on World Food Security can serve as a model for these reforms.

FAO and Rio+20

The Food and Agriculture Organization (FAO) is a specialized agency of the United Nations. Serving all countries, FAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy. FAO is also a source of knowledge and information, and helps developing countries and countries in transition modernize and improve agriculture, fisheries and forestry. FAO has 191 member nations, two associate members and one member organization, the European Union.

What is FAO's mission?

FAO's mission is articulated in Latin by its motto *fiat panis*, which translates into "let there be bread". Achieving food security for all is at the heart of FAO's work – to make sure people have regular access to enough high-quality food to lead active, healthy lives. Its work extends across sustainable agriculture, forestry, fisheries and food systems. Wise use of natural resources and environmental protection, as well as economic and social equity and progress are central in FAO's programme.

How does FAO's mission relate to Rio+20?

The Rio+20 negotiations highlight seven areas that need priority attention, namely jobs, energy, cities, water, oceans, disasters and food. FAO's mission and actions cut across each of these areas.

We can't claim success in sustainable development until the basic right to food for all has been fulfilled. Safety nets and social protection systems are urgently needed. For the longer term, sustainable agriculture strengthens livelihoods and meets increasing demands for food. Reducing food losses and waste will further reduce agriculture's environmental footprint and help ensure food security. Synergies between achieving food security and sustainable consumption and production need to be captured and trade-offs managed. This is at the heart of FAO's mandate.

Key actions undertaken by FAO

The FAO mission is broad and ambitious. Our programme covers all the priority themes of Rio+20. Actions range from setting internationally recognized standards for food and natural resources management, to supporting national programmes in agriculture, fisheries and forestry, to local implementation of sustainable agriculture, fisheries and forestry. Together with the International Fund for Agricultural Development and the World Food Programme, FAO is committed to making the Rio+20 vision believable and achievable.

Introduction: Call for commitments at Rio+20

The world got the vision right at the 1992 Earth Summit in Rio when it focused clearly on human beings. The first principle of the 1992 Rio Declaration (UN, 1992) states:

> *Human beings are at the centre of concern for sustainable development.*
> *They are entitled to a healthy and productive life in harmony with nature.*

Much work has been done since 1992 to move the world closer to a common and sustainable future, but 20 years down the road we have yet to deliver on this fundamental principle – too many people in this world are still *not* living a healthy and productive life while the world grows in ways that are *not* always in harmony with nature. Where have we fallen short?

Healthy and productive lives depend on food security, which is achieved "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). There are very strong linkages between the conditions needed to achieve universal food security and nutrition, responsible environmental stewardship and greater fairness in food management. These intersect in agricultural and food systems at global, national and local levels. One of the great flaws in current food systems is that, despite significant progress in development and food production, hundreds of millions of people are hungry because they lack the means to produce or purchase the food they need for a healthy and productive life. **Food systems must be managed in a way that delivers universal food security.**

A second flaw in current agricultural and food systems is that their environmental impacts are high. The costs and benefits of a sustainable system are not properly reflected in the decisions made by all participants in these systems – the millions who manage ecosystems to produce food and other agricultural goods and services, the world's 7 billion consumers and also the public and private institutions that help shape these decisions. **Food systems must be managed in a way that is sustainable.**

Improving agricultural and food systems is essential for a world with both healthier people and healthier ecosystems. Two key elements of the necessary response are not new, although our understanding of these elements is still improving: that **hunger eradication** is essential for sustainable development, and that **sustainable consumption and production systems** are essential if we are to eradicate hunger and protect ecosystems. Where we have fallen short is in addressing a third element, namely the **governance challenges** that

Agricultural systems include the natural and managed processes by which food and non-food products (such as fuel and fibre) are produced from crops, livestock, fisheries and forestry. Agricultural systems are the source of all the world's food, and the main source of income for most of the world's poor and food-insecure people.

Food systems overlap with agricultural systems in the area of food production, but also comprise the diverse set of institutions, technologies and practices that govern the way food is marketed, processed, transported, accessed and consumed. Food systems influence not only what is being consumed and how it is produced and acquired, but also who is able to eat, and how nutritious their food is.

must be addressed to achieve these goals. While we know what has to be done, we still lack a system of governance that will make sure that what is known and agreed upon is implemented, monitored and evaluated.

To achieve the future we want – a world without hunger and with sustainable development – FAO seeks to stimulate consensus on the changes needed at, global, regional and national levels to eradicate hunger, support the transition to sustainable food consumption and production systems and ensure greater fairness in food management. It calls for this consensus to be translated into a deep and sustainable commitment to act. And it appeals to all stakeholders represented at Rio+20 to adopt **with urgency** a new resolve to work together in a genuine spirit of cooperation and partnership to implement the steps needed and hold themselves accountable for achieving the first principle of Rio 1992.

1 The Rio vision of sustainable development cannot be achieved unless hunger and malnutrition are eradicated

If we had achieved the goals of the sustainable development agenda agreed in Rio 20 years ago, hundreds of millions of people who are hungry today would be free from hunger and malnutrition. Hunger persists even though global food production has outpaced population growth over the past half century.

Hunger – defined as the lack of sufficient calories – goes hand-in-hand with other forms of malnutrition such as protein, vitamin and mineral deficiencies, which are exacerbated by poor access to clean water and hygienic human waste disposal. Today, more than 1 billion people eat enough calories but do not consume enough protein, vitamins or minerals. Undernourishment in children, especially during the first 1 000 days from conception, means they will never reach their full physical and cognitive potential.

For people who are chronically hungry and malnourished, meeting their immediate needs is their paramount concern – planning for the future is often a luxury they cannot afford. Yet most of the world's hungry people depend on agriculture, fisheries and forestry for at least part of their livelihoods, so their daily choices also help determine how the world's natural resources are managed.

Hunger and undernourishment are not just social and moral problems; they have significant economic costs, including reduced lifetime productivity and earnings and unsustainable resource use. Hunger puts in motion a vicious cycle of reduced productivity, deepening poverty, slow economic development and resource degradation. Hunger reduction and sustainable development are tightly linked.

Fair access to resources, employment and income is key to overcoming hunger

Food production and its physical availability are certainly essential to addressing hunger. However, food security is about more than just producing sufficient food – it encompasses the need to ensure access to sufficient and nutritious food at all times. Access to food – the ability to produce or purchase food – highlights the central role of poverty reduction in the fight against hunger. Poverty and food insecurity are still mostly concentrated in rural areas, where people depend directly or indirectly on agriculture, fisheries or forestry for their incomes as well as their food. Reducing rural poverty and improving rural livelihoods will stem premature urbanization and increased urban poverty.

Reducing hunger and malnutrition starts with fair access to resources, employment and income in rural areas. Agriculture, especially smallholder and family farms, can play a catalytic role in the improvement of rural livelihoods. Around 500 million small farms in developing countries face a variety of resource limitations that result in insufficient access to food and nutrition. Many of these smallholders are women, who face additional constraints due to cultural factors and unequal access to productive resources compared with men (FAO, 2011a).

We know that growth in the agriculture sectors of low-income and highly agriculture-dependent economies is twice as effective as that of other sectors in reducing hunger and poverty (World Bank, 2008). Agricultural growth

will act as an engine for the rural economy, creating employment and incomes. But this outcome is not automatic: improved policies, investment and governance are crucial. For chronically hungry people in both rural and urban areas, employment opportunities, well-functioning food markets and stable food prices contribute to improved access to food. Fighting hunger needs to be framed within broader poverty reduction and livelihood improvement frameworks that incorporate health, education, housing, water and sanitation, and natural resource management

Women in agriculture
Closing the gender gap for development

The FAO *State of Food and Agriculture 2010–11* established the business case for addressing gender issues in agriculture and rural employment. The agriculture sector is underperforming in many developing countries, in part because women do not have equal access to the resources and opportunities they need to be more productive. The gender gap is strikingly consistent across countries and contexts: *women have less access than men to agricultural assets, inputs and services and to rural employment opportunities.*

This gender gap is found for many assets, inputs and services and it imposes costs on the agriculture sector, the broader economy and society as well as on women themselves. For rural women and men, land is perhaps the most important household asset to support production and provide for food, nutrition and income security. Yet an international comparison of agricultural census data shows that fewer than 20 percent of landholders are women due to a range of legal and cultural constraints regarding land inheritance, ownership and use.

If women were given the same access to inputs as men on the land women already control, they could increase their yields by 20–30 percent, raising total agricultural output in developing countries by 2.5–4 percent. This alone could lift 100–150 million people out of hunger (FAO, 2011a).

Social protection programmes can address short-term needs and support longer-term growth

The debilitating impact of hunger on the ability to work and on productivity means that immediate action to combat hunger is critical. Well-targeted social protection programmes can quickly cut the incidence of chronic hunger in both rural and urban communities by providing the food people need to fill the nutrient gap or with cash to buy their incremental food and other essentials. Income transfer programmes, channelled through women where possible, offer a highly efficient, administratively simple and inexpensive way to quickly alleviate hunger and related social exclusion. Their impact increases when combined with other interventions such as school meal programmes, nutrition education, better health care and improvements in drinking water supplies and sanitation. By helping the poorest face multiple risks, shocks and stresses, social protection also benefits longer-term productivity, resilience and food security.

Safety nets and long-term growth

Safety nets can do more than reduce poverty and vulnerability. If regular and predictable, they can also change attitudes and behaviour towards risk. Where markets for credit and insurance are lacking or do not function well, safety nets can have strong and positive impacts on income-generating activities and livelihood strategies of the poor.

Programmes such as the Productive Safety Net Programme (PSNP) in Ethiopia and the Fome Zero programme in Brazil explicitly recognize such linkages. The public works part of the PSNP, when regular and predictable and when combined with a package of agricultural support, has improved beneficiaries' food security status, livestock accumulation and their ability to deal with emergencies (Gilligan *et al*., 2009; Berhane *et al*., 2011). The Fome Zero programme embraced the twin-track approach of improving food access and promoting small-scale farm production, implemented through the collaboration of several ministries, municipal governments and civil society. Efforts have ranged from direct provision of food, school meals, maternal/infant nutrition and the establishment of safety nets to institutional changes such as agrarian reform, incentives for small-scale farming, modernization of food supply systems, promotion of urban agriculture, land reform, empowerment of rural communities and universal social protection. The programme is clearly meeting its objectives – from 2003 to 2008 the number of poor fell by 27 percent while the number of extreme poor fell by 48 percent.

Looking ahead to 2050

Beyond the pressing need to address the challenges facing today's hungry and malnourished people, we also must meet the needs of future generations. FAO projects that if current patterns in food consumption persist, 60 percent more food will need to be produced by 2050 (compared with 2005–07) to meet the increase in world demand driven by population and income growth, particularly in developing countries**.** Although the rate of increase in production is about half of that achieved over the past decade (2.2 percent per year) (FAO, 2011b), it still raises two concerns.

First, the projected production increase must be achieved in an environmentally sustainable way given the pressures building on global ecosystems. Analysis from a recent Stockholm Resilience Institute study suggests that climate change, biodiversity loss and other pressures have already reached rates of change that threaten the capacity of earth systems to function (Rockström *et al*., 2009).

Second, even if we achieve the projected increases in food production, over 300 million people may still suffer from chronic hunger in developing countries in 2050, primarily as a result of their lack of access to sufficient food (Alexandratos and Bruinsma, 2012). This is unacceptable but not inevitable. FAO believes that **feeding all of the earth's population** is possible with an increase in food production below the 60 percent projected by the baseline scenario. To "beat the projections" we need to make bold policy decisions that will affect income growth patterns, changes in dietary preferences, levels of food waste and how agricultural production is used for non-food purposes. Significant reform of the governance of agricultural and food systems will ensure the implementation of such policy decisions. All depends on the choices we make today in managing agricultural and food systems.

2 The Rio vision requires that both food consumption and production systems achieve more with less

The millions of people who manage agricultural and food systems – from the very poorest to the most commercialized producers – constitute the largest group of natural resource managers on earth. The daily management decisions of those who farm, keep livestock, fish, manage forests, run agribusinesses – and those of the world's 7 billion consumers – are key to global food security and the health of the world's ecosystems.

Improving agricultural and food systems is thus essential for achieving healthier populations and more stable and resilient ecosystems. We need to harness improvements in consumption, production and the value chains that link them in an integrated drive to make agricultural and food systems more economically, socially and environmentally sustainable.

On the consumption side, we need to reduce over-consumption, shift to nutritious diets with a lower environmental footprint and reduce food losses and waste throughout the food system.

On the production side, we need to assess how the diverse range of agricultural and food systems around the world can be improved to reduce negative environmental impacts (including soil, water and nutrient depletion, greenhouse gas emissions and pollution, and degradation of natural ecosystems). We also need to protect and harness ecosystem services to achieve efficient and resilient growth and provide global public environmental goods such as biodiversity conservation, climate change mitigation and watershed protection.

Encourage sustainable consumption

Future growth in the demand for food will be influenced by choices made by millions of consumers as economies grow and as the earth's population becomes increasingly urban. Poor people's diets, even when they are high in carbohydrates, are low in variety, diversity and nutrient content and are often deficient in micronutrients. Reductions in income poverty will trigger significant – and nutritionally desirable – extra spending on food, especially proteins, sugars and fats.

People in high-income (and increasingly also in middle-income) countries typically have diets that are higher in meat and saturated fat (as well as sugar and salt), often combined with inadequate intake of fruits, vegetables and whole grains. This dietary pattern increases the risk of heart disease, certain types of cancer, stroke and diabetes. Relatively few people were overweight in 1992, but 1.5 billion are now classified as overweight or obese and are predicted to suffer from an array of debilitating non-communicable diseases as they get older, with considerable costs in terms of well-being, productivity, livelihoods and health care. In fact, 65 percent of the world's population now live in countries where overweight and obesity kill more people than underweight (WHO, 2009).

To avoid the risk that this dietary pattern is repeated as the world becomes wealthier, policies are needed to reduce over-consumption – especially of foods that have high environmental and health footprints relative to their nutritional value. A transition to healthier and more sustainable diets contributes to healthier people and ecosystems.

Reduce food losses and waste

In addition to unhealthy patterns in what people actually eat, large but potentially avoidable food losses occur at other post-production stages. Global losses and waste are estimated at roughly 30 percent for cereals (see Figure): 40–50 percent for root crops, fruits and vegetables; 20 percent for oil seeds; and 30 percent for fish (FAO, 2011b).

Food losses translate into lower returns for farmers and higher prices for consumers, making it harder for farmers to earn enough money and consumers to afford enough food. The detrimental effects are also significant for fisherfolk, their families and communities whose incomes and diets depend largely on fish, which spoils quickly in the absence of appropriate preservation technologies and infrastructure.

Food losses and waste

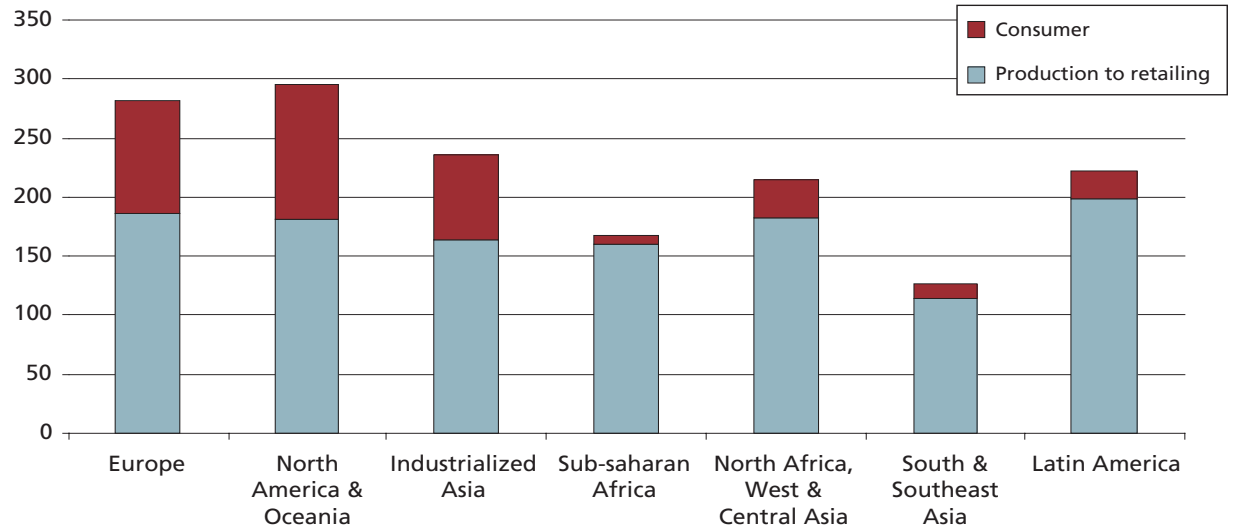
FAO estimates that global food losses and waste amount to 1.3 billion tonnes per year – roughly one-third of the world food production for human consumption – and correspond to more than 10 percent of the world's total caloric energy consumption. Food losses refer to the decrease in edible food mass available for human consumption throughout the different segments of the supply chain. Food losses resulting from decisions to discard food that still has value to others are referred to as food waste.

Food losses and waste occur in both high- and low-income countries, although following different patterns. In medium- and high-income countries, food is largely wasted at the consumption stage. In low-income countries, it is lost mostly during the early and middle stages of the food supply chain; much less is wasted at the consumer level. The causes of food losses and waste in low-income countries are mainly connected to financial, managerial and technical limitations in harvesting techniques; storage and cooling facilities in difficult climatic conditions; infrastructure; packaging and marketing systems; and the fact that loss-reducing technologies are too costly relative to the price of food to make their use cost-effective.

Investing in more efficient systems that reduce losses or waste would also help to reduce greenhouse gas emissions, both directly, as wastage typically generates methane emissions during food disposal, and indirectly, through the need for fewer resources. (The food and agriculture sectors, together, generate 30 percent of total greenhouse gas emissions.) Appropriate approaches for reducing food waste along the food chain vary between high- and low-income countries. In Europe, examples include programmes to increase consumer awareness of food waste and energy use in food products, as well as regulations mandating reductions in organic waste management. In low-income countries, options include promoting low-cost farm storage facilities as well as upgrading transport and processing facilities.

Source: FAO, 2011b.

Food losses and waste, at consumption and pre-consumption stages, in different regions (kg/year/person)



Source: FAO, 2011b.

Energy-smart food systems: less waste and more access

The food sector accounts for around 30 percent of the world's total energy consumption. High-income countries use a greater proportion of energy for processing and transport. In low-income countries, cooking consumes the highest share. At the same time, current energy systems are failing to meet the needs of the world's poor. Almost 3 billion people have limited access to modern energy services for domestic heating and cooking, and 1.4 billion have zero or limited access to electricity (FAO, 2011c). Improving access to energy and ensuring the sustainability of energy resources are two of the most important aspects of achieving sustainable development in food systems.

Sustainable and climate-smart agricultural production systems

Achieving a world with healthy people and healthy ecosystems requires changes in the way that people interact with the environment. Transforming natural resources into food and non-food agricultural products is one of the most pervasive forms of human-environmental interactions. The crop and livestock sectors use 70 percent of all water withdrawals and, together with forestry, occupy 60 percent of the earth's land surface. Livestock production alone uses 80 percent of global crop and pasture area. Food systems consume 30 percent of the world's energy. Oceans cover 70 percent of the earth's surface and sustain fisheries and aquaculture; aquaculture also accounts for a rapidly growing share of land and freshwater use.

In too many cases, human-environmental interaction has had negative consequences for the environment. Agriculture accounts for approximately 30 percent of total greenhouse gas emissions, and is projected to be a significant source of future emissions growth (IPCC, 2007). Agricultural production can have negative impacts on water, soil and air resources as well as wildlife and ecosystem biodiversity and human health (Pretty *et al.*, 2011). Forty percent of the world's degraded lands are located in areas with high poverty rates, with the greatest threat being loss of soil quality, followed

by biodiversity loss and water resource depletion and quality degradation (FAO, 2011d). However, agriculture can also be a major source of global public environmental goods such as climate change mitigation, watershed protection and biodiversity conservation – particularly agricultural biodiversity.

Precisely because agricultural production has such a pervasive impact on the environment as well as significant potential for positive global effects, improving agricultural practices is an essential component of the transition to a more sustainable future. How agricultural systems are managed is key to sustainable development. Agricultural production systems must "do more with less".

Agricultural production systems vary across a wide range of agro-ecologies and involve forestry, fishery, crop and livestock activities. They differ in their impact on income generation and support to food security, as well as in their resilience and environmental impacts. They range from highly capital-intensive systems, relying heavily on mechanization and external inputs such as fertilizer, agricultural chemicals and improved breeds or seeds, to low-input systems where land and labour are the main inputs. Both systems can result in natural resource depletion and pollution and both can also be resource-conserving. It all depends on how these systems are managed. The challenges for managing agricultural and food systems in low-income and highly agriculture-dependent economies are complicated by the fact that agriculture is a key sector for overall economic growth, poverty reduction, food security and nutrition, and overall social development. In industrialized country contexts, the challenges relate more to reducing costs, improving food safety, environmental amenities and nutritional values (World Bank, 2008).

Many techniques can improve the environmental performance of agriculture without compromising yields. While extremely varied, what is needed in each case is to increase radically the use of knowledge-intensive management strategies in all production systems, including by better harnessing ecosystem services.

Harness ecosystem services in agriculture

In all agricultural production systems, the transition to more sustainable practices requires more careful harnessing of ecosystem services. Ecosystem services comprise all the benefits humans derive from ecosystems – direct benefits such as food production as well as indirect ones such as climate regulation, nutrient cycling or cultural values. Ecosystems sustain human life through a range of services such as providing food and drinking water, preserving and regenerating soils, fixing nitrogen and carbon, recycling nutrients, filtering pollution, and much more (FAO, 2007). They are the underlying basis for agriculture and play a determining role in the productivity and resilience of production systems. They also have a wider impact on human welfare through their effects on regulating climate, the functioning of water systems and biodiversity conservation.

Agricultural ecosystems are by far the largest managed ecosystems in the world. In many cases, management approaches have largely focused on producing agricultural commodities, often at the expense of degrading and depleting other ecosystem services. The full range of ecosystem services that agriculture can provide must be recognized and valued if we are to enhance the sustainability and productivity of agricultural ecosystems.

To harness their full potential, agricultural ecosystems need to be managed as part of wider agricultural landscapes. Reinforcing the natural resilience of landscapes is fundamental. Deforestation, degradation of catchments/watersheds,

Forests and ecosystem services

Forests contribute directly and indirectly to food security and nutrition, while providing ecosystem services in broader agricultural landscapes. Forests provide more than 10 percent of the GDP in many of the poorest countries. The forestry sector provides formal employment for 10 million people and informal employment for additional 30–50 million people in developing countries (FAO, 2012a). Food from forests and trees provides valuable sources of protein, minerals and vitamins. Especially in the developing countries of the tropics, indigenous peoples and communities living in or around forests are highly reliant on these resources for their food supply.

Forests serve as safety nets that are crucial for the survival of the rural poor when crops fail or at other times of economic hardship. The collection and sale of non-wood forest products is an important source of household income, especially for women. Trees provide fuelwood for cooking for more than 2 billion people. Forest employment and small- and medium-scale forest enterprises and industries are significant revenue sources for rural people. In the drylands, trees are a primary source of fodder for domestic animals.

Forests and trees also provide other essential ecosystem services. Forests influence the amount of water available and regulate water surface and groundwater flows while maintaining high water quality; they sequester carbon; they can be used as shelterbelts and windbreaks; and also contribute significantly towards reducing soil erosion and protecting against landslides and floods.

land degradation, depletion of reefs and coastal ecosystems – especially coral reefs and mangroves – all reduce nature's defence capacity. Disasters, in turn, contribute to ecosystem degradation and loss, including increased soil erosion, declining rangeland quality, salinization of soils and biodiversity loss. Diversification of varieties, breeds and production activities across agricultural landscapes is another way to increase resilience. Greater diversity in agricultural ecosystems may also lead to healthier and more sustainable diets, which is a particularly important consideration for producers whose consumption is largely drawn from their own production (FAO, 2012b).

Sustainable intensification

Sustainable crop production intensification is an ecosystem-based approach for improving sustainability in cropping systems. It has been defined as producing more from the same area of land while reducing negative environmental impacts and increasing contributions to natural capital and the flow of environmental services (FAO, 2011e). Sustainable intensification that can close yield and productivity gaps in underperforming systems is essential for meeting development and environmental objectives. The concept is not limited to cropping systems but can be applied across livestock, aquaculture and forestry systems (FAO, 2011e; Foley *et al.*, 2011).

FAO's approach to sustainable crop production intensification is the "***Save and Grow"*** model. "Save and Grow" promotes a productive agriculture that conserves and enhances natural resources. It uses an ecosystem approach that draws on nature's contribution to crop growth – soil organic matter, water flow regulation, pollination and natural predation of pests – and applies appropriate external inputs at the right time and in the right amount to improved crop

varieties that are resilient to climate change and use nutrients, water and external inputs more efficiently. Increasing resource use efficiency, cutting the use of fossil fuels and reducing direct environmental degradation are key components of the approach, saving money for farmers and preventing the negative effects of overusing particular inputs.

For example, inefficient fertilizer use is common in certain regions, in some cases as a result of government subsidies. Yet overuse does not benefit plant growth and can lead to the contamination of groundwater and surface water. Inappropriate use of insecticides may actually induce pest outbreaks by disrupting the natural population of predators; overuse of herbicides can lead to the emergence of herbicide-tolerant varieties of weeds. Inappropriate management practices such as irrigating without proper drainage can result in salinization or reduced soil health. Greater attention to maintaining the natural ecosystem can encourage the adoption of management practices based on crop rotations, minimum tillage and the maintenance of soil cover; to the extent possible, reliance on natural processes of predation or biocontrol for pest or weed problems; management of pollination services; selection of diverse and appropriate varieties; and the carefully targeted use of external inputs.

Sustainable intensification also provides energy efficiency savings. Farming systems that make better use of manure, legumes, crop residues or agroforestry to maintain soil nutrient levels will need less nitrogen-based fertilizer. No-till systems will require less fuel for tractors. More efficient use of water in irrigation systems will reduce fuel use for groundwater pumping. A major goal of these sustainable intensification techniques is to increase the energy efficiency of agriculture, making maximum use of solar energy rather than fossil fuel inputs while enhancing soil fertility (Pretty *et al*., 2006). Recycling nutrients as efficiently as possible is a necessity for smallholder producers in developing countries faced with lack of capital (Zundel *et al*., 2008). Closing efficiency gaps in the livestock sector, which currently uses about 30 percent of the earth's ice-free land and around three-quarters of total agricultural land, is a priority for improving the sustainability of agricultural production systems.

Sustainable water use in food systems

Water use has been increasing globally at more than twice the rate of population growth over the last century, and an increasing number of regions are nearing the limit at which water services can be sustainably delivered. By 2025, it is expected that 1.8 billion people will be living in countries or regions with "absolute" water scarcity (<500 m^3 per year per capita), and two-thirds of the world population could be under "stress" conditions (between 500 and 1 000 m^3 per year per capita). Lack of water is a major cause of famine and undernourishment.

How to increase food production using less water is one of the great challenges for the coming decades. This will mean increasing production per unit of water – or water use efficiency. Techniques to achieve this are often the same as those used in sustainable crop production intensification. Another approach is to reduce water demand by transitioning to more sustainable diets and minimizing waste. A 50 percent decrease in food losses and waste at the global level would save 1 350 km^3 a year – almost four times the annual rainfall of Spain. Recycling and reusing waste water both within agriculture and also from urban to agricultural uses can also contribute to solving the growing water shortages.

Sources: FAO, 2012c and FAO, 2012d.

Sustainable livestock sector development

A recent study suggests that an increase in global average feed-to-food conversion efficiency from 5.1 percent to 6.2 percent would reduce land use by 510 million hectares (or 13 percent) by 2030 – with virtually all the decline estimated to come from reduced grazing on grasslands and crop residues – and a 20 percent reduction in global feed use. The productivity growth rates needed to support these changes are well below those estimated to be possible by livestock specialists (Wirsenius *et al*., 2010).

The need to reduce pollution and greenhouse gas emissions from livestock systems and to improve ecosystem services from grasslands are primary concerns. To address these, FAO has instituted a Global Agenda of Action in support of sustainable livestock sector development. The programme is being developed through an informal, broad-based, and voluntary participatory process, focusing on consensus building and collective action among a wide group of sector stakeholders. The resultant Action Programmes will target the improvement of resource use efficiency in the livestock sector to support livelihoods, long-term food security and economic growth, while safeguarding other environmental and public health outcomes.

Because sustainable intensification is locally specific and knowledge-intensive, accelerating the transition to more sustainable systems will call for much greater public investment at global, regional and national levels aimed at expanding research and extension to underpin the shift to more sustainable systems. It will also require greater emphasis on public–private partnerships to stimulate research and development, technology development and uptake, and knowledge management – including metrics for sustainability.

The cost of transitioning to sustainability

Experience has shown that there are often trade-offs between achieving development, food security and environmental objectives. In some cases, the development of agriculture and the transformation of food systems can generate unintended environmental damage, while environmental protection policies can have negative impacts on the poor. Often these trade-offs are triggered or exacerbated by inappropriate policies and weak institutions. Identifying and reducing policy-driven trade-offs is fundamental to improving the sustainability of consumption and production systems, and that will require better alignment of agriculture, food security and environmental policies.

Analysis of sustainable production systems often shows them to be “win-win” in terms of both increasing returns to producers (who include farmers, herders, fishers and foresters) as well as improvements to the environment (Pretty *et al*., 2006). Yet the relatively low adoption rate of such systems seems to indicate they are not attractive to producers. A comprehensive assessment of the costs – and who bears them – is necessary to understanding why this is so. Relevant costs include not only investment and operating expenses, but also opportunity costs – for example the income producers forego during the transition to a new system. It can be several years before positive returns to sustainable agricultural systems are realized, particularly where they involve restoration of degraded ecosystems (McCarthy *et al.,* 2011). Most producers cannot finance such a long period of lost income – even if they stand to make major gains in the future. Indeed, the problem of delayed returns on investments is a significant barrier to achieving

sustainability across all sectors and scales of investment. Investments in sustainability can thus involve trade-offs in the short run, even if they lead to win-win outcomes in the long run.

Risk and transaction costs are two other relevant factors in the transition to more sustainable systems. Transaction costs are the "costs of doing business", including transport and communication costs – as well as costs of coordinating the actions of multiple producers and consumers. Sustainable production systems will require more coordination, for example in managing common-property natural resources, or in coordinating post-harvest, processing, storage and marketing activities. Risk is a major deterrent to investments, and is aggravated by insecure access to resources such as land and water, and by increased uncertainty due to market volatility or climate shocks (FAO, 2012f).

Transitioning to sustainable consumption systems incurs a similar set of costs. Reducing waste involves not only investment and operating costs, but also the transaction costs of coordination among production, processing, storage and marketing phases. Better incorporation of natural resource and nutritional values into agricultural prices and value chains generally leads to an increase in production and marketing costs, which will ultimately be distributed to producers, consumers or traders.

Appropriate institutions and policies can greatly reduce these costs facing individual investors in moving to sustainable systems. For example, social safety nets and programmes to reduce risk and strengthen resilience *ex-ante* can strengthen incentives for investments in sustainable systems (FAO, 2010b). Publicly provided agricultural research, development and extension systems, combined with capacity building, reduce transaction costs and increase incentives for the efficient use of inputs. Institutions that support effective collective action, such as cooperatives or farmer field schools, or innovations in value chains to support smallholder access and incentives for sustainable production, all reduce transaction costs (Cavatassi *et al*., 2009). In such cases, some of the transition costs are shifted from the private to the public sector.

Sustainable intensification in aquaculture

Aquaculture is the fastest-growing food sector, with an annual growth rate of nearly 8 percent for the past decade and supplying 60 million tonnes (close to 50 percent) of the global food fish supply (FAO, 2012e). Aquaculture intensification has the potential – if supported and developed in a regulated and environmentally and socially responsible way – to produce the fish needed to meet the demand for safe and highly nutritious food by a growing population.

Many aquaculture production systems have minimal reliance on freshwater, and greenhouse gas footprints that compare favourably with those of alternative systems of animal protein production. Some systems, such as mussel cultivation, can extract excess nutrients from the aquatic environment thereby mitigating eutrophication. A critical bottleneck is the feed supply, which currently depends on fish meal, fish oil and low-value fish, especially in producing higher trophic-level finfishes and crustaceans. Driven both by market prices and consumer concerns, the sector is increasingly shifting to alternative feed sources, especially from terrestrial origin and fishery by-products. The need for an ecosystem approach to the management of the sector (FAO, 2010a) has also been recognized as key strategy to integrate aquaculture with other food systems. Rice–fish farming and integrated multitrophic aquaculture are good examples of sustainable integration as a base for intensification.

The concept of "common but differentiated" responsibility is a cornerstone of the Rio vision of sustainable development, calling for a just and equitable sharing of costs and benefits in moving to a sustainable future. The principle is particularly important in the context of the agriculture sector, which houses most of the world's poorest people who stand to lose most from a failure to transition to sustainability. It is thus essential that a realistic assessment be made of the full costs of transitioning to sustainability as well as the distribution of the benefits, be it to the investors themselves, or in the form of global public goods. Improved and expanded mechanisms to ensure a just and equitable sharing of these costs as well as benefits are thus essential for achieving the transition to sustainability.

Where are countries likely to obtain the resources needed to invest in sustainable agriculture and hunger eradication? The key mechanism is the reallocation of existing public and private investment resources, moving from investments that have low "sustainability" returns to higher ones. For example, agricultural research and development has consistently shown high returns to both poverty reduction and agricultural growth, and is essential to underpin sustainable approaches in agriculture (FAO, 2012g). Payments for the provision of environmental public goods such as biodiversity conservation, climate change mitigation or protection of water bodies are one potential source of finance that could channel more private-sector finance to sustainable development. Public-sector investments to generate necessary information and build institutions could yield an important return in the form of additional financing streams that can be tapped by the agriculture sector in moving towards more sustainable forms of production (Lipper and Neves, 2011; FAO, 2007). Linking climate change finance to sustainable agricultural investment plans is a potential new and additional source of finance, as discussed next.

Reducing policy-driven trade-offs and expanding investment resources

Reducing trade-offs and expanding financial resources are especially important in the case of climate change – one of the biggest environmental challenges facing sustainable agriculture and food security in the twenty-first century. By mid-century, projections indicate that growing season temperatures in the tropics and sub-tropics will be warmer than any on record (Battisti and Naylor, 2009). In many areas of the world where agricultural productivity and resilience are already low, climate change is expected to reduce productivity further and make production more erratic (Foresight, 2011). At the same time, the agriculture sector is a major contributor to greenhouse gas emissions. Under "business as usual" agricultural growth scenarios, significant increases in emissions from the sector can be expected (Smith *et al.*, 2008). Agricultural systems must change to adapt to changing climate conditions and reduce emissions, all within the greater challenge of changing to support food security and poverty reduction through sustainable agricultural development. Innovative policy and financing frameworks are needed to meet this challenge and make agriculture "climate-smart".

Most developing countries have formulated national climate-change policies or strategies, including national adaptation programmes of action by least-developed countries, and the development of nationally appropriate mitigation action and national adaptation plans are under discussion. Agriculture generally has a major role to play in these strategies, and planned activities are often the same as, or complementary to, agricultural development planning, although conflicts may also arise (Meridian Institute, 2011). Climate-smart agriculture approaches to improving coordination are important in order to reap synergies and avoid the costs of conflicting policy measures or perverse outcomes.

Climate-smart agriculture builds on sustainable agriculture development practices and approaches such as sustainable crop intensification and livestock development and sustainable management of land, water, fisheries and forests. The approach has a strong focus on building resilience in livelihoods, taking into account landscape-scale potential for managing ecosystems for resilience, as well as the importance of non-agricultural sectors in achieving food security under volatile environmental and market conditions (FAO, 2012f). Developing and disseminating varieties, species, and breeds of crops, trees, livestock and fish to support sustainable and stable increases in the returns to agricultural production under climate change is a core challenge, as is building institutions to facilitate access to the diversity of genetic resources needed for adaptation (FAO, 2010b).

Implementing climate-smart agriculture requires the development of location-specific evidence of the potential food security, adaptation and mitigation benefits that can be obtained from a range of sustainable agriculture options, as well as their associated costs. Such evidence is clearly necessary for prioritizing actions, but can also provide a basis for obtaining climate finance and other forms of environmental finance.

Linking climate and agriculture financing for sustainable agriculture

Transitioning to sustainable and climate-smart agriculture will require greater investment than a "business as usual" conventional growth strategy, with higher levels of investment in human, social and natural capital. Emerging forms of climate finance offer a potential new and additional funding source for climate-smart agriculture investments (FAO, 2010b). At the UNFCCC COP 15 meeting in Copenhagen, a total of USD 30 billion was committed for fast-track climate finance to support adaptation and mitigation in developing countries. At COP 16, Parties also committed to build a Green Climate Fund that would reach USD 100 billion per year by 2020. How these funds will be spent is currently under discussion – as are the institutional arrangements for financing mechanisms. Since agriculture is a key sector for both adaptation and mitigation it is important to ensure the accessibility of climate finance. One essential step is to build an evidence base of the adaptation and mitigation benefits that can be generated through the adoption of sustainable climate-smart agriculture practices. A second is to establish low transaction cost mechanisms to channel finance to small-scale agriculture producers (FAO, 2010b).

3 The transition to a sustainable future requires fundamental changes in the governance of food and agriculture and an equitable sharing of the transition costs and benefits

We have known since the first Rio summit a great deal about the nature of the challenges we face and how to address them. However, we have fallen short in recognizing and addressing the governance challenges that must be overcome in order to take the steps needed to achieve commonly agreed goals.

Ultimately, success in eradicating hunger and the transition to sustainable patterns of consumption and production will depend on the decisions of billions of individuals – both producers and consumers. Conditions and incentives that are conducive to sound decision-making will be needed, including mechanisms for identifying and managing trade-offs that can arise in pursuing these multiple objectives. This, in turn, requires building fair and effective governance systems – systems that are transparent, participatory, results-focused and accountable – at the global, regional, national and subnational levels.

Eradication of hunger and sustainable agricultural and food systems are interdependent. Their solution requires going beyond a single set of achieving sectoral policies or a single scale of implementation. It requires the involvement of a broader set of actors, including governments, international organizations, civil society and the private sector. Discussion among a broad range of stakeholders should be based on sound data, independent analysis and interpretation of evidence from diverse sources of knowledge.

We have good experiences to draw on in terms of the principles underlining good governance. The importance of the guidelines presented below is twofold: their content but also the process of building consensus through inclusive multi-stakeholder consultation. The ***Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security***, adopted by the FAO Council in 2004, are a practical, human-rights-based tool to help implement the right to adequate food and are based on a set of principles underlining good governance: equality and non-discrimination; participation and inclusion; transparency, accountability and rule of law; and that all human rights are universal, indivisible, interrelated and interdependent.

The negotiations of the Right to Food Guidelines from 2002 to 2004 benefited from the expertise, the practical experience and the technical knowledge of civil society organizations, including the private sector, which actively participated in the process and are now playing an important role in the context of the implementation of the Right to Food Guidelines. This successful experience of multi-stakeholder engagement inspired other negotiation processes and led to the recognition of the crucial role of civil society organizations in the context of the reformed Committee on World Food Security (CFS).

A more recent example of a multi-stakeholder convergence on global governance issues related to food security and agriculture is the approval of the ***Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security.*** The guidelines are intended to assist states, civil society and the private sector to improve the governance of tenure and thus contribute to alleviating hunger and poverty, empowering the poor and vulnerable, enhancing the environment, supporting national and local economic development, and reforming public administration (see FAO, 2012h).

Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security

The guidelines are the first comprehensive, global instrument on tenure and its administration to be prepared through intergovernmental negotiations. They set out principles and internationally accepted standards of responsible practices for the use and control of land, fisheries and forests. They place the governance of tenure within the context of national food security, and are intended to contribute to the progressive realization of the right to adequate food, poverty eradication, environmental protection and sustainable social and economic development. The guidelines cover a wide range of issues, including promoting equal rights for women in securing title to land, creating transparent record-keeping systems that are accessible to the rural poor, and recognizing and protecting informal and traditional rights to land, forests and fisheries.

Developed over the past three years in a far-reaching and inclusive consultation process, the guidelines come within the context of intensifying competition for land and other natural resources resulting from a variety of factors, including increased demand for food and energy and large-scale purchases of farmland in the developing world by both overseas interests and domestic investors.

The guidelines were finalized though three rounds of intergovernmental negotiations involving 98 countries (plus the European Union as an FAO member organization) and with the participation of non-governmental groups, civil society organizations, UN bodies and other international organizations, farmer associations, and private-sector representatives. The Committee on World Food Security endorsed the Guidelines during the 38th (Special) session on 11 May 2012.

Improved multi-stakeholder governance mechanisms are also critical for the sustainable management of shared ecosystems and living resources such as ocean fisheries, as exemplified by the process leading to the development of the ***Code of Conduct for Responsible Fisheries***. This Code of Conduct is a collection of principles, goals and action aimed at ensuring that fisheries are sustained for the future. The Code calls for collaboration among countries and all stakeholders involved in fisheries and aquaculture to conserve and manage fish resources and their habitats. The Code was developed jointly in 1995 through a participatory process involving FAO, intergovernmental organizations, the fishing industry and non-governmental organizations. The guidelines are voluntary, implemented by governments with technical support from FAO and others.

A key development in terms of new modes of governance has been the reformed Committee on World Food Security (CFS). The reform of CFS envisions the Committee as the foremost platform for a broad range of committed stakeholders working together in a coordinated manner. Similar multi-stakeholder platforms and alliances can be envisaged at regional and national levels, based on the same principles, namely inclusiveness of stakeholders, country ownership and flexibility in implementation in order to better correspond to regional and country circumstances.

Inclusive and evidence-based governance mechanisms are essential to address the challenges we have outlined and the difficult choices they involve to find the right balance between long-term and short-term goals, between local, national, regional and global needs, and between public and private interests and social responsibilities. They can provide political

The reformed Committee on World Food Security A new model to improve global governance of food security

The Committee on World Food Security (CFS) was reformed in 2009 to become the foremost evidence-based inclusive international and intergovernmental platform on food security and nutrition, to strengthen the global governance of food security, improve policy coordination and coherence at global, regional and national levels, promote accountability, share best practices and facilitate support to country-led processes. CFS provides a platform for discussion and coordination. It promotes greater policy convergence, including through the development of international strategies and voluntary guidelines on food security and nutrition, based on best practices and lessons learned from countries that have made progress in reducing hunger.

The new CFS is inclusive. In addition to member countries, it also includes civil society and non-governmental organizations, particularly organizations representing smallholder producers, fisherfolk, herders, landless, urban poor, agricultural and food workers, women, youth, consumers and indigenous people. Participation also includes representation of UN bodies, international financial institutions, international agricultural research institutions philanthropic foundations and the private sector. An essential part of the CFS reform was the creation of the High Level Panel of Experts on food security and nutrition, an innovative science–policy interface to advise CFS and provide evidence-based analysis and advice on issues of importance to the Committee for better-informed policy debates.

and technical support to monitoring and accountability systems that will deliver results on the ground. And they are needed to contribute to policies and institutions that will provide incentives and capacity to eradicate hunger and achieve sustainable consumption and production systems.

Priority areas for policy action

Key areas for action on policy to build the necessary incentives and capacity to eradicate hunger and make the transition towards sustainable agricultural and food systems include: establishing and protecting rights to resources, especially for the most vulnerable; incorporating incentives for sustainable consumption and production into food systems; promoting fair and well-functioning agricultural and food markets; reducing risk and increasing the resilience of the most vulnerable; and investing public resources in essential public goods, including innovation and infrastructure, to create an enabling environment.

Establish and protect rights to resources, especially for the most vulnerable

Access to natural resources – such as land, water, forests or wild food resources is essential for the 2.5 billion people who produce food for their own consumption and as a source of income. Unequal and weak tenure arrangements persist in large parts of the world, which can lead to expropriation, displacement and eviction when powerful investors – be they local, domestic or foreign – lay a claim (HLPE, 2011). This is particularly the case for women and indigenous people. Policy interventions can help close the gender gap in agriculture and rural labour markets, when focused on: *eliminating discrimination against women in access to agricultural resources, education, extension and financial services, and labour markets; investing in labour-saving and productivity-enhancing technologies and infrastructure to free women's time for more productive activities; and*

Global initiatives for the Blue World and food security

The world's marine ecosystems – the Blue World – provide essential food, shelter and livelihoods for hundreds of millions of people. Ocean and inland fisheries as well aquaculture, the fastest growing food sector, are among humanity's best opportunities to deliver to a growing population highly nutritious food with a low ecological impact. But human impacts are increasingly taking their toll on the health and productivity of the world's oceans. This puts at risk the food production potential of the oceans and with it the livelihoods of those who depend on fisheries and aquaculture.

FAO is cooperating on initiatives for the sustainable use and management of ocean resources with a wide range of partners including governments, UN bodies, the World Bank, the private sector and civil society organizations. A priority action is the development and implementation of international guidelines for securing sustainable small-scale fisheries that support the livelihoods of small-scale fisherfolk.

facilitating the participation of women in flexible, efficient and fair rural labour markets. As global competition for natural resources intensifies, asymmetries of power could lead more vulnerable groups to suffer loss of access to natural resources.

Clear tenure rights are necessary to promote equitable access to resources as well as sustainable management. Tenure is the relationship among people with respect to land and other natural resources. The rules of tenure determine who can use what resources of the land, for how long, and under what conditions. Tenure has significant implications for sustainable development. Where the poor and vulnerable have limited and insecure rights to land and other natural resources, it is difficult for them to overcome hunger and poverty. Conversely, equitable and secure rights support social and economic development and environmental sustainability. Weak governance can be found in formal statutory land administration as well as informal and customary tenure arrangements, and is a cause of many tenure-related problems. The poor are vulnerable to the effects of weak governance as they lack the ability to protect their rights to land and other natural resources.

In this context, it is important that countries and their development partners make use of the *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* as appropriate in their food security strategies and policies. The guidelines will serve as an authoritative reference for national authorities when passing laws and setting policy related to access and tenure rights for land, fisheries, and forest resources. The guidelines are also intended to give investors and developers clear indications on best practices and to provide civil society land rights groups with benchmarks they can use in their work on behalf of rural communities.

Incorporate incentives for sustainable consumption and production into food systems

If individual consumers or producers are to take into full account the values of natural resources and the environment when making decisions, these values should be incorporated into planning, institutions, technologies and value chains. Incentives can be created through a range of instruments – including regulations on pollution from agriculture; the development of extension, credit and input supply policies to support sustainable production practices; direct payments for environmental services; and consumer information and labelling, regulation on food

content, advertising, etc. One of the most important incentives for sustainable food systems is the availability of long-term finance to support the transition. The Rio+20 summit offers an opportunity to identify opportunities and gaps in current financing mechanisms and explore possibilities for innovative approaches for linking environmental and agricultural sources of finance as well as public and private partnerships.

Policies that promote the efficient use of agricultural inputs are an important way to improve incentives for sustainable management in industrialized countries, but also in developing countries where subsidies on such inputs are often considered a key component of agricultural growth and food security strategies. Incentives for sustainable use of inputs should be coupled with strong extension programmes and other programmes such as farmer field schools to provide support for improved efficiency in input use. Alignment of incentives can also be a powerful means to better manage natural resources such as wild fish stocks. The potential net economic benefits from better governance and management of marine fisheries have been estimated at USD 50 billion per year (World Bank and FAO, 2009).

Building consumer awareness and capacity to transition to sustainable diets and consumption patterns could be achieved through consumer and nutrition education, removal of perverse subsidies, differential taxation, altering food safety standards and informational labelling. Voluntary standards on sustainability can play a key role in enhancing sustainable consumption as a driver of sustainable production. Making them effective requires more accurate tools to assess sustainability, transparency and comparability in the way the information is communicated.

Promote fair and well-functioning agricultural and food markets

Well-functioning agricultural and food markets can provide incentives to producers and consumers to move towards sustainable consumption and production. At the global level, there is considerable concern about these markets – particularly food markets, which in recent years have been characterized by higher and more volatile prices. Many developing countries have significantly liberalized their agricultural tariffs and reduced their domestic support for farmers, while many developed countries have maintained high levels of domestic farm support.

Fundamental changes in the international trade system are needed to achieve a fairer and more effective system. In a time of rising and volatile prices exacerbated by export restrictions, there is a need for a new agenda for trade talks, with particular attention to safeguarding the needs of food-insecure and food-importing countries, including more space for developing countries to use domestic policies to address their food security needs (HLPE, 2011).

The strengthening linkages between food and energy markets increases the potential for shocks to be transmitted from one sector to the other; thus, care must be taken in agricultural and energy policy formation to avoid exacerbating commodity price volatility. On the production side, sustainable intensification approaches and cutting waste are key measures for reducing agriculture's dependence on energy-intensive inputs. On the demand side, measures such as removing subsidies or increasing flexibility in biofuel mandates have been proposed to reduce the pressure on food markets from biofuels – particularly first-generation biofuels from food crops. Opening international markets for both feedstocks and renewable energy products so production may occur where it is economically, environmentally and socially feasible to do so would also help broaden the market and reduce volatility. At the same time, efforts should be made to accelerate scientific research on second-generation biofuels that would compete less with food (FAO *et al.*, 2011).

National agricultural and food market development is equally important for achieving sustainability and hunger eradication. Improving domestic market infrastructure and building value chains accessible to small and low-income producers will increase agricultural incomes and facilitate access to food.

A legal and institutional environment that promotes and supports cooperation among small and family farmers is also essential so that they can take better advantage of scale economies, including in upstream and downstream activities such as purchasing inputs and processing, and transporting and selling outputs. Developing countries should also be helped to set up properly regulated local commodity exchanges, including derivatives or futures markets (Tangerman, 2011; FAO *et al.,* 2011).

Reduce risk and increase the resilience of the most vulnerable

As noted, food markets in many developing countries function less than optimally because of poor infrastructure, weak institutions and a lack of appropriate regulation. Improving the functioning of domestic markets will smooth variability, facilitating the transfer of food surpluses across geographies and the management of price fluctuations over time. Improving information and transparency on supply, demand and stocks is a key measure for reducing volatility in markets. The Agricultural Market Information System (AMIS) established in 2011 in the wake of food price spikes in international markets involves a number of international and intergovernmental organizations collecting, analysing and disseminating information regarding the food situation and outlook for major producing and consuming countries.

Agricultural Market Information System (AMIS)

The rapid increase in levels and volatility of world food prices in 2006–08 that resulted in a food crisis affecting millions of people worldwide, and again the food price spike of 2010, drew the world's attention on the weaknesses of agricultural market information systems. Weaknesses included lack of reliable and up-to-date information on crop supply, demand, stocks and export availability from countries and regions. At the global level, there was no effective and credible mechanism to identify serious food shortages, hampering efforts to establish links between information, abnormal market conditions and coordinated policy responses.

At the June 2011 meeting, the G20 Ministers of Agriculture launched the Agricultural Market Information System (AMIS). This is a collaborative platform that provides an open global agricultural market information system through the collection and analysis of current and future food market and food policies information. It will forecast the short-term market outlook for wheat, maize (corn), rice and soybeans, thereby reducing price volatility and the incidence and magnitude of panic-driven price surges through increased transparency, information analysis and efficiency of world commodity markets. AMIS is managed by a joint Secretariat located in FAO, with the participation of nine international organizations.

Even with measures to reduce market price volatility, small farmers still face risks from both market and environmental shocks, so reducing vulnerability and increasing resilience of livelihoods and food systems is increasingly important in both emergency and development contexts. The vulnerabilities and risks vary considerably among and within countries and thus responses have to be tailored accordingly.

The Horn of Africa and the Sahel: ending hunger through sustainable approaches for building vulnerable people's resilience

The Horn of Africa and the Sahel are the two most serious hotspots of food insecurity, hunger and malnutrition in the world, with a combined population of nearly 300 million, most of whom live on less than USD 1 a day. The Horn of Africa and Sahelian countries largely depend on agriculture, with livestock contributing up to 20 percent of the economy in a very fragile and drought-prone environment. Conflict and political instability are also a major characteristic of both regions. In terms of food security, the key challenge consists of responding to the immediate needs of vulnerable people and marginalized communities, while stimulating longer-term sustainable productive capacity and livelihood opportunities to enhance their resilience to shocks.

In the Horn of Africa, a number of 'scalable' and highly sustainable low-input approaches have been identified, including climate-smart agriculture and land and water management practices, community-based seed multiplication and distribution systems and access to drought-tolerant multipurpose crops, agro-pastoral field schools and community animal health workers. These approaches build strongly on the region's considerable unexploited natural resources potential (land, water, forest, biodiversity) as well as on smallholder farmers' and pastoralists' local knowledge of production systems. Very promising innovations have also been developed in digital information systems for improved livestock disease surveillance and crop–livestock integration practices.

In the Sahel, development partners are promoting agro-sylvo-pastoral systems combining pasture resources management and livestock techniques. These are based on biodiverse ecological systems that produce multiple products, and more effective sustainable water management practices, including expansion of rainwater harvesting, water reserves to buffer droughts and more efficient irrigation such as drip and furrow irrigation. Other practices include improved post-harvest management (storage, food drying, food processing), strategic animal fodder reserves and fodder conservation, and vaccination to reduce or prevent the spread of animal disease.

Ex-ante protection measures will be needed, as well as improving the efficiency of *ex-post* coping measures. The former include increasing the ecological resilience of agricultural production systems to withstand environmental shocks, extending productive safety net programmes, provision of index-based insurance programmes and enhancing access to weather and climate information for producers. Given the high costs of disasters for food security, it is essential to mainstream risk reduction and adaptation into national development policies and public investment and, more specifically, into policies and investments relating to rural development, agricultural development and food security. The latter include social protection programmes and measures to bridge the gap between humanitarian response and development assistance.

Invest public resources in essential public goods, including innovation and infrastructure

Public funding for agriculture needs to be greatly increased and redirected towards the provision of essential public goods such as innovation and infrastructure and the creation of an enabling environment for private investment in

the sector. In general, there has been significant under-investment in agricultural public goods and services, especially those of relevance to smallholder producers (FAO, 2012g). There has also been significant underinvestment in co-management and community-based management of common pool resources such as fisheries, forests and water resources. Greater public investment in community capacity development and social infrastructure is indispensable for transitioning to sustainable natural resource use patterns and improving the livelihoods of millions of small-scale fishers, pastoralists, forest dwellers and farmers. More public funds are needed for research and dissemination of sustainable food production and handling technologies, as well as in physical and institutional infrastructure to facilitate appropriate private investment.

Targeted public investment in public goods and institutions must also underpin private investment to realize sustainable agriculture. Public investment can leverage much larger flows of private investment along value chains by creating a conducive investment environment and reducing barriers to the transition to sustainable systems. Public investment should also support research, innovation and technology development, knowledge management and dissemination, and market-oriented institutions. Investing in agricultural innovations and technologies, targeting smallholder producers and especially women, is clearly a key priority for achieving sustainable agricultural growth and poverty reduction among these key groups. Technologies to increase resilience, such as drought- and heat-resistant crop varieties, are clearly important in the context of climate change adaptation and risk management.

Massive public and private investments in research and development are required today to develop and disseminate the technologies and information that producers need to increase their returns through systems that improve efficiency and reduce waste and pollution. Reaching smallholders is a major challenge in countries where extension services have been severely reduced or eliminated due to low public investment in agriculture or reforms of public institutions.

Commitment to action

Eradicating hunger and improving human nutrition, creating sustainable food consumption and production systems, and building more inclusive and effective governance of agricultural and food systems are at the heart of achieving the Rio+20 vision of a world with both healthier people and healthier ecosystems. FAO calls on the Rio+20 participants to make the following six commitments:

1. Accelerate the pace of reducing hunger and malnutrition with a view to eradicating these in the not too distant future.

2. Use the *Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security* and the *Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* as the overarching frameworks for achieving food security and equitable sustainable development.

3. Support the efforts of all stakeholders working in food and agriculture, especially in developing and least-developed countries, to implement technical and policy approaches to agricultural development that integrate food security and environmental objectives.

4. Ensure an equitable distribution of costs and benefits from the transition to sustainable agricultural consumption and production, and that people's livelihoods and access to resources are protected.

5. Adopt integrated approaches to managing multiple objectives and linking financing sources for achieving sustainable agricultural and food systems.

6. Implement governance reforms based on the principles of transparency, participation and accountability to ensure policies are carried out and commitments are fulfilled. The Committee on World Food Security can serve as a model for these reforms.

At the most fundamental level, healthy and productive life depends on food security. Without food security, there can be no sustainable development. The conditions needed to achieve universal food security and nutrition, responsible environmental stewardship and greater fairness in food management intersect in agricultural and food systems at global, national and local levels. **In the face of a global population of 9 billion in 2050 and growing pressure on the world's agricultural and food systems, we can no longer afford to ignore the interdependencies between hunger and malnutrition and natural resources and the environment.** We must recognize that the millions of people who manage agricultural systems – from the very poorest to the most commercialized producers – constitute the largest group of natural resource managers on earth. Their decisions, as well as those of the world's 7 billion consumers, are key to global food security and the health of the world's ecosystems. The challenge for participants at Rio+20 and beyond is to support better decisions by building more inclusive and effective governance of agricultural and food systems.

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