

**Proposal
for
Mega Program 7**

Climate Change, Agriculture and Food Security

**Prepared by Climate Change Challenge Program, in partnership with contact points from 15
CGIAR centers and numerous research and development partners¹**

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¹ The proposal concept was discussed at GCARD (c. 100 participants, March, 2010) and then further refined in two meetings: one with CGIAR contact points (April, 2010), and then at a stakeholder meeting in Nairobi (May, 2010) with 80 participants (from agricultural and climate regional agencies, civil society, national agencies, international agencies, advanced research institutes).

Abstract

Achieving sustainable food security in a world of growing population and changing diets is a major challenge under climate change. Successful mitigation and adaptation will entail changes in individual behavior, technology, institutions and food production systems. These changes cannot be achieved without improving interactions among scientists, policy makers and civil society in the research process. This Mega Program (MP7) will build on the new strategic collaboration between the Consultative Group on International Agricultural Research (CGIAR) and the Earth System Science Partnership (ESSP).

By 2020, MP7 will help increase the incomes and well-being of millions of poor people dependent on rural livelihoods, contribute to a reduction in hunger, and contribute to climate change mitigation by enhancing carbon storage or reducing greenhouse gas emissions by 1000 Mt CO₂-eq² below the “business-as-usual” scenario. The vision of success for MP7 includes being recognized, together with the partners, as the foremost global source of relevant research that leads to options and strategies for tackling food insecurity in the face of climate change. MP7 seeks to become a hub that facilitates collective action across multiple Centers and multiple CGIAR MPs. The outcomes planned include (among others): systematic technical and policy support for agricultural risk management strategies that buffer against climate shocks and enhance livelihood resilience in at least 20 countries; and key agencies dealing with mitigation in at least 20 countries promoting new institutional arrangements and incentive systems that favor resource-poor farmers, particularly vulnerable groups and women.

The over-arching objectives of MP7 are: (1) To identify and develop pro-poor adaptation and mitigation practices, technologies and policies for food systems, adaptive capacity and rural livelihoods; and (2) To provide diagnosis and analysis that will ensure the inclusion of agriculture in climate change policies, and the inclusion of climate issues in agricultural policies, from the sub-national to the global level in a way that brings benefits to the rural poor.

There are four Themes. Three “place-based” Themes will identify and develop technologies, practices, partnerships and policies to decrease the vulnerability of rural communities to a variable and changing climate: Theme 1 – Adaptation to Progressive Climate Change; Theme 2 – Adaptation Pathways for Current Climate Risk; and Theme 3 – Pro-poor Climate Change Mitigation. Theme 4 – Integration for Decision Making – provides a framework for the whole of MP7, ensures effective engagement of rural communities and institutional and policy stakeholders, and grounds MP7 in the policy context. Much of the place-based work will be integrated within targeted regions, with activities starting in West Africa, East Africa and the Indo-Gangetic Plains in 2010 and extending to eight regions in total by 2012.

MP7 will make a lasting difference through adopting a strategic, fully embedded focus on capacity building. MP7 research will improve understanding of the underlying drivers of gender disparities as influenced by climate change, then formulating strategies to tackle these and provide inclusive access to emerging investments, tools and policies that deal with climate change.

Specific activities and procedures are planned to ensure coherence among Themes, to produce syntheses across regions and themes, and to build links across all CGIAR MPs. Early “wins” include a planned major role for agriculture in the post-2012 international climate change regime, and a global network of sites collecting comparative data to identify plausible options for adapting to climate change.

The MP7 Secretariat and Independent Science Panel will be primarily responsible for management. The Secretariat will be very small with most activities conducted by Centers.

² A megatonne (Mt) is equal to one million metric tons (tonnes)

Introduction

Background, rationale and challenges

Background

Climate change will have far-reaching consequences for agriculture³ that will disproportionately affect the poor who depend on agriculture for their livelihoods and have a lower capacity to adapt (World Bank, 2007). Climate-related crop failures, fishery collapses and livestock deaths already cause economic losses and undermine food security, and these are likely to become more severe as global warming continues. A recent study estimates the annual costs of adapting to climate change in the agricultural sector to be over US\$ 7 billion (Nelson et al., 2009).

Agriculture and related activities also contribute to global warming, by generating greenhouse gas (GHG) emissions and altering the land surface. Agriculture is estimated to account for about 15% of global GHG emissions and for around 26% if the emissions from deforestation in developing countries – where agriculture is the leading cause of forest conversion – are included (World Bank, 2007). Around 80% of agricultural emissions, including deforestation, occur in developing countries (World Bank, 2007). There remains much untapped technical potential to reduce agricultural emissions and increase agricultural mitigation of emissions from other sectors, notably through reduced deforestation via changes in land use and agricultural practices.

Sustainable food security in a world of growing population and changing diets is a major challenge under climate change. Although estimates of food insecurity vary (Barrett, 2010), the number of undernourished people already exceeds 1 billion and feeding this many people will require more than incremental changes (Federoff et al., 2010). Food production may need to increase by as much as 70% by 2050 when the global population will number 9 billion (World Bank, 2007; Royal Society of London, 2009). Food security depends not only on gross production of staples, but also on agriculture's ability to provide a diverse and balanced food basket, and on the socio-economic factors that determine whether poor people, particularly women, are able to purchase, store, prepare and consume sufficient food.

Rationale

The relationships among climate change, agriculture and food security are complex and dynamic. Agriculture and food systems are heavily influenced by socio-economic conditions such as changing patterns of consumption, macro-economic policies, political conflict and the spread of disease. A report by the World Economic Forum (WEF) warns that: "food security will become an increasingly complex political and economic problem over the next few years" (WEF, 2008). It is therefore vital that initiatives for better climate adaptation and food security are closely aligned.

Responses need to come quickly. Feeding the projected 9 billion people in 2050 requires radical transformation of agriculture over the next four decades, growing more food without exacerbating environmental problems and simultaneously coping with climate change (Godfray et al., 2010). The actions taken over the next 10 years will be especially critical. A new research initiative is needed – one that integrates and applies the best and most promising approaches, tools and technologies. The involvement of farmers, policy-makers, researchers, the private sector and civil society in the research process is vital. Successful mitigation and adaptation will entail changes in individual behavior, technology, institutions, agricultural systems and socio-economic systems. These changes cannot be achieved without improving interactions between scientists and decision makers at all levels of society.

³ The term agriculture is used inclusively to capture the wide range of productive uses of extensive and intensive farmland, rangelands and fisheries and their wider landscapes.

Mega Program (MP) 7 will address the increasing challenge of global warming and food security on agricultural practices, policies and measures. It will do so by building on the new strategic collaboration between the Consultative Group on International Agricultural Research (CGIAR) and the Earth System Science Partnership (ESSP) established under the CGIAR Challenge Program on climate change in 2009. This alliance and its partners bring together the world's best scientists in agricultural, climate, environmental and social sciences to identify and address the most important interactions, synergies and trade-offs between climate change and agriculture. MP7 will thus define and implement a uniquely innovative and transformative research program that addresses agriculture in the context of climate variability, climate change and uncertainty about future climate conditions.

The challenge for climate change modeling

The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) provides an in-depth analysis of recent scientific understanding on climate change (IPCC, 2007). It brings together evidence that confirm that human-induced temperature increases are taking place, with measurable and increasing effects on other parts of the Earth system. Many scenarios are available of how the global climate might change over the next century (IPCC, 2007). Although there are many uncertainties, it is becoming increasingly evident that regardless of mitigation efforts (undertaken today and in the future), temperatures will continue to rise over at least the next five decades because of earlier emissions of greenhouse gases. The magnitude and frequency of extreme events are also likely to increase. Adaptation is therefore a necessary response to climate change. At the same time, mitigation of further climate change is an urgent challenge if future changes are to be limited.

Climate, however, is only one element of the dynamic Earth system. Changes in the physical and biogeochemical environment, either caused naturally or influenced by human activities, contribute to global environmental change. Earth system sciences take a holistic approach to understanding the processes and outcomes of global environmental change by investigating the interactions among land, atmosphere, water, ice, biosphere, society, technologies and economies. The alliance between ESSP and the CGIAR will provide more context-specific (e.g. ecosystems, farming systems) data and information to enhance the predictive accuracy of climate change scenarios and identify cost-effective interventions.

The challenge for agriculture

Agricultural systems are complex and dynamic. Some systems are less vulnerable to short-term climate effects (e.g., some irrigated farming systems). Others (e.g., those relying on rain-fed agriculture) have always been exposed to uncertain and extreme climate but may now face variability beyond the current 'coping range'. In vulnerable systems, climate change threatens food security, livelihoods and economic prosperity (UNDP, 2007).

The AR4 has gathered scientific evidence and expert opinion on the expected impacts of climate change on agricultural systems (IPCC, 2007). The report notes that climate change is already having an impact, for instance, through changes in patterns of variability and associated changes in rainfall distribution. It anticipates with high confidence that projected changes in the frequency and severity of extreme climate events, together with increases in outbreaks of pests and diseases, will have significant consequences for food security. It identifies smallholder and subsistence farmers, pastoralists and fishers as those most vulnerable to these impacts.

The AR4 finds that Africa is highly vulnerable to climate change, because of multiple stresses and low adaptive capacity. Projections indicate an increase in arid and semi-arid land in some countries while others will get wetter but with changes in seasonal patterns. In Asia, potential changes in the monsoon and in glacier and snowmelt are perhaps the greatest threats. Sea-level rise is also of great concern as coastal and deltaic areas are often heavily populated and intensively cultivated. The natural and managed habitats of fish will be greatly influenced, with declining productivity in fisheries very likely. The report recognizes that, with only a decade of research on climate change adaptation, considerable knowledge gaps remain concerning the adaptive capacity of agriculture.

Climate variability and risk has always been a part of agriculture, and farmers have developed many ways of coping with and managing risk. Enhancing coping and adaptation strategies is an important part of the work of the CGIAR, e.g. developing drought-resistant and other abiotic stress-tolerant crop varieties, and soil and water management practices for marginal areas. Climate change introduces a new dimension to the problem. The unprecedented rate and magnitude of climate change presents great challenges to farmers, researchers and policy makers alike.

Current efforts to increase adaptation and mitigation options provide a sound basis for the next phase of research on climate change and agriculture. However, this phase must go far beyond current activities. New responses are needed, as well as new ways of working with partners and also in conjunction with the other CGIAR MPs. These must be instilled with a degree of urgency, reflected in the research agenda and its implementation, and in the delivery and outreach of outputs.

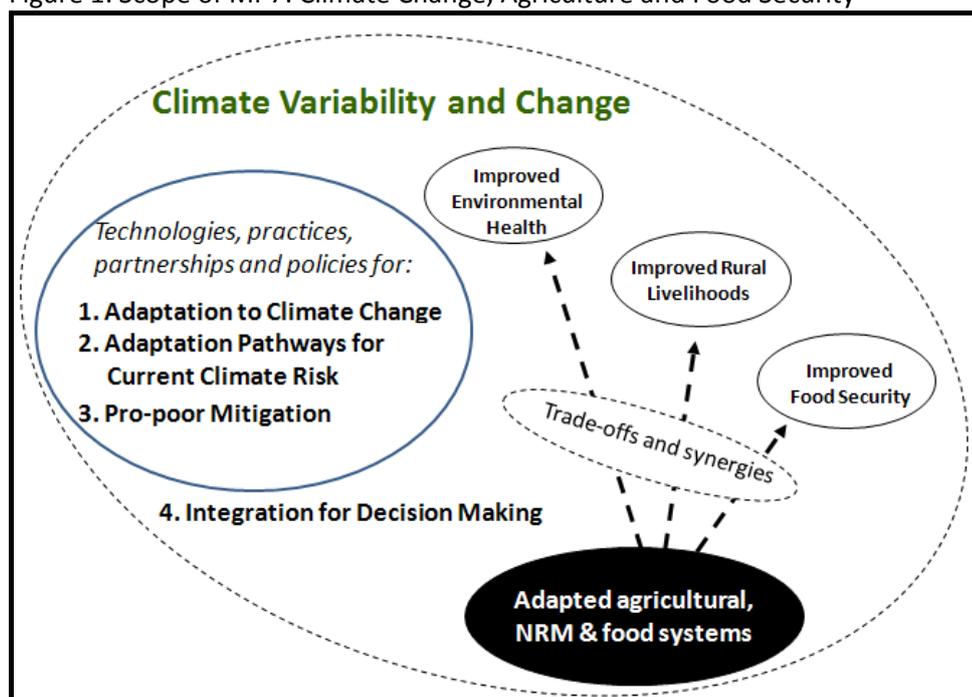
Vision of success and intended impacts

MP7 is designed to contribute to improved agricultural, natural resource management and food systems (Figure 1). Impacts are sought in three dimensions: (a) environmental, in particular related to reducing emissions and improving carbon storage; (b) enhancing rural livelihoods, by reducing vulnerabilities, increasing adaptive capacity, securing assets and raising incomes; and (c) improving food security⁴. While much of the focus will be on agricultural production, the entire food system will be targeted, as solutions to the challenges posed by climate change have to go beyond agricultural production⁵. The three dimensions in which MP7 seeks impact correspond to different groups of ultimate beneficiaries. For impact on livelihoods, the ultimate beneficiaries are resource-poor farmers and other members of the rural and peri-urban poor associated with the agricultural sector. These groups will benefit through reduced vulnerabilities, raised adaptive capacity and higher incomes. For impact on food security, MP7 seeks to help not only the rural poor but also the urban poor that number among the world's one billion undernourished. For impact on environmental health and carbon storage, there will be both local beneficiaries and a global public goods benefit. Although the notion of securing win-win-win outcomes for these three dimensions is appealing (Global Donor Platform, 2009; FAO 2009a), we have to recognize the possibility of trade-offs among these dimensions (Campbell, 2009; FAO, 2009b).

⁴ **Food security** is the state achieved when food systems operate such that “all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO, 1996).

⁵ **Food systems** encompass (i) activities related to the production, processing, distribution, preparation and consumption of food; and (ii) the outcomes of these activities contributing to food security (Ericksen, 2008).

Figure 1. Scope of MP7: Climate Change, Agriculture and Food Security



By achieving impacts on livelihoods, hunger and environmental health, MP7 will contribute directly, along with the other CGIAR MPs to the Strategy and Results Framework (SRF) for the CGIAR.⁶ MP7 has the following impact targets, derived through our own analyses (e.g. see below and Annex 2) and from the analyses undertaken for the SRF:

- By 2020, help reduce poverty by 10%, increasing the incomes of hundreds of millions of people
- By 2020, contribute to a reduction in hunger, cutting the number of rural poor who are undernourished by 25%
- By 2020, help agriculture contribute to climate change mitigation by enhancing storage or reducing emissions, by 1000 Mt CO₂-eq (considering all gases) below the “business-as-usual” scenario.

The vision of success for MP7 includes surpassing these impact targets, achieving the multiple outcomes of MP7 (Table 1), and being recognized, together with partners, as the foremost global source of relevant research results that lead to options and strategies for tackling food insecurity in the face of climate change. In terms of the new CGIAR, MP7 seeks to become a hub that facilitates collective action across multiple Centers and CGIAR MPs.

Evidence that intended impacts can be achieved

To achieve the impacts listed above, MP7 has planned for 12 key outcomes (Table 1). In addition, as linear pre-determined pathways to impact are the exception rather than the rule (Biggs, 1990), MP7 will also put in place procedures and systems for exploiting the opportunities that emerge for outcomes. The planned outcomes cover an inter-woven package of technologies, approaches and policies for both adaptation and mitigation, and are targeted at various levels, from the farm to the global policy arena.

MP7 will work on outputs that are directly relevant to the outcomes listed above. The outputs will, *inter alia*: improve the effectiveness of research undertaken in other CGIAR MPs so that they incorporate the effects of climate change; identify climate risk adjustment strategies to reduce variability in production; and develop mechanisms by which small farmers can participate in carbon markets.

⁶ CGIAR (unpublished). *Draft Strategy and Results Framework for the CGIAR*. Document submitted for discussion at the Global Conference on Agricultural Research for Development (GCARD) 20 March 2010.

In order to reach the desired impacts, at a scale well beyond the sites where field trials and surveys will be undertaken, MP7 will partner with some of the major international multi-lateral and non-governmental agencies, while at the same time being grounded in work with national agricultural, natural resource, environmental and meteorological agencies, the private sector and local non-governmental organizations (NGOs). By influencing global and regional policy processes, MP7 and its partners will also be able to scale up impact. Considerable attention will be given to ensuring coherence across the scales of operation (Cash et al., 2006).

The technologies, practices and policies that are developed will have direct effects (e.g., through agricultural productivity increases, with a 10% increase assumed by 2020) and indirect effects (e.g., lower food prices and increased gross domestic product (GDP) growth rates brought about by agricultural development). We estimate for sub-Saharan Africa (SSA) that there are about 260 million poor in the rural sector who are likely beneficiaries for direct effects, and about 150 million urban poor and 150 million rural poor (poorest of the poor) who are likely beneficiaries for indirect effects (Annex 2). Similar kinds of data and analyses are not available for other parts of the globe, but it can be seen that the number of potential beneficiaries runs into hundreds of millions (within the first five years of MP7, one of the research outputs is a sophisticated *ex ante* assessment tool to evaluate the likely impacts of different research and development approaches).

Modest successes in reducing GHG emissions, perhaps 10% reductions below “business-as-usual” scenarios, in concert with similar levels of improvement in the substitution of fossil fuels by biomass energy, can enhance global climate mitigation by agriculture for the period 2015–2020 by about 1000 Mt CO₂-eq. (considering all gases) below the “business-as-usual” scenario⁷. Intensifying agriculture in existing cultivated and grazed areas while limiting the expansion of extensive production practices into carbon-rich landscapes (e.g. forests in West Africa and grasslands with high soil carbon in the Andes) will be a major route to reducing emissions. If deforestation through agricultural expansion can be reduced by 10% for the period 2015–2020 through agricultural development pathways that involve intensification, a further 500 Mt CO₂-eq. (approx) can be stored. It is also assumed that mitigation initiatives by smallholder farmers will be rewarded, with incomes being supplemented by up to US\$50 per household per annum in some cases.

Table 1. Outcomes planned in each of the four Themes, over a 5–10-year time horizon⁸

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| Theme 1: Adaptation to Climate Change |
| Outcome 1.1: Agricultural and food security strategies that are adapted towards conditions of predicted climate change promoted by the key development and funding agencies (national and international), civil society organizations and private sector in at least 20 countries. |
| Outcome 1.2: Strategies for addressing abiotic and biotic stresses induced by future climate change, variability and extremes, including novel climates mainstreamed among more than 75% of the international research agencies, and by national agencies in at least 12 countries. |
| Outcome 1.3: Portfolio of information sources, guidelines and germplasm available for using genetic and species diversity to enhance adaptation and resilience to changing climate are adopted and up-scaled by national agencies in at least 20 countries and by international organization for the benefits of resource poor farmers. |
| Theme 2: Adaptation Pathways for Current Climate Risk |
| Outcome 2.1: Systematic technical and policy support for farm- to community-level agricultural risk management strategies that buffer against climate shocks and enhance livelihood resilience in at least 20 countries. |
| Outcome 2.2: Better climate-informed management by key international, regional and national agencies of food crisis response, post-crisis recovery, and food trade and delivery in at least 12 countries. |
| Outcome 2.3 Enhanced uptake and use of improved climate information products and services, and of information |

⁷ For original figures see: Smith et al. (2008).

⁸ Achievement of some of these outcomes will require close collaboration with the other CGIAR MPs.

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| about agricultural production and biological threats, by resource-poor farmers, particularly vulnerable groups and women, in at least 12 countries. |
| Theme 3: Pro-Poor Climate Change Mitigation |
| Outcome 3.1: Enhanced knowledge about agricultural investments that leads to better decisions for climate mitigation, poverty alleviation, food security and environmental health, used by national agencies in at least 20 countries. |
| Outcome 3.2: Improved knowledge and tools to support carbon market development to be used by buyers, sellers (including farmers' organizations) and intermediaries for crop-soil management, agroforestry, coastal and irrigated rice systems in at least 20 countries. |
| Outcome 3.3: Key agencies dealing with climate mitigation in at least 20 countries promoting new institutional arrangements and incentive systems that favor resource-poor farmers, particularly vulnerable groups and women. |
| Theme 4: Integration for Decision Making |
| Outcome 4.1: Appropriate adaptation and mitigation strategies mainstreamed into national policies in at least 20 countries, in the development plans of at least five economic areas (e.g. ECOWAS, EAC, South Asia) covering each of the targeted regions, and in the key global processes related to food security and climate change. |
| Outcome 4.2 Improved frameworks, databases and methods for planning responses to climate change used by national agencies in at least 20 countries and by at least 15 key international and regional agencies. |
| Outcome 4.3 New knowledge on how alternative policy and program options impact agriculture and food security under climate change incorporated into strategy development by national agencies in at least 20 countries and by at least 15 key international and regional agencies. |

Strategic goals

The overall goal of MP7 is *to promote a food-secure world through the provision of science-based efforts that support sustainable agriculture and enhance livelihoods while adapting to climate change and conserving natural resources and environmental services*. Working with national and regional partners, promising adaptation options will be identified and evaluated, and through modeling approaches their efficacy in adapting agricultural systems will be quantified and used to provide detailed adaptation pathways at the national, regional and global levels.

MP7 will address this goal by generating the knowledge base and toolsets needed to empower farmers, policy makers, researchers and civil society to manage agricultural and food systems successfully so as to strengthen food security, enhance rural livelihoods and improve environmental health in the context of the challenges arising from current climate variability and progressive climate change.

The over-arching objectives of MP7 are:

1. To identify and develop pro-poor adaptation and mitigation practices, technologies and policies for food systems, adaptive capacity and rural livelihoods.
2. To provide diagnosis and analysis that will ensure the inclusion of agriculture in climate change policies, and the inclusion of climate issues in agricultural policies, from the sub-national to the global level in a way that brings benefits to the rural poor.

The proposed program

Program design

MP7 is designed to help deliver impacts at global, regional and national levels cost-effectively, with a strong emphasis on capacity building, inclusiveness — particularly of women and other marginalized groups – and on pragmatic recognition and evaluation of trade-offs among food security, poverty alleviation and environmental health objectives.

The global Themes

MP7 is structured around four global Themes (Figure 1). Three of these involve field-based testing of adaptation and mitigation technologies in benchmark sites in the targeted regions. These so-called “place-based” Themes will identify and develop technologies, practices, partnerships and policies that will reduce the vulnerability of rural communities to a variable and changing climate:

- Theme 1: Adaptation to Climate Change
- Theme 2: Adaptation Pathways for Current Climate Risk
- Theme 3: Pro-poor Climate Change Mitigation

Themes 1 and 2 identify and assess adaptation pathways at different time-scales. Theme 1 tackles decadal time periods (mostly 2020 to 2050), while Theme 2 addresses current risks associated with climate variability. In the shorter term, since rain-fed farmers, pastoralists and coastal fishers are already vulnerable to current climate shocks, it is essential to help them build resilience through better information and strategies to deal with current climate-induced risk. Not only will greater resilience allow farmers and fishers a wider range of adaptation options in the future, but perhaps more important is the assumption that variation will be even more extreme under climate change. Collectively, these three Themes will demonstrate and assess the feasibility, effectiveness and acceptability of integrated strategies for advancing food security, rural livelihoods and environmental goals in the face of a changing climate; and will identify and prioritize institutional and policy options for overcoming obstacles to implementing these strategies at the scale of the development challenge.

Theme 4 – Integration for Decision Making – provides an analytical and diagnostic framework for the whole of MP7. It also ensures effective engagement of rural communities and institutional and policy stakeholders, and grounds MP7 in the policy context. It will ensure that principles for linking knowledge with action for sustainable poverty reduction (Kristjanson et al., 2009) are applied and local innovation capacity is strengthened. In doing vulnerability assessments and building integrative *ex ante* assessment tools, this Theme helps set the agenda for the place-based Themes, and as such will also provide support to other CGIAR MPs. Theme 4 also provides the framework and tools for baseline diagnosis and ongoing monitoring and evaluation. The policy environment increasingly influences the opportunities and constraints affecting local and national-scale actions that can be taken in response to a changing climate, thus boundary spanning strategies for linking the science to policy at various levels will be critical. Understanding vulnerability, jointly identifying appropriate interventions and assessing their effectiveness with partners, and leaving a sustained legacy of improved decision-making and improved information flows, all depend critically on effective modes of engagement with a range of stakeholders.

Beneficiaries

The three dimensions in which MP7 seeks impact correspond to different groups of ultimate beneficiaries. For impact on rural livelihoods, the ultimate beneficiaries are resource-poor farmers and other members of the rural and peri-urban poor associated with the agricultural sector, including pastoralists, fishers, sawyers, users of wild resources, landless agricultural labourers, local traders, input suppliers and processors. These groups will benefit through reduced vulnerabilities, raised adaptive capacity and higher incomes. For impact on food security, MP7 seeks to help not only the rural poor but also the urban poor

that number among the world's one billion undernourished. For impact on environmental health and carbon storage, there will be both local beneficiaries and a global public goods benefit.

MP7 will reach its ultimate beneficiaries through different sets of carefully selected proximate beneficiaries for each Theme and Objective. These are detailed in the description of the MP7 portfolio (final selection of many national partners will occur once countries and sites are selected). To demonstrate the diversity with a few examples, proximate beneficiaries will include public, private and civil society sectors, and will range from global bodies and processes such as the United Nations Framework Convention on Climate Change (UNFCCC), the World Food Program and the Voluntary Carbon Standard through to organizations and change makers at national and local levels, such as farmers' groups, research stations, insurance companies and government departments.

The regional approach

Place-based research will be undertaken at several spatial levels within so-called "target regions", and will share common research sites and infrastructure where appropriate. While there are many regions in the developing world that warrant research investment, MP7 will not overstretch itself. It will initiate work in three target regions in 2010, add two regions in 2011, and a further three regions in 2012. The three initial focus regions are eastern Africa, West Africa and the Indo-Gangetic Plains (IGP). Criteria for selecting the initial focus regions were:

- Poverty and vulnerability: high degree of vulnerability to climate, large poor and vulnerable populations, drivers of vulnerability that extend beyond the focus region
- Complementary set of social, cultural and institutional contexts
- Complementary climatic contexts, with different temporal and spatial scales of climate variability and degrees of predictability
- Significant but contrasting climate-related problems and opportunities for intervention
- Security, governance and institutional capacity that favor the likelihood of scaling-out results.

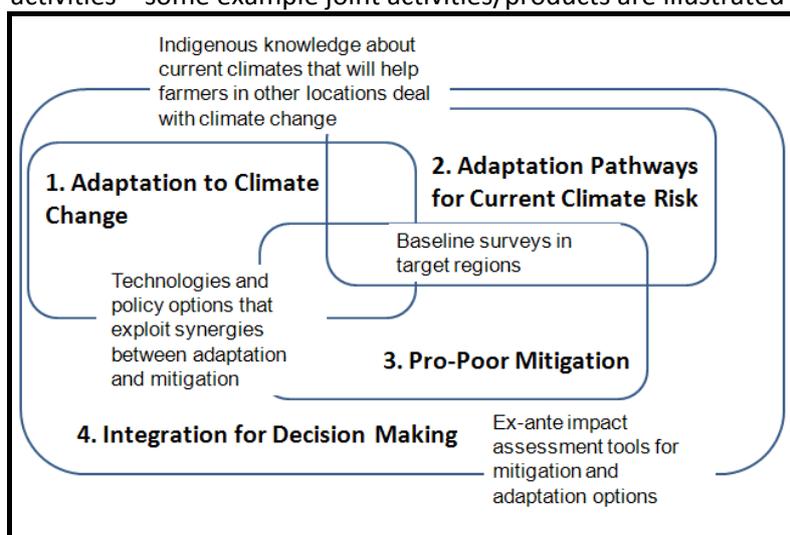
A range of regional partners will be involved in the final selection of field sites and countries within target regions. By early 2011 the initial vulnerability studies undertaken by Theme 4 (Objective 1) will be complete, and will be used to help identify the regions to be selected in 2011 and 2012. The stakeholder meeting in May (2010) identified the key criteria to be used in making the selection of future regions.⁹ Work will not be conducted exclusively in target regions, as a series of global comparative analyses are planned, where site selection will be guided by the thematic and impact considerations.

Achieving coherence among Themes

The agricultural sector is where the adaptation and mitigation agendas are most closely interconnected (Global Donor Platform, 2009). In consequence, the place-based work has to be planned and implemented in a coordinated manner, especially as farmers have to grapple with both adaptation and mitigation issues simultaneously (Figure 2). Theme 3 will have a specific focus on the synergies and trade-offs between adaptation and mitigation strategies. Themes 1 and 2 also have to be implemented in a coordinated manner, as current farmer strategies, coping mechanisms and indigenous knowledge give important insights on how to tackle future climate change. Finally, all the place-based themes will be tied closely to Theme 4, to ensure the tools developed and policy analyses conducted in the latter are useful to the place-based Themes. To achieve this coherence, strong attention will be given to a team approach to planning and implementation, and MP7 will develop a common conceptual framework, will conduct specific activities jointly, and will task Regional Facilitators in building the linkages across Themes in the target regions.

⁹ These will shortly be available on the internet, together with the full stakeholder report (Nairobi Stakeholder meeting, 4-7th May 2010).

Figure 2. Coherence among MP7 Themes needs to be fostered through team work, strong conceptual underpinning and joint activities – some example joint activities/products are illustrated



One of the specific activities that will be conducted to build coherence across Themes will be scenario development (Theme 4, Objective 1). Identifying viable technological and policy options to improve food security in the face of climate and other environmental changes requires improved dialogue between researchers, the policy process and resource managers. Scenario analyses conducted at the regional level and linked to the global level will help to systematically explore such options. These scenarios will form an important aspect of communications and capacity building and will help build regional science and policy teams who can take the MP7 outputs forward. Scenario-building carried out under MP7 will also inform decision-making in the other CGIAR MPs.

Research outputs will be *integrated across Themes within regions* to provide regional public goods linked to specific impact strategies (e.g. work from Theme 1 Objective 3 on diversification strategies to reduce risk and from Theme 2 Objective 2 on improved weather forecasting for managing extreme weather events, will be linked to the key players managing regional crisis preparedness). Research outputs will also be *integrated across regions within Themes* to provide generic understanding and other international public goods (IPGs), feeding into global impact strategies.

Communications and early wins

Part of the vision of success for MP7 is that it becomes the “go-to place” for key stakeholders to seek relevant evidence, knowledge and tools to formulate options and strategies for tackling food insecurity in the face of climate change. MP7 will have an ambitious, well-resourced, proactive communications strategy. A focus of the research strategy will be on developing and implementing innovative approaches to strengthen the link between research, policy and practice. Partnerships will be essential, especially with organizations that communicate directly with farmers, and with global and local media to capture the attention of policy makers and general interest groups in public, private and civil society sectors.

MP7 will use outreach tools geared to specific audiences to communicate knowledge, evidence, tools and other outputs, and to maintain a two-way conversation with stakeholders. Outreach tools have been chosen to reach a good balance between indirect communication from a “basic” platform (website), direct communication (newsletters, briefings, Climate–Agriculture Policy Letters¹⁰ and journal articles), and dialogue among stakeholders (events, webinars, blog). Particular effort will be put into a dynamic Agriculture and Rural Development Day (ARDD) at the annual UNFCCC Conference of Parties (COP), aimed

¹⁰ Once per month, a one page carefully crafted policy message drawing on peer-reviewed literature will be sent to the 5000 individuals in the global and regional communities that are setting the agenda for climate change, agriculture and food security.

at raising the visibility of agriculture and food security in the global climate dialogue¹¹. Materials for communication will go beyond MP7 products, drawing in all noteworthy advances in science that link climate change, agriculture and food security. Building relationships with the media will be a strong focus, with a systematic approach to preparation, timing and networking carried out in close cooperation with the Consortium Office communications team, the ESSP Communications Office, and the communications teams of the main participating centers.

Communication beyond research circles requires highly relevant research in accessible and tailored formats. An early task for MP7 will be to communicate the major near-term outputs, which will include:

- Identification of current farmer practices that have relevance to future climate change (Theme 1)
- Analysis of how institutions concerned with management of food crises and price volatility respond to current climate information systems and how this response could be more accurate and timely (Theme 2)
- New practical systems for measuring GHG emissions at farm level, relevant to resource-poor farmers wishing to participate in carbon markets (Theme 3)
- New vulnerability characterization of agricultural systems for the global tropics to enhance targeting (Theme 4).

Roles of CGIAR Centers and other partners

The CGIAR is in a unique position to lead MP7 due to its 30+ years' experience in agricultural research, which including aspects of climate change. Most CGIAR Centers are specialized in a particular commodity or a particular system, making their contribution to MP7 very complementary. The cross-center collaboration and alignment of research on agriculture and climate change will be a fundamental aspect of MP7. Examples for center-specific contributions, and ultimately cross-center collaboration, include (a) hotspot and vulnerability assessments (CIFOR, CIMMYT¹², CIP, ICARDA, ILRI, WorldFish); (b) development of heat and drought-resistant germplasm (AfricaRice, CIMMYT, IRRI, IITA, ICARDA); (c) climate change modeling (Bioversity, CIAT, ICARDA, ICRISAT, IFPRI, ILRI, IWMI, World Agroforestry Centre); (d) informatics tools for selecting germplasm with desired traits (Bioversity, ICARDA); (e) mitigation options (CIAT, CIFOR, CIP, ICRISAT, IFPRI, ILRI, IWMI, World Agroforestry Centre); (f) responses of pests and diseases to climate change (CIAT, CIP, IITA); and (g) policy research (Bioversity, CIAT, CIFOR, ICARDA, IFPRI, World Agroforestry Centre).

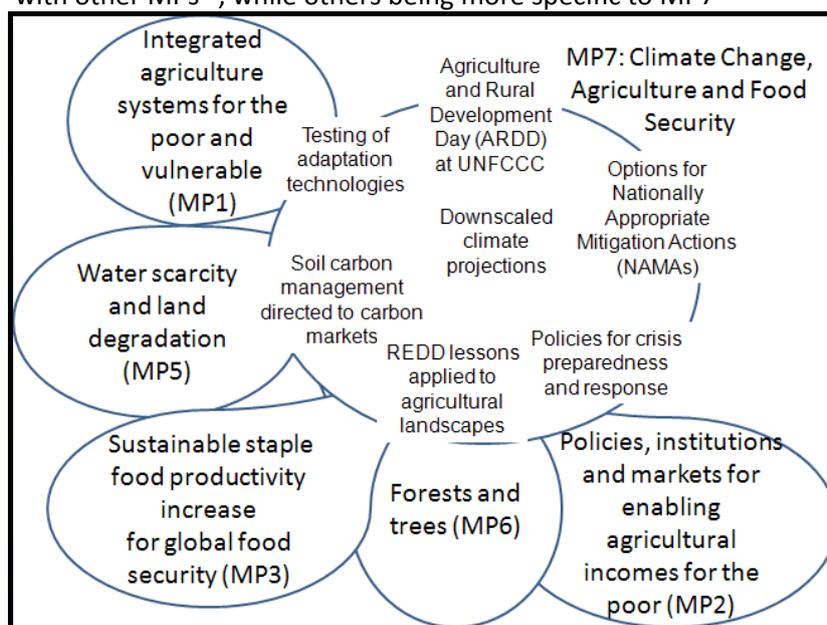
MP7 involves a large body of innovative research with specific impact pathways and strategies. It also has a major role to play in mainstreaming climate-related research into all the CGIAR MPs (Figure 3). This would involve four areas of activity: (a) providing tools, methods and data that can be used in climate-related work in all the CGIAR MPs (e.g., methods for vulnerability assessment, downscaled climate scenarios for specific regions, modeling tools for linking climate and agricultural impact models); (b) providing platforms for multi-site comparative work that will be implemented within diverse CGIAR MPs (e.g., testing of specific management systems across regions); (c) producing syntheses across CGIAR MPs that relate to climate change; and (d) providing the partnerships and opportunities for MPs to deliver results that are relevant to the climate change agenda.

¹¹ ARDD 2009 was regarded as highly successful:

<http://www.ilri.org/regionalplan/documents/Collective%20Action%20News%20December%202009.pdf>

¹² See list of acronyms for expansions of all acronyms in bracketed lists.

Figure 3. Mainstreaming climate-related research into all CGIAR MPs – some illustrative activities/products in MP7 – some closely aligned with other MPs¹³, while others being more specific to MP7



The other MPs will, in turn, collaborate with MP7 in order to develop and provide technologies and information highly relevant for the success of MP7. These include drought and heat tolerant germplasm, water-efficient technology options that contribute to water saving, conservation agriculture practices that increase farming system resilience and adaptation of communities and production systems. MP3 will develop and provide N-efficient varieties and management options that reduce demand for N-fertilizer and sustainable systems that increase carbon sequestration, reduce demand for fossil fuels and directly contribute to mitigation of climate change. MP7 will, in turn, test these technologies in its pilot sites and associated production systems for matching the most promising options with sites and local strategies for their adaptation and dissemination.¹⁴

MP7 offers the opportunity to propose practical methods to operationalize coherence across CGIAR MPs by, for example, developing data collection protocols on which other CGIAR MPs can build, benchmark sites and collaboration on specific research Themes according to each program's comparative advantage. Specific joint activities are planned in the regional sites with MP1, given that program's system- and place-based focus (e.g., work in the Brahmaputra–Ganges–Megna focus region of MP1 will be integrated with MP7 work in IGP). Furthermore, MP7 will provide insights into the strategies required for addressing breeding to address the challenges of climate change; for example, through feeding into the development of breeding strategies (Theme 1, Objective 2) to feed into MP3, and subsequently evaluating the research products coming out of MP3 for their capacity to adapt agriculture to a 2030 climate and beyond. Some of these technologies, such as the development of multiple disease and insect pest-resistant crop germplasm that could be adopted by resource-poor farmers in areas vulnerable to climate change, would be housed in other MPs and carried out by various centers including CIMMYT, IRRI, IITA, CIP and ICARDA.

To ensure impact, strategic partnerships will play a fundamental role. Research within the Themes will be designed by members from the research and policy communities and local partners so as to: (i) maximize benefits to regional/national policy formulation by addressing issues co-defined by regional and national stakeholders; (ii) help transform the research agenda to more effectively deliver the information needs for

¹³ Titles of MPs are likely to undergo further change.

¹⁴ The exact boundaries between MPs need to be examined by the Consortium Board. For example, different components in MP3 propose different mechanisms for testing the technologies they are developing (in MP3, in MP1 and in MP7).

improved food security policy formulation; and (iii) raise awareness of climate change issues among agricultural and food policy makers and resource managers.

Given the regional focus of much of the place-based work, the key regional players will be engaged (and this is happening in the regions targeted for initial work in 2010, e.g. ACMAD, AGHRYMET, ASARECA, FARA, ICPAC, WECARD). Uptake at the national level will require strategic national partners (e.g. think tanks, NARES, NGOs, NMS) to benefit from their ability to understand and influence policies in support of small-scale agriculture, but final selection of partners awaits the country selection process. Key partners in scaling out impact will be the large international NGOs (with initial contacts made with CARE, IIED and Oxfam). On the global policy level, key partners will be influential civil society and advocacy groups able and in a position to voice findings from MP7 research in the global policy debate (e.g. Oxfam) as well as the international development agencies, with whom a major partnership has been developed through ARDD 2009 (e.g. FAO, GFAR, Global Donor Platform for Rural Development, IFAD, IFAP). The key to success will be engagement with the private sector (e.g. insurance companies for weather index-based insurance schemes, coffee and cocoa firms and banks for carbon payments, and the major players at the international level in terms of global outreach and impact)¹⁵.

MP7 has an innovative feature in its formal alliance with the ESSP community. The marriage of CGIAR (whose comparative advantage lies in data and knowledge about diverse local contexts and landscapes) with the ESSP community and their sophisticated climate models will enhance the quality and pertinence of joint research outcomes (e.g., higher-resolution, spatially-explicit models and improved quantification of uncertainty through ensembles). To realize a constructive collaboration, MP7 plans to establish and contribute to exciting platforms for allowing exchange and engagement between the CGIAR and ESSP communities. Bringing together the “climate world” and the “development world” will happen at all levels (e.g., also involving the national and regional climate/meteorological agencies and their agricultural counterparts). Additional research partnerships are being developed with Advanced Research Institutes (ARIs) such as CIRAD, CSIRO, the Resilience Alliance, and numerous Universities.

Management mechanisms¹⁶

The governance and management system is based on lessons learned by the CGIAR in other initiatives involving multiple centers and partners, including Challenge Programs (CPs)¹⁷. A key lesson is that “*a governance body that is composed of independent individuals with no institutional connection to consortium members or CP partners appears to have more advantages and higher potential for effective and efficient performance. However, it should also take into account the need for support provided by a host institution as a legally constituted entity. Programmatic decisions should be left entirely to the CP’s steering committee.*”¹⁸ MP7 is characterized by all Centres having a stake, with no one Centre standing out as a lead Center either thematically or budget-wise, and an on-going commitment to a major international partner (ESSP).

It is proposed that MP7 have an Independent Scientific Panel (ISP), an independent Program Secretariat and a Host Center¹⁹ (see Figure 4; and Annex 3 for further details). The Secretariat will be comprised of a Program Leader supported by a Program Management Team and 4–6 staff. The Program Leader should report directly to the ISP.

The **Independent Scientific Panel (ISP)** will give advice on priority setting and on the strategic allocation of resources as outlined in proposals, annual workplans and proposed budgets, to ensure that the needed set

¹⁵ Inputs into this area of work will be given by key players in the private sector at a forthcoming meeting in Venice (Unilever, Mars, Monsanto)

¹⁶ Acknowledge, with thanks, advice from governance expert Markus Palenberg.

¹⁷ E.g. Woolley et al. 2009; CGIAR Science Council, 2008.

¹⁸ CGIAR Science Council and CGIAR Secretariat, 2007.

¹⁹ “Host Center” is favored over “Lead Centre” given its functions.

of partners and Centers participate in MP7. Decisions about programs should be taken by the ISP alone, without the participation of the Host Center’s observer. This arrangement ensures independence of the MP’s decisions and shields the Host Center from real or perceived conflict of interest. The ISP will lead selection panels for the Program Leader and Program Management Team. The ISP will also play a role in assessing the quality of the research and management systems through an annual monitoring system. The Consortium will appoint the ISP, and the ISP will be primarily responsible to the Consortium. The ISP will interact regularly with the Host Center and with the Secretariat. The ISP will have a Chair, nine members, and three observers. The cost of the ISP is estimated to be \$120,000 per year, a small percentage of the total budget.

The **Secretariat** will facilitate the implementation of MP7, in particular the coordination of activities across Centers and other partners; the preparation of proposals and workplans; the compilation of annual monitoring indicators; and the production of synthesis products and reports. The Secretariat will have a very small staff, as the bulk of activities will be implemented through Center staff (e.g. communications activities, database management, capacity building) through contractual relationships between the Secretariat (as represented by its Host Center) and Centers.

The **Program Leader** will be appointed by the Consortium Board. The Program Leader will be responsible for the day-to-day decisions of MP7, key decisions being made in consultation with the Program Management Team, and with advice from the ISP and Host Center. The Program Leader will report to the Chair of the ISP. The Program Leader will make annual presentations to the Board of the Host Centre, given their financial, legal and institutional responsibilities.

The **Program Management Team** will assist the Program Leader in implementing MP7, and will take responsibility for particular implementation activities. The management team will comprise 5–8 individuals, namely key individuals implementing components of MP7, at least one of which is from the Host Center. These individuals will be drawn from the Theme Leaders (the individuals selected to lead the Themes or sub-themes) and Regional Facilitators (the individuals facilitating the research and engagement strategies within target regions).

Figure 4. Key governance and management structures and their major roles



The **Host Center** will be the main contracting body for MP7. It will sign the performance contract for MP7 with the Consortium Board, and sign the sub-contracts with participating Centers. The Host Centre will be represented as an observer on the ISP, and will have the right to review ISP and Secretariat decisions with respect to potential legal, financial or reputational risks that they may pose.

Participating Centers: A number of the participating Centers will have individual staff members who are on the Program Management Team. Clear arrangements need to be in place with respect to work that could conceivably be conducted under more than MP7. MP7 will operate on the principle that funding coming to MP7 can be allocated to Centers managing activities on the ground for other MPs, and that the Centers in question would manage the activities on the ground in an integrated manner (e.g. activities under MP7 and activities under MP3). MP7-related outputs, outcomes and impacts would be credited to MP7, while those related to other MPs would be credited to those MPs.

Transitioning from the CP to the new Program

The CP on Climate Change was initiated in late 2009 with ten three-year contracts issued in the last six months for key members of the CP team. That team is crucial in terms of the funded agenda, and that agenda needs to be implemented immediately. And, most importantly, that agenda is core to the new Program. A Steering Committee for the CP, selected by the Alliance and ESSP for their expertise on climate change, agriculture and food security, have only just completed one full year of operation.

It is thus proposed that there be a transitional period for management arrangements, where the old structures, with modifications, remain as key components of the transitional management system (see Annex 3). Two transitional phases are recognized, phase 1 for six months, where the current system remains in place, but where preparations are made for phase 2, and phase 2 of an additional 24 months, where new elements are implemented and, where necessary, recruitments are conducted. After 24 months a governance and management review is recommended, drawing on the experiences from this Program and other fast-tracked Programs.

Capacity building

MP7 will make a lasting difference through a strategic, fully embedded focus on capacity building. To achieve its overall goals, the two related areas in which MP7 needs to raise capacity are: (1) researchers' capacity to generate knowledge on managing agriculture and food security under climate change; and (2) multiple stakeholders' capacity to demand, shape and use this knowledge effectively to develop, implement and review policy and technical options in a dynamic environment. These stakeholders include members of farmers' organizations and other community-based organizations; frontline extension agents and development workers; policy makers in civil service departments, parliaments and funding agencies; opinion-formers in civil society, research organizations, national meteorological services (NMS), university networks and the media; and managers and strategists in businesses and NGOs. The vision for capacity development is to enable a co-learning approach between researchers and other stakeholders, building on and enhancing the knowledge and skills of both through structured cross-disciplinary interactions.

Three principles will guide capacity building within MP7. The first is to add value through partnership, by complementing existing capacity-building programs rather than establishing new programs, undertaking joint activities that build on comparative advantages and provide mutual benefits, and working with networks rather than single stakeholder groups. The second is to take a systems approach, acknowledging that capacity building requires institutional investment, not just training packages for individuals, and that agriculture and food security need innovation in governance and institutional change as well as technical agricultural advances to cope with the challenges of climate change. The third is to promote integration rather than add-on of capacity-building activities, ensuring that development of new tools, knowledge and evidence within the research themes includes strategies and resources for building the capacity of researchers and stakeholders to use, adapt and critique these outputs.

Each of the four research themes includes attention to capacity-building outcomes, achieved by working closely with partners. The global change System for Analysis, Research and Training (START, a non-governmental research organization within the ESSP that has a strong track-record in assisting developing countries to build the expertise needed to understand and respond to global and regional environmental change) will be a key partner. Others include the community-based adaptation network AfricaAdapt, women's organizations such as Women's Environment and Development Organization (WEDO) and university networks such as Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) and African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE).

In building researchers' capacity, MP7 will focus on mid-career scientists and post-graduate students, working with partners to provide opportunities for researcher capacity development in ways that also contribute to the research goals of MP7. Illustrative activities and outcomes will include:

- Establish a network of 20–30 PhD students working on GHG emissions from agriculture in the targeted regions (Theme 3)
- Pilot emerging options for agricultural mitigation and managing near-term climate risk, building local capacity in action research and communication (Themes 2 and 3)
- Provide for greater integration across disciplines, particularly between the global environmental change community and its large-scale modeling approaches and the localized agricultural and livelihoods research communities, for example through cross-disciplinary group projects or workshops (all Themes)
- Create opportunities in the form of research projects, internships and exchanges for students, early- and mid-career research scientists, and research-oriented policy makers (e.g. START associates) within MP7's research themes, with positive discrimination towards women and nationals of the regions (all Themes).

MP7 also aims to build capacity among farmers, policy makers, the private sector and civil society to develop knowledge-based policy options and to apply, monitor and adapt these options. MP7 will work strategically with partners to reach this wide spectrum of stakeholders, working with associations and organizations rather than attempting to reach many thousands of individual farmers. Activities and outcomes will include:

- Provide farmers' organizations, community-based natural resource management (CBNRM) institutions and development NGOs with a knowledge platform of promising adaptation practices, technologies and policies (Theme 1)
- Familiarize farmers' organizations, CBNRM institutions and agricultural development agencies with tools and data sets for climate-informed monitoring and prediction of crop, fishery and pasture production, and biological threats (Theme 2)
- Expose policy makers to opportunities, trade-offs and synergies for agricultural mitigation, enabling them to choose among complex options (Theme 3)
- Facilitate development and analysis of a structured range of plausible future scenarios for climate change, agriculture and food security with strategic stakeholder groups at regional level (Theme 4)
- Enable partners to develop better means of communicating information and tools to target under-served groups, which may include specialist technical groups (e.g. meteorological offices), socially or gender differentiated groups (e.g. pastoralists, herbalists or fishers), or private sector groups (e.g. insurance or mobile phone companies) (all Themes)
- Support linkages and knowledge sharing within and across different stakeholder groups (e.g. farmers' organizations, civil society groups working in food security, small-scale enterprise associations, and community-based adaptation networks) (all Themes, overseen by Regional Facilitators).

Gender

MP7 has an explicit goal of gender impact. This will involve understanding the underlying drivers of gender inequalities, then formulating strategies to tackle these disparities and provide inclusive access to emerging investments, tools and policies that deal with climate change. It has strong implications for how the research is carried out, and with whom. Special effort must be taken to hear from and listen to groups that

are frequently marginalized from influential networks (e.g. women in UNFCCC processes), and those least likely to have access to functioning markets and services (e.g. smallholders' access to carbon markets). This will require efforts towards seeing that both women and men are actively engaged in climate change related processes from local to global levels, so as to allow each gender to voice needs and priorities and be heard by policy makers.

Partnering with civil society women's organizations throughout the world – that have begun to act on the almost total exclusion of women from high level climate processes and negotiations – is key to our strategy. They include the Gender and Climate Change Network (GenderCC), the Gender, Environment and Sustainability Network, the Women for Climate Justice Network and the Women's Environment and Development Organization. Based upon the approach and lessons learned in the Fellowship Program African Women in Agricultural Research and Development (AWARD) of CGIAR's Gender and Diversity Program, we propose to set up a program targeting female scientists to work across the target regions of MP7. Our target will be that the first generation of female climate and agricultural professionals take up at least five positions within MP7, or are supported by partner organizations in their home countries by Year 10. We will also set appropriate gender participation targets with our partners and invest in enhanced female leadership and scientific capacity within local partner implementing agencies.

Other approaches and strategies for achieving gender impact include the following:

- Gender-disaggregated analyses of livelihoods and access to key resources, including information and finance, among resource-poor farmers
- Gender-related research questions, such as the role of gender roles and relations in constraining or enabling adaptation
- Gender-related targets related to partnerships for impact, as many local partner organizations tend to exclude women (e.g. farmer's organizations), developed with regional facilitators
- Gender-specific monitoring and evaluation (M&E) indicators developed (e.g. women's control of agricultural decision-making, women's participation in leadership positions in farmer organizations and regional climate and food security networks, etc)
- A competitive small grants program to facilitate innovative ideas for gender-responsive climate change, agriculture and food security research
- Synthesis 'white paper' on gender, climate change, agriculture and food security, based on site-specific analysis

Each of the four research themes has identified key gender-related research questions and outcomes, and gender-disaggregated strategies for achieving outcomes will be developed with partners. No less than 35% of each research theme and regional facilitator budgets will be targeted specifically towards efforts that are directed explicitly at examining differentiation in society, including gender differentiation. Theme leaders will be held accountable for developing and reporting on the gender indicators and targets identified with partners.

Foresight, priority setting and impact assessment

Targeting food security, poverty reduction and sustainable natural resource management interventions that are robust in the face of a changing and uncertain climate requires a strong *ex-ante* analytical capacity to diagnose points of vulnerability and assess the impacts and trade-offs between socioeconomic and environmental goals associated with alternative strategies. Major components of this MP will involve foresight studies, vulnerability assessment and *ex ante* impact assessment. These components will have a strong capacity-building component, ensuring persisting use of the methods beyond MP7, and a strong methodological component, developing new approaches to undertake such activities. In addition, baseline indicators in all target regions will be identified and collected in the first year of regional activities in preparation for impact analysis.

Foresight studies and action involve critical thinking concerning long-term developments, debate to create wider understanding of potential future trajectories, and action to help shape the future. These are all crucial activities in relation to climate change impacts and solutions, given that climates will progressively change over long periods, and given that a multitude of other drivers will influence how such change plays out for agriculture and food security. Thus, Objective 1 in Theme 4 is scenario development. In Objective 1 we will explore, with a range of stakeholders, possible scenarios of the future, potential options for influencing trajectories of change, and opportunities for achieving outcomes and impact. The stakeholder engagement process for the scenario development will draw on emerging results from all MP7 Themes. A major focus will be at the regional scale, but global and local work will also be conducted. Some participants will work at a number of scales (e.g. representatives from farmer's organizations will participate at regional level). Kok et al. (2007) recognise that a major methodological challenge is to achieve coherence and synergies when conducting scenario development across scales. MP7 will do novel work to tackle that challenge and will develop both qualitative scenarios and quantitative analyses, at all scales, as well as using modeling tools developed in Theme 4 Objective 2. Debate during the engagement process will inform priority setting.

Theme 4, Objective 1 will focus on vulnerability assessment, using novel techniques to capture elements of adaptive capacity in communities, and thus earmark areas where specific adaptation and mitigation options may be feasible.

Considerable effort in MP7 will be given to the development of *ex ante* tools for assessing the costs and benefits of different adaptation and mitigation options (Theme 4, Objective 2). These will be designed so as to examine the synergies and trade-offs among the different goals for MP7 (poverty alleviation, food security and environmental health). The tools will also be designed to assess the synergies and trade-offs between adaptation and mitigation options, a topic running throughout Theme 3. These tools need a comprehensive and quantitative framework that both interrogates and pulls together what is known about the climate system, how it may change in the future, the associated impacts on agro-ecosystems and the livelihoods of those who depend on them, food security, and feedbacks to the earth system. While much is known about many components, no integrated framework yet exists and there are key gaps and uncertainties in knowledge. The work proposed under Theme 4, Objective 2 is designed to address these gaps, many of which MP7 is uniquely placed to fill. By Year 3 these tools, supplemented where appropriate by such tools as the Delphi technique, will be used with regional and local partners to drive priority setting in MP7 and help determine the future allocation of funds to Themes and Objectives. The tools will also be international public goods (e.g. for use by development agencies in making strategic choices among different options).

While foresight debates, vulnerability assessments and *ex ante* tools can give insight into priorities, priority setting can be undermined by the self-interest of MP7 participants and institutional politics. This culminates in priorities and budget allocations that are more a result of self-centeredness and compromise than by strategic allocation of resources to those endeavors that will lead to the highest impact. MP7 is fortunate in that it cuts across the entire CGIAR, and if, for example, aquaculture is the key option within a specific context, then it should be possible to allocate funds in that direction. But for this to happen MP7 Secretariat and the Independent Advisory Committee need to be able to recommend those priorities to the Consortium Board, without pressure from the Host Centre or particular Centers. This independence then has to be a cornerstone of the governance and management system (see previous section).

A set of appropriate baseline indicators, on agricultural productivity, rural livelihoods, and biogeophysical attributes, will be collected in the study regions at the start, so that *ex post* impact assessment can be carried out. Care will be given to ensuring that indicators capture cross-scale impacts. Towards year 8, the integrated assessment framework described above will also be used for *ex-post* assessment of the research work, its outputs, and its outcomes, in relation to the baseline indicators.

Monitoring, evaluation and reporting

The MP7 Secretariat will establish an annual monitoring system, with a set of indicators and an annual report. Reports will also indicate progress against the stated activities and outputs in the annual plans. This system should be as simple as possible so as to not over-burden partners. The indicator data and reports will be compiled by the partners and synthesized by the Secretariat. The ISP will assess progress through this system and give feedback to the Secretariat and provide advice to the Consortium Board.

After 24 months a governance and management review will be conducted by independent evaluators, and after four years a comprehensive external evaluation of MP7 will be conducted.

Self-monitoring and self-evaluation will complement the above formal activities. Inter-institutional programs that tackle such complex issues²⁰ as those at the nexus of climate change, agriculture and food security, conducted at multiple scales, are difficult to implement in a coherent and impact-orientated manner. A professional facilitator, experienced in change management and the implementation of complex programs, will be employed to facilitate the exposure of weaknesses, the seizing of opportunities and, most importantly, the cohesion of the research and management team²¹. This activity will be conducted at least once per year and will allow for deep self- and team-reflection. MP7 needs to be implemented using adaptive management principles.

²⁰ Sayer and Campbell (2004).

²¹ In the MP7 proposal development phase, two such facilitated meetings were conducted.

Budget

MP7 Cost Summary

Notes

MP Project Title:

Proposal for Mega Program 7: Climate Change, Agriculture and Food Security

Estimated starting date:

1st November 2010

1

Program Costs

| Cost group | Description | 2010 | 2011 | 2012 | 2013 | Project Costs | |
|------------|--|------------------|-------------------|-------------------|-------------------|--------------------|------------|
| | | Amount (US\$) | Amount (US\$) | Amount (US\$) | Amount (US\$) | Amount (US\$) | |
| 1 | Personnel costs | 1.249.573 | 21.947.619 | 24.870.102 | 26.113.607 | 74.180.901 | |
| 2 | Travel | 174.359 | 3.062.458 | 3.470.247 | 3.643.759 | 10.350.823 | |
| 3 | Operating expenses | 668.376 | 11.739.424 | 13.302.613 | 13.967.743 | 39.678.156 | |
| 4 | Traning / Workshop | 87.179 | 1.531.229 | 1.735.123 | 1.821.880 | 5.175.411 | |
| 5 | Partners / Collaborator / Consultancy Contracts | 523.077 | 9.187.376 | 10.410.740 | 10.931.277 | 31.052.470 | |
| 6 | Capital and other equipment for project | 145.299 | 2.552.049 | 2.891.872 | 3.036.466 | 8.625.686 | |
| 7 | Contingency | 58.120 | 1.020.819 | 1.156.749 | 1.214.586 | 3.450.274 | |
| | Total | 2.905.983 | 51.040.974 | 57.837.446 | 60.729.318 | 172.513.721 | |
| 8 | Institutional Overhead (as a % of Direct program cost) | | | | | | |
| | | 17% | 494.017 | 8.676.966 | 9.832.366 | 10.323.984 | 29.327.333 |
| | Total Program costs | 3.400.000 | 59.717.940 | 67.669.812 | 71.053.302 | 201.841.054 | |

2

Program Funding

| Description | | 2010 | 2011 | 2012 | 2013 | Project Cost |
|----------------------|-----------------------------------|------------------|-------------------|-------------------|-------------------|--------------------|
| | | Amount (US\$) | Amount (US\$) | Amount (US\$) | Amount (US\$) | Amount (US\$) |
| Funding | | | | | | |
| | CGIAR Fund - (Window 1 & 2) | 2.000.000 | 34.844.168 | 39.483.919 | 41.458.115 | 117.786.202 |
| | Current Restricted Donor Projects | 1.400.000 | 23.766.063 | 26.930.685 | 28.277.218 | 80.373.966 |
| | Other Income | | 1.107.709 | 1.255.208 | 1.317.969 | 3.680.886 |
| Total Funding | | 3.400.000 | 59.717.940 | 67.669.812 | 71.053.302 | 201.841.054 |

3

Allocation of funds to MP7 to research themes etc.

| Description | | 2010 | 2011 | 2012 | 2013 | Theme Cost |
|-------------------------|---|------------------|-------------------|-------------------|-------------------|--------------------|
| | | Amount (US\$) | Amount (US\$) | Amount (US\$) | Amount (US\$) | Amount (US\$) |
| | Theme 1 | 1.076.408 | 18.906.134 | 21.519.482 | 22.595.456 | 64.097.480 |
| | Theme 2 | 629.265 | 11.052.476 | 12.580.232 | 13.209.244 | 37.471.217 |
| | Theme 3 | 786.255 | 13.809.862 | 15.718.765 | 16.504.703 | 46.819.585 |
| | Theme 4 | 712.678 | 12.517.543 | 14.247.812 | 14.960.203 | 42.438.236 |
| | University of Copenhagen and Lead Centre (ILRI) | 195.394 | 3.431.925 | 3.603.521 | 3.783.696 | 11.014.536 |
| Total allocation | | 3.400.000 | 59.717.940 | 67.669.812 | 71.053.302 | 201.841.054 |

4

Notes

1. The MP7 includes Bioversity, CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI, IWMI, WorldFish, University of Columbia, University Vermont, University of Leeds and Secretariat at University of Copenhagen. One of the CG centres will be host centre. AfricaRice and CIFOR do not wish to receive funds from the program
2. Three host institutions for Regional Facilitators in three new regions will be added in 2012
3. EU-IFAD, CIDA and Danida funds to CCAFS placed in "Current Restricted Donor Projects" window
4. This includes administration, communications and capacity building

Description of Program Portfolio

Theme 1: Adaptation to Progressive Climate Change

Rationale

Future farming and food systems will need to become better adapted to a range of abiotic and biotic stresses to cope with the direct and indirect consequences of a progressively changing climate manifested by higher temperatures, altered precipitation patterns and rising sea levels, for example. Germplasm improvement; improved crop, livestock, aquaculture and natural resource management; and enhanced agro-biodiversity have a proven track record of decreasing susceptibility to individual stresses, and will offer increasingly important solutions for adapting to progressive climate change (Jackson et al., 2007). Strengthening the adaptive capacities of farmers and other land and aquatic resource users requires a variety of strategies ranging from diversification of production systems to improved institutional settings and enabling policies (Tubiello et al. 2008; Beddington, 2010). Adaptive management to continually refine these strategies will be required. However, significant knowledge gaps exist as to what adaptations options are available, what their likely benefits are, and where and when they should be deployed.

For example, least-developed countries are required to submit National Adaptation Plans of Action (NAPAs) to the UNFCCC, whose Objectives are to identify priority activities that respond to their **urgent** and **immediate** needs to adapt to climate change. Many countries in SSA make no explicit mention of food security in NAPAs. This is just one example of the low level of preparedness of institutions and rural communities. Research for development must play a crucial role in providing cost-effective solutions to not only address current challenges facing rural development and poverty, but also ensure that despite climate change, society continues to develop and ensure food security at multiple scales from villages to the globe.

The challenges lie in the development of holistic approaches to adaptation to progressive climate change (Challinor et al. 2009), which consider the interactions of different technical and policy sectors (including management innovation that increases diversification). This would allow for the development of adaptation options that go beyond sector-specific management and lead to more systemic changes in resource management and allocation, such as targeted diversification of production systems and livelihoods (Howden et al., 2007). This Theme sees adaptation as an opportunity to improve agricultural and food systems through facilitated and targeted change, tracking climate over the coming decades. Impacts are not always negative; hence adaptation is a question of both mitigating or eliminating the negative impacts and taking advantage of the opportunities.

Objectives

The overall goal of this Theme is to build adaptive capacity and food systems that are more resilient to progressive climate change through the provision of technologies, practices and policies. Promising adaptation options will be identified and evaluated, and through modeling approaches their efficacy will be quantified and used to provide plans and strategies to establish detailed adaptation pathways of food systems at the national, regional and global level. The Theme will also provide a portfolio of adaptation options (technologies, practices and policies) that enable food systems to adapt to a 2030 world and beyond. Specifically, the Objectives are to:

- Test and design adapted farming systems to changing climate conditions in space and time through the development of improved choices and integration of crop, livestock, fish and natural resources management technologies;
- Develop strategies for addressing abiotic and biotic stresses induced by breeding for future climate change climatic conditions, variability and extremes, including novel climates;
- Identify and enhance deployment and conservation of species and genetic diversity for increased resilience and productivity under conditions resulting from climate change.

Research approach to International Public Goods

Through field-based evaluations of promising adaptation practices and technologies, and modeling and analysis of likely benefits of different adaptation options at the food-system level, detailed plans and strategies for adapting the food system over the coming decades can be developed. An underlying hypothesis is that agricultural and food systems will become increasingly vulnerable, as many countries in the target regions are producing below their realisable potentials due to a number of physical, economic and policy constraints. The principal research questions for this Theme include:

- How can global climate model (GCM)-based and regional climate model (RCM)-based, near-term (i.e., 1–2 decades) information be incorporated into the design of location-specific adaptation strategies that are robust across the range of possible climate realizations?
- How can climate-driven shifts in the geographical domains of crop cultivars, crop wild relatives, pests and diseases, and beneficial soil biota be anticipated and best managed to protect food security, rural livelihoods and ecosystem services?
- Given a rapidly changing environment of non-climatic drivers, what is the best approach for integrating individual technological, biodiversity management, livelihood, market adaptation and policy options into comprehensive local-level adaptation packages?

The kinds of research products envisaged include new modeling methodologies, new scientific insights into decision-making processes in the face of multiple uncertainties, tested adaptation practices, policies and technologies, and a more profound understanding of the role of socio-cultural factors in the process of enacting system level change.

New content and innovation

This Theme brings together state-of-the-art knowledge and research capacity in the many components of a farming systems through collaboration between multiple CGIAR centers, ARIs, NARES, civil society and private sector. This multi-disciplinary, multi-sectoral and multi-institutional approach to develop resilient farming systems that maintain or enhance food security despite a fundamentally changing climate is novel, needed and achievable. The use of solid climate science to provide projections of climate change with all uncertainties quantified, coupled with agricultural science modeling tools, and explicit expert knowledge of crops, agricultural production systems, food systems and food security has not yet been harnessed and used to truly understand how we can adapt to a 2030 climate and beyond.

Risks

The risks involved are due chiefly to the need for strong integration and significant collaboration with other Themes in MP7, and to the other CGIAR MPs. This risk must be managed through appropriate governance structures that go beyond MP7

Regional balance

This Theme is global in scope, with regional specificities for some Objectives. Theme 4 will provide support to the process of defining regional specificities, but it is fairly clear that the most vulnerable communities requiring support in adapting food systems are in many parts of Africa and South Asia (Thornton et al. 2008). However, regional pockets of food security problems also exist in Mesoamerica, the Andes, the Middle East, the Pacific Islands, and parts of Southeast Asia. Centers of origin for important wild and cultivated genetic resources do not necessarily occur in high-poverty regions, and hence some priorities for Objective 3 may lie in different areas to those of, say, Objective 1.

Linkages to other CGIAR MPs

This Theme is not designed to individually develop new adaptation technologies. Rather, it is designed to add value to technology development from other MPs by providing a climate change context (including leading climate science projections of climatic changes, toolkit of modeling approaches for examining agricultural system–climate interactions) and taking a holistic view to agricultural development plans and strategies under a changing climate. This will require close collaboration with numerous MPs, including:

- MP 1: System specific technologies and management regimes will be tested for their efficacy in a 2030 world and beyond;

- MP 2: Evaluation of adaptation options and strategies within value chains to enable coordinated adaptation from farm-gate to market;
- MP 3: Major collaboration envisaged, whereby Objective 2 supports the development of breeding strategies for major commodities in the face of climate change, and subsequently evaluates specific technologies coming out of MP3 for their efficacy in adapting to a 2030 world (new crop varieties developed under this MP, including the mainstreaming of GCP-based molecular breeding platforms to account for climate change; and Objective 3 builds climate-resilience-oriented germplasm selection and deployment tools initially developed within the Genetic Resources component);
- MP 4: Analysis of adaptation options that may feed back to nutrition and human health through shifts in the food system;
- MP 5: Testing and evaluation of water and soil management options for potential in enabling adaptation;
- MP 6: Building on the lessons of forest-based mitigation.

Theme 1 Objective 1: Adapted farming systems for changing climate conditions in space and time through the development of improved crops, livestock, farmed fish, and natural resources management, technologies and tools

Rationale and research questions

Today's farming systems are adapted, to the extent possible given resource endowments, to the current climate conditions they experience (Below et al. 2010), yet we know little about how well they will stand up to progressive climate change. Many broad-scale analyses identify potentially sensitive regions or crops under progressive climate change (Jones and Thornton, 2003; Parry, 2007; Jarvis et al., 2008; Lobell et al., 2008; Waddington et al., 2010), but there is sparse knowledge at the field, community or sub-national scale as to how well current farming systems can adapt, and what particular agricultural practices, technologies or policies are needed to enable adaptation.

This Objective is about identifying, developing and/or testing candidate adaptation options in production systems. Adaptation options include practices (agronomic innovations, planting strategies, pest/disease management, diversification), technologies (seed varieties, irrigation techniques such as supplemental irrigation and deficit irrigation, on-farm water harvesting etc.) and policies (local- to national-scale credits, subsidies, trade agreements, investment packages, insurance schemes, private-sector business models etc.).

Emphasis is made on both the testing and evaluation of existing practices, technologies and policies, some of which may be developed within other CGIAR MPs (e.g. new seed varieties in MP3), and in some cases on the development *per se* of new practices and technologies within this Objective which are particularly needed in order for our food systems to adapt (e.g. on-farm water harvesting, supplemental irrigation, new irrigation technologies). New technological development should only be made under this Theme if it is considered to explicitly contribute to enhanced adaptation potential of farming systems, and is not being dealt with in other MPs. This Program has neither the capacity nor the mandate to undertake large efforts for crop improvement; it is expected that this will happen entirely in MP3.

One significant novelty coming from this Objective will be the establishment of evaluation and testing sites where technologies coming out of other Programs are tested, not in isolation but together. This more holistic approach to production systems will bring about the possibility of examining how combinations of frontier agricultural technologies can together provide powerful adaptation pathways for farming communities.

Research questions include:

- What practices, technologies or policies are most effective in enabling adaptation for specific target regions, and what is needed to support their transfer?

- What are the institutions, markets and policies needed to ensure that individual farm-based adaptation contributes to broad-scale food system adaptation that result in enhanced food security at regional scales?

Activities

Objective 1 will require the characterization of adaptation options in target regions. It will entail the compilation of existing databases from multiple sources. An example includes the collation of multi-site trial data of a range of crop varieties, which can then be used to examine varietal potential for different future climates across a range of target environments. Another activity will include improving the understanding of institutional arrangements, policies and mechanisms that enhance the adaptive capacity of resource-poor households to adopt new farming practices, strategies and behaviors. Objective 1 will require the development of new technologies and testing across a range of pilot sites, to be identified and established in collaboration with other Themes in the MP. Objective 1 will include modeling activities to out-scale the potential of individual adaptation options across a wide-range of geographies, and through the use of analogs, for example, support field validation of adaptation options for 2030 in today's climates.

Products

- Portfolio of adaptation options with potential for adapting production systems identified, developed and/or tested;
- New and/or existing production system technologies developed and tested which contribute directly to enhanced adaptive capacity in farming systems;
- Document synthesizing institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors; what is working where, how and why, and what else is needed.

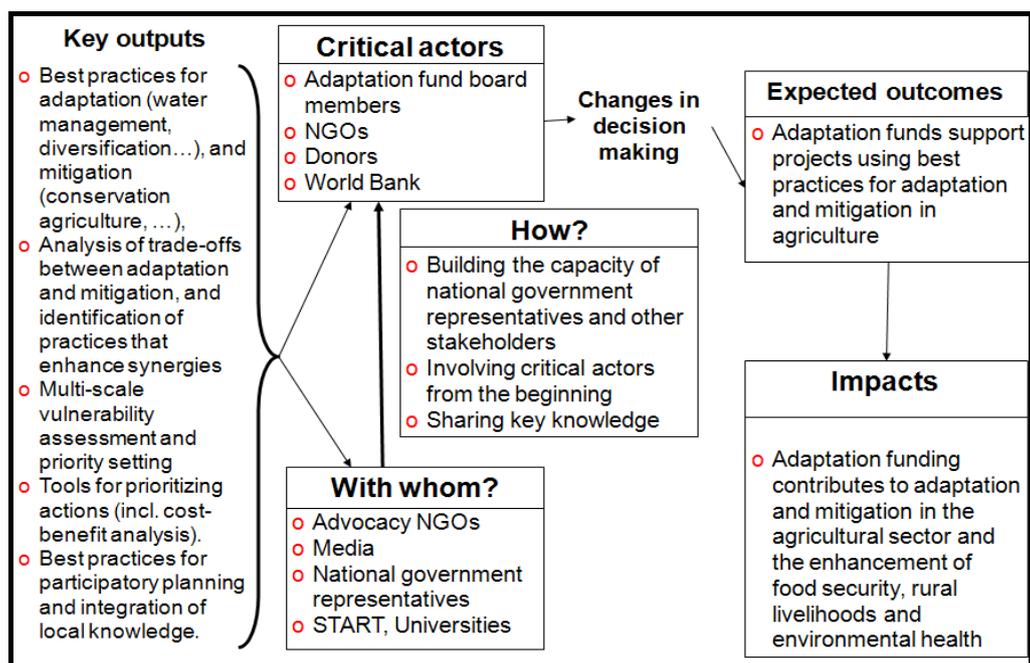
Partner roles

There is a strong emphasis of homeland CGIAR research in this Objective requiring the involvement of multiple centers, but strong collaboration with NARS is required, and with the ESSP in the generation of decadal climate forecasts among other things. The research within this Objective should be developed hand-in-hand with development practitioners interested in the dissemination and implementation of adaptation options at the community level, and so strong collaboration with development NGOs, civil society organizations and the private sector will be sought.

Impact pathways for target environments

Work will be conducted closely with development and funding agencies, so that development practitioners will be informed on the most promising adaptation options for specific geographies and socio-cultural and economic settings, and so that key decision makers will allocate resources for such options. Knowledge and insights into the most appropriate mechanisms of transference and successful adoption will support stakeholders such as development NGOs, civil society organizations and private sector companies. Impact strategies will be developed for specific countries in the target regions through working with a coalition of partners especially the development NGOs (e.g. Oxfam, CARE) and NARES. At global level, the work will feed into the global impact strategy to help shape how adaptation funds are allocated (Figure 5).

Figure 5. Illustrative impact pathway for how MP7 Theme 1, Objective 1 proposes to engage with the global adaptation funds, to ensure that fund guidelines are based on best practice information.²²



Theme 1 Objective 2: Strategies for addressing abiotic and biotic stresses induced by breeding for future climatic conditions, variability and extremes, including novel climates

Rationale and research questions

The expected increases in temperature and shifts in precipitation regimes are predicted to cause significant changes in crop productivity across the globe, through direct abiotic influence or through associated changes in pest and disease pressure. While significant adaptive capacity exists within agricultural and socio-economic systems, models suggest that we are likely to experience biological limitations to production if only current varieties are available for adaptation. Hence, crop improvement through conventional breeding or through biotechnological innovations is hailed as a crucial strategy to ensure long-term maintenance or gain in agricultural productivity (Tester and Langridge 2010). Given that projected demand for food is likely to increase by 60–70% from now to 2050 (Schmidhuber and Tubiello, 2007; World Bank, 2008), significant expectations are being placed on crop improvement to provide a large proportion of these gains, despite the complexities that climatic change bring to the problem. Given the long lead-time between commencement of a breeding program and the release and large-scale adoption of new cultivars in farmers’ fields (minimum 8 years, although evidence suggests that true adoption can take as many as 15–20 years to be successful), it is critical that breeding programs are designed today to address future problems and not necessarily the apparent priorities found today.

It is therefore key that priorities are developed for crop improvement programs based on sound *ex-ante* analysis of future benefits, and that coherent strategies across multiple countries and between institutions are adopted and implemented. International and national donor and government policies should be coordinated in enabling the conception and implementation of these strategies. This Objective is about generating comprehensive strategies for crop improvement through a combination of modeling, expert consultation and stakeholder dialogue.

²² All impact pathways are illustrative based on stakeholder inputs in Nairobi (May 2010). Specific input strategies for national and regional impacts need to be elaborated early on in implementation with appropriate stakeholder groups.

Research question include:

- What are the most cost-effective crop improvement investments to enable tomorrow's crops to produce more under a changed climate?
- What are the most appropriate modeling approaches to design "virtual crops" for the future that can then inform crop improvement programs on a crop-by-crop basis?
- Can currently farmed livestock and fish species cope with expected changes in temperature and salinity, and if not, how can new species or improved breeds be brought into production?

Activities

Multi-site trial data will be collated as a critical input to calibrate and validate crop models. This will be done in collaboration with Objective 1 of this Theme. Objective 2 will then model biotic and abiotic constraints under decadal futures from 2020 to 2050 through the development of a range of crop modeling approaches. The modeling approaches will include the application of mechanistic crop models such as the GLAM model (Challinor et al. 2004), niche-based approaches such as the modified EcoCrop model used by Lane and Jarvis (2007), as well as a number of models to quantify biotic elements. The models will provide the biophysical decision support basis for the scenario-based analysis of social, cultural and economic benefits (in Theme 4, Objective 4). Through the models, and in close consultation with crop-based experts, a set of "virtual crops" will be designed. The efficacy of the virtual crops in addressing the likely conditions for 2020, 2030, 2040 and 2050 will be quantified in terms of the economic, social and cultural benefits expected. This will produce a set of concrete crop improvement strategies for further qualitative analysis. A series of activities will guarantee that research and policy organizations are actively engaged from the early stages of the research in both design and post-project implementation. They will also ensure that once a set of breeding strategies are identified, they are socialized with funding bodies, national and international organizations, universities and other actors, and that concrete plans are established. Additionally, strategies should be mainstreamed into workplans and existing breeding programs, e.g. for crop breeding. For the breeding elements, close collaboration with MP3 is required, so that outputs from this Objective inform breeding programs for each of the MP3 components.

Products

- Detailed crop-by-crop strategies and plans of action for crop improvement that ensure future crops and agricultural systems are adapted to a progressively changing climate;
- Range of modeling approaches developed and validated for assessing future constraints to crop, livestock and fish production and the design of virtual crops;
- Global, regional and national policy briefs for investments in climate-proofed crop, livestock and fish breeding initiatives, feeding into impact strategies related to adaptation funds.

Partner roles

This Objective will build on close collaboration with crop and livestock-based components of MP 3, and integrate closely with ongoing and future Generation Challenge Program (GCP) molecular and breeding platforms. For each crop all major crop improvement programs will be incorporated into the research, including crop improvement programs at CGIAR centers, NARES, ARIs or indeed in the private sector. Strategies will also be developed jointly with donors and national and regional research funding agencies to drive donor policy towards coherent crop improvement plans without duplicity of efforts.

Impact pathways for target environments

Crop breeding initiatives at national, regional and global scale will be fully engaged to ensure that the best-bet plans are put in place, and global and regional donors will be fully briefed on the priorities for investments not only at the crop level but also at the food system level. In the first six months of the MP a multi-stakeholder and cross-CGIAR high-level meeting will be conducted to build consensus amongst partners about the R&D and engagement process.

Theme 1 Objective 3: Targeted identification and enhanced deployment and conservation of species and genetic diversity for increased resilience and productivity under conditions resulting from climate change

Rationale and research questions

The diversity of traits and characteristics among existing varieties of agricultural biodiversity (both inter- and intra-specific) provide enormous potential for adaptation to progressive climate change. However this potential is poorly understood. Under this Objective, research will develop innovative methods and tools for the rapid identification of suitable germplasm materials both *in situ* (in the wild and on farm) and *ex situ* (in gene banks) for integration into breeding programs and production systems to facilitate adaptation to progressive climate change. In addition to testing materials of interest under conditions including analogs for projected future climates, research will evaluate how to facilitate their integration into local production systems and adoption by farmers by analyzing policies and seed systems and defining key interventions to enhance them. In addition to looking at specific varieties/species, the benefits of crop, fish and livestock diversity in production systems as a strategy for maintaining productivity despite climate change and variability and associated impacts (notably pests and diseases) will be assessed.

Research questions include:

- What priority gene pools for climate change adaptation are threatened, and how can they be conserved to ensure their continuing availability?
- How can farmers' knowledge be used to help identify germplasm suited for specific climatic conditions?
- How can access to genetic resources and new practices for local farmers be facilitated?
- How does crop diversity in production systems contribute to maintaining productivity in the face of progressive climate change and increased variability in climate?

Activities

Activities will consist of developing tools and methodologies to rapidly identify materials *in situ* and *ex situ* with traits useful for climate change adaptation and to assure their conservation. Once candidate materials are identified, on-farm evaluation on a range of sites will be used to test their response in different climate conditions in the target regions. This participatory approach will not only allow testing the material in a cost-effective way in a significant number of different agro-ecological conditions, it will also allow farmers' perceptions to be integrated into the evaluation, a key to future adoption. Additional strategies needed to facilitate the uptake will be formulated, focusing on both access to the material and its management. Finally, the contribution of crop, fish and livestock diversity in production systems as a strategy to climate variability and change will be evaluated and promoted.

Products

- *In situ* populations of priority gene pools important to climate change adaptation identified, threats understood and conservation solutions proposed identified;
- Methods and tools developed to facilitate targeted identification of *ex situ* conserved germplasm with traits useful for climate change adaptation, including resistance to biotic and abiotic stresses;
- Strategies to improve existing policies, local management and seed systems, to facilitate the deployment of adapted germplasm;
- Assessment of the contribution of crop, fish and livestock diversity for climate change adaptation.

Partner roles

Collaborators on the *in situ* research will include NARES for crops, fish and livestock, ministries of forestry, fisheries and the environment and international and national conservation organizations for wild relatives, aquatic biodiversity and trees *in situ* in the wild. The *ex situ* activities will be carried out in collaboration with CGIAR centers that manage mandate collections as well as with national gene banks. The local evaluation and adaptation activities and the research on resilience of diverse production systems to progressive climate change will be carried out in close collaboration with NARES, development agencies, local farmer organizations and the Resilience Alliance.

Impact pathways for target environments

Research will produce knowledge, information sources and guidelines as well as making available germplasm that has been selected, collected, conserved and tested to address targeted needs for climate change adaptation in areas likely to suffer most. Intermediate users of the information will include government agencies in target countries, gene bank managers and conservation organizations that will participate and then continue to carry out the priority conservation actions defined by the research. Researchers and breeders in NARES and other institutions will use both the information about the germplasm (and the germplasm itself) to produce varieties better adapted to the conditions resulting from changed climates, including the changed dynamics, distribution and virulence of pests and diseases. Farmers will use and evaluate the selected germplasm and mixtures as well as varieties bred from it by the breeders. New knowledge about the benefits of crop diversity and about seed systems and the policies that affect deployment of germplasm will be used by crisis management agencies as well as NARES and international agricultural/rural development agencies to ensure that suitable and adapted germplasm reaches farmers.

Theme 2: Adaptation Pathways for Current Climate Risk

Rationale

Managing the risk associated with climate variability is integral to a comprehensive strategy for adapting agriculture and food systems to a changing climate. Climate variability today and long-term climate change are two ends of a continuum of time scales at which the climate varies and impacts agriculture. The damage of climate shocks, such as droughts or floods, to health, productive assets and infrastructure can impact livelihoods long after the shock has passed. Climate variability and the conservative strategies that risk-averse decision makers employ contribute to the existence and persistence of poverty – sacrificing income-generating investment, intensification and adoption of innovation to protect against the threat of shocks. Projected increases in climate variability can be expected to intensify the cycle of poverty, vulnerability and dependence on external assistance. This Theme enables promising innovations for managing climate-related agricultural risk at local and regional levels. It also addresses bottlenecks to climate information services that enable a range of agricultural risk management interventions.

Objectives

The overall goal of Theme 2 is to bring promising innovations in climate risk management to bear on the challenge of protecting and enhancing food security and rural livelihoods in the face of a variable and changing climate. Its Objectives are to:

- Identify and test innovations that enable rural communities to better manage climate-related risk and build more resilient livelihoods;
- Identify and test tools and strategies to use advance information to better manage climate risk through food delivery, trade and crisis response;
- Support risk management through enhanced prediction of climate impacts on agriculture, and enhanced climate information and services.

Research approach to international public goods

Theme research targets strategic gaps in knowledge, methodology, information products and services, and evidence that currently impede development of climate-resilient rural livelihoods and coordinated, adaptive decision-making in the food system. It will combine analytical research with participatory co-learning with rural communities and other key actors in the food system, across a range of agroecological and socioeconomic contexts, to provide international public goods such as:

- Synthesized knowledge and evidence to inform targeting and implementation of innovative, climate-informed risk management strategies at local to regional levels;
- Enhanced tools and platforms for monitoring and predicting impacts of climate fluctuations on agricultural production and biological threats;
- A platform for sharing knowledge, tools, guidelines, curricula and evidence to support climate information services for agricultural decision-makers;
- Improved knowledge, tools, data sets and platforms for monitoring and predicting agricultural production and biological threats, and informing management, in response to climate.

New content and innovation

Theme 2 targets emerging (e.g., index-based risk transfer products, adaptive management at multiple scales in response to advance information) and integrated solutions for managing climate-related agricultural risk, which have not been fully explored or mainstreamed within agricultural development due to their newness, major knowledge gaps, climate information constraints, or dependence on more effective coordination among actors. By bridging the climate, agriculture and food security communities, and overcoming bottlenecks to relevant climate-related information services, Theme 2 will enable several innovative opportunities to manage agricultural risk better across scales.

Risks

Achieving outputs and outcomes will depend on the degree to which the Program can engage and influence the agendas of non-traditional CGIAR partners, particularly within the climate and the humanitarian response communities. Uptake of particular interventions may be constrained by farmers' resources and geographic context. Several planned outputs depend on historic meteorological data; hence the need for good partnership with the meteorological services, regional climate centers and the World Meteorological Organisation (WMO). The dependence on integration with the other CGIAR MPs mentioned below must be managed through appropriate governance structures that go beyond the Program.

Regional balance

Work on field- to community-level risk management (Objective 1) will span target regions, but is particularly relevant for rainfed agriculture in high-risk environments. Work on climate services (Objective 3) will also span target regions, and capitalize early on regional climate centers (i.e., ACMAD, ICPAC, AGRHYMET) and substantial investment in climate services (e.g., ClimDev-Africa) in sub-Saharan Africa. Objective 2 activities will be most prominent in sub-Saharan Africa, where the state of food insecurity and the scale of international humanitarian response are greatest. The work will be expanded to other regions as they are added, and in addition Objective 1 will include a global comparative element that cuts across all locations where the CGIAR operates.

Linkages to other CGIAR MPs

Climate and biological threats outputs are inputs into CGIAR MPs 1, 2 and 3. Two-way interaction is expected with MP1 on diversification of farming systems and its impact on risk and vulnerability. Theme 1 will interact with MP2 in the areas of information delivery; risk management through off-farm livelihood diversification, insurance, collective action; and managing risk through the food delivery system. MP3 will contribute to climate-resilient crop germplasm and seed systems, and will benefit from risk implications of cultivar and crop mixes. Climate information can feed into MP5 to provide information on soil and water management, while MP5 will provide options for reducing climate risk through better water management. The Theme will draw on advice from other CGIAR MPs on agricultural enterprises that best work after extreme events (e.g. salt-tolerant varieties after salt intrusion from tsunamis, short-cycle crops to rapidly increase agricultural outputs) or to mitigate extreme events (e.g. drought tolerant crops).

Theme 2 Objective 1: Enable rural communities to manage and build resilient livelihoods

Rationale and research questions

The purpose of this Objective is to enable several promising innovations for managing climate-related agricultural risk. For example, within an enabling environment, seasonal climate prediction offers farmers and local market institutions opportunity to exploit favorable conditions, and more effectively protect themselves from long-term consequences of adverse extremes. There is a rapid resurgence of interest in insurance as a pro-poor climate risk management tool, in part because of innovations that base payouts on an Objective index (e.g., rainfall) that is correlated with losses, and thereby overcome long-standing obstacles associated with asymmetric information. Improving diversification – at the levels of cultivars, farm enterprises and rural livelihood portfolios – is a promising means of reducing risk. Some indigenous community risk management innovations are likely to be transferrable and scalable. These innovations face important knowledge gaps related to targeting, design, institutional arrangements needed, and the special needs of marginalized groups including women. There are numerous technical options for better managing seasonal risk that need development and testing.

Research questions include:

- How effectively do rural communities manage climate-related risk and what technical options show promise?

- What combination of diversification, intensification, innovation and risk transfer has the best prospect for reducing the long-term climate vulnerability of rural communities?
- How can index-based financial risk transfer products be best targeted and implemented to reduce vulnerability to climate shocks and alleviate climate-related constraints to improving rural livelihoods?

Activities

This Objective will create a platform to synthesize and exchange information about farmers' coping strategies and innovations for improving management of climate-related agricultural risk. It will characterize indigenous, community-based risk management strategies with potential for upscaling. The Objective will analyze and address priority knowledge and methodology gaps for pro-poor index-based risk transfer products. Surveys will be conducted to assess the current use, unmet demand and bottlenecks to climate-related information for local-scale agricultural risk management, with disaggregation by gender and wealth. The Objective will analyze determinants and risk impacts of existing cultivar and livelihood portfolios and potential improvements. It will engage rural communities and other local stakeholders to identify, enhance and test suites of agricultural risk management strategies. Using a global approach the Objective will work on agronomic and natural resource management technologies for enhancing climate resilience, and synthesize such work.

Products

Theme research will provide a range of products to inform and guide support for more effective management of agricultural risk, such as documented information about climate-related risks and impacts of current risk management practices; a web-based clearinghouse on risk management innovations (with Themes 1 and 3); and synthesized knowledge and decision tools for targeting and supporting risk management innovations for particular contexts.

Partner roles

Rural communities, other local agricultural stakeholders, and research partners (NARS, CG, universities) will partner in identifying, designing and evaluating context-relevant opportunities to improve risk management; and in co-learning. Farmer associations and strong development NGOs (e.g., CARE, PRADAN) will help facilitate interactions with rural communities, and ensure that research is responsive to the needs of women and other vulnerable groups, and builds on existing knowledge. Work on index-based financial risk transfer products will involve national financial institutions, and coordination with the international research and development community that is working on this area (e.g. BMGF, WB, I4, IRI, CARE, Oxfam). Work on the use of climate-related information will interface with Objective 3, and engage national and regional climate service providers; communication intermediaries such as agricultural extension, development NGOs, and organizations focused on communication through Information and communication technology (ICT) and the media; and a range of local private- and public-sector end users.

Impact pathways for target environments

Key NARS and development NGOs will participate in the design, pilot implementation and evaluation of local risk management interventions. Strategic communication and engagement efforts will target international development organizations, NGOs, policy bodies, and providers of financial and information services that are in a position to scale up country-based initiatives. Co-learning among researchers, institutional partners and rural communities will provide a foundation of knowledge and evidence to inform systematic technical and policy support for more effective farm- to community-level agriculture risk management strategies. A range of communication channels will inform adaptation and development funders and organizations, the CGIAR, and NARES about the long-term impacts of alternative adaptation strategies, leading to better-targeted investment in agricultural development and adaptation, and ultimately to farming systems and rural livelihoods that are more secure in the face of a variable and changing climate.

Theme 2 Objective 2: Managing climate risk through food delivery, trade and crisis response

Rationale and research questions

Decisions made within the food system at a regional scale influence constraints and opportunities that rural communities face and influence food security in urban areas. There is substantial scope to use climate information to better manage grain storage, trade and distribution, and to better target timely assistance during food crises. External assistance can protect productive assets, encourage investment, and stimulate development of the value chain for agricultural products. Early response is essential to effective food crisis management, as delay can greatly increase the humanitarian and livelihood costs; and the availability of quality early warning information is a precondition. The use of advance information to manage regional trade and storage to stabilize prices is a promising component of food security management, as climate-related price fluctuations can lead to acute food insecurity for the relatively poor who spend the majority of their incomes on food, even if total food availability is sufficient to meet a region's needs. This Objective links closely with MP2 in the areas of long-lead climate, market and early warning information; and improved climate-informed management of safety nets and price volatility in the output value chain.

Key research questions include:

- To what degree can advance information about climate inform estimates of the determinants of food security (i.e., availability, accessibility and utilization)?
- What is the feasibility and best strategy to use advance information to target and initiate responses to climate-related market fluctuations and emerging food crisis?
- How can agricultural development and humanitarian response activity and resourcing be coordinated most effectively?
- How can food delivery, crisis response and post-crisis recovery be best managed to reduce climate vulnerability and improve resilience of rural communities?

Activities

This Objective will analyze livelihood impacts of alternative policies and regulations for managing food crises and price volatility. It will work with appropriate food security organizations to explore, develop and evaluate new response strategies based on long-lead prediction, and it will design better information. Further, the Objective will analyze long-term impacts of alternative post-crisis recovery strategies on the climate-resilience of livelihoods.

Products

Research products will include climate information and decision tools to inform food trade and crisis response management; synthesized knowledge, guidelines and evidence to guide relief organizations to re-establish the agricultural sector following crises, vulnerability maps (with Theme 4) and guidelines to target crisis and post-crisis response; and enhanced platforms for coordinating information and action among response organizations.

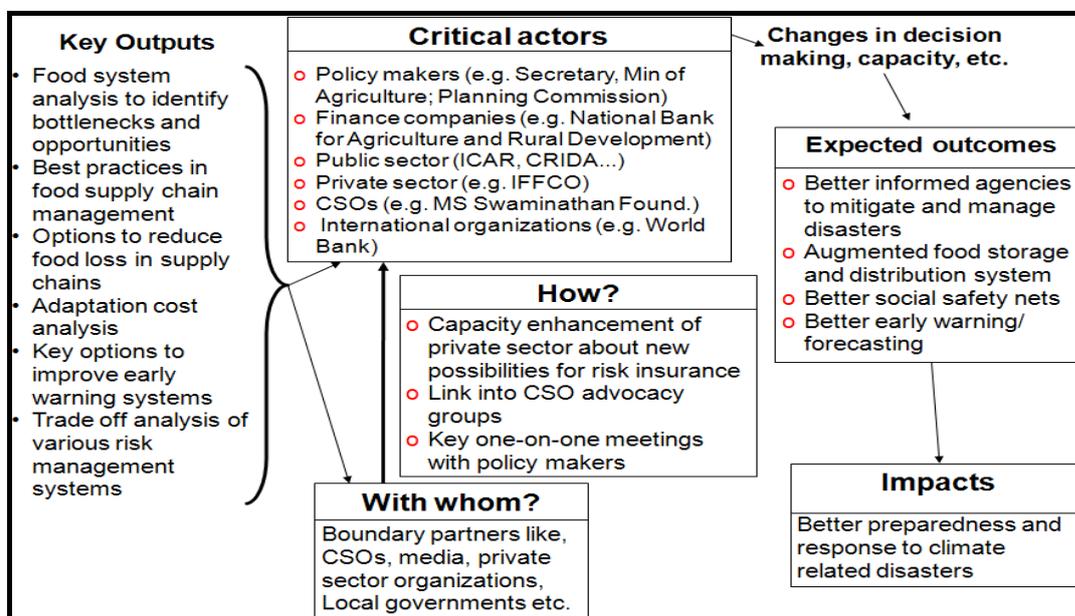
Partner roles

Key food security response (e.g., WFP, food security NGOs, bilateral humanitarian assistance programs) and food trade organizations will engage in evaluation of promising improvements to response mechanisms. Work on improving the use of climate-related information will engage national and regional climate service providers, and crop forecasting and food security early warning organizations. IFPRI, other CG Centers working within MP2 and appropriate ARIs will participate in analyses, vulnerability mapping and development of response guidelines. A range of food trade organizations, food security early warning (e.g., FEWSNet, JRC) and humanitarian response organizations (e.g., WFP), information providers (e.g., the NMS and regional climate centers involved in the Regional Climate Outlook Forum process) and ministries of agriculture will participate in the development of platforms to improve coordination.

Impact pathways for target environments

Improved advance information about climate impacts on food production and food security will be disseminated to organizations responsible for food trade and humanitarian relief through existing information providers and a range of forums. Dissemination through workshops, reports and policy briefs will complement the direct engagement of key food trade and humanitarian relief organizations in the development and evaluation of improved response strategies (Figure 6).

Figure 6. Illustrative impact pathway for working with agencies to improve preparedness and response to climate-related disasters, using outputs from Theme 1, Objective 2.



More timely and better targeted food crisis response will decrease long-term livelihood impacts of crises, reduce disincentives to agricultural producers and markets, and reduce cost of assistance. More timely and effective management of food trade, storage and delivery will reduce the adverse impacts of climate fluctuations on availability and accessibility of food, and on incentives to producers and market institutions.

Theme 2 Objective 3: Enhanced prediction of climate impacts, and enhanced climate services

Rationale and research questions

Several opportunities to better manage climate-related risk depend on information about climate (historic, monitored, predictive) and its impacts on agriculture, but progress in implementing them at the scale of the development challenge is constrained in part by a substantial gap between current operational climate information services and the needs of development. If climate information services are to contribute fully to efforts to adapt agriculture to a variable and changing climate, several gaps need to be addressed in parallel, such as: data availability, design of salient information products and services, modeling frameworks to estimate impacts on agricultural and biological systems, delivery mechanisms, enabling policy, and capacity to respond. Understanding current use of climate information, any obstacles to accessing or responding to information, and underexploited opportunities to use information to manage risk, are prerequisites to developing more effective services. Partnering with emerging initiatives; such as the Global Framework for Climate Services that was endorsed by the World Climate Conference-3 and the ClimDev-Africa joint program of the African Union, UN-Economic Commission for Africa and African Development Bank, enhances the prospect of overcoming information bottlenecks that have limited opportunities to manage agricultural risk.

Research questions include:

- To what degree can available climate and environmental information be used to anticipate and manage variations in crop and forage production, biological threats, and food security outcomes?
- What combination of new products, services, delivery mechanisms and institutional arrangements offers the best opportunity to deliver useful, equitable, transferable and scalable rural climate services?

Activities

This Objective will review current climate information products, services and delivery mechanisms; and constraints and opportunities for using seasonal climate prediction to improve management of agricultural risk. It will inventory climate-sensitive pest and disease modeling and early warning systems, and develop a strategy for enhancing their use for agricultural and food security risk management. The Objective will engage climate information providers and key users to assess needs for climate information, technical and institutional bottlenecks to the production and delivery of useful information, and potential for new or enhanced products and services for risk management applications identified in Objectives 1 and 2. It will evaluate ICT-based and institutional information delivery models for effectiveness, equitability, relevance, transferability and scalability and formulate a strategy; and it will prototype prediction tools and early warning platform for at least 2 strategically important, climate-sensitive biological threats to agriculture.

Products

Research will produce tools and evidence to guide improvements in climate information services for and food security; a strategy for enhancing and upscaling delivery of information services for agriculture and food security; and platforms, tools and data sets for monitoring and predicting crop and pasture production and biological threats.

Partner roles

Key information providers (WMO, NMS and regional climate centers in Africa: ACMAD, ICPAC, AGRHYMET) and local- to regional-level users will participate in the evaluation and improvement of climate information products and services. Development of platforms to translate climate information into agricultural production and biological threat impacts will involve a range of partners such as FAO, NARS, CIRAD, JRC, FEWSNet and AGRHYMET. Scaling up the results will require coordinating with international climate organizations and initiatives such as WMO, GFCS and ClimDev-Africa. Information intermediaries (NARES, development NGOs, media, firms and NGOs involved in rural ICT) will be involved in evaluating and developing strategy to improve and upscale information delivery mechanisms. Participation and feedback from representatives of agriculture (e.g., farmer associations, development NGOs, agribusiness), trade and food security response communities will be vital for guiding and evaluating improvements to climate services. Research will require partnership with the ESSP, in addition to CGIAR, NARES and agricultural ARIs.

Impact pathways for target environments

NMS and international providers of climate services will participate in the process of developing and evaluating improvements to information products and services. Results will be disseminated through a range of forums including international programs (WMO, WCRP) and initiatives surrounding climate services (e.g., GFCS, ClimDev-Africa, regional climate outlook forums). The outreach process will include training and capacity-building for key information providers. Participating regional climate centers and NMS will improve information and services tailored to the needs of agriculture and food security. Partnering with initiatives such as ClimDev-Africa offer a mechanism to upscale improvements in climate information services. Improving climate information products and removing communication bottlenecks will enable improved management of agricultural risk at multiple levels, which will contribute to more resilient farming systems, more secure rural livelihoods, and more effective and less costly crisis response.

Theme 3: Pro-Poor Climate Change Mitigation

Rationale

Agriculture contributes considerably to climate change by contributing 10–12% of total global anthropogenic emissions of greenhouse gases (Smith et al., 2007). Agricultural practices can significantly influence climate change, but many of the world's poorest also depend on agriculture and related natural resources to meet their basic needs. If the poor are to contribute to climate change mitigation, there is a need for mitigation options that also reduce poverty, otherwise unacceptable trade-offs may occur. Two windows of opportunity exist for pro-poor mitigation. The first is the design of low carbon agricultural development pathways. The second is effective participation of the poor in the carbon market. Both require a sound technical understanding of the emissions associated with different land uses, farming practices, livelihoods and food system value chain to understand the mitigation impacts. Both also require an understanding of power dynamics and gender relations to understand who wins and who loses.

Mitigation practices must also address the need for more food and bioenergy, adaptation to climate change, opportunities to maintain traditional socio-cultural practices and crops, and social and environmental sustainability. Synergies are possible; for example, increasing soil organic matter in pastures or crop fields can sequester carbon while improving water retention and soil fertility. Mitigation practices must also address the need for more food and bioenergy, adaptation to climate change, opportunities to maintain traditional socio-cultural practices and crops, and social and environmental sustainability. Synergies are possible; for example, increasing soil organic matter in pastures or crop fields can sequester carbon while improving water retention and soil fertility. Practices that decrease methane production in livestock often result in better feed-use efficiency. Conservation of coastal mangrove forests captures and stores carbon and also buffers against coastal erosion, storm-surges and impacts of sea-level rise, as well as enhancing fisheries production and supporting diverse coastal livelihoods. While significant technical information is available for specific practices, much of it is piecemeal and impacts at the farm and landscape level remain unknown. A better understanding of mitigation opportunities and trade-offs is necessary to inform agricultural development policies and farm-level decision making.

Supportive institutional and market mechanisms will also be necessary to encourage adoption of mitigation practices. Although the combined value of markets for GHG emission reduction is more than US\$100 billion, agriculture has been largely excluded from carbon markets. Increasing the accuracy of estimates of carbon sequestration potential; designing low-cost measurable, reportable and verifiable (MRV) procedures; and investigating innovative methods to reduce other transaction costs and induce permanence are all necessary steps to enable smallholder farmers' participation in carbon markets.

Similarly, the potential of aquatic system carbon sinks ('blue carbon', IUCN, 2009) has been little explored, and the possibilities for coastal resource users to act as ecosystem stewards for coastal and ocean carbon sinks has only been speculated upon.

Objectives

The overall goal of Theme 3 is to identify mitigation strategies that work for the rural poor in developing countries. Special attention will be given to the trade-offs and synergies of mitigation, food security and poverty alleviation, while ensuring the health of water, land and ecosystems at different scales (e.g., farm, landscape, food value chain). The Objectives are to:

- Inform decision makers about the impacts of agricultural development pathways;
- Test and identify desirable on-farm practices and their landscape-level implications;
- Test and identify institutional arrangements and incentives that enable smallholder farmers and users of common-pool resource ecosystems (rangelands, community forests, coastal zones) to participate effectively in carbon markets and reduce GHG emissions.

Research approach to international public goods

The Theme will produce the following international public goods:

- Analysis and identification of agricultural development pathways that best support mitigation and poverty alleviation;
- New methods and systems for GHG monitoring and accounting at smallholder farm, landscape and food system levels;
- Enhanced knowledge about the practice of reduced tillage, agroforestry, community forestry, managing aquatic ecosystems, residue management, nutrient management, improved feeding practices and other practices on GHG fluxes at the landscape level;
- Scientific knowledge and validated simulation models about the trade-offs and synergies among GHG mitigation, food security, poverty alleviation and environmental health to inform policies and investments;
- New pro-poor institutional arrangements and incentives that enable smallholder farmers and common-pool resource users to participate effectively in carbon markets and reduce GHG emissions.

New content and innovation

Theme 3 innovates through synthesis linked to global processes and a clear, analytical focus on the trade-offs and synergies between mitigation and food security, poverty alleviation and environmental health. It will bring information on pro-poor mitigation into international and regional climate policy arenas and take carbon markets into new territories. Specific innovations to add value include:

- Integration of CGIAR (regional- to local-scale data and partners with social science, economic and applied technical capacities) with ESSP community (global and large-scale regional analyses) to enhance research outcomes (e.g. enhance spatially-explicit modeling);
- GHG monitoring systems from ESSP linked to on-farm and landscape-level practices and outcomes, for application of practical mitigation actions;
- Identifying incentives for local actors to benefit from emission markets.

Risks

The major risk is that mitigation measures implemented by the rural poor are shown to be neither feasible nor cost-effective in contributing to reducing GHG levels and making a meaningful contribution to livelihoods. Operational and institutional risks include weak extension agencies, under-supported local capabilities and unreliable governance. There is a political risk of mobilization from politicians and civil society organizations against agricultural mitigation by smallholders on grounds of global social justice, implying that the research needs a strong equity component

Linkages to other CGIAR MPs

The main impact of agricultural practice on carbon sequestration capacity in agricultural landscapes is likely to be via intensification of production that frees up land for restoration and carbon storage in biomass. Therefore the key strategic link will be with MP6 (Forests and Trees), particularly in terms of work at the landscape level (the close causal links between agricultural management and availability of land for forest cover). The Theme will also contribute to MP1, situating mitigation within broader agricultural and other food production systems, MP5 on soil carbon, and MP3 (e.g. methane reduction from rice systems, and intensification of potato production to limit expansion into carbon-rich grasslands).

Regional balance

The Theme will examine the research questions for a) areas where poverty is extreme and scenarios indicate populations to be most vulnerable to climate change (e.g., Sub-Saharan African and South Asia) and b) areas where the highest potential for mitigation and benefits to the rural poor exist (e.g., Southeast Asia, Amazon Basin). The aim is to understand to what extent people in the regions most vulnerable to climate change can contribute to and benefit from mitigation, but also to know where investments in mitigation are likely to have the highest impacts.

Theme 3 Objective 1: Inform decision makers about the impacts of agricultural development pathways

Rationale and research questions

The purpose of this Objective is to inform agricultural development policies about their implications for greenhouse gas fluxes and potential for enhanced mitigation. Increased needs for food production in an era of dwindling natural resources will require strategies for sustainable agricultural intensification and maintaining and enhancing the flow of ecosystem services from non-agricultural landscapes used by the rural poor (forests, grasslands, coasts and wetlands). Higher energy costs and sources of energy will require strategies for energy conservation and efficiency that could lead to new configurations of the rural landscape and market opportunities. In addition, the push for biofuels could change landscapes and have negative impacts on food security. More variable temperatures and precipitation will require adaptation strategies to help farmers adjust to different growing conditions. Better knowledge is needed about the mitigation implications of these policy choices.

Research questions include:

- How can agricultural production be intensified sustainably, while also contributing to climate change mitigation?
- What are the synergies and trade-offs between climate change adaptation and mitigation in different regions?
- How do current and proposed policies at the national, regional and international levels affect GHG gas fluxes and climate change mitigation potential in selected agricultural and non-agricultural food-producing landscapes?

Activities

This Objective will develop alternative scenarios and suitable strategies for agricultural intensification in different regions. This includes comparing the net emissions of a) agricultural intensification through high input agriculture (water, energy) compared with conservation agriculture; b) landscapes where intensified agriculture enables more land to be left as forest or degraded land restored with high levels of aboveground biomass; and c) non-agricultural landscapes which provide multiple ecosystem services, including food provision – e.g. wetlands, coastal zones, grasslands. The Objective will model the mitigation implications of alternative adaptation strategies; clarify the trade-offs between biofuel and food production in different contexts; and it will involve decision makers throughout this process, to share scenarios, models and consideration of alternative strategies.

Products

Products will include syntheses of: a) the net emissions of different scenarios; b) mitigation implications of alternative adaptation strategies; and c) identification of promising options for mitigation that maximize the benefit–cost ratio for mitigation, poverty alleviation, food security and environmental health. Additional outputs will include sensitisation via a series of policy maker and researcher workshops. Results will be shared through websites, policy briefs and scientific articles. Given the need for detailed adaptation information in this Objective, work will be closely conducted with Themes 1 and 2, while some of the tools needed will be derived from Theme 4.

Partner roles

This Objective will target partners involved in high-level planning of and investment in agricultural development, including agriculture, forestry and land use (AFOLU) ministries, planning agencies, the World Bank, IFAD and other donors. It will work closely with the adaptation community to integrate scenarios. It will identify practical livelihood options for farmers in cooperation with development organizations such as CARE. Results will be shared with, for example, the Subsidiary Body for Scientific and Technological Advice (SBSTA) Working Group and other high-level scientific and policy bodies.

Impact pathways for target environments

Key users such as national agencies will be involved in research, design and implementation to identify plausible scenarios and evaluate desirable development pathways. Results should help decision makers to design well-targeted investments and incentives. Results will be shared widely with development organizations such as CARE to shape their strategies for intervention. Capacity will be built via workshops, a global platform and a set of carefully targeted policy communications to national and global policy makers on specific scenarios, trade-offs and options (Figure 7). To bring impacts on a greater scale, the focus will be on communications and interactions with key decision makers in global and regional public bodies and large-scale development NGOs, with outreach beyond the agriculture sector.

Theme 3 Objective 2: On-farm mitigation practices and their landscape-level implications

Rationale and research questions

This Objective investigates the costs and benefits accruing from agricultural practices. The IPCC's AR4 is ambivalent on the potential of agricultural sequestration, largely because different practices vary in outcome. For example, some studies show that reduced or no-till agriculture does not always result in soil carbon gains in locations that already have high soil carbon content; and that the net effects of reduced or no-till practices on N₂O are inconsistent, depending more on soil and climatic conditions. Furthermore, there may be either synergies or trade-offs for local livelihoods, landscape-level environmental sustainability, and wider-scale knock-on effects. Thus more research is needed to establish the actual impacts of putatively desirable on-farm practices. Secondly, it is important to assess the full economic costs and benefits of agricultural mitigation. Many sustainable land management (SLM) practices are beneficial for both agricultural adaptation and mitigation. Furthermore, the mitigation value of agricultural practices may be less in terms of direct impacts on GHG emissions and much more in terms of indirect impacts at the landscape level, for example agricultural intensification that frees up land for forest conservation. Thus, costs and benefits need to be assessed at the local, national, and global levels. Even where data exist, effort will be needed to link this data to mitigation actions through stakeholder involvement.

Research questions include:

- What are the potential direct and indirect economic and environmental costs and benefits from agricultural GHG sequestration and emission reduction?
- What technologies and management systems can deliver GHG sequestration and emission reduction cost-effectively with maximum benefits to poverty alleviation, food security and environmental health at the landscape level?
- What kind of stakeholder involvement and communication is necessary to link emissions knowledge to mitigation actions?

Activities

This Objective will create a global platform for exchange and synthesis of information about innovations in agricultural mitigation. It will identify the carbon sequestration and GHG abatement potential of a variety of natural resource management practices. These practices may include livestock management, agroforestry, fertilizer management and reduced tillage, among others. The Objective will use field results and simulation models to identify the technologies and management systems that best deliver bundles of benefits at the household and landscape levels. Analytical approaches may include a range of technology assessment methods, including economic surplus analyses that simulate different market conditions, technology adoption processes, research spillovers, and trade policy scenarios within a global partial equilibrium model. The Objective will work with field-based partners to develop user-friendly ways of communicating data that farmers and decision makers can use to change their land-use practices.

Products

This Objective will deliver an evaluation of potential direct and indirect economic and environmental

costs and benefits from agricultural mitigation. A wide range of options will be tested, ranging from those that increase soil carbon to water management tools for reduction of GHG emissions from wetlands and tropical reservoirs. In addition, this Objective has methodological outputs, e.g. developing and assessing systems for GHG monitoring and accounting at farm and landscape level, which are needed for formal emission markets. Results will be shared through websites, policy briefs and scientific articles.

Partner roles

FAO will play an important international role in linking the Program to national scientists and government users. IIED will fulfill the same function for the nongovernmental sector. In addition to FAO and IIED, MP7 will involve all CGIAR Centres, and the ESSP community will be a core research partner, particularly with respect to techniques for measuring GHG fluxes and developing robust MRV procedures. National planning and AFOLU agencies will be primary advisors and direct beneficiaries of the research, as will international development agencies.

Impact pathways for target environments

This Objective will produce results of relevance to carbon markets both at the international level and national level (Figure 7). This impact strategy for getting appropriate technologies into farming systems will involve participatory action research with farmers and building coalitions at various levels (e.g. FAO, IIED, CARE, Oxfam etc).

The expected impact is that agricultural development will occur in a sustainable fashion that addresses food needs, reduces property and resulting climate change mitigation. The expected outcomes include that national policymakers and development organizations such as BRAC, PRADAN, Care, Oxfam and other national NGOs in regions. A number of dissemination pathways will be used to communicate results and insights. Besides the regions will support livelihood development options for the rural poor that reduce enhance mitigation. Research results will be shared by involving research users in generating information about likely and alternative agricultural development option, as well as through annual workshops and the final workshop for policy makers, which will be targeted for wide participation and media coverage, materials will be available on the project website (and that of partners), and policy briefs and briefing notes will be designed to communicate ideas in the most efficient way.

Theme 3 Objective 3: Institutional arrangements and incentives that enable smallholder farmers and common-pool resource users to participate effectively in carbon markets and reduce GHGs

Rationale and research questions

Carbon markets exist and offer real benefits, yet smallholders and those who depend on community-managed forests and other carbon-capturing ecosystems have not been able to participate effectively in Clean Development Mechanisms (CDMs) or voluntary markets to date, due to high transaction costs and a lack of information. Experience with payments for environmental services suggests that trade-offs may exist between effectiveness and poverty alleviation. The distribution of projects and certified emission reductions (CERs) has been geographically uneven, and weak collective action has limited participation of resource-poor farmers. Carbon markets may provide incentives for farmers to adopt sustainable agriculture and land management techniques. However, until it becomes cost effective, the poor will have little incentive to participate. This Objective will investigate which institutional arrangements and incentives are best suited to: a) grouping farmers together so that viable quantities of carbon can be sold in the carbon market; b) ensuring that benefits are accessible and shared fairly among the rural poor who supply environmental services; and c) test the extent to which carbon markets can provide sufficient incentives to adopt sustainable agricultural, land and coastal management.

Research questions include:

- How can the poor gain better access to the benefits available through the trade of carbon and

other GHGs?

- What kinds of institutional arrangements are needed to enable carbon credits produced by agriculture in developing countries to be sold and traded?
- What kinds of incentives are needed to encourage farm practices that enhance mitigation?
- How can common-pool resource users participate effectively and benefit from carbon markets through their landscape/seascape stewardship activities?

Activities

This Objective will assess barriers to entry and factors affecting benefits from the carbon market for different social groups, including women, and the range of emerging institutional arrangements and incentives for better inclusion and benefits. It will pilot institutional arrangements, incentive mechanisms and MRV protocols for carbon trade, including both potential project developers and aggregators (including supermarket supply chains, producers of high-value export crops, NGOs and farmers' organizations) as aggregators and disseminators of management system changes. This Objective will test the feasibility of carbon market participation and benefits in areas where mitigation potential may be low, but local farmers are vulnerable and poor (e.g., semi-arid areas of Africa and India) and compare this with areas where mitigation potentials are high (e.g., the Amazon Basin and Southeast Asia).

Products

Key products will identify market-based instruments, policies and institutional arrangements that can improve access of the poor to mitigation benefits, with empirical indications of the impacts of these benefits on poverty alleviation and GHG emissions. There will be targeted communications products for the strategic partners named above, and capacity-building events and workshops to increase the uptake and improve the design of incentive mechanisms and institutional arrangements.

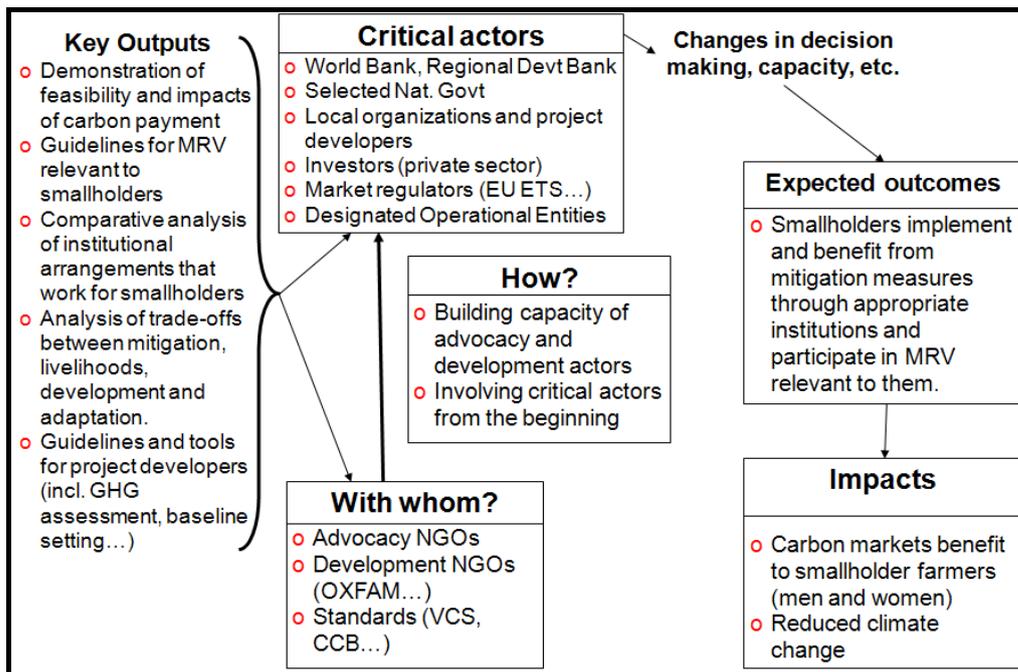
Partner roles

This Objective will work closely with farmers' organizations, intermediaries and buyers in the World Bank, regional development banks, local and project investors, farmers' organizations, intermediaries such as Oxfam and Care, the Climate, Community and Biodiversity A, innovacarbon market to develop and test innovative institutional arrangements and incentive mechanisms. Partners for research and policy impact will include international and national policy research organizations such as EcoAgriculture and Instituto de Pesquisa Ambiental da Amazônia (IPAM). Capacity development will focus on development of understanding of carbon markets, and negotiation and advocacy skills for farmers' interests. The intended users of this research include the World Bank Biocarbon Fund, the Voluntary Carbon Standard and the Climate, Community and Biodiversity Alliance (Figure 7).

Impact pathways for target environments

This Objective will increase carbon market opportunities for small-scale producers and reduce transaction costs by working with three sets of participants in the carbon value chain: 1) aggregator organizations (producer groups, farmers' organizations, natural resource management associations, etc.); 2) intermediary organizations; and 3) private sector players in the voluntary carbon market. Impact will be enhanced by use of carbon market listserves and forums and regional policy forums, as well as regional farmer associations to reach broader research and practitioner audiences. Targeting specific groups, particularly women farmers and farmers in specific geographic localities, will enable more effective outcomes for poverty alleviation. An illustrative impact pathway for the global level is shown in Figure 7.

Figure 7. Illustrative impact pathway for influencing how carbon markets relate to smallholder farmers. The key outputs listed would be derived largely from Theme 3, Objective 3, but also from other Objectives.



Theme 4: Integration for Decision Making

Rationale

The goal of achieving sustainable food security is already under unprecedented pressure from population growth. Climate change will exacerbate the challenge, with potential for highly heterogeneous impacts across space and time. At the same time, interactions between climate change and other drivers of change in agricultural systems (and development generally) remain largely unknown. While broad trends may be discernible, more location-specific detail is required about the impacts of climate change (positive and negative) on food security and the preservation of ecosystem services needed for the long-term sustainability of global agriculture, effects on livelihoods, and options that increase the well-being of people dependent on natural resources.

The research undertaken in this Theme provides an analytical and diagnostic framework for the whole of MP7 that is grounded in the policy environment, incorporates biophysical effects, and ensures effective engagement of rural communities and institutional and policy stakeholders. It will address the need for methods, models, databases and system metrics aimed at two broad challenges: a) enhanced assessment of the likely impacts of climate change on agricultural systems, particularly in the context of other social and economic changes; and b) improved methodologies to assess the likely impacts of different policy and program interventions to foster adaptation and mitigation in terms of poverty alleviation, food security and environmental health. Quantifying impacts and the consequences of policy changes is a critical aspect of identifying trade-offs and thus best-bet options for addressing specific climate challenges. While much is known about some components, there are gaps and uncertainties in the knowledge, processes, model capacity and databases needed for these analyses. The work proposed here is designed to address these gaps, many of which can be filled uniquely by CGIAR researchers and the ESSP. The integrated framework will also form the basis for a monitoring and evaluation system to allow *ex post* impact assessment of research to be carried out in relation to a baseline set of key indicators at study sites.

This Theme also provide an integrative function for MP7 in terms of stakeholder engagement, with engagement planned from local to global levels, both in terms of setting research agendas and providing forums for discussing emerging results, and options for action.

Objectives

Theme 4 provides a critical integrative function for MP7. It will generate standardized global datasets with location-specific elements (through a multi-site data collection effort) and undertake scenario research to provide plausible futures and guide the development of new technologies and policies in the other Themes of MP7. It will also create mechanisms to integrate work conducted by Themes 1–3 at regional and global levels and act as a major conduit for two-way information flow between the CGIAR institutions and the ESSP. Finally, it will provide methods to involve stakeholders more in agenda setting for Themes 1–3 and communicate their individual and integrated outputs. Its research Objectives are to:

- Build platforms and methods to link knowledge with action;
- Assemble data and tools for analysis and planning;
- Refine frameworks for policy analysis.

Research approach to international public goods

The Theme will produce the following IPGs:

- An enhanced analytical framework, suite of tools and infrastructure that will enable stakeholders to understand, diagnose and communicate vulnerability as well as target and assess the likely impacts of adaptation, mitigation and policy interventions.
- Globally consistent, multi-site and publicly accessible data sets on climate change, current agricultural practices, performance characteristics of existing plant and animal germplasm and

management practices, and related variables needed for assessing climate change impacts and opportunities for cost-effective adaptation and mitigation, including vulnerable populations and probabilistic projections of climate impacts under a set of development scenarios.

- Evidence of feasibility, acceptability and impacts (related to food security, livelihoods and the environment) of comprehensive climate change adaptation strategies and mitigation opportunities locally and regionally.

New content and innovation

The work proposed in this Theme has several innovative features:

- It will provide a broad food-security perspective on vulnerability to climate change; something that almost all global assessments and scenario development exercises conducted to date have not addressed fully (Wood et al., 2010). The food system perspective will also foster the transition within the CGIAR from a commodity focus to a more integrated approach.
- The work will mainstream a dynamic approach to vulnerability within the CGIAR through the use of scenario development at global and regional levels and modeling to project possible future vulnerability in relation to plausible storylines, including feedback loops from proposed interventions.
- The work will build a much stronger partnership between the CGIAR and the global change communities worldwide, providing them with common research goals.

Risks

The success of capacity building and uptake of the research will depend on continued global political attention to the impacts of climate change on agriculture and food security. The research proposed in the Theme is highly integrative – across the other Themes of the MP, across the CGIAR MPs as a whole, across disciplines and across research communities – and as such will require strong relationships.

Regional balance

Several aspects of the research in the Theme are of a generic nature, and will draw on data and skills worldwide. One of the early outputs is to identify 'hotspots' of vulnerability beyond the initial three target regions, where development, demonstration and evaluation of adaptation and mitigation pathways will be addressed in particular agro-ecological and socio-economic contexts. The baseline indicator data collection will occur in the target regions, and the scenarios work will also be focused in the target regions.

Linkages to other CGIAR MPs

The focus of Theme 4 on vulnerability will create and necessitate strong links with MP1 (Integrated agricultural systems for the poor and vulnerable). MP7 and MP2 (Policies, institutions, and markets for enabling agricultural incomes for the poor) will share *ex ante* assessment of policies and programs.

Theme 4 Objective 1: Linking Knowledge with Action

Rationale and research questions

Food security in the coming decades will be threatened by a number of factors whose future trends are uncertain. These uncertainties, coupled with the strong influence all these factors have on agricultural and food systems, pose major challenges to research, to policy formulation and to resource management related to food security. A powerful approach to help decision makers overcome these challenges is to run participatory scenarios exercises. These help to build adaptive capacity and enhance decision making under uncertainty through the development of a structured range of plausible futures within which analyses of policy and technical interventions can be undertaken. They also provide an effective mechanism for involving a range of stakeholders and for facilitating debate and communication among them. The whole process of stakeholder engagement and debate about plausible futures will contribute to MP7's foresight analysis and feed into priority

setting (see “Foresight, priority setting and impact assessment”). This Objective will be conducted at local, regional and global levels. At the regional level, qualitative scenarios or ‘storylines’ will be developed using initial global scenarios to provide guidance. By Year 3 an iterative process between regional storyline and global quantitative scenarios will result in both more relevant qualitative scenarios where internal plausibility is maintained with quantitative modeling and global modeling will more appropriately deal with regional scenario issues.

This Objective will provide an integrating forum for the intersection of all the work in MP7, from priority setting to bringing key outputs from MP7 into the stakeholder processes. It will also interface closely with policy processes at global and regional levels and in the countries selected for detailed work. In so doing it will work closely with Objective 3.

Research questions include:

- What are the plausible futures encompassing interactions between changes in climate and other key drivers of agricultural systems and food security?
- What are the key factors causing vulnerability to climate change and climate variability among agricultural and food systems and the people who depend on them, and how may this vulnerability change in the future?
- What are the main choice options to deal with climate change impacts and who are the key decision makers?

Activities

A major activity under this Objective will be the development of a structured range of plausible futures within which analyses of policy and technical interventions can be undertaken. Similar work will be conducted at more local levels (e.g. within the benchmark sites or at national levels as part of national processes). Here the emphasis will be on understanding the key issues faced by farmers in relation to climate change and understanding what options are feasible in specific national contexts. Scenario work will also be conducted at the global level. This will be linked to key global processes (e.g. those driven by the UNFCCC, IPCC and G8).

Another activity will be to carry out multi-scale vulnerability assessments, building on what has already been done and identifying who is vulnerable and why, what are existing practices, and how vulnerability may change in the future.

Products

- Coherent set of scenarios to 2030 and 2050 for each target region and globally, which examine potential development under a changing climate and differing pathways of economic development.
- Maps, reports and policy briefs about vulnerability that can be used to inform the targeting of research activities in the other Themes of MP7 and in other CGIAR MPs.
- Major events at global level linked to products that are targeted to ongoing international processes (Agriculture and Rural Development Day at COP16 and COP17; targeted side events to help develop the UNFCCC workplan for agriculture).

Partner roles

The scenario activities will be conducted working closely with the ESSP and with regional and national stakeholders in each of the target regions. These will form an important aspect of communications and capacity building and will help build regional science–policy teams who can take MP7 outputs forward. At the global level, the key partners are the Canadian International Development Agency (CIDA), the UK’s Department for International Development (DFID), the European Union (EU), FAO, the Global Forum on Agricultural Research (GFAR), the Global Donor Platform for Rural Development, the International Federation of Agricultural Producers (IFAP) and the World Bank. Once countries and benchmark sites are selected, partners at local levels will be selected and engaged.

Impact pathways for target environments

The scenarios will form the basis for vulnerability and trade-off analyses throughout MP7 and will guide the targeting and development of appropriate adaptation and mitigation strategies in the target regions, helping to mainstream climate variability and climate change issues into national, regional and international agricultural development strategies and institutional agendas. At global level, work will be coordinated with that of the Global Donor Platform for Rural Development and its partners. This proved an effective way to build consensus within the highly complex policy processes of COP15, and similar engagement has been planned for 2010 and beyond.

Theme 4 Objective 2: Assembling data and tools for analysis and planning

Rationale and research questions

No comprehensive framework exists to analyze the implications, both positive and negative, of human responses to the climate challenge in terms of regional food security and the preservation of important ecosystem services, upon which the long-term sustainability of global agriculture must be based. There are key gaps and uncertainties in knowledge concerning some processes, in model capacity, and in appropriate high-resolution databases. For example, uncertainties surround CO₂ effects on crop growth in developing countries. The work under this Objective will address some of these gaps and will be focused particularly on data and tools for integrative assessment (e.g. combining adaptation and mitigation agendas, and exploring synergies and trade-offs among outcome targets). A key research question is: what are the critical knowledge and data gaps and how can these gaps be filled effectively?

Activities

A first step is to collect information on the existing situation in the CGIAR, ESSP and elsewhere about datasets, tools, methods and infrastructure that can be used for vulnerability assessment. A series of scoping studies will identify critical gaps. Some of these can already be anticipated; for example, downscaling climate model outputs to temporal and spatial scales that are appropriate for biophysical and socio-economic modeling, making improvements in crop modeling and coordinating site-specific data collection approaches using standard data protocols and reporting mechanisms.

One group of activities will be focused on climate science, including the identification of climate trends and variability in the target regions, and assessment of methods for downscaling climate change information for agriculture and natural resources management. There are also crucial information gaps concerning near-term climate prediction, corresponding with time periods for which there is great user demand for information.

Another group of activities relate to database development and collation. An early activity in MP7 at the regional sites will be site characterization and baseline data collation, building as far as possible on existing sites, databases and information. These baselines will also form the basis for *ex-post* evaluation of research activities in later years.

A third group of activities relates to making improvements to biophysical and socio-economic models and the interactions among them. MP7 will work on enhancing the geographic precision of agricultural impact models for more targeted analysis, so that policymakers, researchers and farmers can make decisions with a greater understanding of the interactions between local conditions, national policies and programs, and international developments. Work during the first year will involve several scoping studies on agricultural impact model gaps and needs, bringing together the key global players to decide on how these gaps and needs can be addressed most effectively.

Products

This work will result in a framework and set of modeling tools and databases to analyze the implications, both positive and negative, of human responses to the climate challenge in terms of

regional food security and the preservation of important ecosystem services, upon which the long-term sustainability of global agriculture must be based. Products will include cutting-edge and innovative climate model outputs that can be utilized in the other Themes, considerably enhanced agricultural impact and global economic models, downscaled models that allow much higher resolution predictions of climate and agricultural impacts within regions, and new high-quality databases that are accessible to inputs and utilization by national agencies.

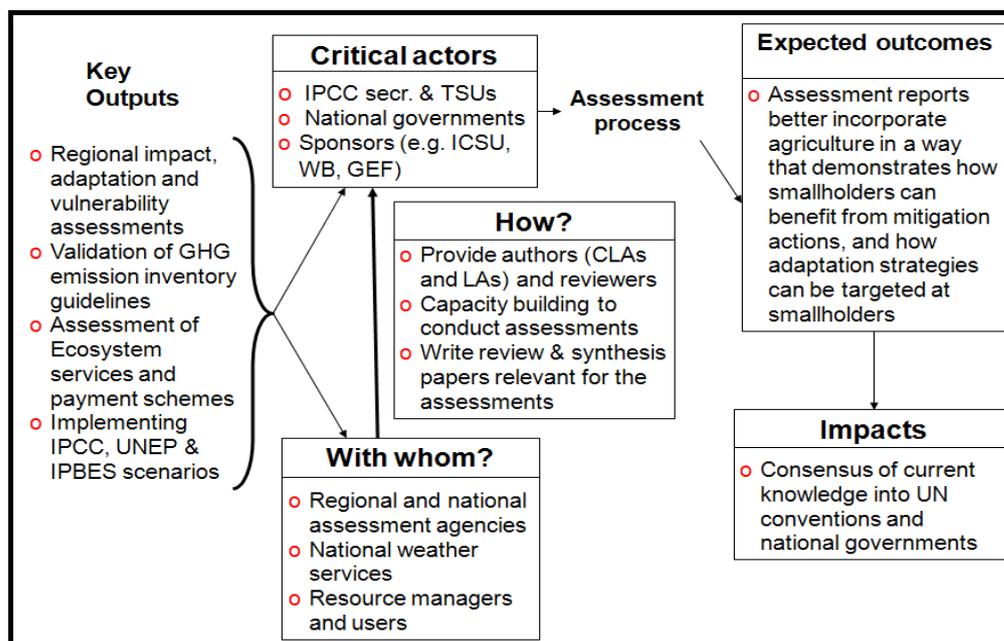
Partner roles

These activities will be conducted through an extensive array of partners. The international climate science community will be engaged to bring cutting-edge climate science to MP7. The ESSP, the CGIAR (through the Consortium for Spatial Information, the IMPACT modeling environment of IFPRI and other initiatives), and regional and national stakeholders in each of the target regions, will contribute to database collation, building on the considerable amount of information that already exists. Work will build on earlier International Geosphere-Biosphere Programme (IGBP) (Ingram, 1996) and other climate change crop modeling efforts and directly involve the international agricultural impacts modeling community through ARIs (e.g. IIASA, the Netherlands Environmental Assessment Agency) and key players such as the International Consortium for Agricultural Systems Applications (ICASA) and the recently-launched Global Crop Modeling Project (GCMP). NARES researchers will be partners in improved model development and will also be supported for capacity development as needed.

Impact pathways for target environments

The key intended users of the tools and datasets will be the numerous agencies involved in planning for and researching climate change impacts on agriculture, food security and natural resource management, NGOs and the private sector. The program will target these users by engaging the dozen or so key agencies that drive the agenda on climate change information provision, and by making available the tools and datasets in appropriate formats. Arming the next generation of agricultural researchers and the public with state-of-the-art agronomic, environmental and policy-related information sets will result in important spin-off benefits in areas of the world where these may be the only practicable sources of quantitative information that can be used to help make decisions. This objective will target the IPCC amongst others (Figure 8)

Figure 8. Illustrative impact pathway for bringing MP7 data and analysis into the IPCC process. The key outputs listed would be derived from Theme 4 and Theme 3 activities.



Theme 4 Objective 3: Refining frameworks for policy analysis

Rationale and research questions

There is a wide range of policy and program options for dealing with climate change effects; however there has been little analysis of the trade-offs and synergies possible among the environmental, livelihood and food security aspects. Furthermore, a wide range of technology and policy options relating to risk management, adaptation and mitigation are being pursued or considered in different regions. Systematic analyses of these interactions and strategic engagement with partners along with investments in communication efforts to share the results will lead to better policy and program choices.

Research questions include:

- What are the consequences of international, national and local policy and program options for improving environmental benefits, enhancing livelihoods and boosting food security in the face of a changing climate?
- Given the plausible futures in specific regions, what are the promising policy and program options to support adaptation and mitigation?

Activities

The principal set of activities in this Objective is to carry out *ex-ante* assessment of a wide range of technology and policy options related to risk management, adaptation and mitigation, and to evaluate the trade-offs and synergies among the environmental, livelihood and food security aspects. These analyses, carried out over a range of time and spatial scales, will include quantification of the uncertainties associated with the methods used, and will reflect the information needs of different stakeholders. Of equal importance is providing the tools to do this type of assessment to a wide range of stakeholders.

Working with coherent sets of scenarios that describe global and regional development pathways and estimates of vulnerability impacts into the future (Objective 1), one key activity to address this Objective is integrated assessment modeling at different scales, using a suite of tools and datasets to permit more precise understanding of the consequences of technology, policy and program choices made by national governments and international institutions, with a focus on the potential for CGIAR research. They will be based upon unprecedented integration between biophysical and socioeconomic modeling of global agriculture and natural resource systems. Research will deepen our understanding of the complex linkages between socioeconomic and environmental change and the functioning of agricultural systems and human well-being. The product will be a comprehensive modeling environment integrating socioeconomic, biophysical and technological responses to global, regional and local consequences of policy choices, from agricultural technology investments to property rights, trade and macroeconomic policies. It will provide an improved platform to assist international agricultural research centers, development agencies and national governments in strategic planning and in making investment decisions as they confront the coming challenges of climate change.

Early on in MP7 implementation, integrated assessment will be focused on *ex-ante* analysis to help set in place systems for monitoring and evaluating MP7 research activities. In later years, the framework and data collected will be used for *ex-post* assessment of the research outputs and outcomes, in relation to a baseline set of key indicators measured at the start of the work in the target regions and case-study sites.

Another set of activities to address this Objective is communication of the information and outputs generated. There is considerable need to enhance the two-way flow of information between end-users and scientists. To start this process, interactive stakeholder workshops will be held early on in target regions, applying 'Linking Knowledge with Action' tools that will help to build effective

information networks. These will build on the regional teams involved in the scenarios activities, and outputs from scenario analyses and integrated assessment will be fed into stakeholder dialogues via these networks in subsequent years.

Products

The activities undertaken as part of this Objective will result in global and regional assessments of climate change impacts on agricultural systems and food security, and ultimately will result in a set of detailed information products on promising adaptation and mitigation options.

Partner roles

These activities will be conducted through an extensive array of partners, including the CGIAR, the international ESSP research community and regional bodies and climate change-related programs and networks (e.g. ASARECA, WECARD, Clim-Dev, AfricaAdapt) and national stakeholders (NARES, NGOs, farmer organizations, etc.) in each of the target regions. Within countries, the key agencies will be the national planning agencies.

Impact pathways for target environments

This work will provide information on alternative strategies and scenarios that can be used by agencies to implement adaptation and mitigation strategies. It will engage key actors to ensure that climate variability and climate change issues are mainstreamed appropriately into national, regional and international agricultural development strategies and institutional agendas. Policy outputs will be delivered through coalitions of policy partners and decision makers, researchers, regional information networks, pro-poor civil society organizations and development agencies that have been engaged through efficient private-public partnership processes. Outputs will inform the ongoing negotiations of the UNFCCC and the assessment processes of the IPCC by conducting comprehensive integrated assessments that quantify vulnerability reduction, food security enhancement and environmental health in target regions.

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Acronyms and Abbreviations

| | |
|----------------|--|
| ACMAD | African Centre of Meteorological Application for Development |
| AFOLU | agriculture, forestry and land use |
| AGRA | Alliance for a Green Revolution in Africa |
| AGRHYMET | Centre Regional de Formation et d'Application en Agrométéorologie et Hydrologie Opérationnelle |
| ANAFE | African Network for Agriculture, Agroforestry and Natural Resources Education |
| AR4 | Fourth Assessment Report of the IPCC |
| ARDD | Agriculture and Rural Development Day |
| ARI | Advanced Research Institute |
| ASARECA | Association for Strengthening Agricultural Research in Eastern and Central Africa |
| AWARD | African Women in Agricultural Research and Development |
| BMGF | Bill and Melinda Gates Foundation |
| CAADP | Comprehensive Africa Agriculture Development Programme |
| CARE | Christian Action Research and Education |
| CB | Consortium Board |
| CDM | Clean Development Mechanism |
| CER | certified emission reductions |
| CGIAR | Consultative Group on International Agricultural Research |
| CIAT | International Center for Tropical Agriculture |
| CIDA | Canadian International Development Agency |
| CIFOR | Centre for International Forestry Research |
| CIMMYT | International Center for the Improvement of Maize and Wheat |
| CIP | International Potato Center |
| Cirad | La recherche agronomique pour le développement |
| ClimDev-Africa | Climate for Development in Africa Programme |
| COMESA | Common Market for Eastern and Southern Africa |
| COP | Conference of the Parties |
| CP | Challenge Program (of the CGIAR) |
| CRS | Catholic Relief Services |
| DFID | Department for International Development (UK) |
| ECOWAS | Economic Community of West African States |
| ESSP | Earth System Science Partnership |
| EU | European Union |
| FAO | Food and Agriculture Organization (of the United Nations) |

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| FARA | Forum for Agricultural Research in Africa |
| GCM | Global climate model |
| GCMP | Global Crop Monitoring Project |
| GCP | Generation Challenge Program |
| GCTE | Global Change and Terrestrial Ecosystems Program |
| GDP | Gross Domestic Product |
| GEC | Global Environment Change |
| GECAFS | Global Environment Change and Food Systems |
| GenderCC | Gender and Climate Change Network |
| GFAR | Global Forum on Agricultural Research |
| GFCS | Global Framework for Climate Services |
| GHG | greenhouse gas |
| GIS | Geographic information systems |
| GLAM | General large area model |
| I4 | Index Insurance Innovation Initiative |
| ICARDA | International Centre for Agricultural Research in the Dry Areas |
| ICASA | International Consortium for Agricultural Systems Applications |
| ICPAC | IGAD Climate Prediction and Applications Centre |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| ICT | Information and communication technology |
| IFAD | International Fund for Agricultural Development |
| IFAP | International Federation of Agricultural Producers |
| IFPRI | International Food Policy Research Institute |
| IGAD | Intergovernmental Authority on Development |
| IGBP | International Geosphere-Biosphere Programme |
| IGP | Indo-Gangetic Plains |
| IIASA | International Institute for Applied Systems Analysis |
| IIED | International Institute for Environment and Development |
| IITA | International Institute for Tropical Agriculture |
| ILRI | International Livestock Research Institute |
| IMPACT | This refers to the climate model developed by IFPRI |
| IPAM | Instituto de Pesquisa Ambiental da Amazônia |
| IPCC | Intergovernmental Panel on Climate Change |
| IPG | International public good |
| IRI | International Research Institute for Climate and Society |
| IRRI | International Rice Research Institute |
| ISP | Independent Scientific Panel |

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|---------|--|
| ISPC | Independent Science and Partnership Council |
| IWMI | International Water Management Institute |
| M&E | Monitoring and evaluation |
| MP | Mega Program |
| MRV | measurable, reportable and verifiable |
| NAPA | National Adaptation Plan of Action |
| NAMA | Nationally Appropriate Mitigation Actions |
| NARES | National agricultural research and extension system |
| NCAR | National Center for Atmospheric Research |
| NGO | non-governmental organization |
| NMS | national meteorological services |
| PRADAN | Professional Assistance for Development Action |
| PIK | Potsdam Institute for Climate Impact Research |
| RCM | Regional climate model |
| RF | Rockefeller Foundation |
| RUFORUM | Regional Universities Forum for Capacity Building in Agriculture |
| SBSTA | Subsidiary Body for Scientific and Technological Advice |
| SC | Science Council |
| SLM | sustainable land management |
| SRF | Strategy and Results Framework (of the CGIAR) |
| SSA | Sub-Saharan Africa |
| START | Global change System for Analysis, Research and Training |
| UCAR | University Corporation for Atmospheric Research |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNREDD | United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries |
| WECARD | West and Central African Council for Agricultural Research and Development |
| WEDO | Women's Environment and Development Organization |
| WEF | World Economic Forum |
| WFP | World Food Programme |
| WMO | World Meteorological Office |

Annex 1: Products, users, outcomes and impacts

Theme 1: Adaptation to Progressive Climate Change

| Key final products | Intermediate users | Final users | Outcomes | Impacts |
|--|---|--|--|--|
| <i>Objective 1: Adapted farming systems for changing climate conditions in space and time through the development of improved crops, livestock, farmed fish, and natural resources management, technologies and tools</i> | | | | |
| <p>Design of adapted farming systems and technologies for changing climate conditions in space and time through the development of improved crops, livestock, agronomic practices, water management and natural resource management tools</p> <p>Building of regional and national capacities to produce high quality strategies, e.g. through NAPAs and NAMAs</p> <p>New knowledge-synthesizing institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors; what is working where, how and why</p> | <p>Policy makers at sub-national, national and international scales; international development NGOs, local development NGOs</p> | <p>Resource-poor farmers</p> | <p>Outcome 1.1: Agricultural and food security strategies that are adapted towards conditions of predicted climate change promoted by the key development and funding agencies (national and international), civil society organizations and private sector in at least 20 countries</p> | <p>Reduction of vulnerability to climate variability and change, and more resilient food systems</p> |
| <i>Objective 2: Strategies for addressing abiotic and biotic stresses induced by breeding for future climatic conditions, variability and extremes, including novel climates</i> | | | | |
| <p>Understanding and evaluating the response of different varieties/crops to climate change in time and space, and generating comprehensive strategies for crop improvement through a combination of modeling, expert consultation and stakeholder dialogue</p> | <p>Breeders, physiologists, biotechnologists, agronomists</p> | <p>Extension services, resource-poor farmers</p> | <p>Strategies for addressing abiotic and biotic stresses induced by future climate change, variability and extremes, including novel climates mainstreamed among more than 75% of the international research agencies, and by national agencies in at least 12 countries</p> | <p>Reduction of vulnerability to climate variability and change</p> |
| <i>Objective 3: Targeted identification and enhanced deployment and conservation of species and genetic diversity for increased resilience and productivity under conditions resulting from climate change</i> | | | | |

| Key final products | Intermediate users | Final users | Outcomes | Impacts |
|--|---|-----------------------|---|--|
| New knowledge, guidelines and germplasm available for using genetic and species diversity to enhance adaptation, productivity and resilience to changing climate | Breeders, extension services, farmers, agricultural development organizations, NARES, government agencies, conservation organizations | Resource-poor farmers | Portfolio of information sources, guidelines and germplasm available for using genetic and species diversity to enhance adaptation and resilience to changing climate are adopted and up-scaled by national agencies in at least 20 countries and by international organization for the benefits of resource poor farmers | Reduction of vulnerability and sustained production despite climate variability and change |

Plan for Theme 1, Objective 1: Adapted farming systems for changing climate conditions in space and time through the development of improved crops, livestock, farmed fish, and natural resources management, technologies and tools

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|---|--|--|---|
| 2011 | Compilation of existing databases on crop performance related to climate from multiple sources (i.e. multi-site trial data of a range of crop varieties) | Platform for multi-site trials of technologies and varieties established for analysis of GxE interactions and calibration and validation of crop models | Willingness of partners to share multi-site trial data | West Africa, East Africa Indo-Gangetic Plains New target regions added in subsequent years | CGIAR Centers, CIRAD, NARS and other ARI institutions involved in agricultural trials |
| 2011 | Identification and establishment of technologies to be tested and developed across a range of pilot sites | New production system technologies developed which contribute directly to enhanced adaptive capacity in farming systems | Interest from local partners in managing pilot sites, willingness of partners to provide candidate technologies for trialling. | Pilot sites in target regions | CGIAR Centers in collaboration with other themes in the MP, NARS, ARIs, CIRAD. |
| 2012 | Modeling methodologies to outscale the potential of individual adaptation options across a wide range of geographies (i.e. use of analogues in space and time) | Explicit knowledge of the potential application domains for agricultural practices, technologies and policies, and knowledge on best means of transferring these technologies and ensuring their adoption | Availability of sound climate projections to 2030 and beyond. | Developing countries | CGIAR Centers, ESSP, NARS and ARIs |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|--|--|--|
| 2013 | Characterization of climate adaptation options in target regions | Portfolio of adaptation options with potential for adapting production systems identified, developed and/or tested | Sufficient technologies tested in 2011 and 2012 and successful means of extrapolating application domains. | Sub-set of target regions representative of developing country conditions | CGIAR centers, international development NGOs, national government, NARS. |
| 2013 | Understanding of institutional arrangements, policies and mechanisms that enhance the adaptive capacity of resource-poor households to adopt new farming practices, strategies and behaviors that reduce their vulnerability in the face of a changing climate | Document synthesizing institutional arrangements, policies and mechanisms for improving the adaptive capacity of agricultural sector actors; what is working where, how and why, with disaggregation by gender and other social strata Building of regional and national capacities to produce high-quality NAPAs and NAMAs | Partners have sufficient incentives to engage and people trained remain in local institutions | West Africa, East Africa Indo-Gangetic Plains New target regions added in subsequent years | African & S.Asian University networks; international development NGOs, government, regional bodies |

Plan for Theme 1, Objective 2: Strategies for addressing abiotic and biotic stresses induced by breeding for future climatic conditions, variability and extremes, including novel climates

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|--|--|---|
| 2011 | Ensuring research and policy organizations are actively engaged from the early stages of the research in both design and post-project implementation of the strategies developed | High-level meetings with key stakeholders that result in mainstreamed strategies in workplans and existing breeding programs | Willingness of crop breeding institutions to participate in program; inclusion of women's and men's crops in the program | West Africa, East Africa Indo-Gangetic Plains New target regions added in subsequent years | Crop-breeding institutes (CG Centers, ARIs, NARS), regional decision-making and priority-setting bodies (ASARECA, FARA, WECARD), donors, national governments |

| | | | | | |
|------|--|---|--|--|---|
| 2011 | Development of a range of crop modeling approaches to model biotic and abiotic constraints under decadal futures from 2020 to 2050 | Range of modeling approaches developed and validated for assessing future constraints to crop production and the design of virtual crops | Availability of climate projections and sufficient data on abiotic and biotic interactions with climate | Global | Crop-based components of MP3, GCP, molecular and breeding platforms CG Centers, NARS, ARI breeding institutes, private sector breeding companies |
| 2012 | Design of a set of “virtual crops” and assessment of their efficacy in addressing the likely future conditions in terms of the economic, social and cultural benefits expected | Detailed crop-by-crop strategies and plans of action for crop improvement developed, incorporating portfolio of national, regional and global priorities | Availability of models and data | Global | CG Centres, ARI modeling groups, NARS scientists |
| 2013 | Socialization of identified set of breeding strategies with funding bodies, national and international organizations, universities and other actors | Global, regional and national policy briefs for investments in climate-proofed crop breeding initiatives, and crop breeding institutions coordinated in development of climate-proofed crops for a 2030-2050 world. | Willingness of crop breeding institutions to adjust priorities based on priority setting results, and donor coordination in funding of future breeding programs. | West Africa, East Africa Indo-Gangetic Plains New target regions added in subsequent years | Crop-breeding institutes (CG Centers, ARIs, NARS), regional decision-making and priority-setting bodies (ASARECA, FARA, WECARD), donors, national governments |

Plan for Theme 1, Objective 3: Targeted identification and enhanced deployment and conservation of species and genetic diversity for increased resilience and productivity under conditions resulting from climate change

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|------------|----------|-------------|----------------|----------|
|------|------------|----------|-------------|----------------|----------|

| | | | | | |
|------|--|---|--|--|--|
| 2011 | Developing tools and methodologies to rapidly identify candidate germplasm with traits useful for climate change adaptation and identification of threats to in situ material | Methods and tools to facilitate targeted identification of ex situ and in situ germplasm with traits useful for climate change adaptation, including resistance to biotic as well as abiotic stresses and analyses of threats to priority in situ germplasm | Adaptation traits easily identifiable and availability of sufficient data. | East Africa; Asia; global | CG Centers, national genebanks, NARS, |
| 2011 | Develop crop suitability atlas of identified local varieties conserved in genebanks based on genebank information and environmental conditions using Geographic Information system (GIS) | Crop suitability maps for priority crops developed | Good georeference data of accessions are available | East Africa | CG Centers, , national genebanks, NARS, |
| 2012 | Participatory on-farm evaluation on a range of sites to test candidate material response in different climate conditions | Adaptive germplasm, suited for different future climate conditions, selected based on response and farmer preferences, and corresponding future production zones identified | Genetic resources policy permits movement of germplasm to pilot sites | Pilot sites in East Africa | CG Centers, national genebanks, NARS, Extension officers NGOs and local farmer organizations, Farmers, |
| 2012 | Documenting farmers' traditional knowledge of diversity assessment and its use in adapting to the changing climate and raising their awareness about the implications of climate change for agriculture and the role of genebanks in providing germplasm; associated capacity building | Database and management system to serve as a depository of traditional knowledge on farmers coping with climate change; public awareness (radio programmes, posters/ brochures) materials produced | Rural radio partners are a credible source of information; Farmers have access to radios | East Africa | CGIAR centres, NARS, National genebank, Media; Extension services, Farmers organizations |
| 2013 | Evaluation of promising genebank accessions collected from areas with specific environmental conditions and phenotyping for gene discovery | Accessions identified with interesting traits important for climate change adaptation | Exchange of germplasm supported by participating countries | Asia Pacific-Oceania, Latin America and Caribbean ; East and West Africa | National, regional, and international genebanks; advanced lab |

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|------|--|---|--|---------------------|--|
| 2013 | Developing a seed dissemination system for deployment of adapted (climate ready) local varieties to farmers; associated capacity building | Seed deployment mechanisms involving local seed systems | Local seed providers ready to participate and collaborate with the project | East Africa | Local seed providers; farmers cooperation; Community genebanks; National Genebank; Extension service Development agencies, Crisis response agencies (i.e. WFP) |
| 2013 | Evaluation and formulation of strategies needed to facilitate uptake, focusing on access to the material, its deployment and its management; associated capacity building | Policy guideline document on use of adapted germplasm from genebanks to adapt to climate change made available to policy makers; Strategies to improve existing policies, local management and seed systems to facilitate the deployment of adapted germplasm | Supportive government policies; Willingness of international bodies to revise policies related to germplasm access | East Africa; global | Ministries of Agriculture, National climate change fora; CGIAR Centres, national genebanks |
| 2013 | National and global collections enriched with germplasm important for adapting to climate change and information about materials and their traits integrated into Information system; development of complementary conservation strategies for in situ materials | Genebank collections integrating germplasm specifically focused on climate change adaptation; information on climate adaptation traits integrated into information system; guidelines for complementary in conservation of priority genebanks | Policy framework in place for sharing of information | East Africa; global | CG Centers, , national genebanks, NARS, |

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|------|--|--|---|--|--|
| 2013 | Development of participatory approaches and methods to assess the contribution of diversity in production systems for climate change adaptation; capacity building provided to collaborators | Assessment of the contributions of crop diversity in production systems to adapt to climate change | Sufficient data points and comparative conditions to compare the resilience of diversified as compared to simpler systems in the face of variable and changing conditions | East Africa New target regions added in subsequent years, with additional funding | CG Centers, ministries of forestry, the environment and international and national conservation organizations, national genebanks, NARS, development agencies and local farmer organizations |
|------|--|--|---|--|--|

Theme 2: Adaptation Pathways for Current Climate Risk

| Key final products | Intermediate users | Final users | Outcomes | Impacts |
|---|--|---|--|---|
| Objective 1: Enable rural communities to manage and build resilient livelihoods | | | | |
| Synthesized knowledge of how best to target and implement innovative risk management strategies for rural communities; evidence of their feasibility, acceptability and impacts | CGIAR, development funders, organizations concerned with insurance (e.g., BMGF, RF, AGRA), regional agriculture policy bodies (e.g., CAADP), NARES, rural finance sector, development NGOs | Rural communities, organizations of resource-poor farmers, agribusiness | Systematic technical and policy support for farm- to community-level agricultural risk management strategies that buffer against climate shocks and enhance livelihood resilience in at least 20 countries | Farming systems and rural livelihoods that are more secure in the face of a variable and changing climate |
| Objective 2: Managing climate risk through food delivery, trade and crisis response | | | | |
| Enhanced knowledge of how to use advance information to best manage: a) climate-related market risk through food delivery and trade; and b) climate risk through food crisis response and post-crisis recovery. And evidence of the resulting impacts on rural communities and agricultural markets | a) Providers of climate and food security early warning information b) CGIAR, regional trade communities (e.g., ECOWAS, COMESA), climate and market information providers | a) Food security humanitarian response organizations and funders; b) National and regional trade organizations | Better climate-informed management by key international, regional and national agencies of food crisis response, post-crisis recovery, and food trade and delivery in at least 12 countries. | Enhanced food crisis response decreases long-term livelihood impacts, reduces disincentives to agricultural development, reduces cost of assistance; while more timely management of trade, storage and delivery reduces adverse impacts of climate fluctuations on food accessibility and incentives |

| Objective 3: Enhanced prediction of climate impacts, and enhanced climate services | | | | |
|--|---|--|--|---|
| <p>a) Enhanced knowledge, products and evidence to support the development and delivery of climate information services that best meet the risk management needs of agricultural decision-makers</p> <p>b) Improved knowledge, tools, data sets and platforms for monitoring and predicting agricultural production and biological threats, and informing management, in response to climate</p> | <p>a) Global, regional and national climate service providers, communication intermediaries (e.g., NARES, development NGOs, media, ICT industry)</p> <p>b) CGIAR, NARES, regional climate services providers, early warning information, communication intermediaries</p> | <p>a) Rural communities, agricultural inputs and rural finance providers, agribusiness</p> <p>b) Agribusiness, food security humanitarian response donors and organizations, rural communities</p> | <p>Enhanced uptake and use of improved climate information products and services, and of information about agricultural production and biological threats, by resource-poor farmers, particularly vulnerable groups and women, in at least 12 countries.</p> | <p>Enhanced use of advance information to manage climate-related risks leading to more resilient farming systems, more secure rural livelihoods, more effective and less costly crisis response</p> |

Plan for Theme 2, Objective 1: Enable rural communities to manage and build resilient livelihoods

| Year | Activities | Products | Assumptions | Target regions | Partners |
|-------------|--|---|--|-----------------------|---|
| 2010 | Analyze priority knowledge and methodology gaps for index-based risk transfer products, and formulate Program value-addition and partnership strategy | Scoping and strategy report on priority knowledge and methodology gaps for index-based risk transfer, Program advantages and strategy; Platform to coordinate research with other relevant initiatives. | Value addition to other index insurance initiatives; resource-poor farmers have access to index-based risk transfer products | Global | Institutions working on index insurance (e.g., I4, BMGF, RF, Oxfam, WFP, IRI, CIRAD) ARIs and CG Centers to be identified |
| 2011 | Create a platform to synthesize and exchange information about farmers' coping strategies, innovations for improving management of climate-related agricultural risk | Web-based platform and clearinghouse on farmers' coping strategies, innovations for improving management of climate-related agricultural risk | Partners willing to share findings through platform | Developing countries | Joint activity with Theme 3. Web developer to be determined. |

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|------|---|---|--|-------------------------|--|
| 2011 | Characterize climate-related risk, and survey current formal and informal responses to risk with potential for transfer and upscaling | Report, media brief on responses to risk, including farmers' stories. | Effective, equitable participation of rural communities, support of intermediaries | E Africa, W Africa, IGP | CIRAD, NARS, ILRI, ICRISAT, other CG Centers to be determined |
| 2011 | Participatory pilot demonstration and evaluation of indigenous and new risk management strategies, e.g., use of climate and early warning information; diversification, index-based insurance | Stakeholder networks and workshops. Preliminary report on pilot activities | Stakeholders identify context-relevant risk management strategies, and participate in their improvement and testing. Capable NGOs partner. | E Africa, W Africa, IGP | Farmer associations, NARS, development NGOs (e.g., CARE, PRADAN), ICRISAT; ILRI, other CG Centers to be determined, based on target locations |
| 2012 | Synthesis and dissemination of on-going work on agronomic and natural resource management technologies for enhancing climate resilience, to inform targeting and Program strategy | Major synthesis report, with associated case studies from diverse agro-economic systems; Decision support tools or guidelines for matching and combining technologies for given context | Access to relevant work across CG Centers and targeted NARS. Uptake of results by key agencies | Global | CIRAD, relevant NARS and CG Centers (e.g., CIP, ICRISAT, IRRI, IWMI, ICARDA, CIMMYT, CIAT, IITA, WorldFish, AfricaRice), with appropriate links to other CG Programs |
| 2012 | Comparative analysis of livelihood strategies that help cope with climate variability to inform development strategy | Key synthesis paper prepared for top journal, and associated media release timed to COP17 | Uptake of results by key agencies | Global | CIP, ICRISAT, IFPRI, WorldFish, ICARDA |
| 2012 | Survey current use, unmet demand and bottlenecks to use of climate-related information to manage agricultural risk, and formulate intervention strategy | Report and journal article on demand, use, strategies to enhance use of climate-related information. Awareness and capacity-building activities with relevant agencies. | Uptake of results by key agencies | E Africa, W Africa, IGP | NMS, regional climate centers, others to be determined |

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|------|--|--|---|---|--|
| 2013 | Characterize climate-related risk and survey current formal and informal responses to risk | Report on current responses to risk; website with farmers' stories; Media brief of findings | Uptake of results by key agencies | In the two new regions that are added | Relevant NARS and CG Centers to be determined |
| 2013 | Analyze determinants and risk impacts of existing cultivar and livelihood portfolios, and potential improvements | Report and journal article examining risk impacts of existing cultivar and livelihood portfolios, and potential improvements | Uptake of results by key agencies | E Africa, W Africa, IGP and two new regions | CIRAD, NARS, CG Centers and Programs to be determined |
| 2013 | Scale out findings in initial target regions to newly added regions | | Relevant information products, services, and uses can be engaged in each region. | New regions added in 2011/2 | To be determined |
| 2013 | Synthesize results from participatory pilot demonstrations of local-level risk management strategies (e.g., index insurance, climate forecast use) | Report and journal article on improved local-level risk management strategies. Regional stakeholder workshops. | Will be replicated in other research locations as they are established in each region | E Africa, W Africa, IGP | To be determined, based on selection of target countries |

Plan for Theme 2, Objective 2: Managing climate risk through food delivery, trade and crisis response

| Year | Activities | Products | Assumptions | Target regions | Partners |
|-----------|---|---|---|---|---|
| 2010-2011 | Scoping study and stakeholder consultation on current use, emerging opportunities to incorporate advance information into management of climate-related food crises and food price fluctuations, to inform Program strategy | Scoping report (2010) and workshop (2011) on current state, trends, emerging opportunities to incorporate advance information into management of climate-related food crises and price fluctuations | Capable food security and trade organizations available to participate. | Global (food security); E. Africa, W. Africa, IGP (trade) | Cornell U, participating food security (e.g., WFP, CRS, World Vision) and trade organizations to be identified; IRI |
| 2012 | Analyze alternative rules to manage food crises and price volatility in response to current information, and potential lead time and accuracy improvements | Report, brief and journal article on approaches to manage food crises and price volatility. Workshop with food security and trade organizations | Capable food security organizations available to participate. | Global | IFPRI, participating food security response organization to be identified |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|---|-------------------------|--|
| 2012 | Analyze drivers and impacts of food price volatility | Report, brief and journal article on drivers and impacts of food price volatility | Adequate market, climate and livelihood data are available. | E Africa, W Africa, IGP | IFPRI, other research partners to be determined |
| 2013 | Engage select food security organizations to explore, develop, evaluate new response strategies based on long-lead prediction; and design improved information | Journal article, policy brief, media on new response strategies based on long-lead prediction. Enhanced platform for coordinating information and action among response organizations. | Capable food security organizations available to participate. | Global | Cornell U., IFPRI, food security response organizations to be identified |

Plan for Theme 2, Objective 3: Enhanced prediction of climate impacts, and enhanced climate services

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|---|--|---|-------------------------|---|
| 2010 | Review current climate information products, services and delivery mechanisms; and constraints and opportunities for using seasonal climate prediction to improve management of agricultural risk | Journal paper and strategy brief on current climate services, opportunities and constraints for seasonal forecasts for risk management, including access by gender and social groups | | E Africa, W Africa, IGP | ACMAD, IRI, ICRISAT, NMS |
| 2010 | Inventory climate-sensitive pest and disease modeling and early warning systems, and develop Program strategy for enhancing their use for agricultural and food security risk management. | Report and strategy brief on biological threat early warning. | Review will identify suitable opportunities to enhance early warning and management of strategic climate-sensitive biological threats | Global | CIAT, IITA, CIP, other relevant CG Centers to be determined |
| 2011 | Evaluate ICT-based and institutional information delivery models for effectiveness, equitability, relevance, transferability and scalability; and | Report on effectiveness, equitability, relevance, transferability and scalability of ICT based delivery systems | Institutional and technological capacity is sufficient to support widespread delivery of | Global | Kiwanja.net, UCAR, Microsoft Research |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|-----------|---|--|---|-------------------------|---|
| | formulate Program strategy | | climate services. | | |
| 2011–2012 | Develop and evaluate calibrated improved historic meteorological data sets for seasonal forecast, crop, pasture and biological threat forecasting applications | 2011: Calibrated rainfall data and methodology paper; Proof of concept report for temperature and solar radiation 2012: Full validated data set; Journal paper | NMS and regional climate centers participate and share data. Full set of METEOSAT images processed and available. | E Africa, W Africa | AGRHYMET, NMA (Ethiopia), IRI, Reading U., CIP, others to be determined |
| 2013 | Assess needs for climate information; technical and institutional bottlenecks to the production and delivery of useful information; and potential for new or enhanced products and services for risk management | Report and brief on needs for climate information, technical and institutional bottlenecks, potential new products and services; Awareness and capacity-building events for climate information providers, intermediaries and users. | Participatory evaluation (Objectives 1 and 2) will identify demand, relevant uses for climate-related information. | E Africa, W Africa, IGP | IRI, WMO, ClimDev-Africa, NMS, ICRISAT; other CG, regional and national partners to be determined |
| 2013 | Develop improved methodology and a platform for climate-informed, long-lead forecasting of crop and forage production, and biological threats | Crop and forage monitoring and forecasting platform, documentation; validation report; training activity; journal article | Effective collaboration with food security early warning organizations; Uptake by key food security, trade and index insurance users. | Global | IRI, FAO, CIAT, ICRISAT, ILRI, CIP, other CG Centers working on crop forecasting, food security early warning providers and ARIs to be determined |
| 2013 | Prototype prediction tools and early warning platform for at least 2 strategically important, climate-sensitive biological threats to agriculture | Early warning tools, platform, documentation; validation report | Demonstrated feasibility of forecasting strategically important biological threats. | | CIAT, IITA, CIP; other CG Centers early warning providers and ARIs to be determined |

Theme 3: Pro-Poor Climate Change Mitigation

| Key final products | Intermediate users | Final users | Outcomes | Impacts |
|--|--|--|--|--|
| Objective 1: Inform decision makers about the impacts of agricultural development pathways | | | | |
| <p>New understanding about agricultural development pathways for balancing the trade-offs among mitigation, poverty alleviation, food security and environmental health</p> <p>Enhanced capacity in regional and national policy and research organizations to analyze the implications of different development scenarios</p> | <p>SBSTA Working Group, IPCC, ESSP, academics, GECAFS, CARE, the World Bank, IFAD and other donors</p> | <p>AFOLU ministries, planning agencies, development organizations</p> | <p>Enhanced knowledge about agricultural investments that leads to better decisions for climate mitigation, poverty alleviation, food security and environmental health, used by national agencies in at least 20 countries.</p> | <p>Decision makers choose agricultural development strategies that create synergies between mitigation and other policy goals, with investment in agricultural development related to mitigation increasing by 10%</p> |
| Objective 2: On-farm mitigation practices and their landscape-level implications | | | | |
| <p>New understanding about the direct and indirect economic and environmental costs and benefits from agricultural mitigation, and systems developed for GHG monitoring and accounting at farm and landscape level</p> <p>Network of PhD students developed for studying GHGs in developing country agriculture</p> | <p>CG Centers, Global Carbon Project, Terrestrial Carbon Group, Winrock International, Voluntary Carbon Standard, private sector, universities</p> | <p>UNFCCC, national planning and AFOLU agencies, international development agencies, carbon market investors</p> | <p>Improved knowledge and tools to support carbon market development to be used by buyers, sellers (including farmers' organizations) and intermediaries for crop-soil management, agroforestry, coastal and irrigated rice systems in at least 20 countries</p> | <p>10% reduction in emissions from agricultural landscapes and enhanced livelihoods</p> |
| Objective 3: Institutional arrangements and incentives that enable smallholder farmers to participate effectively in carbon markets and reduce GHGs | | | | |
| <p>Enhanced understanding about the institutional arrangements,</p> | <p>Organizations of resource-poor farmers, intermediaries and buyers in the carbon</p> | <p>World Bank Biocarbon Fund, Voluntary Carbon Standard, Climate, Community and</p> | <p>Key agencies dealing with climate mitigation in at least 20 countries promoting new</p> | <p>Participation by smallholders in Project areas increase by 25%, and overall</p> |

| Key final products | Intermediate users | Final users | Outcomes | Impacts |
|---|--|-------------------------------|---|---|
| market-based instruments, policies and incentives that can improve access for the poor to mitigation benefits, with empirical indications of the impacts of these benefits on poverty alleviation and GHG emissions | market, international and national policy research organizations such as EcoAgriculture and IPAM | Biodiversity Alliance, donors | institutional arrangements and incentive systems that favor resource-poor farmers, particularly vulnerable groups and women | distribution of benefits includes at least 25% of smallholders in project areas |

Plan for Theme 3, Objective 1: Inform decision makers about the impacts of agricultural development pathways

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|---|---|--|---|---|
| 2011 | Develop alternative scenarios for strategies for agricultural intensification and adaptation in different regions | Report on: a) the net emissions of different scenarios; b) mitigation implications of alternative adaptation strategies; and c) identification of promising options for climate mitigation, poverty alleviation, food security and environmental health, including understanding of access by different genders and social groups | Agricultural intensification will be necessary to meet future food demand; mitigation will be possible among resource-poor farmers | Global, E and W Africa, Indo-Gangetic Plains, Amazon Basin, SE Asia | CG Centers; ESSP; Global Carbon Project; Universities of Vermont, Oxford, Leeds, Edinburgh; World Bank; CAR; EcoAgriculture; IIED; FAO; developing country partners to be decided based on countries selected |
| 2012 | Involve decision makers in sharing scenarios, models and consideration of alternative strategies | Synthesis report and scientific article on agricultural development pathways; capacity building of decision makers in use of appropriate tools | | Global, E and W Africa, Indo-Gangetic Plains, Amazon Basin, SE Asia | CG Centers, ESSP, Global Carbon Project, U of Vermont, and numerous other partners to be identified |
| 2013 | Assess impacts on poverty alleviation, food security and environmental health at multiple scales | Synthesis report shared in major global forums on climate change and food security | Preliminary data ready from PhD network (Objective 2) | Developing countries | CGIAR centers, ESSP, Global Carbon Project, University of Vermont, and numerous other partners to be identified |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|-------------|--|--|
| 2013 | Workshops with regional and national policy makers and researchers to analyse and discuss the implications of different agricultural development scenarios | User-friendly website, capacity building events and workshops (one per region) | | Global, East and West Africa, Indo-Gangetic Plain, Amazon Basin, SE Asia | CGIAR centers, ESSP, Global Carbon Project, University of Vermont, World Bank, IFAD, Ecoagriculture, IIED, FAO, START, AFOLU ministries, developing country partners tbd |

Plan for Theme 3, Objective 2: On-farm mitigation practices and their landscape-level implications

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|---|---|---|--|
| 2011 | Create a global platform for exchange and synthesis of information about innovations in agricultural mitigation | Web-based platform and clearinghouse identifying mitigation impacts of on-farm practices and their landscape-level implications | Interest and willingness of partners to contribute findings to platform | Developing countries | CGIAR centers, with a multitude of partners |
| 2011 | Establish a PhD network for studying GHG emissions; and develop a system for monitoring and accounting at farm level | Network established and methods guidelines produced | Simple methods can be devised for widespread application | Developing countries, with a focus on target regions | Advanced Research Institutes (University of Copenhagen, University of Oxford and others) |
| 2012 | Measure GHG fluxes and develop MRV, working with partners in the ESSP | Synthesis of preliminary results | Cost effective measures and MRV are possible | Global, East and West Africa, Indo-Gangetic Plains, Amazon Basin, SE Asia | CG Centers (e.g. IWMI, CIAT, CIP, ILRI, ICRISAT, IRRI, ICRAF, CIMMYT) and numerous partners from PhD network |
| 2013 | Validated simulation models that can be used to identify the mitigation potential of different options | Validated simulation models that can be used to identify the mitigation potential of different options | Sufficient data exists to validate simulation models | Global | ARIs (to be selected) |
| 2013 | Identify a set of target practices that produce win-win outcomes at | Report, website, policy briefs and scientific article evaluating the | Practices that increase mitigation, livelihood | Developing countries | CG Centers, ESSP, Global Carbon Project, U of Vermont, and |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|---|--|--|----------------------|---|
| | the household and landscape level | potential direct and indirect economic and environmental costs and benefits from agricultural mitigation | benefits and environmental benefits are possible | | numerous other partners to be identified |
| 2013 | Work with field-based partners to develop user-friendly ways of communicating data that can be used by farmers and decision makers to change their land-use practices | User-friendly website, capacity building events and workshops (one per region) for the design of incentive mechanisms and institutional arrangements | | Developing countries | Global Carbon Project, U of Vermont, World Bank, CARE, IIED |

Plan for Theme 3, Objective 3: Institutional arrangements and incentives that enable smallholder farmers and common-pool resource users to participate effectively in carbon markets and reduce GHGs

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|---|---|--|
| 2011 | Assess barriers to entry and factors affecting benefits from the carbon market for differentiated social groups including women, and the range of emerging institutional arrangements and incentives for better inclusion and benefits | Report on differentiated access to carbon markets, and how different kinds of beneficiaries can be reached | Carbon market participation and potential benefits will be uneven among regions and farmers | Global, E and W Africa, Indo-Gangetic Plains, Amazon Basin, SE Asia | CG Centers, ESSP, Global Carbon Project, U of Vermont, World Bank, CARE, EcoAgriculture, IIED, FAO |
| 2012 | Identify promising market-based instruments, policies and institutional arrangements | Report, website, policy briefs and scientific article identifying promising institutions, market-based mechanisms and policies | Resource-poor farmers will participate in carbon markets if incentives are sufficient | Global, E and W Africa, Indo-Gangetic Plains, Amazon Basin, SE Asia | CG Centers, ESSP, Global Carbon Project, U of Vermont, World Bank, CARE, EcoAgriculture, IIED, FAO |
| 2013 | Pilot institutional arrangements, incentive mechanisms and MRV protocols for carbon trade, | Synthesis report on institutional arrangements market-based Instruments, policies and | | Tragteded regions | CGIAR Centers (IFPRI, ICRAF, ILRI, CIAT) , World Bank, CARE, EcoAgriculture, |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|--|---|---|
| | including potential project developers and aggregators (supermarket supply chains, producers of high-value export crops, NGOs and farmer organizations) | incentives that can improve access for the poor to mitigation benefits, with empirical indications of the impacts of these benefits on poverty alleviation and GHG emissions | | | IIED, FAO |
| 2013 | Test the feasibility of carbon market participation and benefits in high and low mitigation potential areas | Feasibility analysis for different areas | Investors see agriculture-based markets as profitable | Targeted regions | CG Centers, ESSP, Global Carbon Project, U of Vermont, World Bank, CARE, EcoAgriculture, IIED, FAO |
| 2013 | Workshops (one per region) and capacity development initiatives to increase the uptake and improve the design of incentive mechanisms and institutional arrangements | User-friendly website, capacity building events and workshops (one per region) for the design of incentive mechanisms and institutional arrangements | Institutional arrangements, market-based instruments, policies and incentives exist and have had sufficient experience to show results | Global, E and W Africa, Indo-Gangetic Plains, Amazon Basin, SE Asia | CG Centers, ESSP, Global Carbon Project, U of Vermont, World Bank, IFAD, EcoAgriculture, IIED, FAO, START, AFOLU ministries, developing country partners to be determined |

Theme 4: Integration for Decision Making

| Key final products | Intermediate users | Final users | Outcomes | Impacts |
|--|---|--|---|--|
| Objective 1: Linking knowledge with action | | | | |
| <p>For each region, coherent sets of scenarios to 2030 and looking out to 2050 that examine potential development scenarios under a changing climate and differing pathways of economic development</p> <p>Global and regional maps, tables and associated syntheses, showing current vulnerable populations in relation to food security to 2030 and 2050</p> | Other Themes in the Program, other CGIAR Programs, regional and ESSP partners | Global Adaptation Fund, UNREDD, the World Bank, IPCC, UNFCCC/SBSTA, key bilateral donors developing adaptation and mitigation strategies, large international NGOs, key regional and national actors | Appropriate adaptation and mitigation strategies mainstreamed into national policies in at least 20 countries, in the development plans of at least five economic areas (e.g. ECOWAS, EAC, South Asia) covering each of the targeted regions, and in the key global processes related to food security and climate change | Food security enhanced for currently undernourished people, and emissions reduced in smallholder farming areas |
| Objective 2: Assembling data and tools for analysis and planning | | | | |
| Integrated assessment framework, toolkit and databases to assess climate change impacts on agricultural systems and their supporting natural resources | Other Themes in the Program, other CGIAR Programs, regional partners | Research for development agencies, national, regional and international planning agencies | Improved frameworks, databases and methods for planning responses to climate change used by national agencies in at least 20 countries and by at least 15 key international and regional agencies. | Research efficiency increased, enhanced decision-making in planning agencies |
| Objective 3: Refining frameworks for policy analysis | | | | |
| Climate change impacts assessed on agricultural systems and their supporting natural resources, and likely effects of specific adaptation and mitigation options, and trade and agricultural policies, analyzed | Other Themes in the Program, other CGIAR Programs, regional partners | Agencies involved in planning for and researching climate change impacts on agriculture and natural resource management, key bilateral donors, large international NGOs, key regional | New knowledge on how alternative policy and program options impact agriculture and food security under climate change incorporated into strategy development by national agencies in | Food security enhanced for currently undernourished people, and emissions reduced in smallholder farming areas |

| Key final products | Intermediate users | Final users | Outcomes | Impacts |
|--------------------------------------|--------------------|---------------------|--|---------|
| and communicated to key stakeholders | | and national actors | at least 20 countries and by at least 15 key international and regional agencies | |

Plan for Theme 4, Objective 1: Linking knowledge with action

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|---|---|---|--|
| 2010 | Interactive stakeholder/partnership-building workshops held in the three regions | Workshop reports, strengthened climate change - agriculture – food systems networks with new partners | Sufficient incentives for full engagement on part of local partners | W Africa, E Africa, IGP | Farmers' orgs, NARES, NGOs, private sector, ARIs, regional bodies, networks, ICT experts |
| 2010 | Regional scenario storyline development in the three regions | Prototype regional scenarios produced (main regional uncertainties identified, initial regional storylines developed, reports and initial scoping for model analysis) | Regional stakeholders and country partners identified by mid-2010 | W Africa, E Africa, Indo-Gangetic Plains | National and regional partners, GECAFS, ESSP |
| 2010 | Agriculture and Rural Development Day 2010 at COP16 | High-level synthesis report on the role of agriculture in climate change adaptation and mitigation. Prototype scenario analyses | Writer for high-level report willing to take up the task at short notice | Global | Global Donor Platform for Rural Development, IFAD, IFAP, GFAR, FAO |
| 2011 | Regional scenario storylines finalized for three initial regions | Regional scenarios produced | Regional stakeholders remain engaged | Original regions | National and regional partners, GECAFS, ESSP |
| 2011 | Regional quantitative scenario analyses | Interim analyses presented for IMPACT analysis | Regional teams able to interact effectively with research community worldwide | W Africa, E Africa, Indo-Gangetic Plains Global (2012) | National and regional partners, GECAFS, ESSP; IMPACT modellers |
| 2011 | Agriculture and Rural Development Day 2011 at COP17 | High-level report on the agricultural work program for agriculture | UNFCCC accepts to have an agricultural work program in 2010 | Global | Global Donor Platform for Rural Development, IFAD, IFAP, GFAR, FAO |
| 2011 | Vulnerability | Vulnerability maps with | Appropriate | Global (2011) | National and |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|--|--------------------------|---|
| | assessment | up-to-date datasets from a food security and sustainability perspective; papers, policy briefs | metrics are found to represent vulnerability dynamically | | regional partners, GECAFS, ESSP |
| 2011 | Regional policy and program choices identified | Policy paper and brief; raised capacity among policy makers to use tools to make policy and program decisions | Strong partnerships with policy making bodies in the regions | W Africa, E Africa, IGP | Climate and agriculture policymakers, regional bodies, national planning agencies |
| 2012 | Regional vulnerability assessment | Vulnerability maps with up-to-date datasets from a food security and sustainability perspective; papers, policy briefs | Appropriate metrics are found to represent vulnerability dynamically | All selected regions | National and regional partners, GECAFS, ESSP |
| 2013 | Regional regional scenario analyses expanded to additional regions | Coherent set of quantified development scenarios under a changing climate and differing pathways of economic development, used to identify livelihood opportunities and threats regionally | Strong buy-in by stakeholders to scenario process and outputs | Expanded list of regions | National and regional partners, GECAFS, ESSP, CGIAR, ARIs |

Plan for Theme 4, Objective 2: Assembling data and tools for analysis and planning

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|---|--|---|---------------------------------------|---|
| 2010 | Initiate baseline indicator framework and data collection | Regional site characterization and baseline data collation | Target regions, countries and sites identified | W Africa, E Africa, IGP | National and regional partners, CG Centers |
| 2011 | Workshop for current and future regions to identify climate downscaling needs | Priorities derived for downscaling needs, including a set of papers on current downscaling initiatives | In-region demand for downscaling | Global, but focused on target regions | CG Centers (IWMI, CIAT, ILRI, CIP), Oxford & Leeds Universities |
| 2011 | Work with ESSP community to identify the best suite of climate data for the initial regions | Suite of downscaled climate data for the 2030s to 2090s, for homogenized applications in the Program | Weather and climate inputs to the Program are tightly defined | Global; W & E Africa, IGP | UK Met Office, Oxford & Leeds Universities, NCAR, PIK, IRI |

| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|--|---|---------------------------------|--|
| | Using climate data available, prepare synthesis reports for each of the initial target regions | Regional climate characterization and evaluation of global and regional climate model performance for target regions | Climate models can be evaluated appropriately on a regional basis | Global; W Africa, E Africa, IGP | UK Met Office, Oxford & Leeds Universities, NCAR, PIK, IRI |
| | Compile all relevant data for the initial targeted regions | Databases for soils, weather, agricultural systems, natural resources | Data are accessible | Global, regional | All partners, CG Centers, ARIs |
| | Investigate gaps in modeling tools | Scoping studies on agricultural impact model gaps and needs | Agreement reached on a global modeling agenda | Global | CG Centers, ARIs, GCMP, ICASA |
| 2012 | Investigate new ways of dealing with near-term climate change impacts | Decadal/near-term climate products | New approaches to near-term climate prediction implemented in appropriate tools | All target regions | UK Met Office, Oxford & Leeds Universities, NCAR, IRI |
| | Extend data & model toolboxes to new regions | Regional characterization extended to more regions | | All target regions | National and regional partners, CG Centers |
| 2013 | Integrated assessment framework and toolkit | A functioning integrated assessment framework and toolkit that can be used to analyze likely effects of specific adaptation and mitigation options in target regions | Framework able to cater for differences by gender and social group | All target regions | All partners, CG Centers, ESSP, ARIs |

Plan for Theme 4, Objective 3: Refining frameworks for policy analysis

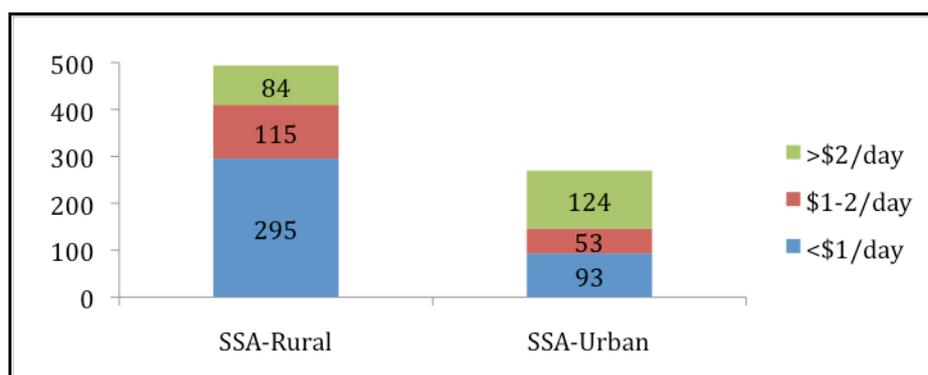
| Year | Activities | Products | Assumptions | Target regions | Partners |
|------|--|---|--------------------------------|-----------------------------------|---|
| 2010 | Initiate capacity development activities with national policy actors | Series of planned capacity development initiatives | | W Africa, E Africa, IGP initially | IFPRI, National and regional research partners and stakeholders |
| 2011 | Information platform development | Synthesis of data and maps of existing climate change | Building on existing networks; | W Africa, E Africa, IGP initially | National and regional research |

| | | information networks | regional bodies support this | | partners and stakeholders |
|------|--|---|---|-----------------------------------|---|
| 2012 | Synthesis of case studies on the impacts of climate change in diverse agricultural systems | Major synthesis report targeted to COP17, that lays out the policy options for adaptation | Case studies available | Global | CGIAR Centers (CIP, CIAT, ILRI, ICRISAT, IFPRI, IRRI, ICRAF, IWMI, ICARDA, WorldFish) |
| 2012 | Integrated assessment process continued | Global and regional assessments of climate change impacts on agricultural systems and food security | Appropriate data, tools, methods can be assembled | Global; W Africa, E Africa, IGP | National and regional partners, the Program, other CG Programs |
| 2012 | Information platform development | Scenario and food security dialogues and new information partnerships developed and documented | Strong cooperation and dove-tailing with existing initiatives | W Africa, E Africa, IGP initially | National and regional research partners and stakeholders |
| 2013 | Integrated assessment process continued | Set of information products on likely climate change impacts on agricultural systems, and promising adaptation and mitigation options | Viable set of adaptation and mitigation options | All regions | National and regional partners, the Program, other CGIAR Programs |

Annex 2: The profile of likely beneficiaries in sub-Saharan Africa²³

The SSA population is estimated to have been over 760 million in 2005 with 65% (about 500 million) living in rural areas and 35% (270m) in urban areas. In urban areas, 146 million people live on less than US\$2 per day, about two thirds of the rural figure (Figure A1). In rural areas, 60% (295m) live below the \$1.25 per day threshold, and another 23% (115m) earn \$1.25–2.00. This adds up to 410 million rural poor living below \$2 per day.

Figure A1. Poverty in sub-Saharan Africa (total population 763m in 2005)



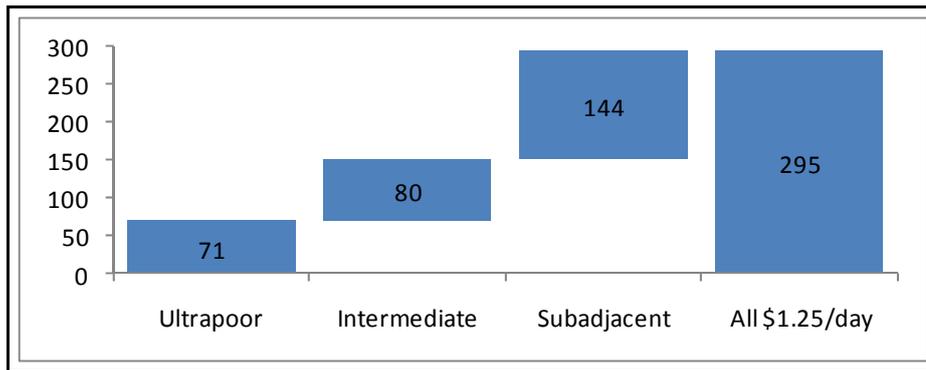
Looking deeper into the rural poor category, a preliminary analysis suggests they can be divided into three sub-groups (Figure A2):

- Subjacent: \$0.75–\$1.25 per day
- Intermediate: \$0.50–\$0.75 per day
- Ultra-poor: under \$0.50 per day

Approximately 24% (71m) of the \$1/day poor are ultra-poor and another 27% (80m) are in the intermediate category. It is important to note that ultra-poor (and to a lesser degree, the intermediate poor) are likely to have certain characteristics that make them more difficult to reach directly with the type of research outputs envisaged in this Program. While many of the rural ultra-poor are heavily involved in agriculture and derive a significant share of their income from agriculture, they typically have fewer productive assets than their less-poor counterparts. For example, we would expect the ultra-poor to have less land (and lower productivity), fewer livestock (and lower quality), less human capital, live in more marginal environments, have lower overall access to physical and knowledge inputs, and to be less well connected to markets. On a national level, countries with a higher prevalence of ultra-poor may have fewer overall natural resource endowments, and a policy environment that is comparatively less favorable to agriculture, rural populations, and the poor, or all of the above. All of this is further complicated by the fact that the poorest of the poor suffer from more frequent and greater intensity of hunger. For these groups much of the research envisaged will benefit them only indirectly, by lowering food prices and increasing employment opportunities if the technologies are labor-intensive.

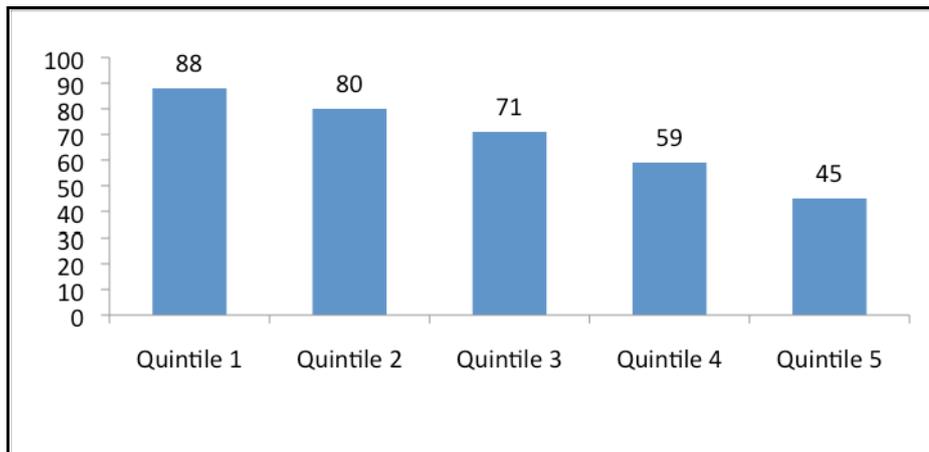
²³ This analysis of likely beneficiaries in SSA is drawn from personal communication from Stanley Wood and colleagues, IFPRI. MP7 will put in place *ex ante* tools that will greatly enhance this kind of analysis for all regions.

Figure A2. Partitioning the poor into sub-groups



A key determinant of the potential for impact from agricultural investments is the extent to which households are engaged in the agricultural sector. The preliminary analysis reported in Figure A3 summarizes agricultural participation as reported by households in each income quintile. There is clearly significant engagement in agriculture, not only among the poorest of households (almost 90% average participation across countries) but even in the highest quintiles. However it is clear that participation in agriculture decreases as income rises. The poor rural households in SSA that participate in agriculture derive an average of over 80% of their income from it. However, this figure varies significantly across countries (e.g., 60% for Kenya and over 90% for Nigeria) and across households within countries.

Figure A3. Agriculture participation rates by households in Sub-Saharan Africa



In summary, there are 295 million poor in the rural sector in SSA who are potential beneficiaries of MP7 (direct effects), with an additional 146 million urban poor and 115 million “poorest of the poor” who are likely beneficiaries via indirect effects.

Annex 3: Governance and Management

Seeking simplicity and independence

Challenge Programs have suffered from governance and management structures that have not been sufficiently detached from the Centers. This has resulted in lack of independence and decision making that favors the Host Center. Of all the MPs, it is arguable that Climate Change is the one in which almost every Center has a major stake. It would be possible to design a governance structure such as an association or a similar institutional arrangement that incorporates all Centers that wish to participate but this would add a new layer of governance and might complicate the decision-making process. Such structures are also likely to lead to decisions based on compromises rather than strategic choices. To avoid this, the key features of the management system of MP7 are the Independent Scientific Panel (ISP), the independent Secretariat and a Program Leader who reports directly to the ISP.

Independent Scientific Panel

The key function of the ISP is to give advice on priority setting, the strategic allocation of resources and the employment of members of the Secretariat; also on assessing the quality of the research and management systems through an annual monitoring system and through participating in the performance review of the MP7 Program Leader and Management Team.

MP7 has the opportunity to drive budget allocations by foresight analysis and *ex ante* impact assessments, since a major component of the research (Theme 4, Objectives 1 and 2) is to set up such systems. The ISP will provide the key mechanism to ensure that the emerging results lead to strategic allocation of resources.

The nine members of the ISP shall be experts (minimum 5) on climate change, agriculture and food security and and/or representatives (minimum 3) of key stakeholder groups (e.g. IFAP). There will be three observers (one from the Host Center, one representative selected from participating Centers and one from the ESSP (the main ARI partner). ISP members should serve a three-year term, with possibility of renewal for a further three years. The ISP should constitute a nominations committee that makes nominations for new members, with appointments approved by the Consortium Board.

The benefits of the advice of the ISP on research priorities and the strategic proposed allocation among themes, regions and Centers will far outweigh the annual costs of about \$120 000.

The ISP is differentiated from the Independent Science and Partnership Council (ISPC) by its focus on strategic allocation choices within MP7; its more regular interaction with the Secretariat and Host Center; its more detailed engagement in annual monitoring of progress; its composition of experts on climate change, agriculture and food security; and its accountability to the Consortium rather than to the Fund Council. The Board of the Host Center could not play this role because of conflict of interest issues, and as no Center Board will have the necessary scientific and partnership expertise to cover the MP7 agenda.

Program Leader

The proposal is to have the Program Leader appointed and contracted by the Consortium Board. As the Consortium has legal status it could conceivably be the party to contract the Program Leader. However, in the early months it are unlikely to have the human resource capabilities to do the contracting, in which case the Program Leader could be contracted by the Host Center, but with service agreements between the Host Center and Consortium on lines of reporting, liability etc²⁴.

²⁴ While such an arrangement is complex, it is feasible, as indicated by the current arrangements for the Director of the Challenge Program on Climate Change, Agriculture and Food Security. While his personal contract is with a Center, he reports to the Chair of the Steering Committee, and liability for his direct actions rests with the University of Copenhagen.

Liability for the direct actions and decisions of the Program Leader should rest with the Consortium²⁵, while liability for implementing components of the program should rest with the Host Center and participating Centers.

Program Management Team

The Program Leader would propose the structure and composition of the Management Team, with input from the ISP and Host Center and final approval by the ISP. Provisions for changing the composition of the Management Team will be made so that the composition reflects how research priorities shift over time.

Host Center

While a proposal is made for an Interim Host Center (see below), the Consortium Board will make the final choice of Host Center after the transitional phase, with advice from the ISP. A close working relationship between the Host Center and Secretariat will be established to ensure that proposals emanating from the Secretariat will be accepted by the Host Center, in relation to the Host Center's legal, financial and reputational risks.

Main participating Centres

The Secretariat will have the responsibility of circulating proposals, work plans and budgets to the main participating Centers that have a stake in such documents. The Secretariat will receive comments from the Centers and attempt to satisfy the Centers' concerns regarding legal, financial and reputational risks. However, ultimately the responsibilities and liabilities for implementing the components of MP7 that are contracted to Centers rests with the Centers.

Steps in the Program Cycle

Table A1 illustrates some of the key roles among the various management structures.

Table A1. CGIAR Program cycle steps and roles of principal management structures*

| | Program Management Unit (Secretariat) | Independent Scientific Panel (ISP) | Host Center (HC) | Main participating Centers (MPC) | Consortium Board (CB) |
|---|--|---|---|---|---|
| Step 1. Develop funding and performance agreements | Ex ante impact assessment Develop initial proposals and submit to ISP, HC and MPCs Develop final proposals, in dialogue with HC | Give advice to Secretariat on draft proposals Give advice on final proposals to CB | Give input into draft and final proposals Submit final proposals to CB | Give input into draft proposals | Make decisions on submitted proposals Submit proposals to Fund Council Develop final funding and performance agreements with HC |
| Step 2. Implement programs | - Facilitate co-ordinated actions across Centers and partners - Ensure synthetic reporting across Centers and partners Help mobilise resources for MP7 | Provide advice as requested | Implement components of research as per performance agreements and Secretariat implementation plans | Implement components of research as per performance agreements and Secretariat implementation plans | Coordinate program implementation using results-based management |

²⁵ Unless they are able to allocate that responsibility to a third party through a contractual arrangement, as is suggested in the transitional phase, while the Consortium establishes itself, with University of Copenhagen willing to assume that responsibility.

| | | | | | |
|--|---|--|--|---|---|
| Step 3. Monitor achievement of agreed targets | Self-monitor progress of Program Prepare synthetic monitoring reports across Centers and partners Take corrective action as needed | Evaluate annual progress Give advice to Secretariat and HC Provide overview of evaluation to CB | Self-monitor progress of MP7 that HC is responsible for Prepare monitoring reports Take corrective action as needed | Self-monitor progress of MP7 that MPC is responsible for Prepare monitoring reports Take corrective action as needed | Monitor progress Take corrective action as needed |
| Step 4. Evaluate Program every 4 years | - External and self- evaluation | Provide advice as requested to CB | External and self-evaluation | External and self-evaluation | Assess evaluations |

*The last column in the table shows the CB, which in turn interacts with the ISPC, Funders Forum and Fund Council (not shown in this table – see Table 1 in “Framework for the CGIAR Fund” Chapter 3 in “Voices for Change”)

The transition from the Challenge Program (CP) to the Mega Program

As indicated in the main text, a transition period is recommended. For the transitional phase (Table A2) it is proposed that:

- the current steering committee for the Challenge Program is converted, with modifications, into the ISP
- the current CP Director becomes the interim Program Leader for the duration of his current contract
- the University of Copenhagen (UoC), the host of the CP secretariat, acts as the Secretariat, under contract from the interim Host Center (UoC and ILRI currently have an agreement for UoC to act as the host for the CP Secretariat)
- the Program Management Team is built from some of the CP Theme Leaders and Regional Facilitators, with additional recruits.

No one Center can claim it is able to cover the full spectrum of climate change issues; no one Center stands out as having a competitive advantage over the other Centers; and no one Center has a significantly larger budget than another in climate change research. For practical reasons, it is proposed that ILRI assumes the role of Host Center during the transitional period. ILRI currently has an employment contract with the Director of the CP, and has established a series of service agreements with the UoC for flow-through funds. ILRI also has a major role to play in the current CP: leading one of the Themes and hosting a Regional Facilitator. The agreement between the UoC and the Alliance will be changed to one between UoC and ILRI, with special attention to liability issues, where liability for Secretariat staff will rest with UoC, but liability for implementing components of the program rests with ILRI.

Table A2. Key activities in the transitional phases

| Phase 1: CP structures continue | Phase 2: New structures initiated | | | |
|--|--|---|--|--|
| Month 0–6 | Month 6–12 | Month 12–18 | Month 18–24 | Month 24–30 |
| | | | Governance and management review | |
| SC to make proposals on key gaps that it has in its composition and to develop a transition plan, to be approved by the Consortium | New SC fully functioning, with new recruits | | Recruit replacements for some of the founding SC members | Implement review recommendations that are accepted by the CB |
| New agreement between Secretariat (UoC) and HC to be negotiated (current agreement is between the Alliance and UoC) | New Secretariat arrangements fully functioning | | | Implement review recommendations that are accepted by the CB |
| Main Participating Centers identified and composition for Program Management Team finalized | New Program Management Team selected (some current contracts renegotiated) | New Program Management Team fully functioning | | Implement review recommendations that are accepted by the CB, including those related to Host Centre and Program Leader. |