Food and Agriculture Organization of the United Nations

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STRENGTHENING SECTOR POLICIES FOR BETTER FOOD SECURITY AND NUTRITION RESULTS

Climate change

POLICY GUIDANCE NOTE | 5

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STRENGTHENING SECTOR POLICIES FOR BETTER FOOD SECURITY AND NUTRITION RESULTS

This policy guidance note is part of a series that the Food and Agriculture Organization of the United Nations (FAO), the Directorate for International Cooperation and Development (DEVCO) of the European Commission and partners are producing to support policy makers address the food security and nutrition situation in their country. Each note provides guidance on how to sharpen the focus of sector policies in order to achieve sustainable food security and nutrition outcomes.

Contents

Introduction

The purpose of this note is to guide policy makers at country level to identify entry points for assessing and addressing food security and nutrition (FSN) in the face of climate change. It includes background information on how climate change and variability affect the agriculture sectors and FSN and how the agriculture sectors and dietary patterns contribute to GHG emissions. This note provides guidance on how to pursue adaptation-mitigation synergies in the agriculture sectors and on how to assess and design conducive policies that are coherent across sectors and domains and build upon international policy instruments under the UNFCCC. International and domestic climate finance options are also described.

Reducing hunger and micronutrient deficiencies is an important challenge as almost 795 million people are chronically undernourished, one fifth of whom are stunted children under the age of five. There is a strong correlation between the chronically undernourished and the 836 million people living in extreme poverty, who are often small-holders living in rural areas (FAO,

Key messages

- The agriculture sectors are simultaneously contributors to climate change and vulnerable to it, and they offer unique synergies between adaptation and mitigation action.
- Climate change poses many risks for ecosystems and agro-ecosystems, food systems, incomes and trade, livelihoods, and all four dimensions of food security. Extreme events are increasing in frequency and intensity, threatening the agriculture sectors and the livelihoods they support. In developing countries, they are severely affecting the livelihoods and FSN of vulnerable households and communities due to their lower adaptive capacities. Beyond 2030, the impacts of climate change on the productive capacity of the agriculture sectors and thus FSN will become increasingly severe in all regions.
- Climate change and extreme events are two among other factors, such as urbanisation, global population growth and environmental pollution that are asserting pressure on the agriculture sectors and FSN.
- Food producers and processors along the supply chain face numerous barriers that prevent them from adopting practices and technologies to help them upscale their adaptive and productive capacity and their mitigation contributions.
- Conducive policy frameworks that are coherent across sectors are needed to provide incentives and support to overcome these barriers. Climate change policies, activities and investments are strongest when built upon an analysis of adaptation–mitigation synergies and trade-offs, as well as co-benefits such as ecosystem health, human development and income/job creation.
- Disaster risk reduction (DRR) plans should be mainstreamed into these policy frameworks.
- Increased public and private investment in sustainable systems and supply chains is crucial. Public investment is needed inter alia to adapt or enhance infrastructure, research and extension, climate information, financial services and market access in view of a changing climate. Service provision for primary health care, water and sanitation are key for supporting food security and nutrition in the face of climate change.

2016b). Furthermore, continuous global population growth and dietary changes will drive growing food demand, and production will need to increase by 60 percent by the middle of this century to meet the increasing demand (Alexandratos & Bruinsma, 2012).

It is widely recognized that climate change and variability have an impact on agro-ecosystems, which in turn affects the productive capacities and sustainability of the agriculture sectors (crops, livestock, forestry, fisheries and aquaculture). This can have socio-economic implications on the livelihoods and food security and nutrition[1] (FSN) of the most vulnerable. Impacts on agricultural yields and livelihoods will vary across regions and countries, but will become increasingly adverse over time and potentially catastrophic in some areas. The agriculture sectors are also significant greenhouse gas (GHG) emitters.

The 2030 Agenda and its Sustainable Development Goals (SDGs) recognize that we can no longer look at FSN, livelihoods and the sustainable management of natural resources separately. Achieving the SDGs requires ensuring coherence and complementarity of policy frameworks and adaptation as well as mitigation activities across the agriculture sectors and beyond.

The need to simultaneously address SDGs 2[2] and 13[3], among others, is also emphasized by the Paris Agreement, which, adopted in 2015 and ratified in 2016, became the first international climate agreement to prioritize food security. One of its key objectives is to strengthen the global response to the threat of climate change by keeping a global temperature rise well below 2 degrees Celsius above pre-industrial levels and to strengthen the ability of countries to deal with the impacts of climate change. The importance of supporting climate change adaptation and mitigation through the agriculture sectors while improving their productivity capacity is also emphasized in countries' Nationally Determined Contributions (NDCs), which represent the country-driven roadmap of how to implement the Paris Agreement (FAO, 2016d).

To support FSN in the face of climate change, policy advisors should support the development of coherent policy frameworks that take into consideration the interrelatedness of all relevant sectors and serve the objective of improving the adaptive and productive capacity of the sectors while supporting healthy diets for the most vulnerable through nutrition-sensitive programming. This Note aims to serve as orientation material for policy advisors and policy-makers confronted with the challenge of ensuring FSN in the face of climate change and extreme events.

Scope of this guidance note

This Note provides information and guidance to policy-makers and advisors on:

- Expected effects of climate change on FSN;
- GHG emission sources through which the agriculture sectors contribute to climate change;
- Activities for addressing climate change impacts and for contributing to climate change mitigation, to protect FSN;
- International and national policy frameworks that create an enabling environment for climate change adaptation and mitigation actions in the agriculture sectors while enhancing their productive capacity;
- Sources of national and international finance for ensuring FSN in the face of climate change; and,
- Entry points to analyse FSN in the face of climate change and how to identify policies and activities.

[1] Definition of food security: Food security exists 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 (http://www.fao.org/economic/ess/ess-fs/en/).

[2] End hunger, achieve food security and improved nutrition and promote sustainable agriculture

[3] Take urgent action to combat climate change and its impacts.

Background

Climate change, the agriculture sectors and food security and nutrition

The agriculture sectors, FSN and millions of livelihoods are vulnerable to climate change and climate variability. At the same time, the agriculture sectors are also emitters of GHGs. This section explores how the agriculture sectors and FSN are affected by climate change and how they contribute to it.

Effects of climate change on the agriculture sectors and livelihoods

Climate change and climate variability events such as the El Niño-Southern Oscillation (ENSO) have been observed to impact the productivity of the agriculture sectors, and are projected to continue to do so, with strong regional variations (FAO, 2016a).

The effects of climate change can be direct or indirect. Direct impacts on the productivity of the agriculture sectors are caused by modifications in the physical environment such as CO_2 levels, air and water temperature, rainfall patterns and sea level. Indirect effects affect production through biological changes such as shifting biogeographies of pollinators and can be difficult to observe in less controlled environments such as natural forests and capture fisheries (FAO, 2016b; 2016c). These effects usually evolve over time. Relatively large climate variabilities underline the importance of understanding their effects on the productivity of the agriculture sectors. Extreme events such as floods, droughts and storms are expected to become more frequent and intense due to climate change. Unlike climate change impacts that evolve over time, extreme events pose an immediate and often catastrophic threat to the productivity of the agriculture sectors, FSN and ultimately the livelihoods of the most vulnerable (FAO, 2016b).

Table 1 provides an overview of the many dimensions through which climate change has been observed and is likely to continue to affect the productivity of the agriculture sectors, FSN and livelihoods.

Although some areas such as Northern latitudes may see the productive potential of their agriculture sectors raised, most areas will experience a reduction and/ or increased variability in crops, livestock, forestry, fisheries and aquaculture yields. Climate change impacts will affect FSN in developing countries in low-latitude regions first and foremost. If GHG emissions continue, in the long-run (beyond 2030) agriculture sectors worldwide will be negatively impacted (FAO, 2016a).

Impacts of climate change on food security and nutrition

Climate change affects nutrition status through its multiple impacts on the four dimensions of food security, diseases, water safety, sanitation, livelihoods and caregiving. The impacts will be felt first and foremost by the most vulnerable populations (the poor), whose livelihoods depend on the agriculture sectors and who are based in areas most vulnerable to climate change (FAO, 2016b).

Climate change and the four dimensions of food security (FAO, 2016b):

- **Food availability** may decrease and become more variable. Crop yields are more affected in low latitude regions than at higher latitudes and impacts are more severe with increased warming. Many of the areas where crop yields are projected to decrease are regions already confronted with food and nutrition insecurities. Marine fisheries in the tropical belt are predicted to decrease by up to 40 percent, while high-latitude regions could experience an average of 30-70 percent increases (2055 relative to 2005) (IPCC, 2014). Trade is expected to play a key role in adjusting to climate change-driven shifts in food production patterns. However, with the yield capacity across agriculture systems likely being reduced globally post-2030 and continuous global

TABLE 1. **Implications of climate change and extreme events for the agriculture sectors**

	Effects & Consequences (not exhaustive: source, if not stated otherwise, is IPCC, 2014)
Crops	Higher temperatures, and more frequent and longer hot spells that occur during critical periods of crop development, lead to lower yields, even crop failure. In Northern latitudes, increasing temperatures may extend the growing season in some areas, leading to higher productivity if sufficient moisture is available, and with increased possibilities for grazing and forestry as well. Reduced and/or altered rainfall distribution and shorter growing season can each lead to lower yields, or prevent some crops from being grown at all. In other areas, increased rains can raise crop-yield potential. Farming in low-lying coastal areas will become more vulnerable to flooding from high tides and higher sea levels. More frequent extreme events, including storms, drought and prolonged hot spells, can cause harvest losses. Diseases and pests are projected to increase in frequency and intensity.
Livestock	Climate change affects livestock production in multiple ways, both directly and indirectly. The most important impacts are experienced in animal productivity, yields of forages and feed crops, animal health and biodiversity. Impacts of climate change on animal health are well documented, especially for vector-borne diseases. Diseases such as West Nile virus and Schistosomiasis are projected to expand into new areas, as are bluetongue or Lyme. Outbreaks of Rift Valley fever in East Africa are also associated with increased rainfall and flooding due to ENSO events (FAO, 2016b).
Forestry	Impacts of climate change on forest ecosystems include both increased and decreased plant growth and an increased frequency and intensity of pests and diseases. In some cases, climate change is impairing the ability of forests to deliver critical environmental services, such as watershed protection, to the detriment of the livelihoods of forest dwellers, forest-dependent communities and others who benefit from forests. Extended dry periods and higher temperatures increase the risk of bush and forest fires. More frequent extreme weather events, including storms, drought and prolonged hot spells, can cause reduced forest growth and have implications for foraged insects needed as source of protein and minerals to support healthy diets.
Fisheries & Aquaculture	Higher aquatic temperatures shift the habitat ranges of aquatic species, may reduce fish stocks and lead to species loss in some areas, and increase the risk of disease for marine and freshwater life. Periods of elevated sea surface temperatures lead to progressive loss of coral reefs through bleaching events. Ocean acidification through the uptake of CO_2 harms mangroves and corals and reduces the growth of shellfish and food sources for fish. Extreme events such as storms along coastal areas, including cyclones, will harm coastal fishing, could damage aquaculture and harm mangroves. Climate change and extreme events are impacting the livelihoods of those directly and indirectly dependent on coastal fisheries and aquaculture, in particular small-scale fisherfolk. Fishing in the open ocean will be increasingly dangerous do to extreme events such as storms (FAO, 2016c).

population growth and subsequent rising demand for nutritious food, the practicality of trade to support FSN might have its limitations in the long run. In addition, the nutritional value of various important crops and animal produce is changing under continuous CO_2 emissions (Box 1).

- Access to food is likely to become increasingly difficult for those depending on the agriculture sectors and natural resources for their livelihoods. In addition to affecting the production capacity of the agriculture sectors, climate change poses a risk to the potential growth in incomes and the ability of poor people to purchase nutritious food. Demand may rival supply, and food prices may become more volatile. The combination of reduced or stable purchasing power with rising food prices poses a serious threat for the poor globally. People with low incomes, and without opportunities to secondary incomes or substitutions such as growing their own food, may then find it difficult to access sufficient food in terms of quantity and quality. Furthermore, changing climatic conditions are impacting the processing of agriculture products. For example, traditional food processing such as drying of fish is being affected by increasingly wet conditions in the Arctic, threatening the livelihood strategies of indigenous communities (IPCC, 2014). Supply and storage systems may also be adversely affected by climate change, thus potentially putting limitations on trade as a coping mechanism. Moreover, climate change affects men and women differently because of gender-based differences in access to resources needed to, for example, adopt climate-smart practices and technologies (WB, FAO and IFAD, 2015). Given the outstanding role women have in most family feeding structures, they are crucial actors in maintaining and improving FSN in the face of climate change (FAO, 2016b).

Box 1 Changes in the nutritional value of plants

Some changes are expected in the nutrient content of foods as CO_2 levels continue to rise, which may make it increasingly difficult to achieve and maintain healthy diets. Important crops, such as potato, rice and wheat, when grown under higher concentrations of CO_2 (likely be reached before the end of this century) have 10-15 percent less protein (Taub *et al*., 2008) and contain 15-30 percent less zinc and iron (Ainsworth and McGrath, 2009). The content of 25 different minerals and trace elements in 130 different plant species were found to decline by an average of 8 percent when grown under higher levels of CO_2 (Loladze, 2014). Similarly, secondary effects of heat stress in poultry and other animals include the production of eggs, milk and meat with reduced nutritional content.

- **Utilization of food** may be threatened by the impacts of climate change on ecosystem services, agro-ecosystem productivity and the livelihoods of vulnerable small-scale producers, poor urban inhabitants and indigenous populations, forcing these groups to reduce the quantity and/or quality of their food consumption. This will be a particular threat to infants, young children and women. Diarrhoeal diseases will increase in the future due to reduced water quality, mostly impacting low-income populations. Consequently, the capacity to absorb the nutrients in consumed food is likely to be reduced where access to sound sanitation is absent. Climate change is expected to cause around 250 000 additional deaths/year from malnutrition,

malaria, diarrhea and heat stress between 2030 and 2050 (WHO, 2016). Climate change related increases in incidences of food-borne diseases such as mycotoxins and ciguatera fish poisoning have already been observed. Climate change and variability do not only endanger the productive capacity of the sectors but also the very services needed to support FSN, such as public health services and social protection systems.

- **Stability of food** may be impacted by changes in seasonality and other variability phenomena, increased variance of ecosystem productivity, reduced stability of potable water supplies, more frequent extreme events, increased supply risks and reduced supply predictability, leading to more variable output, prices and incomes.

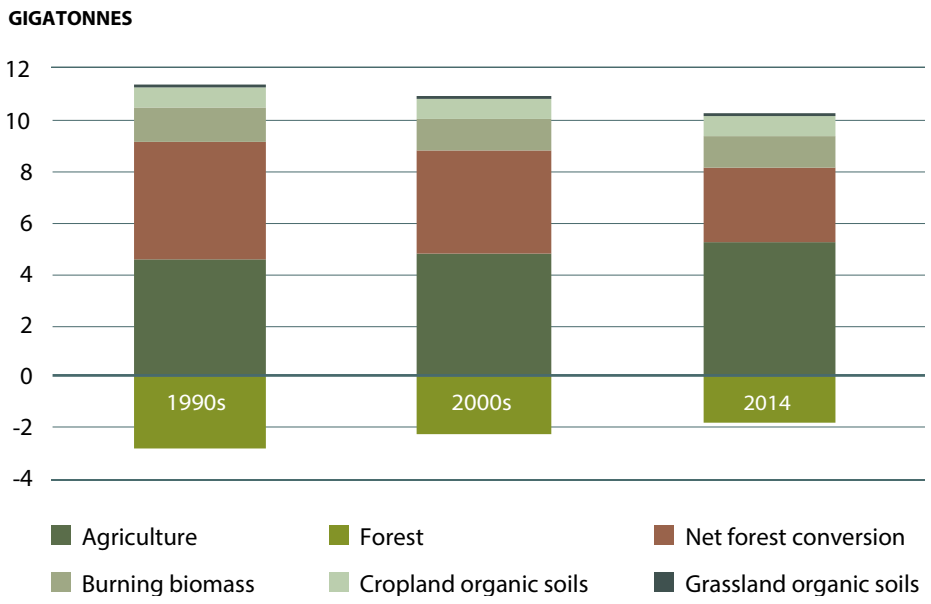
Contributions of the agriculture sectors to climate change

FAO (2016a) estimates that GHG emissions from agriculture (crops and livestock), forestry and other land uses (AFOLU) amount to 21 percent of total global GHG emissions. The main sources are:

- Release of CO_2 from forests when they are converted to fields and pastures, cleared for logging, or degraded due to unsustainable management;
- Methane (CH_4) from (enteric) fermentation in the digestive tracts of ruminant livestock;
- CH_4 from flooded paddy rice fields; and
- Nitrous oxide (N2O) from fertilizer and manure use and leguminous plants and trees.

Emissions from crops and livestock increased by around 18 percent from 1990 to 2010. On the contrary, GHGs from forest conversion have decreased, yet the contribution of forests to carbon sequestration is estimated to have fallen since the 1990s. Overall, total emissions from the AFOLU sector have fallen since 1990 (Figure 1). However, future food demand, driven by population and/or income growth, is expected to cause the emissions linked directly and indirectly to agriculture production to rise (FAO, 2016a).

FIGURE 1. **Annual average net emissions from agriculture, forestry and land use change, in carbon dioxide equivalent.**



Source: FAO 2016a.

The emissions illustrated in Figure 1 are not the only GHGs associated with the agriculture sectors. Substantial additional CO_2 emissions, mostly related to the energy intensity of modern food systems, are being released in processes related to, for example, the manufacture of fertilizers, pesticides and herbicides, and in machinery use, food processing and transformation,

storage and transport. In fact, food systems currently consume an estimated 30 percent of the world's available energy, with more than 70 percent of that share being consumed beyond the farm gate (FAO, 2016a).

Furthermore, it is estimated that every year approximately one-third of the food produced for human consumption is lost, representing a huge waste of land, water, energy, labour and inputs, and unnecessary emissions of millions of tons of GHGs (FAO, 2016a). In low-income countries, the highest losses are in small- and medium-scale agriculture and fisheries production and processing, whereas in middle- and high-income countries, food waste is caused mainly by consumer behaviour and by policies and regulations which address other sectoral priorities (ibid.). Food losses in low-income countries can be addressed by, for example, improved transportation infrastructure and post-harvest handling (including hygiene and access to electricity for cooling). Storage facilities should adhere to standards supporting food safety.

If the increase in global temperature is to be kept below 2° C, the agriculture sectors must contribute to climate change mitigation. Increasing resource-use efficiency while reducing negative externalities is thereby key. Improving the input/output ratio per unit produced would help to mitigate direct GHG emissions while also contributing to the utilization of opportunities to sequester carbon through, for example, reforestation and afforestation and the rehabilitation of degraded soils (FAO, 2016a).

Diet choices and climate change

Dietary patterns at the population-level can drive climate change. In higher-income countries (but also increasingly in middle- and to some extent low-income countries), diets have evolved towards higher consumption of livestock, produce, vegetable oils and sugar. Food consumption patterns are further influenced by increasing urbanization, which is now also prominent in low-income countries. Urbanization, in fact, often goes often hand in hand with increasing incomes, allowing for diets richer in processed foods (FAO, 2017).

The consequences of these dietary patterns have been widely studied, and the results provide evidence that livestock products are responsible for increasing emissions, mainly through feeds and enteric fermentation, and from conversion of forest to additional grazing land (Garnett, 2011; Popp *et al*., 2010). Moreover, the consumption of these food types can cause malnutrition phenomena, such as obesity and related non-communicable diseases, to occur at the population-level.

Addressing climate change for food security and nutrition

This section introduces a list of activities at different levels of intervention to increase the adaptive capacity of the sectors and their mitigation contributions, where possible. Climate-smart agriculture (CSA) is introduced as an approach to promote adaptation-mitigation synergies while sustainably improving productivity and managing trade-offs. Barriers to the adoption of adaptation and mitigation activities are explored.

Adapting to climate change and variability

Climate change and variability are affecting food security and nutrition along the whole supply chain. Multiple activities exist to improve the adaptive capacity of the agriculture sectors and entire food systems when confronted with climate change and variability, including extreme events. Activities need to be context-specific to avoid maladaptation and achieve the best possible outcome. Adaptation activities must take into account the need to sustainably increase production in order to support socio-economic development and address the increasing demand for food, driven by population growth and changing diets. The goal of boosting food production by 60 percent (above 2006 levels) to feed 9 billion people by 2050 does challenge the total net emission reduction coming from AFOLU and the long-term goal of carbon neutrality by 2050.

Table 2 summarizes activities to improve the adaptive capacity of the sectors through the lens of FAO Adapt priority themes[4] (FAO, 2011a). These themes have been identified by analysing adaptation needs of the sectors from the local to the global level. Many of these themes are linked, and capturing potential synergies requires adaptation approaches that are comprehensive and holistic. The following sections are inspired by the FAO Adapt priority themes.

TABLE 2. **Priority themes to improve the adaptive capacity of the agriculture sectors (non-hierarchical order)**

FAO Adapt Priority Themes
Data and knowledge for impact and vulnerability assessment and adaptation
Institutions, policies and financing to strengthen capacities for adaptation
Sustainable and climate-smart management of land, water and biodiversity
Technologies, practices and processes for adaptation
Disaster risk management

Data and knowledge for assessment and adaptation

Continued research and downscaling of physical and bio-climatic models are needed to create the evidence base required for location-specific and sustainable adaptation activities. The "International Panel on Climate Change's 5th Assessment Report (IPCC AR5)" (IPCC, 2014) provides vast information on climate change impacts.

To improve location-specific adaptive capacities of the agriculture systems and those dependent on them, a number of tools and methods for assessing vulnerability and present and future impacts are available (an overview of tools for assessing FSN in the face of climate change and variability is provided from page 25 onwards).

[4] The adaptation activities in this section present a non-exclusive overview of FAO ADAPT and relevant activities. The complete list of activities can be found at FAO-ADAPT Framework Programme on Climate Change Adaptation (FAO, 2011a).

In many cases, information on observed (and likely) climate change and variability impacts on the productive capacity of the agriculture sectors, FSN and dependent livelihoods is available in a specific location. Providing venues for sharing existing knowledge and data between different stakeholders (including indigenous groups, civil society organizations, non-governmental organizations, scientists, food producers of all scales, government agencies and the private sector) across sectors (the agriculture sectors and beyond) and all levels of governance (local to national) is crucial for unlocking this often "hidden" information and to incrementally fill existing knowledge gaps.

Disseminating the data and knowledge collected by applying assessment tools and methods and/or listening to experiences is important for raising awareness of climate change and variability, related risks and opportunities, and for enhancing the willingness of food system stakeholders to invest in and adopt climate-smart practices and technologies.

Institutions, policies and financing to strengthen capacities

Improving FSN in the face of climate change and variability requires adjusting institutional structures and arrangements. This includes defining adequate policies that sustainably improve the adaptive capacity of the agriculture sectors *and* support nutrition-relevant services. To achieve the best possible outcome, policies and coordination frameworks must be coherent. Policies that improve the adaptive capacity of the agriculture sectors are ideally combined with the provision of social services for the most vulnerable. Nutrition-sensitive programming is crucial for ensuring FSN of the most vulnerable. Access to climate finance is an important catalyst for countries to implement adaptation activities effectively (please find more detailed information on climate finance from page 21 onwards).

- **Coherent policy and coordination frameworks**

  Given the interrelatedness of the agriculture systems and their linkages with other (natural resources) sectors, cross-sectoral coordination of activities that support climate change adaptation and sustainable productivity growth is essential. Agencies often work in relative isolation, even at cross-purposes. Poor coordination between government agencies (and other non-governmental stakeholders) and adaptation activities can cause avoidable trade-offs to occur, often to the disadvantage of the most vulnerable.

  However, even where inter-agency coordination exists, optimizing current conditions and minimizing vulnerability to future change, trade-offs may still occur. For example, converting mangroves into shrimp farms may increase incomes and food supply, but it may also increase vulnerability to climate extremes and climate change as mangroves provide crucial ecosystem services such as coastal defence (with regard to storm surges, tsunamis, sea level rise and erosion) and socio-economic benefits such as food and employment opportunities. Diversifying agriculture or rural livelihoods builds long-term resilience (including more stable and higher incomes), but it may decrease income in the short term. These trade-offs need to be carefully assessed when designing policies.

  In addition, it is important to recognize that the agriculture sectors often compete for resources – for example freshwater – and sometimes act as safety nets for each other. For instance, where crop and livestock production fail, people tend to move to forestry and fishery to support their livelihoods. To support effective adaptation activities that do not increase resource competition and merely shift demand-related pressure from one sector to the other, policy frameworks are ideally cross-sectoral and take into consideration social protection, disaster risk management, agriculture, fisheries and

forestry, and climate change aspects. When designing policies and programmes in response to climate change, gender equity trade-offs need to be systematically analysed and addressed (FAO, 2016b).

For adaptive activities to have a lasting and sustainable impact, policy frameworks should be coherent across different sectors, include incentives for adopting climate-smart practices and allow for good governance and accountable management structures.

Institutional and governance mechanisms that engage and allow for the participation of local (indigenous) stakeholders, and enable multi-stakeholder dialogue, knowledge sharing and bottom-up management of natural resources, are relevant for improving the adaptive capacity and thus the productivity of the sectors and consequently the livelihoods of those who are dependent on them.

Vertical planning across levels of governance that allows local institutions to participate in defining and implementing policies is crucial. Furthermore, policies need to facilitate the uptake of practices and technologies that increase the adaptive capacity of the sectors through incentives such as improved access to credit and insurance as well as information and training. Please find more information on global and national policy frameworks from page 19 onwards.

- **Providing services for the most vulnerable**

Adequate, well-designed and context-specific social protection programmes help support the most vulnerable in overcoming poverty, hunger and undernutrition, as well as tackle some of the main vulnerabilities of households to climate risks. Social protection refers to the set of policies and programmes aimed at preventing or protecting all people against poverty, vulnerability and social exclusion throughout their life, with an emphasis on vulnerable groups. Nutrition-sensitive social protection such as pro-poor insurance schemes can help smallholders' take up climate-smart investment opportunities and thus acquire knowledge on climate-smart practices and access to technologies that help to sustainably improve their productivity and efficiency. DRR plans that take into account long-term safety nets have already been developed and implemented (see Box 2).

Further case studies on social protection for food security and nutrition can be found in the *Social protection for food security report* (HLPE, 2012). The report "The State of Food and Agriculture: Social Protection and Agriculture - Breaking the cycle of rural poverty IN BRIEF" provides further information on the scope of social protection and its potential impact on food security, nutrition, investment and growth (FAO, 2015).

Box 2

Social protection and climate risk management in Ethiopia

Ethiopia has connected DRR and social protection at the policy level. Its Livelihoods, Early Assessment and Protection (LEAP) project has assisted the Government of Ethiopia in developing a comprehensive national weather risk management framework. LEAP links Ethiopia's Productive Safety Net Programme to a contingency fund. Based on a weather index, a tailored LEAP software programme estimates the costs of scaling up the Productive Safety Net Programme and thus allows for a timely response in case of droughts or floods (Hazel *et al*., 2010).

However, social protection programmes alone are not sufficient to generate long-term capacity to reduce poverty and generate secure and stable access by poor rural households to sufficient quantities of nutritious food. Investments to sustainably support the productivity of the sectors are also necessary to improve FSN.

The nutritional status of individuals and/ or entire populations is also dependent on health care, clean water and sanitation. Governments are responsible for ensuring that such services are available and accessible. Non-provision of related infrastructure and services can translate into higher incidences of diseases such as diarrhoea, with detrimental implications for the utilization of consumed nutrients, and particularly severe consequences for infants. Education services on health care and nutrition are crucial for avoiding potential malnutrition consequences such as mortality, disability, poor cognitive development and poor health and economic productivity.

- **Nutrition-sensitive programming**

  Supporting food security *and* nutrition in the face of climate change requires nutrition-sensitive interventions that address the underlying causes of malnutrition by incorporating nutrition goals and actions from a wide range of sectors. In fact, policies and programmes that increase agriculture productivity can still leave the most vulnerable of society at risk of malnutrition. It is therefore important to mainstream explicit nutrition goals and activities into policies designed to support the sustainability of the agriculture sectors and dependent livelihoods. Key principles for nutrition-sensitive programming include the promotion of diverse and nutrient-rich food, respecting the socio-cultural context, ensuring gender-sensitive initiatives, promoting health and food safety, targeting the most vulnerable groups and ensuring social inclusion, and adopting a multi-sectoral approach and good governance (see FAO "Key Recommendations for Improving Nutrition through Agriculture and Food Systems, " 2015). More information on the need to employ multi-sectoral approaches to nutrition is provided in the EU-UNICEF brief "Multi-sectoral approaches to nutrition: nutrition-specific and nutrition-sensitive interventions to accelerate progress" (n.d.). More information on nutrition-sensitive agriculture can be found in the FAO "Toolkit for nutrition-sensitive agriculture and food systems".

Climate-smart management of land, water and biodiversity

The healthy functioning and resilience of the ecosystems that support the productivity of the agriculture sectors depend to a great extent on biological and genetic diversity. Sustainable and climate-smart management needs to be based on a thorough understanding of the ecosystem services secured by agricultural, aquatic and forest biodiversity. As the threat of climate change and more intense and/or frequent extreme events is new, fine-tuning of on-going management practices might not be sufficient to support the sectors in the future. This could imply, for example, that shifting from tillage-based production to a non-tillage-based system, such as conservation agriculture, would be required to improve the adaptive capacity and potential mitigation contributions of the crop sector. Shifting production management towards more climate-resilient systems is ideally supported by incentives and tools for more productive, equitable and sustainable management of land, water, aquatic and forest resources, including secured access to land and water. The FAO publication "Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security" provides guidance on securing resource access (FAO, 2012).

Technologies, practices and processes for adaptation

The built-in adaptive capacity of ecological and human systems may not be enough to deal with expected medium- to long-term impacts of climate change and variability. It is therefore important to upscale research on and develop and disseminate technologies, practices and processes that help increase the adaptive capacity of the agriculture sectors and those directly and indirectly dependent on them.

- **Developing and Identifying technologies, practices and processes for adaptation**

  Improving the adaptive capacity of the agriculture sectors to climate change requires identifying and promoting the breeding and conservation of crops, trees, livestock and fish adapted to the changing climate. Furthermore, the application of technologies for efficient and safe use of inputs such as energy, fertilizer, water, seeds, feeds and pesticides should be supported to improve the input/output ratio in agriculture production and processing. Ecosystem-based technologies and practices, including in soil, land, water, forests, rangeland and fisheries, should be promoted to support the functioning of ecosystem services and a healthy biodiversity. A wide range of sector-specific response activities that help to increase the adaptive capacity to climate change risks are described in the FAO report "Climate change and food security: risks and responses" (FAO, 2016b).

  Further research into farming systems, processing and storage facilities adapted to new weather patterns, pests and diseases will be critical. Research will require testing combinations of farming, processing and storing techniques, improved farming systems, species, varieties and breeds from existing scientific knowledge; as well as identifying and breeding varieties and breeds suited to the new conditions. Altered rainfall patterns may mean that there is no longer sufficient surface or groundwater to sustain existing irrigation. The AR5 "Summary of Policymakers on Impacts, Adaptation, and Vulnerabilities" introduces climate change response activities and sheds light on further potential areas of research (IPCC, 2014).

  More research will need to be accompanied by increasing investments – for example, in efficient irrigation to ensure that future water supplies will be adequate to maintaining and/or increase the productive capacity of the agriculture sectors. Research will need to be publicly and privately funded (find more information on climate finance from page 21 onwards). For seeds, publicly funded research can be complemented by commercial research on breeds and varieties that resist changing and extreme conditions. Indigenous knowledge also needs to become a topic of research. Local knowledge of how to cope with harsh and fluctuating production environments must be integrated within climate change adaptation strategies (FAO, 2016r).

- **Disseminating knowledge: advice and extension services**

  Producers and stakeholders along the food supply chain must be supported through advice and extension services to understand (likely) climate change and variability impacts, including risks and opportunities. In this context, enabling interactions between producers and extension agents, researchers and stakeholders (e.g. ministries of agriculture, forestry and fisheries, trade, finance, non-governmental organizations (NGOs), input suppliers, traders and processors) is crucial for developing gender-responsive solutions that are specific to local ecosystems, agriculture systems, and the socio-economic circumstances of those directly and indirectly dependent on the agriculture sectors. Taking into consideration local and indigenous knowledge on climate change impacts, agro-ecosystems and food production, processing and storage will help tailor appropriate location-specific responses. Box 3 provides a practical example of successful advice and extension services for climate change adaptation capacity development.

Box 3

Farmer field schools in Mali: Providing advice and extension services

Launched in 2012, the project "Integrating Climate Resilience into the Agricultural Sector for Food Security in Rural Areas" is based on 15 years' experience of the Integrated Pest Management Programme on farmer field schools (FFS) and sustainable agriculture supported by FAO and implemented by governments and national stakeholders.

The FFS approach is a community education approach based on the principles of experimentation, learning by doing and cooperation. Through weekly field learning sessions, groups of 20–25 farmers from the same village are provided with a risk-free environment to test innovations and build their capacity to adapt to climate change throughout the season. Learning is facilitated by a facilitator who underwent the same learning cycle over a season to understand the principles of non-formal education while learning about existing climate change adaptation practices. Therefore, FFS provide ideal learning platforms for farmers to adapt existing climate change adaptation practices from research, extension and traditional practices to their own needs and contexts, as necessary for effective locally adapted climate change adaptation to take place.

Due to the full involvement of the national and local authorities, the project was able to scale up the FFS/climate change adaptation approach from nine communes (2012) to more than 134 communes (2014). It resulted in the capacity building of 16,237 producers, of whom 5,321 were women; the adoption of improved seeds in 242 villages within 134 communes, with the dissemination of 13 improved/adapted varieties of sorghum, cowpea, rice, millet and maize in three agro-ecological zones; and the implementation of four new agroforestry perimeters managed and maintained by four farmers' organizations, of which 75 percent of the members are women (FAO, 2016b).

Challenges included limited policy coordination and marginal inclusion of agriculture sectors in climate change planning. This was tackled by setting up an inclusive national climate change group including the Ministry of Agriculture, Agency for Environment and Sustainable Development, *Ministère de l'Administration Territoriale et de la Décentralisation*, *Commissariat à la Sécurité Alimentaire*, farmers' organizations, NGOs and research institutions. Stakeholders met twice a year to exchange knowledge on climate change, identify climate-smart practices taking into account indigenous knowledge, and visit field activities. Information sessions were conducted for political and administrative authorities (including local authorities) on, for instance, the role of agriculture in climate adaptation and mitigation and how to access climate finance. Dynamic and innovative rural institutions are critical in supporting farmers to transition to climate-smart agriculture, including well-structured farmer networks/organizations.

Significant improvements in FSN in the face of climate change can be accomplished by providing advice to farmers on available sustainable agriculture practices. Wide adoption of practices such as the use of nitrogen-efficient and heat-tolerant crop varieties, zero-tillage and integrated soil fertility management would boost productivity and farmers' incomes, and help lower food prices. By one estimate, the number of people at risk of undernourishment in developing countries in 2050 could be reduced by more than 120 million through widespread use of nitrogen-efficient crop varieties alone (FAO, 2016a).

Disaster risk reduction

In addressing extreme events, DRR is often significantly more cost-effective than post-disaster response. In fact, field-based evidence shows that for every USD 1 spent on DRR, USD 2–4 are returned in terms of avoided or reduced disaster impacts (FAO, 2016b). Yet, investment in proactive DRR measures in the agriculture sectors is extremely low. Importantly, DRR is relevant to address acute (sudden-onset) climate impacts (short time frame and high severity; examples include all hazards that will happen anyway but whose frequency, severity and/ or location is changed by climate change) as well as chronic (slow-onset) climate impacts (longer time frame that causes a permanent change; examples include ocean acidification and sea-level rise).

Assessing and reducing the root causes of risks and increasing the resilience of livelihoods and food systems to lessen the impacts of acute and chronic climate change impacts are integral components of effective climate change adaptation measures. Given the increasing occurrence of extreme events in many regions, DRR tools such as weather-forecasting systems are immensely valuable for protecting the agriculture sectors, livelihoods and food security and nutrition (see Box 4).

The Sendai Framework for Disaster Risk Reduction provides guidance on how to address extreme climate (and other) events in an integrated

Box 4 Transmitting accurate weather forecasts

Weather forecasting is improving. In the early 2000s it was suspected that droughts in Southern Africa might be linked to ENSO warming in the Pacific Ocean; today the teleconnections are reasonably well established, meaning that warnings can be issued with high probabilities more than one month before the growing season starts (Iizumi *et al*., 2014; Jury, 2015).

Scope exists for more innovative ways of transmitting weather forecasts. In the Lushoto Hills of Northern Tanzania and in Colombia, seasonal weather forecasts are offered to farmers in combination with discussion of crop options suited to the local farming systems, drawing on both formal and indigenous technical knowledge (Dinesh, 2016). Investments in forecasting and extension of weather services are not just defensive: in years with fewer extreme weather events, better forecasting can improve husbandry and raise yields.

Innovative ways of working with farmers to make full use of forecasts and their own observations are being developed. In Java and Lombok, Indonesia, village-based Science Field Schools meet once a month to facilitate exchange of agro-meteorological information between farmers, extension workers and scientists. Farmers are encouraged and trained to record rainfall, pests and diseases, and crop development; combined with forecasts, the information collected by farmers can be assessed to work out how best to respond to anticipated weather/ climate patterns (Winarto and Stigter, 2016).

and demand-responsive way. The framework is based on four pillars: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in DRR for resilience; and (iv) Enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation and reconstruction (UNSDR, 2015). Further information on disaster risks and assessment methods is provided in the report "Resilient Livelihoods Disaster Risk Reduction for Food Security and Nutrition Security" (FAO, 2013b).

Mitigating greenhouse gas emissions

Several adaptation activities (as outlined on pages 8 - 15) contain potential adaptation-mitigation synergies. This section therefore explores activities to reduce GHG emissions from agriculture (crops and livestock), forestry and other land-use activities and how these can contribute to achieving adaptation-mitigation synergies.

Reducing emissions from production

- **Prevent the conservation of forest, peatlands, and other wetlands to farmlands**

  Diversified ecosystems with an intact biodiversity structure are usually less susceptible to pests and diseases and to drier climatic conditions than monocultures. In fact, the sustainable management of upland wetlands and floodplains supports the maintenance of water flow and quality, and the conservation and restoration of forests stabilizes land slopes and regulates water flows.

  The FAO report State of the World's Forest 2016 provides examples of countries with positive trends in forest cover, simultaneously contributing to FSN and climate change mitigation. Regulation of land use has been the main measure deployed. An alternative to regulation is to offer incentives to maintain forests. Payments for Environmental Services may be made to forest users or forest-dependent communities by either the government or commercial companies (benefits include, for example, a steady flow of water from a forested catchment).

  The UN collaborative programme on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD), established in 2008, provides assistance to countries to develop capacities needed to receive payments for actions to reduce forest carbon emissions. The REDD+ mechanism provides a framework that incentivizes developing countries to reduce emissions from forested lands and invest in low-carbon sustainable development pathways. REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

- **Reduce emissions from ruminants**

  Technical options exist for mitigating emissions from ruminants (see Gerber *et al*., 2013 for details). Much can be done by raising the efficiency of feed production and animal feeding and improving animal health, especially among the least technically efficient producers. Such improvements will, in most cases, make economic sense in addition to reduced emission intensity per unit of production. To achieve reduction emissions, further research on animal health, pasture management, feed production and feeding regimes to reduce emissions is needed. Improving overall resource-use efficiency contributes to reducing total production costs and makes capital available for investing in practices that enable climate-resilient production. Alternatively, non-ruminant and other options to cattle can be promoted. These alternative options must guarantee sufficient intake of protein and other micro-nutrients that are found in ruminant products.

Capturing carbon in farming and forest systems

Appropriate crop land and pasture management can considerably increase the carbon content in soils. Agroforestry is also a way to capture carbon: by introducing more trees into farming systems, stocks of carbon can be locked into the standing trees and below-ground biomass. This is only one benefit from agroforestry, as most agroforestry systems promote synergies between the trees and crops that either increase yields or reduce the need for fertilizer and other external inputs; they may also reduce erosion and make systems more environmentally sustainable. Promoting carbon capture requires continuous agricultural research into sustainable land management practices and agroforestry and similar systems, and their promotion through extension. The example of reducing emissions in Mozambican farm systems (see Box 5) provides a practical example of adaptation-mitigation synergies when capturing carbon in farming systems.

Reducing emissions in the food supply chains

Emissions arise upstream of farms, from production of fertilizers and agro-chemicals, and downstream in transport and processing. The emissions related to downstream processes are more significant than upstream emissions. Mostly related to energy use, downstream emissions are still increasing. The Energy-Smart Food for People and Climate Programme (ESF), which uses a water-energy-food nexus approach to support developing countries in ensuring adequate access to modern energy services at all stages of agrifood chains, improves energy efficiency and increases the share of available and renewable energy.

A prime way to reduce the intensity of these emissions is to reduce food loss and waste**.** It is estimated that one third of food is lost in the food supply chain (FAO, 2011b). In developing countries, waste occurs mainly on-farm, for example in storage and in processing. In these cases, investments in improved post-harvest techniques and practices are crucial.

Box 5 Reducing emissions in Mozambican farming systems

The main source of GHG emissions in Mozambique is burning of the Savannah, mainly to hunt wild animals and secondarily to clear land for agriculture and collecting wood fuel (MICOA, 2003). Slash-and-burn clearance is conducted to clear new plots when old plots are abandoned. For the typical small farm in less humid and semi-arid environments, growing maize and root crops, with some small areas for additional food and cash crops, it would be possible to:

- Reduce or replace ploughing by either ripping or using planting pits — the former when there is draft power, the latter when methods are manual. This should allow more infiltration of water to the root zone. Careful placement of fertilizer — with methods such as micro-dosing — offer better returns for any fertilizer used, whether inorganic or organic; and
- Nitrogen-fixing trees, such as *Faidherbia albida*, planted at around 100 trees per hectare to provide additional fertilization.

These measures promise less movement of soil and reduce the overall need for manufactured fertilizer, and thus reduce nitrous oxide emissions. They also help conserve moisture, reducing the loss of crops to drought. Further, they can contribute to raising yields, allowing farmers to produce more without converting forest, bush and grass to cultivated fields, thereby avoiding emissions from land conversion. The preserved trees would also provide forage.

(Source: Wiggins *et al.* 2011).

Balancing future diets

Livestock production, especially from ruminants, can result in high emissions for each kg of food produced. Evidence exist that diets with low environmental impacts are often healthier. Typically, healthy diets with a relatively low environmental impact include foods based on minimally processed tubers, whole grains, legumes, fruit and vegetables, and moderate quantities of meat and dairy products. For a healthy diet, consumption of these products might need to increase slightly for some populations that face protein deficits, while for other populations with excess consumption it should decrease. Many healthy diets also feature seeds and nuts, with small quantities of fish and seafood, and with a very limited intake of processed foods high in fat, refined sugar and salt (FAO and FCRN, 2016).

National policies for awareness raising and consumer education are means to promote healthy and climate-friendly diets. Dietary guidelines can help in shaping a more sustainable and health-enhancing food system by providing guidance on dietary patterns that are not only coherent with nutritional requirements but also generate fewer environmental impacts, thereby reducing the pressure that rests on food production systems and that is often exacerbated by climate change. Countries such as Brazil, Germany and Qatar have started to integrate environmental sustainability concerns into their national dietary guidelines in recent years. The FAO Summary Report "Influencing Food Environments for Healthy Diets" provides detailed information on how to sustainably link food systems, food environments and diets (2016e).

Climate-smart agriculture

The Climate-Smart Agriculture (CSA) approach helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate.

CSA aims to tackle three main objectives:

- sustainably increase agricultural productivity and incomes;
- adapt and build resilience to climate change; and
- reduce and/or remove GHG emissions, where possible.

Adaptation activities presented on page 8 - 15 contain potential mitigation synergies, and Box 5 explores how activities for reducing GHG emissions can also generate productivity and adaptation benefits. Understanding potential synergies between adaptation, sustainable production growth activities and mitigation is important, as utilizing similar processes and capacities can help to expand positive policy outcomes with often limited resources.

CSA does not define *a priori* which practices are climate-smart, as the suitability of practices is context- specific. Five key intervention areas are required to promote climate-smart food systems that can sustainably contribute to FSN in the face of climate change, while considering the context-specific environmental, social and economic aspects of the agriculture sectors:

- **Expanding the evidence base**: the evidence base includes current and projected effects of climate change in a country, key vulnerabilities in the agriculture sectors and for food security, the identification of adaptation and mitigation options and potential synergies, barriers to adoption, and required policy and institutional responses to overcome them. Data on climate change impacts and FSN are increasingly available. However, further data collection and down-scaling of models are important. Expanding the evidence base on hazards, exposure, vulnerabilities and risks will allow for the design of well-targeted adaptation strategies (see Box 6 for more information on generating evidence for CSA). Given that climate change brings both sudden and slow-onset change, such analyses need to be institutionalized and regularly conducted to track change in the system (both agro-ecological and socio-economic).

Box 6

EPIC: generating evidence for Climate-Smart Agriculture

In 2012, the Economics & Policy Innovations for Climate-Smart Agriculture Programme (EPIC) and the European Union launched the project Climate-Smart Agriculture: capturing the synergies between mitigation, adaptation and food security to address climate change and food security simultaneously. EPIC is currently being operated in Kyrgyzstan, Malawi, Mozambique, Tanzania, Viet Nam and Zambia.

The purpose of this project was to look at the interrelationships between climate change and FSN and, in close cooperation with governments, local institutions and universities, support these countries in securing policy, technical and financial conditions needed to sustainably increase agriculture productivity and incomes while increasing the climate change resilience of the agriculture sectors and reducing/removing GHG emissions where possible.

In order to generate the evidence base needed to identify climate-smart strategies that suit the local context and needs, EPIC assesses: (1) how climate change may alter the effectiveness of existing agricultural policy and investment frameworks in supporting food security and agricultural development in a country; (2) how policies and institutions need to be reshaped to achieve climate-smart FSN in the face of climate change; and (3) available policy options to overcome barriers to adoption of CSA practices and livelihood strategies.

Early lessons learned from the projects in Malawi, Viet Nam and Zambia indicate that operationalizing CSA at the country level requires strong links between research and policy as well as greater coordination between the agriculture sectors, climate change and food security and nutrition policies. Based on analytical analyses of CSA potential in a large set of practices in crops, livestock and forestry, and the barriers to their adoption, the programme developed CSA strategic frameworks for each country to guide policy-making to support sustainable production growth and FSN in the face of climate change.

Source: FAO EPIC Website.

- **Supporting enabling frameworks**: coherent policies, plans and investments are needed to underpin climate-smart action. Frameworks and plans should contribute to sustainably increasing the productive capacity of the sectors *and* support nutrition-sensitive interventions.
- **Strengthening national and local institutions**: strong institutions and coordination mechanisms are needed that are well-embedded in the political landscape, and well-positioned to identify and address specific gaps in capacity, efficiency and system resilience for the sector. Strong local institutions to empower, enable and motivate small-scale food producers are essential, as they enable reciprocal exchange of knowledge, capacity needs and plans. Interactions between farmers and other stakeholders from various sectors and policy domains should be facilitated to achieve resource-use efficient cross-sectoral policy outcomes that help to utilize synergies and reduce trade-offs.
- **Enhancing financing options:** innovative mechanisms that link and blend climate finance and investments with sector specific needs are essential for developing and implementing climate-smart food systems (see page 24 on climate finance).

- **Implementing practices at field level:** small-scale food producers are the primary sources of knowledge about local food systems. Adopting climate-smart approaches should be closely linked to their knowledge, requirements and priorities, and their participation in local projects. Capacity building for governmental and non-governmental stakeholders improves their ability to help identify and implement suitable and sustainable national and sub-national policies for the sector. Extension services for CSA to disseminate information on crops, livestock, forestry and fisheries and other natural resources in the face of climate change, and training on climate-smart practices and technologies, are crucial.[5] The suitability of CSA practices is context-specific. The Mitigation of Climate Change in Agriculture (MICCA) Programme of FAO has supported an action-research programme to identify best practices suitable for individual local contexts (see Box 7). Small-scale food producers' organizations can support the dissemination of relevant knowledge at field level (see Box 8).

Barriers to adopting adaptation and mitigation activities

Prominent barriers to adopting climate-resilient and low-carbon practices include: insufficient access of the most vulnerable to knowledge on suitable practices and technologies; upfront investment costs and lost production during transition periods; distance to markets and poor infrastructure; tenure insecurity; weak governing institutions; inefficient institutional cooperation; poor social capital such as membership in farmer groups; fragile resource endowments; and exposure to shocks and risks (FAO, 2016a). Targeted public investment is required to help farmers, especially smallholders, overcome these barriers.

Smallholder food producers, in particular women, face high barriers to accessing finance needed to adopt climate-smart practices and technologies. These barriers are defined by limited financial literacy, little credit history, few other sources of income, lack of collateral, and the difficulty in reaching potential lenders from often remote locations. Reducing these barriers is particularly important as smallholder food producers and small and medium enterprises are an important engine of rural development (FAO, 2016a).

Financial services, where available, should be tailored to smallholder circumstances and thus enable investment in activities adapted to climate change, including diversification, value addition and sustainable increases in

Box 7

MICCA's action-research programme to identify best practices

To identify best practices, the Mitigation of Climate Change in Agriculture (MICCA) Programme of FAO has supported an action-research programme bringing together scientists, extension agents and farmers to identify and develop CSA practices for the pilot projects in Kenya and Tanzania. The project in western Kenya provided support to farmers to develop a system that integrates crops with livestock and trees. The project in central Tanzania has centred on an upland farming system oriented to cereals. Farmers of both projects report higher yields, more food, and better incomes. Both projects have also supported the exploration of ways to measure GHG fluxes at village level. Since some measures require change at landscape level, collective action is indicated.

[5] In India and other countries, Digital Green uses videos prepared by farmers to demonstrate to other farmers what they have learned and perceived useful. For other examples, see Sala *et al.*, 2016.

productivity. Frequently, repayment schedules are too short for longer-term investment or do not reflect the seasonality of the food-producing cycles and therefore do not match the seasonal cash flows of farmers. Adjusting the availability and accessibility of financial services to cash flows is crucial to enable farmers to use investment opportunities for climate-smart food production systems (FAO, 2016a).

Where changing agriculture practices is primarily aimed at mitigating GHG emissions or capturing carbon, small-scale producers are often unlikely to experience direct personal benefits that match the required financial investment. Where public exceed private benefits, providing incentives to producers for adopting low-carbon practices is highly reasonable as it is in the interest of society overall. Incentives can include, but are not limited to, providing grants, and payments for the environmental services they generate. Schemes that provide financial incentives need to be accompanied by monitoring, reporting and verification to assure compliance.

Similar to small-scale food producers, small- and medium-sized enterprises often experience challenges when trying to access finance. These enterprises play an important role in increasing smallholders' income, rural job generation and productivity and efficiency along the value chain. Insufficient availability of and/or access to finance reduces the potential of these enterprises to contribute to agriculture development and thus to FSN.

Box 8

Working with farmers' organizations to develop CSA

In **Cambodia**, interest in farmers' organizations, called "Agricultural Communities", has revived. These have worked with the Improving Food Security and Market Linkages for Smallholders and other projects. Life & Nature, a GEF project, has supported farmer field schools to develop a curriculum to address adaptation to climate change.

In **Viet Nam**, the Farmer's Union helps to promote Climate-Smart Villages. Given that most staff from the Union are female, particular attention has been paid to the priorities of women farmers — including promoting practices that economize on labour, given the heavy demands on rural women's time.

In **Zambia**, the National Farmers' Union has started a Climate Change Mitigation and Adaptation Initiative that trains farmer members, provides information on climate change and how to respond to it, and promotes fruit production.

Sources: Rioux *et al*, 2016; David,2016; Ghandi and Dunlop, 2016; Sala *et al.*, 2016

Policy frameworks for FSN in the face of climate change

The extent of the agriculture sectors' contributions and vulnerabilities to climate change requires concerted global and concrete national action. The following sections outline the major international policy frameworks that guide common climate change actions and summarize the instruments designed to link international climate change commitments to concrete measures at the national level.

Global policy frameworks

The United Nations Framework Convention on Climate Change (UNFCCC),[6] signed by 165 countries and 197 Parties, entered into force on 21 March 1994 and is the framework treaty for addressing climate change. The UNFCCC states that GHG emissions ought to be stabilized *"at a level that would prevent dangerous anthropogenic interference with the climate system… such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner"* (Article 2).

The UNFCCC embraces all anthropogenic sources of GHG emissions and all impacts of climate change, including the agriculture sectors and food security. This was especially reaffirmed by the Paris Agreement, which entered into force in 2016 and recognizes *"the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse effects of climate change"*. The UNFCCC also recognizes the importance of land use, land-use change and forestry in addressing climate change. The Paris Agreement represents a paradigm shift in climate change policy away from a mere focus on sustainable production towards an inclusive structure that integrates food security and nutrition.

To support the reduction of emissions linked to forest degradation and deforestation, UN-REDD was created in 2008. The UN-REDD Programme supports nationally led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including indigenous peoples and other forest-dependent communities.

Addressing the urgent need to continuously improve the global community's capacity to proactively respond to disasters such as extreme (weather) events, the Third UN World Conference on Disaster Risk Reduction has adopted the Sendai Framework for Disaster Risk Reduction 2015 – 2030 in 2015.

The importance to create a low carbon and climate resilient future through *inter alia* the agriculture sectors is further reflected in the 2030 Agenda for Sustainable Development and Sustainable Development Goals (SDGs). Climate resilient agricultural production is central to the effort of achieving global food security by 2030 (Sonwa *et al*., 2016).

National policy frameworks

At the UNFCCC Climate Conference (COP21) in December 2015, countries' Intended Nationally Determined Contributions (INDCs) served as the basis for negotiations and helped to achieve the Paris Agreement on climate change. Guidance on how to design and prepare the INDCs is provided by UNDP, among others.[7] The INDCs turn into Nationally Determined Contributions (NDCs) the moment a Party ratifies the Paris Agreement of specifies otherwise.

[6] The UNFCCC is a "Rio Convention", one of three adopted at the "Rio Earth Summit" in 1992. Its sister Rio Conventions are the UN Convention on Biological Diversity and the Convention to Combat Desertification.

[7] Please find UNDP Guidance on how to design and prepare INDCs/ NDCs at http://www.undp.org/content/undp/en/home/librarypage/climate-and-disaster-resilience-/designing-and-preparing-intended-nationally-determined-contribut.html

In their INDCs and, eventually, their NDCs, countries outline their roadmap for achieving the Paris Agreement through country-driven processes. Under the provisions of the Paris Agreement, countries are expected to submit an updated NDC every five years.

The FAO report "The Agriculture Sectors in the Intended Nationally Determined Contributions: Analysis" found that the agriculture sectors feature prominently both in the INDCs and the NDCs: 98 percent of countries (131 out of 134) that include priority areas for adaptation and/or adaptation actions mention the agriculture sectors, including 93 percent of developing countries. Of these 131 countries, 55 countries refer to the importance of upscaling education, research and capacity building for achieving their contributions. Agriculture and land use, land-use change and forestry are considered by 89 percent of countries (168 out of 189) when describing their mitigation contributions, including 86 percent of developing countries. A total of 116 countries refer to the agriculture sectors with regard to both adaptation and mitigation. This is indicative of the potential to leverage adaptation-mitigation synergies (FAO, 2016d).

The INDCs and NDCs serve as an opportunity to outline countries' relevant adaptation and mitigation communications, policies and programmes such as National Communications, Nationally Appropriate Mitigation Actions (NAMAs), National Adaptation Programmes of Action (NAPAs) and National Adaptation Plans (NAPs) (non-hierarchical order). Not all countries describe their national adaptation and mitigation communications, policies and programmes in their INDCs/NDCs. However, the NDCs provide a sound overview about countries' overall ambition with regard to adaptation actions, productivity increases and mitigation efforts in general and in the agriculture sectors. The broad scope provided by the INDCs and NDCs allows for learning about the national importance of different sectors and can benefit the process of identifying entry points for policy frameworks that allow for the utilization of adaptation-mitigation synergies and of identifying potential trade-offs.

All parties to the UNFCCC submit National Communications. Non-Annex 1 countries[8] set out their national circumstances in relation to climate change, their national GHG emissions inventories, and steps taken to facilitate adequate adaptation and mitigation of climate change.

- **NAMAs** are specific actions designed to encourage transformation in productive activities towards emission reductions relative to the expected "business as usual" emissions scenario of 2020 (for details on the NAMA approaches, see UNFCCC, 2016a). Within the UNFCCC, NAMAs are facilitated by combining technology transfer with grant-based and concessional loan-based financing, in addition to capacity development support. Some countries have designed NAMAs to valorize the mitigation potential of their agriculture sectors. However, insufficient financing structures have to some extent undermined countries' efforts to reach their most ambitious mitigation contributions.
- **NAPAs** were designed for Least Developed Countries to set out their priority areas for climate adaptation through the identification of concrete projects (for different countries' NAPAs, see UNFCCC, 2016). The agriculture sectors and freshwater resources are covered prominently in NAPAs. Countries have prioritized these sectors through extensive stakeholder consultations. In general, country teams assessed climate change impacts and vulnerabilities and the available capacity for increasing resilience. The Least Developed Countries Fund is one source for financing projects under a NAPA.

[8] **Non-Annex I** Parties are mostly developing countries. Certain groups of developing countries are recognized by the Convention as being especially vulnerable to the adverse impacts of CC, including countries with low-lying coastal areas and those prone to desertification and drought. Others (such as countries that rely heavily on income from fossil fuel production and commerce) are more vulnerable to the potential economic impacts of CC response measures. The Convention emphasizes activities that promise to respond to the special needs and concerns of these vulnerable countries, such as investment, insurance and technology transfer.

- **NAPs'** objective is to reduce vulnerabilities to climate change and increase adaptive capacities by integrating adaptation into existing and new development policies and programmes (for more information, see UNFCCC, 2016c). In 2012, UNFCCC issued the NAP Technical Guidelines, which lay the groundwork for the formulation and implementation of NAPs (UNFCCC, no date). This note emphasises the need to have the agriculture sectors become a key cornerstone of the NAPs for the following reasons; they are: 1) amongst the most climate-sensitive, highly exposed and most affected sectors; 2) key to FSN, not only because they provide food, but also because they play an essential role in the economy of many and are providing livelihood and income to the most vulnerable population; 3) managing natural resources, including land, water, biodiversity and genetic resources and as such have a key role in the adaptation of ecosystems and of their contribution to adaptation of countries and societies. A collaborative FAO-UNDP programme Integrating Agriculture in National Adaptation Plans (NAP-Ag Programme) undertakes pilot country support to integrate agriculture sectors and food security into the NAPs. Tailored guidance is provided through the "Supplementary Guidelines for Addressing Agriculture, Forestry and Fisheries in National Adaptation Plans" (FAO, 2017 forthcoming). Funding for the formulation and implementation of the NAPs are not yet sufficient. A number of European Union, bilateral programmes are providing funding for broader adaptation planning and NAPs, as well as the GCF through a NAP Readiness Window, which provides support to countries for up to USD 3 million.

It is crucial that the UNFCCC policy instruments be integrated in sectoral and cross-sectoral planning. Beyond national policy instruments linked to the UNFCCC, most countries have an array of environmental, climate, agriculture and food policies; however, their objectives, plans or implementation strategies are often not fully coherent. Alignment between these policies and approaches is a significant step towards a climate-resilient and low-carbon future, especially where funding is limited. Coherence of policy objectives, plans and implementation strategies is essential between the agriculture sectors *and* beyond. In addition to policies and plans specific to climate change, sector as well as FSN policies should mainstream the need to adapt to and mitigate climate change. Reprioritizing the policy agenda is essential for achieving FSN and to ensure resource-use efficiency in light of climate change. Even where climate change has been recognized in the national policy agenda, overlapping objectives can cause non-optimal outcomes. Careful assessment is required to prevent unintended impacts when designing policies (e.g. polices to increase the productivity of the agriculture sectors).

Climate finance

Major investments are required to improve the adaptive capacity, productive capacity and mitigation contributions of the agriculture sectors. These investments are channeled through public and private national, regional and international entities towards climate change adaptation and mitigation projects and programmes, which support adaptation and mitigation activities to spur the transition towards low-carbon, climate-resilient growth and development through capacity building, research and socio-economic development. These investments, referred to as climate finance, refer to transfers of public resources from developed to developing countries and, more widely, all financial flows related to climate change adaptation and mitigation. The key international source for channeling climate finance to developing countries is the Copenhagen Green Climate Fund (GCF), which was launched in 2014.

National finance

Private investment is the most important source of agriculture financing (FAO, 2016a). Within the private sector, farmers, from small to large, are the biggest investors in agriculture systems and provide many times what governments provide for rural infrastructure and agriculture research and development. Positive investment returns can take one to several production cycles, which should be taken into consideration by financial institutions. Access to appropriate financial services is critical to enable farmers to move to or upscale sustainable farming practices. However, such access remains constrained (see page 19). Financial service providers face challenges linked to the transaction costs of serving many small-scale and dispersed customers, and managing the impact of seasonality of cash flow, which will be further exacerbated by climate change. Perceptions of low profitability, along with high actual and perceived risks, limit the development and expansion of appropriate services. Climate finance could be used strategically to increase the flow of private capital into agriculture (FAO, 2016a; World Bank, 2016a).

Private investment is further underpinned by **domestic budgets**, which are a key source of climate-relevant public finance in the agriculture sectors and far outweigh the flows of international climate finance. Systematic integration of climate change considerations in policies and planning can ensure that existing resources are spent more effectively in addressing climate change challenges and goals, also in the agriculture sectors.

Public investment for improving FSN in the face of climate change is required for many types of support, including agricultural research into varieties of crops, trees, breeds of livestock and fish for resilience to more variable weather, and research into adapted, more resilient farming systems that can also capture carbon. Other opportunities for well-targeted public investments include: agricultural advice and extension that helps generate and disseminate climate-smart practices; and the provision of platforms for knowledge exchange between all stakeholders, enabling scientists and technical specialists to connect with food producers. Sufficient public funding should also be dedicated to DRR and management, including early warning systems and long-term weather forecasting. Further public investment is needed for water management such as irrigation, where potential exists, and, where appropriate, sea defences, both vegetative and physical. Public services for health and nutrition, including primary health care, water and sanitation, are also of utmost importance. Extension services to provide education on FSN in the face of climate change need to be considered in public investment plans. Public institutions require sufficient capacities (including finance and well-trained staff) to coordinate public finance so that it benefits FSN most efficiently. To support FSN in the face of climate change,

designing nutrition-sensitive agriculture investments will be increasingly crucial. The report "Designing nutrition-sensitive agriculture investments – Checklist and guidance for programme information" provides detailed information in that context (FAO, 2015).

International climate finance mechanisms

The architecture of international climate finance consists of bilateral and multilateral development finance bodies and dedicated multilateral climate funds explicitly designed to support climate adaptation and mitigation actions in the agriculture sectors (FAO, 2016a). Even though bilateral and multilateral commitments are increasing, especially since 2010, available climate finance is still limited with regard to the agriculture sectors (OECD DAC, 2015). Moreover, additional international climate finance will be needed in the future to support a low-carbon and especially climate-resilient future and thus FSN around the globe.

Data suggest that bilateral development assistance has been the dominant source of international public finance for climate change adaptation in agriculture. When combining bilateral and multilateral funds, adaptation finance exceeds mitigation finance, but in forestry, mitigation finance dominates (OECD DAC, 2015). Bilateral and multilateral funds report a significant focus on capacity development, including *"policy and administrative management and institutional strengthening across the agriculture sectors"* (FAO, 2016a).

One of the most significant **bilateral funds**, the Global Climate Change Alliance (GCCA), was established by the European Union in 2007 to strengthen dialogue and cooperation with the African, Caribbean and Pacific Group of States (ACP States) on climate change issues. In continuation, in 2015, the GCCA+ flagship initiative was launched to help the world's poorest and most vulnerable places tackle climate change. Priority areas include climate change mainstreaming and poverty reduction, increasing resilience to climate-related stresses and shocks, and sector-based adaptation and mitigation strategies. The two pillars of the GCCA+ to provide support are: (i) the forums for dialogue and exchange of experience; and (ii) providing technical and financial support to the world's most vulnerable countries. Strategically important issues such as ecosystems-based adaptation, migration and gender equality are positioned under the second pillar. Today, the GCCA+ has a budget of €300 million and supports 51 programmes in 38 countries. Public and private entities located in the ACP States can apply for support.

In terms of **multilateral funds**, the Global Environment Facility (GEF), established 1991 as the principal financing mechanism under the UNFCCC**,** is one of the largest funds financing mitigation and adaptation in the context of agriculture, forestry, fisheries and food security projects and programmes**.** In 2015, the fund reported to COP21 that since its creation, it had financed 839 climate change projects in more than 167 countries (FAO, 2016a).

The Green Climate Fund (GCF), launched in 2014 as the main operating entity of the UNFCCC, is the world's largest multilateral climate fund. It is expected to manage and allocate a major share of the USD 100 billion that high-income countries have committed to mobilizing annually from public and private sources by 2020, and aims for a 50:50 balance between adaptation and mitigation investments over time. The GCF Board – composed of 24 UNFCCC members with equal representation from developed and developing countries – is also committed to support countries' Nationally Determined Contributions (NDCs).

The GCF aims for a floor of 50 percent of the adaptation allocation for particularly vulnerable countries, including Least Developed Countries. The GCF recognizes the need to ensure that developing country partners exercise ownership of climate change funding and integrate it within their own NAPs. To strengthen programme coherence and stakeholder coordination at the

national level, every developing country has appointed a National Designated Authority (NDA), who acts as the interface between the country and GCF. The NDA is responsible for communicating the country's strategic priorities for financing a low-carbon and climate-resilient future.

Gender-responsive finance mechanisms to climate change will be crucial to establishing sound policies and on-the-ground interventions. Both the GEF and GCF pose gender-specific conditions for *"projects to produce economic, social and gender development co-benefits"* (Schalatek and Nakhooda, 2014).

Pledges of support announced at the COP21 (Paris, 2015) suggest that the agriculture sectors are perceived as key opportunities to support both climate mitigation and adaptation, with at least USD 5.6 billion pledged to new and existing initiatives or funds (NCE, 2015). Recent support for cross-cutting programmes also demonstrate renewed financial support in the run-up to 2020. The GEF announced new climate finance commitments of USD 3 billion from across its Focal Areas.

Among the dedicated multilateral climate funds, which are relatively small but focused, the Least Developed Countries Fund (LDCF) is of particular significance. Established in 2011 under the UNFCCC, it supports Least Developed Countries whose economic and geophysical characteristics make them especially vulnerable to climate change impacts. All agriculture sectors are considered under this fund. Similarly, the Adaptation Fund finances projects and programmes, based on country needs, views and priorities that help vulnerable communities in developing countries adapt to climate change. The Adaptation Fund's Readiness Programme for Climate Finance aims to help strengthen the capacity of national and regional implementing entities to receive and manage climate finance.

IFADs' Adaptation for Smallholder Agriculture Programme (ASAP) is specifically designed for mainstreaming climate change within IFAD's agricultural portfolio, focussing on financing programmes that support smallholder food producers and local community resilience. Working in more than 30 developing countries, ASAP is among the largest global financing sources supporting the adaptation of poor smallholder farmers to climate change.

The architecture supporting forest conservation has largely been designed to support the three phases of REDD+, from REDD+ Readiness to verified emission reductions with payments based on results. Significant dedicated climate funds that finance forest conservation include the Forest Investment Programme, designed to offer bridge finance between early policy and capacity-building support and efforts to demonstrate successful programmes that will lead to verified emission reductions on the ground. National funds such as the Amazon Fund have also mobilized and allocated significant sources of finance for a range of regionally specific actions that reduce the drivers of deforestation. Between 2010 and 2014, dedicated multilateral climate funds approved USD 1.2 billion for mostly forest and REDD+ mitigation projects and programmes.

Of the major multilateral climate funds, the fisheries sector is supported through, for example, the Amazon Fund, the LDCF and the Special CC Fund (FAO, 2016a).

More information on the sectoral focus of various climate funds can be found in the report The State of Food and Agriculture (FAO, 2016a). An overview on climate finance funding sources and opportunities for supporting the resilience and sustainable growth of the agriculture sectors is presented on the Climate-Smart Agriculture 101 Website.

Stepwise approach
Addressing food security and nutrition in the context of climate change

This section outlines four steps to guide the process of assessing and addressing the FSN situation in the face of climate change and the present policy framework and institutions governing climate actions. Finally, guidance is provided on identifying priorities of action supporting FSN in the face of climate change.

FIGURE 1. **Four steps for addressing food security and nutrition in the context of climate change**

Step 1 WHO IS AT RISK OF WHAT

When analysing FSN vulnerabilities in the face of climate change at the national and local levels, it is important to:

(i) Understand the immediate and underlying causes that keep the hungry, food-insecure and malnourished trapped in a vicious cycle of chronic deprivation. The FIRST Guidance Notes on fisheries, livestock and forestry provide detailed information on how to assess the FSN in the individual agriculture sectors.

The FSN situation in a country should be assessed based on existing information such as national documents and online databases (Box 9). Planned reviews should be broadened to include nutrition and food security-related aspects, such as food and nutrition-related problems of the target population and nutritional value of crops planted. Furthermore, food storage, processing and preparation methods; household food distribution; child feeding practices and knowledge, attitudes and practices related to food should be assessed and understood.

(ii) Understand how climate change, variability phenomena and extreme events are affecting and are projected to affect the agriculture sectors and the FSN situation, including risks and opportunities.

The FSN situation in the face of climate change, variability phenomena including extreme events on the national and/or subnational level should be assessed based on existing information. National documents containing relevant information include NAPAs, NAMAs, National Communications to the UNFCCC and, more recently, NAPs and NDCs (see page 22 for detailed information on these documents).

Numerous databases provide information on climate change impacts, variability phenomena including extreme events. A non-exhaustive overview of databases that provide relevant information, also in the FSN context, is provided in Box 10.

Where assessment of climate change impacts is still insufficient to support actionable policies, assessment tools such as the Modeling System for Agricultural Impacts of Climate Change (MOSAICC) can help to explore climate change impacts and activities suitable for addressing these impacts in a specific context. Currently, MOSAICC is being employed in Peru and the Philippines in the framework of the project Analysis & Mapping of Impacts under Climate Change for Adaptation & Food Security (AMICAF). Box 11 provides a list of tools relevant for assessing climate change impacts on the agriculture sectors.

Guiding questions when reviewing information on FSN in the face of climate change include, but are not limited to:

- How many food-insecure and/or malnourished exist in total and which population groups are most affected (e.g. women, infants, children, minorities, the elderly)?
- How many of these groups/individuals depend on the agriculture sectors for their livelihoods? To what extent and how have climate change and extreme events been observed and/or are predicted to impact the agriculture sectors?
- What are the risks and/or opportunities for the productivity of agro-ecosystems, dependent livelihoods and FSN when confronted with long-term climate change, variability and/ or extreme events?
- Which, if any, social protection programmes exist to support vulnerable groups and individuals to cope with food insecurity and factors that can potentially undermine the intake of sufficient nutrition?

Step 2 WHAT GOVERNS ACTIONS AT THE NATIONAL LEVEL?

Once the potential impacts of climate change on agriculture sectors, livelihoods and FSN have been observed and/or understood, relevant national and subnational

Box 9 Understanding the current FSN situation

- FAO's National Food Balance Datasheet
- FAO's Food Security Indicators
- FAO's Guidelines for assessing nutrition-related Knowledge, Attitudes and Practices
- FAO's International Network of Food Data Systems
- WHO's Global Health Observatory Data
- The Global Dietary Database

Box 10 Understanding impending risks to FSN and FSN in the face of climate change and variability

- USAID's Famine Early Warning System Network
- FAO's Global Information and Early Earning System
- World Bank's Climate Change Portal
- Climate Risk and Adaptation Country Profiles
- Climate Change, Agriculture and Food Security Programme

policies should be reviewed and analysed.[9] Relevant policies can be directly and indirectly linked to FSN and/or climate change. It is therefore advisable to review a broader set of policies. Policies to promote adaptation and mitigation activities in the agriculture sectors should not be developed in isolation from other development goals such as poverty eradication, gender equality, clean water, sanitation, quality education and FSN.

The process of reviewing the national and subnational policy framework and the extent to which they correspond to the findings collected under Step 1 provides a good opportunity to identify potential gaps, adaptation-mitigation synergies, trade-offs and co-benefits. Understanding gaps, synergies, trade-offs and co-benefits when reviewing the coherence of relevant policies across different sectors and levels of governance is crucial for (re-)designing individual policies and/or entire frameworks to improve FSN in the face of climate change. Policies must correspond to location-specific, socio-economic and environmental conditions and needs.

Policies to support FSN in the face of climate change need to promote and ensure coherence across sectors. In this context, the interrelatedness between the agriculture sectors and non-agriculture sectors (e.g. energy and water) needs to be addressed. Policy domains such as social security, education, resource tenure and gender should be equally analysed to maximize co-benefits of existing and newly designed policies.

It is advisable to review a country's National Communications to the UNFCCC, NAPAs, NAMAs, NAPs and NDCs. These documents provide information on the range of policies and government/sector-based engagement on climate change issues and link international climate change commitments to concrete adaptation and mitigation actions at the country level. Reviewing regional and global agreements such as the 2030 Agenda and the SDGs provides useful guidance for policy-making at the national and subnational levels. To complement the policy review process, collecting information on the implementation status and successful enforcement of policies is advisable.

Guiding questions when reviewing FSN in the face of climate change policies include, but are not limited to:

- Have climate change considerations (increasing adaptive capacities and mitigation, where possible) been included in FSN policies and vice versa? Have climate change considerations been included in agriculture sector policies (along the entire supply chain)? Have FSN and agriculture sector policies been aligned with policies addressing extreme events and DRR? Do policies stimulate productivity growth of the sectors while including nutrition-sensitive policies? Are the policy incentives provided in different policy areas coherent?
- Are relevant policies backed up by respective legal and financial frameworks?
- What are the intended results of such existing policies? Do indicators exist for measuring the progress in achieving these results?
- Are the policies designed to effectively and sustainably support the most vulnerable? Do social protection programmes reflect climate-related risks

Box 11 Relevant tools for assessing FSN in the face of climate change

- MOSAICC
- CLIMPAG
- AQUASTAT
- FAOSTAT
- CCAFS spatial downscaling data

[9] It is important to fully comprehend and build upon already existing initiatives, programmes and projects related to CC and/or FSN.

and vulnerabilities? Do small and vulnerable producers have access to relevant finance to adopt and upscale climate-smart practices?

- Have all potential synergies and/or trade-offs been fully understood and addressed where possible?
- Are policies supporting research and extension services conducive to creating and transferring knowledge on climate-smart practices and technologies among all stakeholders? Are local organizations supported through knowledge and/or financial resources to support the dissemination of relevant climate change knowledge, practices and technologies?

Step 3 WHO IS RESPONSIBLE AND FOR WHAT?

Understanding the scope for policy interventions to support climate-resilient, productive and, where possible, low-carbon food production for FSN in the face of climate change requires a thorough understanding of the political economy (who are the state and non-state stakeholders, what are their interests, and to what extent can they influence policy processes and outcomes?), ranging from the local to the national level.

The ministries responsible for working on climate issues include, but are not limited to, agriculture, water, livestock, environment, natural resources, fisheries, finance and infrastructure. Most countries have a national-level climate change focal point, often located in the Ministry of Environment. This focal point is usually in charge of coordinating climate change-related work at the national level. Additionally, various sectoral ministries have established their own climate change units, focal points, task forces, etc. The Government of Kenya also has a Climate Change Secretariat located within the Office of the Prime Minister and has set up a Climate Change Unit in the Ministry of Agriculture, Livestock and Fisheries. In Uganda, the Climate Change Department is situated within the Ministry of Water and Environment. In addition, over 130 developing countries have appointed a National Designated Authority (NDA) to act as interface between the country and the Green Climate Fund. These NDAs are responsible for communicating the country's strategic priorities for financing a low-carbon and climate-resilient future. These units, secretariats, departments and authorities are responsible for organizing funding proposals, offering specialist expert guidance and/or coordination, and facilitating the coordination and integration of climate change policies. The UNFCCC instruments mentioned under Step 2 provide information on the responsible ministries and involved stakeholders.

In many countries, policy-making for climate change and coordination of related adaptation and mitigation activities has been in part decentralized. Local development plans (for example, see County Government of Kitui, Kenya, 2016[10]) document the specific development objectives and sometimes outline development challenges linked to climate change issues. In Isiolo and Kitui Counties, in the dryland regions of Kenya, where severe droughts occur every three to five years, County Adaptation Planning Committees have been established to coordinate funding for ward-level projects (NDMA, 2014) in addition to broader inter-ministerial action on climate change.

In addition to identifying responsible national and local government agencies, the policy advisor will need to understand the involvement of other relevant stakeholders such as research institutions, the private sector, farmers, forest-dwellers and fisherfolk and their organizations, other NGOs and community-based organizations, and international partners. The UNFCCC instruments mentioned under Step 2 often provide useful information on the level of involvement and participation of non-governmental stakeholders.

Guiding questions when conducting the institutional assessment include, but are not limited to:

- Who are the main stakeholders involved in the policies reviewed and analysed under Step 2? What are their interests and powers? Are there

[10] The annual development plan of the County Government of Kitui is available at http://www.kituicountyassembly.org/userfiles/KITUI%20COUNTY%20ANNUAL%20DEVELOPMENT%20PLAN%202016%20-%202017.pdf

stakeholders that represent the interests of those individuals and communities most vulnerable to climate-related risks and poor FSN?

- How and by whom is the policy agenda set for climate change and FSN? By whom are they advised? Do subnational, national and regional influences contribute to the process of agenda-setting? How inclusive of relevant actors is the process of setting the agenda and designing relevant policies?
- Are agriculture sector and food security and nutrition stakeholders involved in climate change policy processes?
- What are the existing coordination mechanisms between sectors and stakeholders to advance coherent policy design and implementation at national and sub-national levels? Are there any weaknesses or gaps that prevent meaningful participation by all concerned and/or hinder coordinated implementation?
- Do those responsible for implementing or coordinating climate action in the agriculture sectors have adequate resources to carry out their roles?
- Who/which institutions are the national focal points for climate finance mechanisms? In particular – who is the NDA for the GCF? Are ministries in charge of agriculture sectors and food security in regular contact with these focal points?

Step 4 DEFINING PRIORITIES

The results of the policy and institutional screening carried out under steps 2 and 3 should highlight gaps and weaknesses that may hinder coherent and coordinated action in support of FSN in the face of climate change.

These gaps and weaknesses should be confirmed through cross-sectoral and multi-stakeholder dialogue. Ideally this should take place in the context of existing policy processes and coordination mechanisms, but where these do not exist, dedicated consultation processes and events may be required in addition to bilateral discussions with different stakeholders. The same mechanisms should be employed to identify priorities for action based upon the gap analysis, and in view of existing development priorities set by national policy frameworks and development plans across sectors and development plans, including in the context of the SDGs.

Principal issues to address are systematic areas of disconnect. At the institutional level, these arise where agriculture sectors and FSN stakeholders do not participate in climate policy processes and decisions and vice versa. At the policy instrument level, these relate to incoherent incentives created by policies in different areas that hinder rather than support agricultural producers in adopting climate-smart agricultural strategies.

As outlined in Step 2, policies that support FSN in the face of climate change should be embedded in a framework that considers and integrates various sectors and domains. Aligning objectives and related policies and activities provides vast opportunities for creating synergies and co-benefits. It is important to that all stakeholders be allowed to participate, contributing their diverse knowledge and skills, thus benefitting the identification of objectives and ultimately the process of implementing policies and actions.

Beyond alignment of policies and strengthening of coordination mechanisms, to promote coherent planning and implementation at national and sub-national levels, the identification of investment priorities to facilitate a transition to or upscaling of climate-smart agricultural practices and strategies requires the assessment of the suitability, advantages and disadvantages, costs and benefits and potential for adaptation-mitigation synergies of different options.

Guidance tools for prioritizing policies and activities for adaptation, mitigation and sustainable increases in agriculture productivity can be found in the "*Climate-Smart Agriculture Sourcebook*" (FAO, 2013a, updated version including country-level guidance forthcoming in 2017) and the Climate-Smart Agriculture 101 Guide (CCAFS, 2016).

Concluding remarks

The global community, united by the challenge to address climate change and its impacts on the agriculture sectors, created the Paris Agreement, a historic breakthrough for achieving FSN in the face of climate change.

Climate change is affecting the productivity of the agriculture sectors and will continue to do so unless countries translate their ambitious mitigation and adaptation contributions as outlined in their NDCs into action as soon as possible. FSN is and will continue to be affected not only through changes in the productive capacity of food systems but also through impacts on infrastructure, clean water and human health.

Addressing these impacts and their wider implications urgently requires upscaling efforts that support improving the adaptive capacity of the agriculture sectors and beyond, especially in developing countries in low- and mid-latitude regions, which are affected first and foremost by climate change. Taking action today, also with regard to DRR, will save resources and thus contribute to socio-economic welfare. The benefits of strong, early action on climate change and extreme events will by far outweigh the costs of delayed action.

Policy frameworks that support climate change must be coherent across sectors (to avoid maladaptation), taking into account the linkages of the agriculture sectors with each other, as well as with additional sectors and policy domains such as water, gender and social protection. Importantly, these policy frameworks should be nutrition-sensitive, as increasing productive capacity alone does not necessarily translate into FSN. Various UNFCCC instruments and other funding mechanisms exist to support the design of policies that are coherent across sectors and that can carry FSN now and in the future.

The current food systems are likely to produce sufficient food to feed the growing global population, but to do so in an inclusive and sustainable manner requires major transformations. Climate change and extreme events are additional stressors that require imminent, comprehensive, holistic and concerted action at the international level to be accompanied by context-specific and sustainable activities on the national and sub-national levels that support producers to become and remain sustainable.

Annex

Key readings

Complementary to the note

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By topics

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Recommended websites

Site	What you will find
http://www.fao.org/climate-change/en/	FAO's information on CC. Many informative pages on different aspects can be found
http://www.fao.org/climate-smart-agriculture/en/	Climate Smart Agriculture portal by FAO
http://www.fao.org/in-action/micca/en/	The Mitigation of CC in Agriculture (MICCA) programme by FAO
http://www.fao.org/climatechange/epic/home/en/	Economics and Policy Innovations for Climate-Smart Agriculture (EPIC) programme by FAO
http://www.fao.org/in-action/naps/en/	Integrating Adaptation into National Adaptation Plans: A joint FAO-UNDP programme by FAO
http://www.fao.org/climatechange/amicaf/en/	Assessments of climate change impacts and mapping of vulnerability to food insecurity in the face of climate change to strengthen household food security with livelihoods' adaptation approaches by FAO
https://ccafs.cgiar.org	Information on climate change and how it relates to agriculture and food security by the Research Program on Climate Change, Agriculture and Food Security
https://csa.guide/csa/what-is-climate-smart-agriculture	Part of the CCFAS site, this is a specific guide to CSA
http://sdwebx.worldbank.org/climateportal/	World Bank Climate Change Knowledge Portal for Development Practitioners and Policy Makers. It is a central hub of information, data and reports about climate change around the world
https://csa.guide	Implementation Guide for CSA by the Research Program on Climate Change, Agriculture and Food Security
https://www.ipcc.ch/	Intergovernmental Panel on Climate Change information on scientific and technical aspects of climate change
http://www.wri.org/our-work/topics/climate	World Resource Institute, variety of publications on climate change
https://www.odi.org/programmes/climate-environment	Overseas Development Institute's information on climate finance
http://www.iied.org/climate-change	International Institute for Environment & Development's Source of information on development policy, linking local priorities and global challenges
http://climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2015/	Climate Policy Initiative's information on climate finance landscape

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