



联合国
粮食及
农业组织

Food and Agriculture
Organization of the
United Nations

Organisation des Nations
Unies pour l'alimentation
et l'agriculture

Продовольственная и
сельскохозяйственная организация
Объединенных Наций

Organización de las
Naciones Unidas para la
Alimentación y la Agricultura

منظمة
الغذية والزراعة
للأمم المتحدة

PROGRAMME COMMITTEE

Hundred and Twentieth Session

Rome, 7 - 11 November 2016

Strategy for FAO's work on climate change

Queries on the substantive content of the document may be addressed to:

Ms Maria Helena Semedo
Deputy Director-General (Coordinator for Natural Resources)
Tel. +39 06570-52060

*This document can be accessed using the Quick Response Code on this page;
an FAO initiative to minimize its environmental impact and promote greener communications.
Other documents can be consulted at www.fao.org*



mr738



Food and Agriculture
Organization of the
United Nations

FAO

CLIMATE

CHANGE

STRATEGY

Contents

List of abbreviations.....	4
Executive summary.....	5
A. Introduction.....	6
The agricultural sectors and the Paris Agreement.....	6
B. Climate change impact - food and agriculture.....	7
C. Climate work at FAO.....	8
Evolution.....	8
Vision.....	8
Approach.....	8
Country-driven.....	9
Regional.....	9
Global.....	9
Short- and long-term.....	9
Climate-smart.....	10
Cross-sectorial and multi-stakeholder.....	10
D. Guiding principles.....	10
Give precedence to food security, poverty reduction and sustainability.....	10
Leave no one behind.....	10
Support policy integration and mainstreaming.....	11
Promote evidence-based, scientific approaches.....	11
Promote ecosystem-based approaches.....	11
Learn from experience.....	11
Lead by example.....	11
E. Expected Outcomes.....	11
F. Plan of Action.....	12
Outcome 1. Enhanced capacities of Member Nations on climate change through FAO leadership as a provider of technical knowledge and expertise.....	13
Outcome 2. Improved integration of food security and nutrition, agriculture, forestry and fisheries considerations within the international agenda on climate change through reinforced FAO engagement.....	14
Outcome 3. Strengthened coordination and delivery of FAO work on climate change.....	14
Annex 1: The impacts of Climate Change on the food and agricultural sectors.....	19
Food security.....	19
Nutrition and human health.....	20
The agricultural sectors.....	21
Natural resources.....	23
Post-production stages.....	24

List of abbreviations

AFOLU: Agriculture, Forestry and Land Use = Agriculture, Forestry and Other Land Use

Agenda 2030: 2030 Agenda for Sustainable Development

CBD: Convention on Biological Diversity

CCAM: Climate Change Adaptation and Mitigation

CO₂: Carbon Dioxide

COP21: 21st Conference of the Parties to the UNFCCC

CPFs: Country Programming Frameworks

CSA: Climate-smart Agriculture

DRR: Disaster Risk Reduction

FAO: Food and Agriculture Organization of the United Nations

GCF: Green Climate Fund

GDP: Gross Domestic Product

GEF: Global Environment Facility

GHG: Greenhouse Gas

ha: Hectares

IDWG CC: Interdepartmental Working Group on Climate Change

IFAD: International Fund for Agricultural Development

IFIs: International Financial Institutions

[I]NDCs: [Intended] Nationally Determined Contributions

IPCC: Intergovernmental Panel on Climate Change

LDCs: Least Developed Countries

LLDCs: Land-locked developing countries

LULUCF: Land Use, Land Use Change and Forestry

MTP: Medium Term Plan

NAMAs: Nationally Appropriate Mitigation Actions

NAPs: National Adaptation Plans

NDC: Nationally Determined Contributions

NRC: Climate and Environment Division

PWB: Programme of Work and Budget

SDGs: Sustainable Development Goals

SFM: Sustainable Forest Management

SIDS: Small Island Developing States

SPs: FAO Strategic Programmes

TNCC: Technical Network on Climate Change

tCo₂e/ha/year: Tonnes of carbon dioxide equivalent per hectare per year

UN: United Nations

UNCCD: United Nations Convention to Combat Desertification

UNDP: United Nations Development Programme

UNEP: United Nations Environment Programme

UNFCCC: United Nations Framework Convention on Climate Change

WFP: World Food Programme

WMO: World Meteorological Organization

Executive summary

1. 2015 was an extraordinary year of global commitment towards a better future. In September, the international community laid out the vision of a hunger-free, more equitable, sustainable, peaceful and resilient world by creating the 2030 Agenda on Sustainable Development with its 17 Sustainable Development Goals (SDGs). In December, the Paris Agreement on climate change pledged to keep global warming “well under” two degrees centigrade and to create a climate resilient future. In Addis Ababa, the Action Agenda on financing this demanding, complex and interconnected Agenda was adopted.
2. FAO has actively contributed to creating these milestones. Based on FAO’s work for over a decade, the Climate Change Strategy has been formulated to focus FAO’s work on climate change in light of these landmark decisions. Driven by the desire to best serve its Member States in achieving their commitments under the Paris Agreement and their priorities under the Sustainable Development Goals, it translates FAO’s core mandate into strategic choices and action priorities at global, regional and national levels.
3. The food and agricultural sectors¹ are central for human development; they need to be at the centre of the global response to climate change. As this Strategy shows, the food and agricultural sectors are vulnerable to a most worrying degree and face great challenges in adapting to climate change. Support for agriculture, particularly smallholder farmers, is pivotal to achieving SDGs 1 and 2 under a changing climate.
4. At the same time, the food and agricultural sectors represent enormous potential and opportunities to create synergies between both, the climate and development agenda. FAO can support this development with a wealth of knowledge and suitable tools and advocates for funneling large-scale climate finance into the sectors where investment can bear fruit on multiple areas for the future we want.
5. FAO envisages a world in which food and agricultural systems and dependent livelihoods have become resilient to the impacts of climate change through adaptation measures and mitigation options. Its approach connects global commitment with local action. The Strategy is grounded in seven principles relating to social inclusion, environmental sustainability and results-oriented action.
6. Three outcomes frame the FAO Climate Change Strategy and Plan of Action:
 1. Enhanced capacities of Member Nations on climate change through FAO leadership as a provider of technical knowledge and expertise.
 2. Improved integration of food security, agriculture, forestry and fisheries within the international agenda on climate change through reinforced FAO engagement.
 3. Strengthened coordination and delivery of FAO work on climate change.
7. The Strategy is an integral part of FAO’s Strategic Framework, Medium Term Plan and Programme of Work and Budget. The Strategy will be implemented through a Plan of Action, which sets out the results to be delivered by FAO through its Strategic Programmes, including through enhanced partnerships.

¹ For the purposes of this document, ‘agricultural sectors’ are understood to comprise crops, livestock, fisheries and aquaculture, and forestry.

A. Introduction

8. For more than 70 years, FAO has been working on its core mandate to eliminate hunger, food insecurity and malnutrition, to reduce rural poverty, and to make agriculture, forestry and fisheries more productive and sustainable. The Sustainable Development Goals (SDGs) with their prominent commitment to end poverty and hunger bring this mandate centrally into the 2030 agenda.

9. Climate change jeopardizes the achievement of these vital goals for human development. The ever-increasing impacts of the changing climate threaten to undercut and possibly reverse the progress that has been made in the fight against hunger and malnutrition in recent years. Slow onset environmental change processes, increasing climate variability and more frequent and severe extreme weather events impact agricultural productivity and add pressure to already fragile food and ecological systems. Smallholder producers and the rural poor in developing countries are particularly vulnerable to the effects of climate change and climate variability largely due to limited resilience and diversity in their production systems – factors that also make it more difficult to adopt practices that support improved climate change adaptation and mitigation (CCAM).

10. The negative impacts of climate change will be felt by all countries, and most severely in Least Developed Countries (LDCs), Small Island Developing States (SIDS) and areas with particularly fragile ecosystems (e.g. drylands, mountains, coastal areas). These are the same locations where attaining the goals of Agenda 2030 is already most crucial and challenging.

11. Food and agricultural systems have great adaptation potential that can bring about greater resilience in the production and supply of food while also protecting and enhancing natural resources. They also offer considerable climate change mitigation potential both in the form of reducing emissions intensity per unit produced, as well as carbon sequestration in soils and biomass. Increased ambition will be needed to achieve the agreement's goal to stay "well below" 2 degrees centigrade. It is in this context that the Strategy focuses on providing quality support to its Members to fulfil their commitments in their food and agricultural sectors.

The agricultural sectors and the Paris Agreement

12. The agricultural sectors are moving into the central role in the global response to climate change they need to play. At the global level, the Paris Agreement recognizes in its preamble "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", embracing the more inclusive concept of "food security".

13. At national level, Member States are guided by their nationally determined contributions (NDCs) that Parties submitted ahead of COP21² as an expression of their intent at the time (INDCs *Intended* Nationally Determined Contributions). Having based the Paris Agreement on their individual contributions, countries are now turning their attention to the implementation of these adaptation and mitigation commitments.

14. An analysis of the Intended Nationally Determined Contributions, shows that member states see the agricultural sectors as being central to their response to climate change: out of the 189 countries that had submitted INDCs as at 29 July 2016, 89 percent of all countries include agriculture and/or land use, land use change and forestry (LULUCF) as a sector in their mitigation and/or adaptation contributions.³ Agriculture and LULUCF are among the most referenced sectors in

² INDC Portal: <http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx>

³ FAO, forthcoming. *The agriculture sectors in the Intended Nationally Determined Contributions*.

countries' mitigation contributions (as targets and/or actions). LULUCF is referenced in 83 percent of all countries' INDCs, and as such is second only to the energy sector.

15. 98 percent of all INDCs include priority areas for adaptation and/or adaptation actions in the agriculture sectors.⁴ Of these countries, 97 percent refer to crops and livestock, while 88 percent refer to forests and 64 percent refer to fisheries and aquaculture. At the same time, 116 countries refer to the agriculture sectors *both* with regard to mitigation and adaptation, and approximately 50 countries endorse or even prioritize actions based on the potential synergies between mitigation and adaptation in the context of the agriculture sectors. 32 countries specifically refer to climate-smart agriculture (CSA) in their INDCs.

16. The agricultural sectors are only now receiving the high-level attention required to mobilize funding to realize their full potential in providing food security, eliminating poverty and maintaining resilient ecosystems under a changing climate. However, a meagre 8 percent of total spending by Multilateral Development Banks on climate change adaptation and mitigation related investments went on agriculture and ecological resources in 2014.⁵ Further effort is needed to ensure that international climate reflects the vital importance of the agricultural sectors.

17. Addressing agriculture in national responses to climate change and the achievement of the Sustainable Development Goals are mutually reinforcing. Agriculture is uniquely placed to deliver on climate and development in tandem. This is particularly true for the central goals of eradicating poverty and hunger, SDGs 1 and 2, which are of central importance for this Strategy.

B. Climate change impact - food and agriculture

18. Climate change is already affecting the food and agriculture sectors, and these effects are projected to grow, along with global average temperatures. While some positive effects of climate change are foreseen in certain contexts, the majority of anticipated climate impacts give cause for serious concern. This holds true particularly in developing countries, where the food and agricultural sectors contribute significantly to national Gross Domestic Product, but are already absorbing approximately 22 percent of the economic impact caused by medium- and large-scale natural hazards and disasters.⁶ Up to 122 million more people worldwide may live in extreme poverty by 2030 as a result of climate change and its repercussions on the incomes of small-scale farmers.⁷

19. The impacts of climate change on food and agriculture are interconnected across environmental, social and economic dimensions. Climate impacts and entry points are presented in Annex 1 for five important areas relevant to food and agriculture: food security; nutrition and human health; the agricultural sectors; natural resources; and post-production stages.

⁴ FAO, forthcoming. *The agriculture sectors in the Intended Nationally Determined Contributions*.

⁵ 2014 Joint Report on Multilateral Development Banks' Climate Finance: <http://www.worldbank.org/content/dam/Worldbank/document/Climate/mdb-climate-finance-2014-joint-report-061615.pdf>

⁶ FAO, 2015. *The impact of natural hazards and disasters on agriculture and food security and nutrition*. <http://www.fao.org/3/a-i4434e.pdf>

⁷ FAO 2016, *The State of Food and Agriculture: Climate Change, Agriculture and Food Security*. <http://www.fao.org/3/a-i6030e.pdf>

C. Climate work at FAO

Evolution

20. The goals of FAO are to eliminate hunger, food insecurity and malnutrition, reduce rural poverty, and make agriculture, forestry and fisheries more productive and sustainable. FAO recognizes that these goals cannot be fulfilled without decisive action on climate change.

21. The FAO portfolio on climate change has grown exponentially since its beginnings in the 1980s. Sectorial work programmes or strategies addressing climate change perspectives were defined by forestry (2010),⁸ crops (2011),⁹ fisheries (2012)¹⁰ and livestock (2013).¹¹ In 2010, FAO launched the concept of climate-smart agriculture (CSA), an approach designed to help develop the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change.¹² CSA was also conceived to address the lack of attention to agricultural sectors in the international climate agenda. In 2011, FAO provided a more extensive framework for climate change adaptation: FAO-Adapt.¹³ In the wake of the Rio+20 Conference in 2012, climate change featured as one of the FAO 14 themes framing the Organization's engagement in the Post-2015 Development Agenda negotiations.

22. An estimated 15 percent of the project portfolio of FAO in 2016 can be identified as being dedicated to, or significantly associated with climate change. In 2015, climate change was adopted as a cross-cutting theme of the FAO Strategic Framework, meaning that climate implications and opportunities are being reflected in each Strategic Programme at regional and country level (see Annex 1). The 2015 *Evaluation of FAO's contribution to climate change adaptation and mitigation*¹⁴ noted that FAO has unique strengths with which to address CCAM, and advised that results could be optimized through strategic changes in the way FAO currently works on climate change.

Vision

23. FAO envisions a world free from hunger and malnutrition, where food and agriculture contribute to improving the living standards of all, especially the poorest, in an economically, socially and environmentally sustainable manner.

24. In this context, FAO sees a world in which food and agricultural systems and dependent livelihoods are resilient to the impacts of climate change through both adaptation measures and mitigation potential.

Approach

25. The FAO approach to climate change is country-driven. The Nationally Determined Contributions under the Paris Agreement present a natural framework for FAO's work on climate change, as they already define, at the highest political level, targets and strategies for responding to

⁸ FAO, 2010. *FAO, forests and climate change*. <http://www.fao.org/docrep/017/i2906e/i2906e00.pdf>

FAO, 2013. *Climate change guidelines for forest managers*.

<http://www.fao.org/docrep/018/i3383e/i3383e00.htm>

⁹ FAO, 2011. *Potential effects of climate change on crop pollination*. <http://www.fao.org/3/a-i2242e.pdf>

¹⁰ FAO, 2012. *Strategy for fisheries, aquaculture and climate change*.

ftp://ftp.fao.org/fi/brochure/climate_change/strategy_fi_aq_climate/2011/climate_change_2011.pdf

¹¹ FAO, 2014. *Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities*. <http://www.fao.org/3/i3437e.pdf>

¹² FAO, 2010. <http://www.fao.org/climate-smart-agriculture/en/>

¹³ FAO, 2011. <http://www.fao.org/climatechange/27594-03ecd7bd225b93086e7dca3944de64307.pdf>

¹⁴ FAO, 2015. *Evaluation of FAO's contribution to Climate Change Adaptation and Mitigation*.

<http://www.fao.org/3/a-bc126e.pdf>

the consequences and addressing the causes of climate change. In addition, FAO programmes must approach climate change in its full context, by engaging with regional and global agendas, bridging short- and long-term timeframes, being climate-smart and working across sectors and stakeholder groups. This composite approach to climate change adheres to the FAO principles for Sustainable Food and Agriculture and serves to enhance the climate perspectives of existing FAO social and environmental policies.

Country-driven

26. This approach will be in line with development effectiveness principles anchored in country ownership, leadership, commitment and mutual accountability. Countries' NDCs under the Paris Agreement provide the framework for collaboration between FAO and Member Nations on climate change, according to the priorities and commitments they outline. FAO's Country Programming Frameworks (CPFs) will need to take NDCs into account alongside national policies and strategies in the agricultural sectors.

27. FAO supports countries in strengthening their institutional and technical capacities for climate change adaptation and mitigation in the agricultural sectors. National policies and strategies on climate change need to reflect and include the adaptation needs and mitigation potential of food and agricultural systems, and vice versa, planning in the agriculture, forestry and fisheries sectors need to take into account climate perspectives.

Regional

28. FAO country-level actions take place in the context of regional priorities, as well as the global climate and sustainable development agenda. Many issues that affect food and agricultural systems are transboundary in nature. These include climate change itself, and issues affected by climate change such as water availability, pests and diseases and extreme climatic events. Addressing environmental factors such as agro-ecological conditions and social factors such as diet,¹⁵ benefit from a regional perspective. FAO will intensify its efforts to foster regional collaboration, facilitate the exchange of experiences and lessons, as well as the access to resources and technical capacity; and will thus realize economies of scale through undertaking regional activities.

Global

29. Climate change is a global issue requiring a global response. FAO advocates on behalf of food security and nutrition, as well as environmental, social and economic sustainability for farmers, pastoralists, fishers, foresters and other rural dwellers at the global level. Within the broad, diverse and multi-sectorial international debate on climate change, FAO will intensify its work within the UN system, among Multilateral Financing Institutions, with development partners and partners in the private and civil society sectors to ensure that food and agricultural systems are featured as a global priority within the climate agenda.

Short- and long-term

30. Disaster risk reduction is significantly more cost effective than post-disaster response. Addressing the root causes of risks and increasing the resilience of livelihoods and food systems to lessen the impacts of natural and man-made disasters can also introduce effective adaptation measures with co-benefits for climate change mitigation. FAO's work on climate therefore spans support for, and lessons learned from disaster risk reduction and emergency response to current hazards and support for long-term climate change adaptation and mitigation efforts.

¹⁵ IPCC SPM 4.2.3, p. 25: "Demand-side measures, such as changes in diet and reductions of losses in the food supply chain, have a significant, but uncertain, potential to reduce GHG emissions from food production (medium evidence, medium agreement). Estimates vary from roughly 0.76–8.6 GtCO₂eq/yr by 2050 (limited evidence, medium agreement)." https://ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policy-makers.pdf

Climate-smart

31. Climate-smart agriculture (CSA) provides an inclusive conceptual framework for a wide range of agricultural interventions in diverse contexts. The 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. It is an approach for practitioners and decision-makers to assess a range of options and identify context-appropriate solutions at farm, landscape and national levels that maximize benefits, pursuing synergies and managing trade-offs across the following three objectives: (a) sustainably increase agricultural productivity and incomes; (b) adapt and build resilience to climate change; and (c) reduce and/or remove greenhouse gas emissions, where possible. CSA is not a set of practices that can be universally applied.

Cross-sectorial and multi-stakeholder

32. FAO promotes and supports integrated landscape and value chain approaches, identifying the optimal interventions which address climate change adaptation and mitigation challenges while also taking into consideration social, economic and environmental constraints and opportunities within the landscape and through entire value chains. At the same time, FAO works across agricultural and natural resources sectors and promotes cross-sectorial approaches with the understanding that different food and agricultural systems face different constraints, offer different opportunities and may impact upon each other. Engagement with other sectors, such as energy, health and transport can add value to CCAM action in all sectors. This requires working with multiple stakeholders from public and private sectors and civil society at appropriate levels (local to global).

D. Guiding principles

33. The Strategy aims to facilitate FAO's contribution to the transition of food and agricultural systems and dependent livelihoods to become more resilient to climate change. It is founded on the following principles of social inclusion and environmental sustainability:

Give precedence to food security, poverty reduction and sustainability

34. Climate change undermines food security, nutrition, poverty reduction and sustainability in many contexts, and creates opportunities for improvement in others. FAO applies its core functions through its Strategic Programmes to address climate change, in line with the *Vision for Sustainable Food and Agriculture (SFA)*.¹⁶

Leave no one behind

35. Through its long experience in people-centered work on agriculture, rural development and climate change, FAO recognizes that CCAM work requires participatory and inclusive modalities in order to ensure that everyone can benefit, and that no one is left behind. Consequently, FAO considers gender-specific vulnerabilities, needs and capabilities with regard to climate change; the vulnerabilities, needs and capabilities of indigenous people; as well as other vulnerable communities, including communities living in fragile environments such as SIDS, drylands, mountain areas or coastal zones. The Strategy is implemented in the context of the FAO Policy on Gender (2013)¹⁷ and the FAO Policy on Indigenous and Tribal Peoples (2010).¹⁸ Planning focuses on

¹⁶ FAO, 2014. Building a common vision for Sustainable Food and Agriculture. <http://www.fao.org/3/a-i3940e.pdf>

¹⁷ FAO, 2013. *FAO policy on gender equality*. <http://www.fao.org/docrep/017/i3205e/i3205e.pdf>

¹⁸ FAO, 2010. *FAO policy on indigenous and tribal peoples*. http://www.fao.org/fileadmin/user_upload/newsroom/docs/FAO_policy.pdf

identifying and acting to protect and enhance support in particular to those livelihoods, communities and systems that are most vulnerable to the adverse impacts of climate change.

Support policy integration and mainstreaming

36. FAO promotes both the integration of CCAM into policies and strategies relating to the food and agricultural sectors, as well as the integration of food and agricultural sector considerations into climate-related policies. Such policy harmonization lays a strong foundation for cohesive action, and is proven to be more effective than stand-alone solutions.

Promote evidence-based, scientific approaches

37. Interventions supported by FAO are always built upon evidence-based science. Where uncertainties remain, scenarios to support informed decision-making are provided.

Promote ecosystem-based approaches

38. Ecosystems provide valuable services that help to build resilience and reduce the vulnerability of people and their livelihoods to climate change impacts. Integrating the protection of biodiversity and ecosystem services into adaptation strategies and mitigation options increases the resilience of human and natural systems to climate and non-climate risks, providing benefits to society and the environment.

Learn from experience

39. Knowledge management, strategic partnerships, South-South Cooperation and other mechanisms are optimized to share experiences and learn lessons, as well as to identify gaps that FAO and its partners can fill. The Strategy is guided by existing, relevant FAO Strategies, in particular on Capacity Development (2010)¹⁹ and Partnerships (2012).²⁰

Lead by example

40. Interventions embody the principles they seek to convey. FAO demonstrates its commitment on having integrated CCAM considerations into its programming and project cycle. In addition, the Organization is committed to a sustainable future by continuing to reduce the environmental impact of FAO's own operations under its Corporate Environmental Responsibility Policy, interlinked with the UN Greening the Blue initiative.²¹ Efficiency in construction projects and in FAO offices, smart travel, and sustainable procurement practices are important ways in which the Organization increasingly supports itself and its partners in the quest for green development.

E. Expected Outcomes

41. This Strategy guides FAO's action to achieve three mutually reinforcing outcomes:
1. Enhanced capacities of Member Nations on climate change through FAO leadership as a provider of technical knowledge and expertise.
 2. Improved integration of food security and nutrition, agriculture, forestry and fisheries considerations within the international agenda on climate change through reinforced FAO engagement.
 3. Strengthened coordination and delivery of FAO work on climate change.

¹⁹ FAO, 2010. *Corporate Strategy on capacity development*.

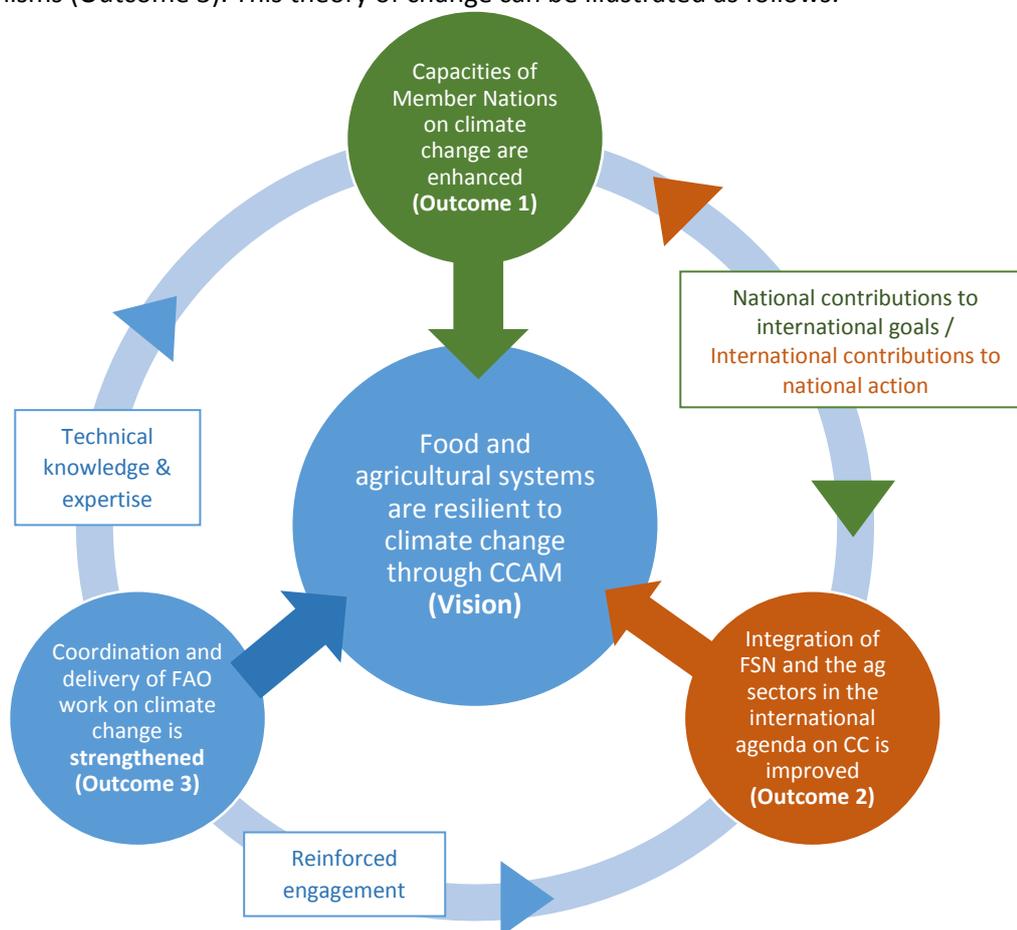
<http://www.fao.org/docrep/meeting/019/k8908e.pdf>

²⁰ FAO, 2012. *FAO Organization-wide Strategy on partnerships*.

http://www.fao.org/fileadmin/user_upload/corp_partnership/docs/stratbrochure_en_web.pdf

²¹ <http://www.greeningtheblue.org/>

42. These outcomes focus the strategy and FAO's action on the enhancement of Member Nations' capacities (Outcome 1), within the enabling environment of the international agenda sustainable development and in particular on climate change (Outcome 2). The achievement of Outcomes 1 and 2 necessitates the strengthening of FAO's capacities and streamlining of existing FAO mechanisms (Outcome 3). This theory of change can be illustrated as follows:



F. Plan of Action

43. Action to be taken by FAO to implement the Climate Change Strategy are set out for each expected outcome of the Strategy. The actions will be carried through FAO's Strategic Programmes and Objective 6, including through enhanced partnerships, and measured by FAO's results framework.

Outcome 1. Enhanced capacities of Member Nations on climate change through FAO leadership as a provider of technical knowledge and expertise

44. National priorities will guide the support that FAO provides to each Member Nation in meeting the commitments of their NDCs within the broader sustainable development context. Noting the extensive ongoing work programme in countries supported by FAO, the Strategy will augment efforts with a specific focus on CCAM delivery at country level through the following actions. FAO will:

- a) **Directly support NDC implementation in the food and agricultural sectors in countries through policy processes, capacity-development and technical interventions on the ground.**
- b) **Facilitate country access to financing for the food and agricultural sectors by improving access to national and international climate finance**, providing assistance for drafting investment programmes and supporting countries in making their domestic investments more climate-smart.
- c) **Support countries to integrate food security, agricultural sector considerations and climate change across relevant national policies and regional policies, strategies, programmes.** This applies to frameworks on CCAM (in particular NDCs, National Adaptation Plans (NAPs), Nationally Appropriate Mitigation Actions (NAMAs) and the implementation of the Sendai Framework for Disaster Risk Reduction), as well as national and regional agriculture, forestry and fisheries frameworks. FAO's Country Programming Frameworks will be updated to reflect national climate priorities and hence target resources and action most effectively.
- d) **Guide countries to develop and adopt Disaster Risk Reduction and upstream of adaptive and preventive approaches** as a cost-effective way to deal with the significant impacts of climate-triggered extreme events.
- e) **Convene multi-country technical and policy exchanges to address emerging issues relating to climate change** and advance understanding and adoption of best CCAM practices among Member Nations.
- f) **Develop new codes of practice, guidelines, standards and other documents that support countries in addressing climate change more effectively.** Responses to climate change will require new measures to protect consumers and producers of food and agricultural products, as well as natural resources. Existing norms and standards across FAO will integrate climate change perspectives where relevant.
- g) **Strengthen national and regional institutional capacity to generate, collect and use data and information that enhances their ability to address climate change adaptation and mitigation.** This will include, among others, weather, yield and loss data, greenhouse gas emissions, soil carbon and water availability, and the capacity to exchange information among farmers, government authorities, research establishments and the private sector. Countries will be assisted to develop dissemination systems that make relevant information accessible to farmers and others who would benefit from it, for example through cellphone networks and mass media channels.
- h) **Develop new tools and disseminate existing tools to assist with analysis of and planning for the impacts of climate change and new national reporting requirements.** Links will be made with partners to use or adapt their tools and thus avoid duplication of effort.
- i) **Increase knowledge and technical support to countries on climate-smart agriculture approaches.** Successful approaches will be upscaled, and new approaches will be developed in collaboration with partners where gaps and needs are identified.
- j) **Leverage strategic national partnerships with key research and implementation actors in the international climate and development process including national authorities, farmers and food producers, academia, the private sector and civil society** to synergize and complement the financial, human, and technical resources needed to improve delivery, avoid

duplication, make more efficient use of resources, and mobilize finance in support of national programmes.

Outcome 2. Improved integration of food security and nutrition, agriculture, forestry and fisheries considerations within the international agenda on climate change through reinforced FAO engagement

45. FAO commits to reinforce and strengthen its role as the international advocate for food security and nutrition, agriculture, forestry and fisheries considerations in the context of climate change. This set of actions aims to guide international priority setting and thereby serves to create an enabling environment for national action.
46. In particular, FAO will:
- a) **Ensure that the perspectives of food security and nutrition, agriculture, forestry and fisheries, rural livelihoods and natural resource management and conservation are appropriately prioritized in international fora addressing climate change.** Key fora include the UNFCCC, the SDGs and the Addis Ababa Action Agenda in the context of Agenda 2030; the UNFCCC's sibling conventions, the UNCCD and CBD; the Sendai Framework for Disaster Risk Reduction; and the World Humanitarian Summit process, among others.
 - b) **Extend its engagement to relevant fora that do not specifically deal with the agricultural sectors, such as those dealing with humanitarian issues, migration or conflict.** FAO will explore the possible role of climate change in triggering or exacerbating conflict, migration and social instability through pressures on food and agricultural systems and rural communities.
 - c) **Maintain and strengthen its role as a provider of global data and information resources and knowledge and technologies on CCAM,** including global goods such as data on food insecurity around the world, and global GHG databases on agriculture and land use.
 - d) **Convene the food and agricultural sectors with the other sectors that primarily deal with climate change,** including environment, energy, industry, transport, economic development/planning and investment, as well as sectors with consequential interests such as health, social, labor, education, defense and others. FAO will work through its networks of decentralized offices to do so.
 - e) **Leverage strategic international partnerships with key research and implementation actors in the international climate and development process including UN System, public, private, research and civil society organizations** to synergize and complement the financial, human, and technical resources needed to improve delivery, avoid duplication, make more efficient use of resources and mobilize finance in support of national programmes.
 - f) **Work with relevant funding bodies to promote higher profiling of food and the agricultural sectors in financing decisions related to climate change.** Key partners include the Green Climate Fund (GCF), Global Environment Facility (GEF), regional development banks, multilateral and bilateral development partners, the private sector, as well as other innovative financing opportunities.

Outcome 3. Strengthened coordination and delivery of FAO work on climate change

47. As a cross-cutting theme under the Strategic Framework, climate change will be reflected in each Strategic Programme (Annex 1) and relies on the contribution of all FAO units at all locations and on the active engagement of Member Countries and partners.

48. FAO will strengthen and streamline internal mechanisms for coordination, knowledge development and management, innovation and delivery. The Strategy will be backed by an extensive and continuing learning programme to ensure good understanding of what FAO can offer to countries on CCAM in food and agricultural systems and how this support can be delivered most effectively.
49. Specifically, FAO will:
- a) **Establish a Climate and Environment Department under the Deputy Director-General, Climate and Natural Resources.** The department will play an important role in supporting Member States' drive to climate, land and water, environment and bio-economy action²² at scale. It will facilitate the delivery of FAO's cross-cutting work on climate change adaptation and mitigation, climate policy and finance, environment and promoting sustainable bio-economies.
 - b) **Maximize its impact through strategic partnerships** guided by the FAO Strategy on Partnerships.²³ Particular attention will be given to:
 - The Rome-Based agencies: The International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP);
 - UN agencies, programmes and Conventions: UNFCCC, World Meteorological Organization (WMO), The United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), the Convention on Biological Diversity (CBD) and the United Convention to Combat Desertification (UNCCD) and UN-REDD partners;²⁴
 - Investment institutions: Allowing FAO to bring its tools, data and technical expertise to bear in a wider network of programmes, as well as enhancing opportunities for resource mobilization;
 - Development partners, academia and research, the private sectors and civil society organizations.
 - c) **Expand internal programmes for sharing knowledge and fostering learning** to ensure continuous learning and access to the latest information in the rapidly developing and diverse field of climate change. In particular, the capacities of FAO's country, subregional, regional and liaison offices will be strengthened to enable them to effectively engage with relevant climate change processes and stakeholders. The Technical Network on Climate Change will serve to share knowledge and the delivery of learning for individuals, units and the institution as a whole.
 - d) **Measure progress in implementing this Strategy.** Progress will be measured through relevant indicators of FAO's results framework.

²² See *Final Communiqué of the 2015 edition of the Global Forum for Food and Agriculture* (GFFA, Berlin 17 January 2015).

²³ FAO, 2012. *FAO Organization-wide Strategy on partnerships*.

http://www.fao.org/fileadmin/user_upload/corp_partnership/docs/stratbrochure_en_web.pdf

²⁴ UN-REDD stands for the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.

50. The following table shows the current and expected future contributions of FAO's Strategic Programmes and Objective 6 actions to the outcomes of the Climate Change Strategy.

<p>Outcome 1 - Enhanced capacities of Member Nations on climate change through FAO leadership as a provider of technical knowledge and expertise.</p>	<p>Outcome 2 - Improved integration of food security, agriculture, forestry and fisheries within the international agenda on climate change through reinforced FAO engagement.</p>
<p>SP1 - Contribute to the eradication of hunger, food insecurity and malnutrition</p>	
<ul style="list-style-type: none"> • Supporting countries and regions to help orient climate change policy and action towards enhanced food security and nutrition outcomes. • Providing guidance and advice to enhance countries' capacities to effectively integrate food security and nutrition considerations into national and regional policies, strategies, programmes on CCAM including their NDCs. • Providing information and assistance to member countries to improve access to international climate finance and ensure food security and nutrition concerns are incorporated in the requests. 	<ul style="list-style-type: none"> • Improving data and evidence building and associated capacities to better inform policy and investment decisions on the interlinkages of food security, nutrition and climate change. • Strengthening evidence and capacities to analyse the impact of climate change on food security and nutrition and on how food and agriculture (including healthier diets) can enhance adaptation and mitigation • Promoting coherence and complementarity of international commitments on climate change with related global agendas and fora on sustainable development, such as SDG1 on ending poverty, SDG 2 on ending hunger, the Rome Declaration on Nutrition (ICN2, 2014) and the UN Decade of Action on Nutrition (2016).
<p>SP2 - Increase and improve provision of goods and services from agriculture, forestry and fisheries in a sustainable manner</p>	
<ul style="list-style-type: none"> • Promoting sustainable production systems for crops, livestock, forestry, fisheries and aquaculture that are climate-resilient and address climate change adaptation and mitigation, and thereby promoting the implementation of the 2030 Agenda for Sustainable Development and Paris Agreement. • Developing or improving policies and governance mechanisms to address sustainable production, climate change and environmental degradation in a coherent and integrated way. • Improved implementation of policies and international instruments, in particular to support institutions in implementing policies and international instruments that foster sustainable production and address climate change and environmental degradation. • Strengthening decision-making based on evidence and derived from sectoral/cross-sectoral analysis of data, information and knowledge, including through developing capacities of institutions to collect data and produce evidence for decision-making on sustainable production, climate change and environmental degradation, including relevant SDGs. 	<ul style="list-style-type: none"> • Effectively integrating agriculture, forestry and fisheries in international governance mechanisms related to 2030 Agenda, climate change, biodiversity and environmental agendas, including mechanisms or instruments under FAO's responsibility. • Developing strategic knowledge products that address global issues and that integrate information on sustainable production, climate change and environmental degradation.

SP3 - Reduce rural poverty	
<ul style="list-style-type: none"> • Improving understanding of the social and economic impacts of climate change, in particular on the most vulnerable groups, and analyzing the links between climate change and rural poverty, including through collection and sharing of evidence that can be fed into policy and programming. • Mainstreaming gender equality, equity and social inclusiveness into climate-related planning processes and promoting inclusive and diversified sustainable food and agriculture systems to help reduce rural poverty and avoid crises that may include distress migration, conflict over resources or greater discrimination against women or particular social groups. • Supporting employment creation schemes in affected areas to enable households to diversify their incomes and engage in green entrepreneurship with a focus on women and youth. • Designing and supporting poverty reduction risk management strategies, including social protection, for the poor and most vulnerable communities (including indigenous peoples, women and youth) to prevent and mitigate climate-related risks, based on their own expertise and stewardship of natural resources. 	<ul style="list-style-type: none"> • Advocating for inclusive sustainable rural transformation as a tool to avoid climate change related distressed migration and conflicts over resources. • Improving understanding of the social dimensions of climate change in triggering or exacerbating social instability, poverty and gender inequality through pressures on food and agricultural systems and livelihoods in rural areas.
SP4 - Enable more inclusive and efficient agricultural and food systems	
<ul style="list-style-type: none"> • Improving understanding of the adaptation and mitigation benefits of inclusive, efficient and sustainable agrifood value chains. • Promoting good adaptation and mitigation practices, such as using water and energy efficiently and using renewable energy along value chains. • Exploring potential co-benefits of redesigning existing value chains and energy supplies for climate change mitigation. • Supporting countries in integrating climate change considerations into agrifood systems policies, strategies and programmes. 	<ul style="list-style-type: none"> • Engaging with global climate-related initiatives to strengthen dialogue and partnership with the private sector. • Advocating for a bioeconomy approach in agrifood system development, and for better alignment of climate change strategies and the greening of value chains. • Developing international data and analysis in support of more inclusive and efficient agricultural and food systems to address challenges posed by climate change. • Identifying and applying innovative or improved financial approaches and investment mechanisms and services for climate friendly agrifood system development.

SP5 - Increase the resilience of livelihoods to threats and crises	
<ul style="list-style-type: none"> • Assessing risks and vulnerabilities and guiding countries towards enhanced Disaster Risk Reduction and Climate Change Adaptation strategies and practices that prioritize prevention of climate-induced disasters as a significantly more cost-effective option than rehabilitation and recovery, while ensuring sound capacities for response to disasters whenever they cannot be avoided. • Addressing both localized pressures and international impacts such as from increased migration. • Providing regular data analysis, monitoring and early warning systems to regions and countries on hazards and threats which are influenced by the impacts of climate change. 	<ul style="list-style-type: none"> • Engaging in international fora such as the Sendai Framework for Disaster Risk Reduction and the World Humanitarian Summit process to promote climate resilience and the risk reduction approach. • Improving understanding of climate change pressures on food and agricultural systems and livelihoods in rural areas and their role in triggering or exacerbating conflict and migration. • Introducing data from monitoring information systems for damage and loss from extreme events on agriculture, food security and nutrition in international processes.
Across all SPs / Coordinated by Objective 6 - Technical quality, knowledge and services	
<ul style="list-style-type: none"> • Supporting countries to integrate the agricultural sectors in defining their NDCs and support strategic dialogues at regional and international level. • Supporting countries to integrate a gender perspective in their National Adaptation Plans and in the implementation of their NDCs. • Providing information, assistance and support for project development to countries to improve access to international climate finance. • Strengthening national institutional capacity to deliver on climate change adaptation and mitigation in food and agriculture. • Building evidence on the effects of adapted technologies on food security under climate change and the barriers to their adoption and upscaling. 	<ul style="list-style-type: none"> • Strengthening integration of food and agricultural perspectives in international climate-related fora. • Advocating for increased investment for climate change adaptation and mitigation for food and agricultural sectors. • Advocating in UN system processes for a stronger role of the agricultural sectors in countering climate change.

Annex 1: The impacts of Climate Change on the food and agricultural sectors

1. The impacts of climate change on food and agriculture are interconnected across environmental, social and economic dimensions. Climate impacts and entry points are presented for five important areas relevant to food and agriculture: food security; nutrition and human health; the agricultural sectors; natural resources; and post-production stages.

Food security

2. Climate change stands to undermine the four dimensions of food security in different ways. **Food availability** will be compromised by projected yield declines across the crop, livestock and fisheries and aquaculture sectors (see 'agricultural sectors'), especially in sub-Saharan Africa and South Asia, where most of today's food insecure live. This will raise the pressure on the natural resource base and add to upward pressure on international food prices, while global food supply needs to increase by 60 percent from 2006 to 2050 to meet the needs of a growing population and changing diets²⁵. Expected changes in natural resources and growing conditions also mean that climate change will very likely change the geography of production. For instance, in many cases, production is projected to shift from low latitude areas to high latitudes areas, and thus, from food deficit areas to food surplus areas.

3. Climate change also compromises **food access** by affecting the purchasing power of consumers, especially of the poor²⁶. Impacts on production directly translate into social and economic impacts through a range of different pathways that can result in changes in agricultural incomes and prices and also affect trade patterns and investment trends (see 'post-production stages'). Regarding food prices, most model projections indicate some price increases as a result of climate change, although the magnitude and locations vary considerably across models and climate change scenarios²⁷.

4. Climate change affects **food utilization** primarily through its impacts on food safety and health (see 'nutrition and human health')²⁸. In general, climate change is likely to reduce food safety through a higher incidence of food-borne diseases. Climate also affects health via multiple pathways, including geographical shifts in vector-borne diseases, heat stress and natural disasters, which in turn affect the nutrition of people and their ability to provide care as well as nutritional contents of food²⁹.

5. With regards to **food stability**, the risks to food and nutrition security are exacerbated by the expected increase in the frequency and intensity of climate-related events. Shocks and crises caused by extreme weather events destroy resources and infrastructures and hence reduce overall food production capacity. Another potential impact of climate change lies in an increased food price volatility. Recent international food price spikes often followed climate extremes in major producing countries, and have become more likely as a result of climate trends. Nutrition and human health

6. Linked to food security, climate change directly affects the **nutrition** of millions of people, undermining current efforts to address undernutrition and hitting the poorest the hardest, especially women and children. It is seen as a significant "hunger-risk multiplier" for which some

²⁵ Alexandratos, N. and Bruinsma, J. (2012), World Agriculture towards 2030/2050, The 2012 Revision FAO, <http://www.fao.org/docrep/016/ap106e/ap106e.pdf>

²⁶ Campbell, B., et al. (2016), op. cit.

²⁷ Campbell, B., et al. (2016), op. cit.

²⁸ Campbell, B., et al. (2016), op. cit.

²⁹ Campbell, B., et al. (2016), op. cit.

forecasts anticipate 24 million additional malnourished children by 2050 – almost half of them in sub-Saharan Africa³⁰. This negative impact will be significant in developing countries, especially on per capita calorie availability, childhood undernutrition, and undernutrition-related child deaths³¹. The composition of diets, as well as caloric availability, are both risk factors for climate-related health impacts. A 2016 model³² projects that by 2050, climate change will reduce per capita food availability by over 3 percent, fruit and vegetable consumption will decline by 4 percent and the consumption of red meat will fall slightly. Next to this, climate change is expected to increase the incidence of diseases that will contribute to undermining the body's ability to absorb nutrients. The great majority of people whose diets are inadequate, both in terms of calories and micronutrients, live and work as farmers, pastoralists or fishers in rural farming communities in the developing world.

7. Integrated **food safety** management to control the safety of foods along value chains will be required as a consequence of climate change affecting food production systems and supply chains.³³ For example, shifting patterns of algal blooms are expected to expose new countries to ciguatera fish poisoning, a severe food-borne illness. Higher temperatures and humidity are increasing the risk of fungal growth and thus contamination of stored cereals and pulses with mycotoxins (fungal metabolites). Climate change will cause unexpected changes in patterns of plant and animal diseases, which will increase the risk of over- or misuse of agricultural chemicals in an effort to control these diseases. The management of these challenges will require all operators along the value chain to be able to implement suitable good practices.

Nutrition and human health

8. Linked to food security, climate change directly affects the **nutrition** of millions of people, undermining current efforts to address undernutrition and hitting the poorest the hardest, especially women and children. It is seen as a significant “hunger-risk multiplier” for which some forecasts anticipate 24 million additional malnourished children by 2050 – almost half of them in sub-Saharan Africa³⁴. This negative impact will be significant in developing countries, especially on per capita calorie availability, childhood undernutrition, and undernutrition-related child deaths³⁵. The composition of diets, as well as caloric availability, are both risk factors for climate-related health impacts. A 2016 model³⁶ projects that by 2050, climate change will reduce per capita food availability by over 3 percent, fruit and vegetable consumption will decline by 4 percent and the consumption of red meat will fall slightly. Next to this, climate change is expected to increase the incidence of diseases that will contribute to undermining the body's ability to absorb nutrients. The great majority of people whose diets are inadequate, both in terms of calories and micronutrients, live and work as farmers, pastoralists or fishers in rural farming communities in the developing world.

³⁰ IFPRI, 2009. Food policy report “Climate Change: Impact on agriculture and costs of adaptation.”

<http://www.ifpri.org/publication/climate-change-impact-agriculture-and-costs-adaptation>

³¹ IPCC, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap7_FINAL.pdf

³² Springmann M., Mason-D’Croz D., Robinson S., Garnett T., Godfray H.C. J., Gollin D.; Rayner M.; Ballon P., and Scarborough P. (2016). *Global and regional health effects of future food production under climate change: A modelling study*. The Lancet.

³³ FAO, 2008. *Climate Change: Implications for Food Safety*.

<ftp://ftp.fao.org/docrep/fao/010/i0195e/i0195e00.pdf>

³⁴ IFPRI, 2009. Food policy report “Climate Change: Impact on agriculture and costs of adaptation.”

<http://www.ifpri.org/publication/climate-change-impact-agriculture-and-costs-adaptation>

³⁵ IPCC, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap7_FINAL.pdf

³⁶ Springmann M., Mason-D’Croz D., Robinson S., Garnett T., Godfray H.C. J., Gollin D.; Rayner M.; Ballon P., and Scarborough P. (2016). *Global and regional health effects of future food production under climate change: A modelling study*. The Lancet.

9. Integrated **food safety** management to control the safety of foods along value chains will be required as a consequence of climate change affecting food production systems and supply chains.³⁷ For example, shifting patterns of algal blooms are expected to expose new countries to ciguatera fish poisoning, a severe food-borne illness. Higher temperatures and humidity are increasing the risk of fungal growth and thus contamination of stored cereals and pulses with mycotoxins (fungal metabolites). Climate change will cause unexpected changes in patterns of plant and animal diseases, which will increase the risk of over- or misuse of agricultural chemicals in an effort to control these diseases. The management of these challenges will require all operators along the value chain to be able to implement suitable good practices.

The agricultural sectors

10. In the **crop sector**, there is evidence that climate change has already negatively affected wheat and maize yields in many regions and at the global level³⁸. The Intergovernmental Panel on Climate Change (IPCC) warns that decreases in crop yields of 10 to 25 percent and more may be widespread by 2050³⁹. The increased frequency of warmer nights in most regions is damaging for many crops, with observed impact on rice yields and quality. The number of crop varieties has decreased dramatically during the 20th century, raising concerns for adaptive capacity, genetic vulnerability and nutritional diversity. Ecological processes which are typical in diverse cropping systems, have been replaced or suppressed by the use of external inputs. Intensive mono-cropping systems have expanded across the globe, leading to lower resilience of agro-ecosystems and livelihoods. The conservation of both crop and wild plant genetic resources is therefore an important adaptation measure⁴⁰. Climate change is also expected to have a significant impact on the frequency and intensity of plant pest and disease outbreaks. For example, an increase in extreme weather events (i.e. drought spells, intense short-lived widespread rainfall, including cyclones), in addition to causing severe disruption in their own right, can lead to more frequent and intense plant pest and disease outbreaks, as was the case during the Desert Locust outbreaks in Northwest Africa and in Yemen in late 2015 and early 2016⁴¹.

11. **Livestock**, including feed crops, contributes approximately a third of GHG emissions from the AFOLU sector⁴². However, FAO estimates that a reduction of up to 30 percent can be achieved through improved feed and stock management⁴³. The livestock sector experiences important negative climate impacts in animal productivity, yields of forage and feed crops, animal health and biodiversity. For example, in various Sub-Saharan African countries, 20-60 percent losses in animal numbers were recorded during serious drought events in the past three decades. In South Africa, dairy yields were predicted to decrease by 10-25 percent under certain climate change scenarios⁴⁴. Increased temperatures and reduced precipitation have direct negative impacts on yields, and records during drought events can reveal important drops in forage production. Increased animal pest, disease and epidemic outbreaks are another likely result of climate change.

³⁷ FAO, 2008. *Climate Change: Implications for Food Safety*.

<ftp://ftp.fao.org/docrep/fao/010/i0195e/i0195e00.pdf>

³⁸ Lobell D.B., Schlenker W. and Costa-Roberts J. (2011). *Climate trends and global crop production since 1980*, Science, 333(6042), 616-20

³⁹ IPCC, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap7_FINAL.pdf

⁴⁰ FAO, 2015. *Voluntary guidelines to support the integration of genetic diversity into national climate change adaptation planning*. <http://www.fao.org/documents/card/en/c/290cd085-98f3-43df-99a9-250cec270867/>

⁴¹ FAO, 2016. *Desert locus bulletin*. <http://www.fao.org/ag/locusts/common/ecg/2293/en/DL450e.pdf>

⁴² FAO, 2013. *Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities*. <http://www.fao.org/docrep/018/i3437e/i3437e.pdf>

⁴³ FAO, 2013. *Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities*. <http://www.fao.org/docrep/018/i3437e/i3437e.pdf>

⁴⁴ IPCC, 2014. http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-PartB_FINAL.pdf

12. The impacts of climate change on **fisheries and aquaculture** occur as a result of both gradual atmospheric warming and associated physical and chemical changes of the aquatic environment⁴⁵. Climate change is likely to affect already vulnerable fisheries and ocean-dependent communities through less stable livelihoods, changes in the availability and quality of fish for food, and rising risks to their health, safety and homes. One scenario projects a decrease in landed fish value of 21 percent and a total annual loss of USD 311 million by 2050 over 2000 values, and a significant loss in fisheries-related jobs of almost 50 percent in 14 West African countries⁴⁶. Overall, rising temperatures are predicted to reduce catches of main fish species by 40 percent by 2050⁴⁷. Extreme events such as deep sea ocean swells, particularly high temperatures, and cyclones can affect the ability of ecosystems such as coral reefs and mangroves to provide services crucial for livelihoods and food security. Climate change and carbon absorption in the aquatic systems are and will continue to manifest changes in aquatic systems through rising water temperatures, increased thermal stratification, changes in salinity and freshwater content, changes in oxygen concentrations, and ocean acidification. Climate change is also a compounding threat to the sustainability of capture fisheries and aquaculture development in marine and freshwater environments as it exacerbates issues already faced by the sector such as overfishing, pollution and disease, as well as the natural variability within the aquatic systems, impacting both local access to food and globally traded fisheries products. The primary potential for GHG reduction in the fisheries and aquaculture sector has been associated with reducing fuel and energy use either through direct or indirect action.

13. Although **forest ecosystems** are inherently dynamic, the speed of predicted climate change is likely to far exceed the natural capacity of many forest species and ecosystems to adapt. Climate change constitutes a direct threat to forest ecosystems, forest-dependent peoples and society as a whole through reduced delivery of products and forest ecosystem services. Reduced forest productivity, forest dieback, increased pest and disease outbreaks, increased wildfire incidences or severity and loss of forest biodiversity in various global locations are evidence of climate change impacts. Forest degradation, reduced availability of forest products and impaired forest ecosystem services, such as regulation of water supply and erosion, affect the wellbeing of local forest-dependent communities as well as water supplies and food production in downstream areas. Climate impacts on forests affect food security by reducing forest foods, forest-employment and income, environmental sustainability and availability of fuelwood needed for food production. Adaptation measures in the forest sector are therefore crucial for food security as well as poverty alleviation. Forests as important carbon stocks, sinks and sources, are key to the global carbon balance. Deforestation and forest degradation contribute an estimated 10-11 percent of global greenhouse gas emissions. On the other hand, afforestation and reforestation, forest restoration and agroforestry development have significant mitigation potential, which can also provide adaptation benefits. By 2030, forestry mitigation options could contribute to reductions of 0.2 to 13.8 Gt CO₂e per year at carbon prices up to US\$100 per tonne CO₂e and to reductions of 0.01 to 1.45 Gt CO₂e per year at prices below US\$20 per tonne CO₂e.⁴⁸ In addition, climate benefits can be achieved by the use of timber and harvested wood products that store carbon in the long term, in place of fossil fuel based on other materials.⁴⁹ Climate change actions in forestry will need to

⁴⁵ IPCC, 2013. http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf

⁴⁶ Lam V.W.Y., Cheung W.W.L., Swartz W., and Sumaila U.R., 2012. Climate change impacts on fisheries in West Africa: implications for economic, food and nutritional security. *African Journal of Marine Science*, 34(1), 103-117

⁴⁷ IPCC, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap7_FINAL.pdf

⁴⁸ IPCC, 2014. https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf

⁴⁹ FAO, 2010. *Impact of the global forest industry on atmospheric greenhouse gases*. <http://www.fao.org/docrep/012/i1580e/i1580e00.pdf>

optimize mitigation and adaptation benefits and consider these options in light of forest management objectives.

Natural resources

14. Climate change poses large-scale threats to natural resources that are essential to agricultural production. Damage to and depletion of natural resources undermines the natural ecological processes on which healthy, productive landscapes rely. Key resources under pressure include the following.

15. It is estimated that climate change will become the main driver of **biodiversity** loss⁵⁰. Along with a higher risk of extinctions, it is predicted that temperature increases will impact ecosystem functioning, including those important for food supply. By 2100, the resilience of many ecosystems is likely to be exceeded by an unprecedented combination of change in climate, associated disturbances such as flooding, drought, wildfire, insects, ocean acidification, and other global change drivers such as land-use change, pollution, and over-exploitation of resources.⁵¹ It is therefore very likely that climate change will affect the ecosystem services provided by agricultural biodiversity. Loss of biodiversity may also lead to significant losses of **genetic diversity** within the species most important for food and agriculture. The sustainable use of genetic resources for food and agriculture will thus be the foundation for many of the adaptation strategies required in food and agriculture.⁵²

16. At the same time, **soils**, the basis for plant growth, degrade and are lost at high rates as a consequence of climate change impacts on landscapes. Loss of soil fertility is mostly accompanied by soil carbon losses, making soil degradation a source for carbon dioxide (CO₂) emissions. Increases in soil carbon stabilize soils, improve its buffer and storage function for nutrients and soil water, and thus help farmers' resilience to climate change while also mitigating increased atmospheric CO₂. Restoration and rehabilitation of degraded lands has the important co-benefit of potentially sequestering carbon. This potential is enormous: around 200 million hectares (ha) of degraded land could be restored by 2030. Many of these areas include organic soils which have an even larger potential to sequester carbon and their restoration under different scenarios could bring additional financial resources to communities that depend on today's degraded lands. For example, estimates for potential carbon sequestration (which includes soil carbon sequestration) from the agricultural sector ranges from 0.3 to 4.6 GtCO₂eq/yr⁵³. Looking at soil carbon sequestration alone, restoration of degraded lands was estimated to have the potential to sequester up to 7.26 tonnes of CO₂ per hectare per year (tCO₂/ha/year)⁵⁴ which, when accumulated to 2030, would greatly contribute to mitigating the current global CO₂ emission levels.

17. Climate change is projected to significantly reduce renewable **surface water and groundwater resources** with particular intensity in most dry subtropical regions. For each degree increase in global surface temperature, approximately 7 percent of the global population is

⁵⁰ Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Biodiversity Synthesis*. World Resources Institute, Washington, DC

⁵¹ IPCC, 2007. <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>

⁵² FAO, 2008. *Climate change and biodiversity for food and agriculture*.

http://www.fao.org/uploads/media/FAO_2008a_climate_change_and_biodiversity_02.pdf and FAO, 2015: *Coping with Climate Change: The roles of Genetic Resources for Food and Agriculture*. <http://www.fao.org/3/a-i3866e.pdf>

⁵³ IPCC, 2011. www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf

IPCC, 2007. http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch8s8-4-2.html

McKinsey, 2013. Report "Pathways to a low-carbon economy: Version 2 of the global greenhouse gas abatement cost curve."

http://www.mckinsey.com/client_service/sustainability/latest_thinking/pathways_to_a_low_carbon_economy

⁵⁴ IPCC, 2007. http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch8s8-4-2.html

projected to be exposed to a minimum of 20 percent decrease of renewable water resources⁵⁵. Agriculture is now responsible for approximately 70 percent of the global water withdrawals. With the impacts of climate change, many regions are likely to face substantial water scarcity. If not dealt with properly and in a timely manner, water shortages will result in increasing competition between water users, which may constrain agricultural production, affect food security, incomes and livelihoods. Adjusting the agricultural sector to less water availability is crucial to ensure food security into the future.

Post-production stages

18. **Post-harvest stages** consume over 70 percent of the energy and emit about 30 percent of GHGs of total agri-food chains (excluding those from land use change)⁵⁶. In addition, food loss and waste is responsible for about 8 percent of global GHG emissions⁵⁷. Improved energy efficiency along the length of the agri-food chain and the deployment of renewable energy systems to displace fossil fuels and to provide access to modern energy, especially in post-harvest or post-capture activities, can reduce emissions. Increased access to modern energy and technologies facilitates increased food productivity (on and off-farm), hence reducing the emission intensity per unit of food produced. Consumption patterns can significantly influence GHG emissions, meaning that related adjustments in policy, industry and consumer behaviour can be influential in the response to climate change.

19. The shift in the production potential induced by climate change could result in substantially higher **trade** flows from mid- to high latitude areas to the low latitudes areas.⁵⁸ Many factors will eventually affect the volumes and the composition of trade flows under climate change. They include yields and yield potentials under new agro-climate conditions, changes in the suitability of arable land, the availability of precipitation and water for irrigation, developments in energy markets, population growth and changes in consumption patterns. They also include policies, with an obvious role for trade policies at the global and regional level. Trade can play a stabilizing role in compensating for regional changes in productivity and food price volatility as well as an equilibrating role between resource rich and resource poor regions.

⁵⁵ IPCC, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap3_FINAL.pdf

⁵⁶ FAO, 2011. *Energy-smart food for people and climate*. <http://www.fao.org/docrep/014/i2454e/i2454e00.pdf>

⁵⁷ FAO, 2015. *Food wastage footprint and climate change*. <http://www.fao.org/3/a-bb144e.pdf>

⁵⁸ IPCC, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-FrontMatterA_FINAL.pdf