Agriculture and Food Security Exemplar to the User Interface Platform of the Global Framework for Climate Services

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GFCS
GLOBAL FRAMEWORK FOR CLIMATE SERVICES

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AGRICULTURE AND FOOD SECURITY EXEMPLAR

TO

THE USER INTERFACE PLATFORM

OF THE

GLOBAL FRAMEWORK FOR CLIMATE SERVICES

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EXECUTIVE SUMMARY

Agriculture and food security are closely linked to weather and climate conditions through extreme events such as droughts and heat waves, floods and storms. Climate-related disasters such as droughts and floods can lead to crop failure, food insecurity, destruction of key livelihood assets, mass migration of people, and negative national economic growth. Adverse weather and climate conditions directly affect agricultural productivity, livelihoods, water security, land use, agricultural marketing systems, market instability, food prices, trade and economic policies; and small-holder farmers, fishers, livestock herders and forest dependent communities are often highly vulnerable to these impacts. Extreme weather, climate variability, and long-term climate change pose important challenges to future agriculture and food security.

There is an opportunity to incorporate climate information into agricultural development through a holistic integration of climate services into practices and policy for development decisions in agriculture and food security. Achieving this decision-making capability calls for accelerated development of climate services applications to support such integration, while also adapting to climate extremes and change.

It is important is recognize that food security is a complex issue that involves non-climatic factors. However, climate-related disasters can exacerbate food insecurity. FAO has identified the following four aspects of food security:

1. Food Availability: There should be sufficient quantities of quality food supplied through domestic production, imports, and food aid.
2. Food Access: There should be access by individuals to adequate resources for obtaining food and ensure a nutritious diet.
3. Utilization: An adequate diet, clean water, sanitation, and health care are needed for nutritional well-being of the population. This aspect stresses the importance of non-food inputs in food security.
4. Stability: At the national, household and individual level there must be access to adequate food at all times and there should be no risk of losing access due to sudden shocks such as economic or climatic crisis. This aspect refers to both availability (1) and access (2).

Therefore, weather and climate information are particularly critical for food availability and stability, and all four dimensions of food security have strong connections to either one or more of the priority sectors of the GFCS.

The vulnerability of agricultural systems and food security to climate conditions depends on the following determinants:

- With increases in global population, there is a greater demand for food and food production systems also move to climate sensitive and marginal areas to meet the demand;
- Dwindling natural resources due to competition for land (urban settlements, environmental resources, energy) and water creates additional stresses on food security;
- High proportion of rural population, dependence on agriculture and poverty are underlying causes of vulnerability and are exacerbated by increased frequency, severity and intensity of weather and climate extremes and have continued to increase food deficits, and have failed to prevent widespread famine in many high risk areas;
- Furthermore, in recent years, severe droughts in major agricultural areas, coupled with increased demand for biofuel and restrictive trade policies, resulted in unprecedented grain price hikes and market instability.

All of these above determinants led the United Nations (UN) World Food Summit to call for better national agricultural statistics and early warning and forecasting systems for reducing the vulnerability and for improving food security.

The Intergovernmental Panel on Climate Change has highlighted multiple climate risks to agriculture and food security, and described the potential for meteorological information to improve early warning systems for meteorological risks. Climate change will act as a hunger risk multiplier, exacerbating the risk factors that affect food security. Climate change will exacerbate existing threats to food security and livelihoods from a combination of increasing frequency of climate hazards, diminishing agricultural production in vulnerable regions, expanding health risks, increasing water scarcity, and intensifying conflicts over scarce resources, which will likely lead to new humanitarian crises, as well as increasing displacement.

Agricultural systems that wisely use climate information can help to make better informed decisions at policy, institutional and community levels that improves the efficient use of limited resources, and increases crop, livestock and fisheries production by reducing impacts of climate risks and enhancing opportunities. The Global Framework for Climate Services' User Interface Platform, which stresses the need for user-oriented, demand-driven services, can identify most vulnerable populations and help to improve their food security. On the other hand, decision-makers must be aware of the value of climate information; and getting that timely information to farmers is paramount. For example, drought early warning systems can inform governments and international aid agencies of upcoming food security crises months before the situation develops into a famine to ensure timely action. Similarly, advance climate information can help to optimize the farm level activities and improve efficient use of inputs.

Until recently, there has been no coherent comprehensive global approach to support the management of climate risks to key development sectors, including agriculture and food security, water, energy and health. The Third World Climate Conference held in 2009, and the World Meteorological Congress in 2011 mandated a Global Framework for Climate Services (GFCS) to bridge this gap and identified agriculture and food security as one of the priority sectors alongside disaster risk reduction, water resources, and health. The GFCS is now an overarching strategic priority for WMO, guiding all of its work with national meteorological agencies. The GFCS can enhance the efforts of the World Meteorological Organization (WMO), the Food and Agriculture Organization (FAO) and the World Food Programme (WFP), among others, for climate risk monitoring and analysis, and for promoting a more integrated approach to sustainable development and building the resilience of the most vulnerable people. The WMO has placed a significant emphasis on providing a service to society, building on the data or forecasts it typically provides.

This Exemplar on Agriculture and Food Security outlines the priority needs of the agriculture and food security community, and the way in which the Framework can enable the community to be an active partner in climate services for better climate information that meets the community's specific needs. This plan describes the scope and function of Agriculture and Food Security work, key components and actors, and proposed activities and resource requirements. In addition, 16 case studies of successful climate services in Agriculture and Food Security are provided in Annex 1.

The recommendations of the Report of the High Level Task Force and Third Word Climate Conference (WCC-3) followed by outputs of many expert meetings, inter-agency consultations, workshops and dialogues organized as part of the GFCS preparatory process informed and contributed to this report. Therefore, this Exemplar has been developed through a fully participative process involving all relevant partners and stakeholders.

This Exemplar will be a contribution to the User Interface Platform of the GFCS though there are other aspects that are related to other pillars (i.e. Observations and Monitoring). It will show measurable progress towards each of the identified objectives. They will include, for example: conducting a global gap analysis on barriers to the use of climate information for agriculture and food security decisions, evaluating and developing technical guidance for climate-informed early warning systems, and pilot projects that strengthen agriculture and food security surveillance and response. There are four projects proposed in this Exemplar with a budget of CHF 3,395,000 for 2013-2015.

1 INTRODUCTION

Agriculture and food security in the 21st century faces multiple challenges. Climate change is expected to affect all of the components that influence food security: availability, access, stability and utilization. The overall availability of food is affected by changes in agricultural yields as well as changes in arable land. Changes in food production, together with other factors, could impact food prices, which would affect the ability of poor households to access food markets. Decreased water availability and quality in some areas could result in increased health and sanitation problems such as diarrheal disease which, together with changes in vector-borne disease patterns, has the potential to increase malnutrition, and negatively affect food utilization. Extreme weather effects disrupt the stability of food supply as well as people's livelihoods. Increases in extreme weather, such as floods and drought, as a result of climate change, would exacerbate this trend and could have a negative impact on livelihoods that depend on climate-sensitive activities such as rain-fed agriculture and livestock rearing.

Agriculture has to produce more food and fibre to feed a growing population, more feedstock for a potentially huge bio-energy market, contribute to overall development in the many agriculture-dependent developing countries, adopt more efficient and sustainable production methods, adapt to climate change and find effective ways to combat uncertainties[1]. Agriculture is a high risk industry, not only subject to the adverse influence of natural hazards but it is also challenged by the risk of market price fluctuations, policy changes, and ecology deterioration. With global climate change, agricultural risk has become an important issue in recent years. Extreme weather disasters and higher volatility in food prices in global markets during recent years have highlighted the importance of stable agricultural production and global food security. The sources of risk in agriculture are numerous and diverse. Limited water resources, drought, desertification, land degradation, erosion, and natural hazards are major risk factors affecting farming. The number of hydrometeorological hazards in particular (such as droughts, floods, tropical storms and wild fires) measured an average of 195 per year in 1987-1998 and 365 per year in 2000-2008. Worldwide, economic costs related to natural disasters have been estimated at about $50 to 100 billion annually, meaning that they have increased 14 fold since the 1950s[2].

In the past three centuries the total area of cultivated land has increased more than 450%[3]. Currently 68-69% of the global land area is for agriculture, rangeland and forestry. In particular 30% of the land is for forest and woodlands, 12% for arable and permanent crops, and 26% for permanent meadows and pasture[4]. In 2008, one third of the world's workers were employed in agriculture. In most developing countries, three out of four people live in rural areas and are highly dependent on agriculture for their food security and livelihoods[5]. If the world's population continues to depend on agricultural products as they have in the past, it is estimated that by 2050 arable land in use will increase by more than 70 million hectares from adjusted 2005 totals, without accounting for biofuel production.[6] According to some estimates, 50% more food will be needed by 2030[7].

Fish comprises about 20 per cent of the animal protein in the diets of over 2.8 billion people[8]. The contribution of fish to dietary animal protein can reach 50 per cent in the world's poorest regions,

[1] http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf
[2] Buchdahl J., Climate Change Fact Sheet Series - Programme Report, Atmosphere, Climate & Environment Information Programme, Manchester Metropolitan University.
[3] (Matson, *et al.*, 1997)
[4] Bruinsma, J. (2009). The resource outlook to 2050: By how much do land, water and crop yields need to increase by 2050 (p. 33). Rome: FAO
[5] http://home.wfp.org/stellent/groups/public/documents/communications/wfp201794.pdf
[6] Tilman, D. et al. "*Forecasting Agriculturally Driven Global Environmental Change"* in Science 13 April 2001, page 281.Vol. 292 no. 5515 pp. 281-284, and also http://*www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf*.
[7] FAO 2010
[8] According to the Food and Agricultural Organization (FAO), 2008 report *http://home.wfp.org/stellent/groups/public/documents/communications/wfp201794.pdf*.

and up to 90 per cent in small island developing states. This important role of fisheries is threatened by changes to the environment associated with increased emissions of greenhouse gases, including higher water temperatures and increases in ocean acidification, changing marine fish distribution. Add to that stress from overfishing and land-based pollution dead zones from land-based pollution, all of which reduce fish abundance and species diversity. Aquaculture, one of the fastest growing animal-food producing endeavours, is affected by warming temperature, displacing species, like fresh water molluscs. Fisheries play a crucial role in providing food security and opportunities to earn income, particularly in developing countries.

Forestry likewise plays a crucial role in improving livelihoods, especially of rural farmers, providing fuel wood, animal fodder, besides fruits and nuts. Animal husbandry and agro pastoralism provide important food sources[9] through meat, milk, and eggs. Climate change can affect the production and health of animals, and the suitability and range of pasture lands. Livelihoods can be lost when herds of livestock are affected by heat waves or floods.

The vulnerability of agricultural systems and food security depends on many factors. Increases in global population produce greater demand for food. Dwindling resources due to competition for land (urban settlements, environmental resources, energy) creates additional stress on food security. Increased frequency, severity and intensity of weather and climate extremes have contributed to food deficits and failure to prevent widespread famine in many high risk areas. Severe droughts in major crops areas, especially in recent years, coupled with increased demand for biofuel, restrictive trade policies and inappropriate speculative investments, resulted in unprecedented grain price hikes and market instability. In fact, in 2009 and 2010, the global price of wheat and corn increased by 80%. These and other factors led the United Nations World Summit on Food in 2009 to call for better national agricultural statistics and early warning and forecasting systems for food insecurity and vulnerability.

Climate change and variability is likely to modify the productivity and distribution of oceanic fisheries. In particular, the productivity of colder water species may be reduced in subtropical waters and the distribution of spawning areas and fisheries may be affected – such species are unlikely to be able to extend their ranges further poleward due to the lack of suitable habitat. On the other hand, the productivity of warmer water species may be enhanced in subtropical waters and distribution of more tropical species may expand southward. Increasing climate variability will make fisheries management, and the forecasts of fisheries production, more challenging. A better understanding of climate and its impacts on oceanic fisheries is critical to the future management of these valuable resources for subsistence and market-based economies and cultures. Developing countries and Small Island Developing States that depend heavily on fish for food and exports will also need special assistance in adapting to the effects of climate change on oceanic fisheries.

Climate change will act as a hunger risk multiplier, exacerbating the risk factors that impact food security. Without significant efforts to improve livelihoods and build resilience, climate change is projected by 2050 to increase the number of people at risk of hunger by 10 to 20 per cent and to increase the number of malnourished children by 21 per cent[10]. A combination of increasing frequency of hazardous climatic changes, diminishing agricultural production in vulnerable regions, expanding health risks, decreasing water availability, and heightened conflicts over scarce resources will intensify existing threats to food security and livelihoods, leading to new humanitarian crises, as well as increasing displacement of populations.

[9] FAO Climate Change Implications for Food Safety
[10] Parry et al., 2009; Nelson et al., 2010.

1.1 Objective, Scope and Functions of the Agriculture and Food Security Exemplar

The overarching goal of the Agriculture and Food Security Exemplar is to benefit agriculture and food security outcomes through improved management of climate-related risks, by pursuing, inter alia, the following objectives:

1. Develop effective partnerships and dialogue between climate service and agriculture and food security users at all levels to enhance the climate resiliency of the agriculture and food security community/sector;
2. Monitor and respond to the evolving needs of agriculture and food security community/ sector by developing and working to mainstream climate services into core agriculture functions (i.e., phenology, crop surveillance, preparedness and risk management, multi-sectorial food security);
3. Advocate that the provision of sustainable agriculture and food security are considered an end-goal of other sectors, including climate, DRR, water, health, and bring the benefits of CS for other sectors full spectrum through joint applications between multiple sectors, (i.e., joint monitoring efforts, pest and disease control with health sector, risk management with water and DRR, etc.);
4. Support agriculture decision-makers with appropriate and timely information and services to integrate environmental and climate factors into agriculture planning strategies and practice processes at the national, regional, and global levels;
5. Enhance operational and technical cooperation on environmental, disaster risk and climate matters, and undertake joint actions to support sustainable agriculture and food security.

Several partners were involved in developing this Exemplar including the World Meteorological Organization, Food and Agriculture Organization, the World Food Programme and the International Federation of the Red Cross and Red Crescent National Societies. These partners share this common goal in climate services.

The objective of this Exemplar is to provide an extended example of climate services, which in turn identifies needs of the agriculture and food security sectors, characterizes abilities in climate services, and suggests ways to improve performance and management of agriculture and food security systems from global to local levels using climate information.

The scope of this Exemplar broadly includes all climate-sensitive aspects of Agriculture and Food Security.

Broadly speaking, agriculture includes crops, animal husbandry, and fisheries, but necessarily encompasses plants, horticulture, harvesting wild products, captures both fisheries and aquaculture, grazing, forage, some forestry including agro-forestry, timber fuel as well as bio fuels. Because more is known about climate and cropping than perhaps the other areas, there is more emphasis here on crops and less on the other, no less important, aspects of agriculture. Climate services in agriculture extend to where it can help develop sustainable and economically viable agricultural systems, improve production and quality, reduce losses and risks, decrease costs, increase efficiency in the use of water, labour and energy, conserve natural resources and decrease pollution by agricultural chemicals or other agents that contribute to the degradation of the environment.

Also, agricultural users are at the global, regional, national, sub-national and local levels, and that they are comprised of different types (subsistence/small scale/commercial farmers, local governmental officials and technocrats, extension service workers etc.). These users are active partners and need information on the climate system, both for the next season and for the next 20-40 years. In the case of farmers, who bear the brunt of climate change, this information is important as well as what this change means for agricultural, forest and fishery communities.

Food Security includes availability, access, utilization, and stability. As defined by the Food and Agriculture Organization, food security exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. To realize food security objectives, all four aspects must be fulfilled simultaneously:

- Food Availability: sufficient quantities of quality food supplied through domestic production, imports, and food aid;
- Food Access: access by individuals to adequate resources for obtaining food and ensure a nutritious diet;
- Utilization: an adequate diet, clean water, sanitation and health care are needed for the nutritional well-being of the population. This aspect stresses the importance of non-food inputs in food security;
- Stability: at the national, household, individual levels, there must be access to adequate food at all times and there should be no risk of losing access to due sudden shocks such as economic or climatic crises.

Weather and climate information are secondary issues for Access and Utilization. But because climate services are critical for the food Availability and Stability, there is more emphasis here on these two aspects of Food Security. Simply put, Access measures whether a wide variety of food is available at farms and in local markets and Stability refers to the vulnerability context and risk factors that impact negatively on food availability or access to food.

Food security is a complex issue that involves technological as well as environmental factors. Technological advances ranging from improved crop varieties and farm management systems to decision support tools for strategic long-term planning have benefitted agricultural productivity. Yet, despite these advances, agricultural systems fail to prevent food insecurity, and programmes that improve agriculture techniques must continue to improve. Non-climatic issues that affect food security are outside the scope of this Exemplar. Among those factors are population increase, trade limitations, insufficient agriculture investments, and global financial crisis. Not every famine is caused by a natural disaster. However, climate-related disasters can exacerbate food insecurity. Agricultural systems continue to be vulnerable to climate conditions, like extreme events (heat waves, hurricanes, floods, droughts), extreme temperature and precipitation, increasing temperature, and their after effects, more runoff, lower soil moisture, retreating glaciers effecting melt water source for agriculture, warming ponds and streams, soil erosion, and so forth.

In addition to the critical climate services required for the agricultural sector, the GFCS will need to prioritize climate services for the wider food security sector for areas including food security policy and programmes, safety nets, food security early warning/early action systems, and nutrition programmes (working in close collaboration with other sectors such as Health).

Aware of the climate-sensitive aspects of agriculture and food security, the Exemplar should function to:

1. Assess areas where climate information and services are useful to agriculture and food security activities;
2. Review successful use of climate services;
3. Make a gap analysis;
4. Provide a work plan to improve delivery, uptake and use of climate services for agriculture and food security communities;
5. Propose key activities to foster interactive work across the agencies and organizations.

The Exemplar plan should be implemented flexibly to meet a diverse range of stakeholder interests and requirements, which will undoubtedly evolve over time as technologies and science progress and as new environmental and societal challenges arise. As stated earlier, crops have special emphasis in the Exemplar, due to the more extensive experience with climate-related productivity. More attention to fisheries, livestock, forestry and biofuels is warranted as the Framework develops.

Sixteen case studies of successful climate services in Agriculture and Food Security are provided in Annex 1.

1.2 Justification for an Agriculture and Food Security Exemplar

This Exemplar highlights many activities already underway between the agricultural and food security communities and the weather and climate communities. It points the way forward to better coordinate, collaborate, and expand on joint initiatives. This extended example should serve to improve agrometeorological services and help food communities around the world cope with the increasing impacts of climate variability and climate change. There is a rich base of experience concerning the use of climate information and climate risk management at all levels from farm to global food markets. This experience provides a base of need that justifies continuing with further concerted efforts put forward in this Exemplar.

The agricultural and food security community already coordinate and collaborate on many issues. The justification for this Exemplar is to expand on these previous collaborations and to better coordinate future activities in order to reap the many benefits it will provide moving forward.

To begin with, the World Meteorological Organization's Commission for Agricultural Meteorology has several priorities for work along these lines. Priorities include: (1) developing enhanced services for the agricultural, livestock, forestry and fisheries communities and partner agencies, including climate services; (2) encouraging development of a knowledge sharing interface between forecasters/scientists and the agricultural decision-makers; and (3) supporting agrometeorological training at regional, national and local levels. At its fifteenth session in July 2010, the Commission and a number of international organizations pledged improved agrometeorological services for the farming community around the world to cope with the increasing impacts of climate variability and change. The agriculture and food security sector have had a good relationship with climate information providers for many years[11].

Collaborating and interacting at the United Nations level, the Food and Agriculture Organization, the World Food Programme, the International Fund for Agriculture Development and the World Meteorological Organization contribute to several joint workshops, training courses, and conferences for knowledge exchange. Some of these more recent occasions appear in Table 1. In addition to weather- and climate-related activities, these leading Rome-based food agencies and other organizations are involved in the High Level Panel of Experts on Food Security and Nutrition, which advises the Committee on World Food Security. The Panel releases reports on many subjects such as biofuels and food security and a recent report entitled "Investing in smallholder agriculture for food and nutrition security."

[11] See the report of the High Level Task Force on GFCS page 117.

Table 1. Recent workshops, events and substantive interactions among various agencies on climate services related to agriculture and food security

- 22-26 March 2004 - Inter-Regional Workshop on Strengthening Operational Agrometeorological Services at the National Level, Manila, Philippines (FAO, USDA)
- 8-21 April 2005 - WMO/FAO/AGRHYMET Regional Training Workshop for the Francophone Countries on Meteorological Information for Locust Monitoring and Control, Niamey, Niger
- 14-18 November 2005 - WMO/FAO Training Workshop on GIS and Remote Sensing Applications in Agricultural Meteorology, Gaborone, Botswana
- 8-12 April 2006 - WMO/FAO Regional Workshop for the Anglophone Countries on Meteorological Information for Monitoring and Control, Muscat, Oman
- 25-27 October 2006 - International Workshop on Agrometeorological Risk Management: Challenges and Opportunities, New Delhi, India (FAO, CTA, USDA)
- 25-29 August 2008 - WMO/FAO/UNESCAP International Symposium on Climate Change and Food Security in South Asia, Dhaka, Bangladesh
- 27-30 April 2009 - International Workshop on Adaptation to Climate Change in West African Agriculture, Ouagadougou, Burkina Faso (WMO, FAO, ILRI, ICRISAT, UNEP)
- 12-14 July 2010 - International Workshop on Addressing the Livelihod Crisis of Farmers: Weather and Climate Services, Belo Horizonte, Brazil (WMO, FAO, Brazilian Ministry of Agriculture, Livestock, and Food Supply, Brazilan Society of Agrometeorology, Asia-Pacific Network for Global Change Research (APN), International Federation of Agricultural Producers (IFAP), USDA)
- 29-31 March 2011 - Regional Workshop on Climate Change and Food Security in ASEAN Plus Three Countries, Beijing, China (WMO, FAO)
- 3-5 October 2011 - International Workshop on Climate and Oceanic Fisheries, Rarotonga, Cook Islands (WMO, UNESCO, Asia-Pacific Network for Global Change Research, Secretariat of the Pacific Community)
- 13 - 16 November 2011 - International Conference on Adaptation to Climate Change and Food Security in West Asia and North Africa, Kuwait City , Kuwait (WMO, Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA), FAO, International Center for Agricultural Research in the Dry Areas (ICARDA))
- 17-19 April 2012 - WMO/FAO METAGRI-OPS Training of Trainers Workshop, Monrovia, Liberia
- 22-24 October 2012 - International Conference on Adaptation of Agriculture and Food Security to Climate Change in Central Asia and Caucasus, Tashkent, Uzbekistan
- 10-12 December 2012 - Scaling up Good Practice in Climate Services for Farmers in Africa & South Asia, Saly Portudal, Senegal (WMO; USAID, CCAFS)
- 11-15 March 2013 - High-level Meeting on National Drought Policy (HMNDP) , Geneva, Switzerland
- 14 April 2013 - WMO/WFO Workshop on Climate Services for Farmers, Niigata, Japan

These and many other exchanges show collaboration outside of the direct Global Framework meetings. To take one recent example, the High-Level Meeting on National Drought Policies, culminated over two years of inter-agency consultations. The main partners, the Food and Agriculture Organization, the United Nations Convention to Combat Desertification, and the World Meteorological Organization, were joined by the International Organizing Committee, which included the following organizations: Spanish Met Agency, Bureau of Meteorology of Australia, Indian Ministry of Agriculture, South African Weather Service, China Meteorological Administration Russian Federal Service for Hydrometeorology and Environmental Monitoring, Seoul National University, Brazilian Centre for Strategic Studies and Management, International Centre for Agricultural Research in the Dry Areas, George Mason University (USA), Earth For All Organization (a Non-Governmental Organization), World Bank, the University of Nebraska US

Drought Mitigation Center, and International Crops Research Institute for the Semi-Arid Tropics. This long list exemplifies both the interest in climate services and the need for a Framework!

1.3 Components of the Framework and inter-linkages with other pillars and sectors

The Global Framework for Climate Services is an end-to-end system that uses observations, technology and scientific understanding as inputs for the development of climate services to meet user requirements. There are five components (see Figure 1): Observations and Monitoring, Research, Modelling and Prediction, Climate Services Information System, User Interface Platform, and Capacity Development, has its own requirement for internal monitoring of its ability to meet deadlines, achieve agreed outcomes and deliver expected results expected.

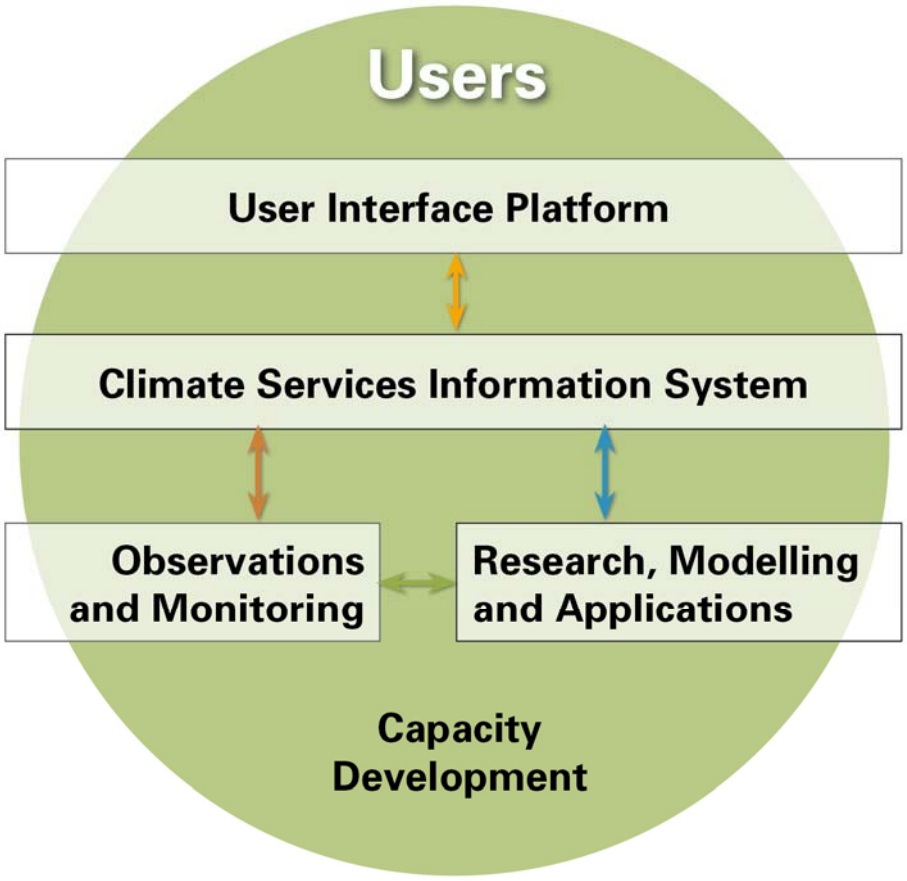

Figure 1: Components of the Global Framework for Climate Services

The priorities and activities articulated in this Exemplar will inform and benefit from the developments made in the other pillars of the Framework, and how each relates to this Exemplar is examined in turn.

User Interface Platform (UIP)

The User Interface Platform pillar will help bring together the many participants in agricultural and food security sectors, providing a structured means for users, user representatives, climate researchers and operational climate service providers to interact and co-design products. The Agriculture and Food Security meeting on the User Interface Platform identified some structure and

process steps to be undertaken implementing user interfaces. Suggestions for user interfacing within the Agriculture and Food Security sector follow, recalling the four outcomes of a successful user interface, feedback, dialogue, outreach and evaluation:

a. Feedback: Identifying the optimal methods for obtaining feedback from user communities:
   - Conduct stakeholder mapping (scale diagram, with decision points for each stakeholder, tactical and strategic, for each agricultural industry), including classifying stakeholders;
   - Reduce top-down approaches and improve bottom-up efforts recall that the agriculture sector is large and diverse, and that complex impacts are often felt at local scales;
   - Identify users in the whole supply chain of the agriculture industry (with livestock, fisheries (both aquaculture and capture)), sugar, and forestry interests and extension officers, farmers, policy makers, researchers, NGOs, media, insurance and finance, and transport;
   - Devise ways of interacting continuously and sustainably with users (Climate Outlook Fora, for example. are often only "occasional").
b. Dialogue: Building dialogue between climate service users and those responsible for the observation, research and information system pillars of the Framework:
   - Develop better, multidisciplinary linkages;
   - Encourage free exchange of data and climate information.
c. Outreach: Improving climate literacy in the user community, and literacy of the climate community in user needs:
   - Ensure provision of climate inputs to, and participation in, vulnerability mapping;
   - Conduct hazard mapping and crop zonation mapping;
   - Mobilize users to be more active in use and dissemination of climate information;
   - Consider what is appropriate for risk management and for adaptation (processes differ for these time scales).
d. Evaluation: Developing monitoring and evaluation measures for the Framework that are agreed between users and providers:
   - The climate-agriculture interface should be well developed at all appropriate levels including policy, investment, operational, East-West operational, etc.);
   - Develop an appropriate structure for each level;
   - Categorize mechanisms;
   - Identify existing mechanisms from a sector basis;
   - Institutionalize mechanisms and policies.

Observations and Monitoring (OBS)

The agriculture and food security community relies on appropriate and timely phenological, environmental, and climate information at relevant spatial and time-scale data points to make informed decisions. Available, accessible, comprehensive and useful weather and climate information can help agriculture and food security decision-makers improve their understanding of climate's impact on agricultural development and food systems, and their estimates of populations at risk (risk mapping). Phenological information, such as the date apple blossoms appear, or events exceeding the fish species' temperature tolerances, can help gauge impacts of climate change. It can also help determine timing of interventions and investments and monitor and predict year-to-year variations in productivity. Early warning systems for agriculture and food security, as well as longer-term trends of potential impacts become part of climate change assessments. By removing climate as a factor, such information can also improve the assessment of the impact of agriculture and food security interventions. Weather and climate information can be particularly helpful to anticipate, prepare for and respond to agriculture or food security risks, on both short time scales to address problems triggered by climate extremes (i.e., droughts, thermal extremes) as well as longer term risks associated with climate change (e.g., increased frequency of cyclones, desertification).

Additional helpful observations [12] [13]are those used to build indicators of food security risk that can be used in the Food Security Information and Early Warning System (FSIEWS). Crop yields, land cover and change, cultivated, forest, and rangeland areas, area affected by salinization and erosion by water and wind, fishery and aquaculture areas, sea surface and freshwater surface temperatures, vegetation index, digital elevation models are examples of what the system can provide. Other data dimensions include socio-economic and market conditions, monitoring food supply and demand balance, price information, and purchasing power and also health and nutrition monitoring.

More work is needed in identifying existing weather station networks' data that National Meteorological and Hydrological Services can incorporate into their data bases, and that can be integrated into the data bases of the service providers. This activity should be underway before considering adding more weather and climate stations.

Climate Services Information System (CSIS)

For the Climate Services Information System (CSIS), inputs from the agricultural and food security sector will be crucial in developing new products. Intra- and inter-seasonal variability has a major impact on agriculture and food security. Seasonal climate outlooks can influence decisions on which varieties to plant and when, or the best timing for spraying where plant disease outbreaks are likely to occur, or perhaps estimate the quantity of water needed for irrigation or whether to reduce livestock numbers if a drought is forecast. Farmers may be unprepared for expected weather conditions and make decisions based on an understanding of general climate patterns in their regions. Better climate predictions three to six months in advance can help shape appropriate decisions, reduce impact and take advantage of forecasted favourable conditions. Seasonal forecasts provide probability distribution for monthly to seasonal means of climate parameters (in terms of their departures from long-term averages), such as rainfall and temperature, several months in advance that can be used for crop yield estimates. Yet, information about growing season weather beyond the seasonal average is also needed, such as growing degree days, chill days, and changes in the growing season.

Particular products for fisheries may be in order as well. Changes in temperature will have far-reaching consequences on changes in the distribution patterns of migratory fishes. Forage fishes, like herring and mackerel, and young ground fishes, like cod and haddock, will respond to such variations in temperature in different ways. Farmed fish, for example, tilapia, carp, and milkfish pond aquaculture in the tropical Pacific and other locations, also have preferred temperature ranges and cannot survive beyond minimum and maximum temperatures limits. Climate change can be expected to affect the reproduction, recruitment and growth of oceanic fish species, and may also impact cyclic changes in the production level of marine ecosystems in ways that may favour one species or group over another. Long-term records of the abundance for most species are limited to historical commercial and recreational landings. This makes climate-related trends in fish abundance difficult to detect.

Seasonal climate forecasts tend to have more skills during the El Niño-Southern Oscillation (ENSO) events. Although the ENSO phenomenon occurs within the Tropical Pacific, it affects inter-annual weather variability in many other regions of the world. Good teleconnections with ENSO do exist with the regional climate during cropping seasons in West Africa, Southern Africa and the October-December "short rains" in East Africa. Countries in these regions jointly access forecasts based on such teleconnections through the Regional Climate Outlook Forums (RCOF), and develop a consensus-based seasonal climate outlook. For example, a seasonal rainfall forecast prepared by the Southern Africa Regional Climate Outlook Forum (SARCOF), delineates areas of expected rainfall anomalies in probabilistic form, in tercile categories (above-normal, normal and below-normal).

[12] The GEOSS 10 year Implementation Plan list a wide range of observation parameters for many sectors.
[13] The FAO uses a range of observations in food security indices. See URL http://www.gripweb.org/gripweb/?q=countries-risk-information/databases-information-systems/food-security-information-and-early-warning

However, such regional-scale outlooks are far from being a climate service adapted to farmers' needs. The output of the model was originally developed to support National Meteorological and Hydrological Services to spatially downscale the forecasts. It must be interpreted in terms of agricultural impacts and management implications. One example is the Crop Climatic Risk Zoning (CCRZ) of the Brazilian Ministry of Agriculture. It uses climate products as part of a tool kit to recommend sowing dates for more than 40 crops. It is reviewed annually in order to incorporate every new year in the risk calculation. Migrating coffee crop plantations to higher altitudes would be one potential result.

In actual practice, regional-scale seasonal forecasts reach national stakeholders in the original form, format and scale without any improvement and adaptation to the needs of users within their countries[14]. By contrast, the Food Security Risk Index (FSRI)[15], measures availability, access and stability of food supplies in a manner that is perhaps more directly applicable to the user community. Therefore, this kind of feedback from the agricultural and food security sector to the CSIS is important.

Research and Modelling and Prediction (RMP)

While there is always a need for basic research, improving linkages between the work of the development agencies and the research community is a priority. Researchers must know about real-world problems facing agricultural producers. Increasing interaction between these two communities will produce research benefitting agriculture and food security sectors.

At best, skill is much lower for seasonal forecasts as compared to that of shorter range weather forecasts, and in some places in the world there is limited or no skill in seasonal forecasts. Often these forecasts are presented in a probabilistic form. Interpreting these can be a challenge for users. For example, how can climate outlooks help inform decisions about improved feeds and selective breeding for higher temperature tolerance? On a longer timescale, climate change scenarios provide a fundamentally different type of information from either weather or seasonal forecasts. Yet, on the 30 to 50 year time frame, they can be used to guide major investment decisions relating to long-term water management such as whether and where to build new reservoirs. New conditions, rapidly melting ice in the Arctic Oceans and less snow cover at high latitudes, may have consequences far away that influence large scale phenomena like monsoons. Again, probabilistic measures are often used, but interpreting them for effective decision-making requires new paradigms. A further complication arises when users of climate services have difficulty relating science-based forecasts and outlooks with those obtained from traditional (indigenous) methods. Greater collaboration is needed to bring the scientific and indigenous worldviews together in the delivery of climate services.

Research and Modelling and Prediction are crucial and strong developmental links to joint climate and agriculture and food security applications, studies and metrics, and to creating new products and services for the needs of the agriculture and food security communities. For example, the project "Seasonal Weather Forecasting for the Food Chain" inspired climate scientists to collaborate with agronomists, farmers, and processors. Together they applied climate knowledge to peas, sugar beets, apples and other crops learning how to improve supply and reduce losses. Additional climate research may be applied to potential poleward spread of pathogens and the poleward expansion of crops. Climate projections may apply to forest species physiological thresholds and the potential range of insects and diseases like the woolly algid and pine bark beetle. Predictive products can be developed for new ranges for wine, rice, maize, peanut ,wheat, soybeans, potatoes and maize as well as changing planting dates for cereals and oilseeds, overwintering or summer survival of crops and of areas with conditions susceptible to diseases like wheat rust. Longer range projections may define areas with likely increased desertification or salinization.

[14] (Hansen et al., 2011).
[15] Developed by a risk analysis and mapping company Maplecroft, based on FAO's food security indicators http://maplecroft.com/about/news/food_security.html

Work conducted under this Pillar in other sectors, such as water, disaster risk reduction and health, also has benefits for agriculture and food security. Research will expand the available knowledge base for the benefit of the agriculture and other sectors. Through joint modelling and prediction-related activity between agriculture and climate users, available products and services for the agriculture and food security sector are likely to strengthen quality and reliability, thereby increasing the utility and confidence in climate services.

Capacity Building

Capacity Building can significantly enhance training activity to serve as a bridge between science and technology on the one hand and the decision-makers on the other. A critical focus of this Exemplar is education and training. In particular, there is a need to build capacity to use the satellite data services, especially the products that can be used in agricultural applications, like proxy measurement for soil moisture, and indicators of locust activity. The Exemplar works closely with climate service users, making it natural that the Exemplar's critical capacity building objective be a major focus. Many potential users of climate services are already users of weather services; however the fundamental differences in the nature of these services leads to the need for user education and awareness, and vice versa, as climate services providers need to develop the sort of information users need in a comprehensible and timely manner.

Extending climate services as advocated in this Exemplar can be an effective mechanism for expanding significantly the capacity building programme in agriculture and food security, linking knowledge awareness, training, interdisciplinary work, and outreach.

Many of the Exemplar's activities will have to be coordinated with other components. For example: the CSIS will make great use of the Regional Climate Outlook Forums (RCOFs) to bring climate service producers together to agree the content of outlooks as well as the standards and procedures for their transmission. This Exemplar will highlight the important role in bringing the climate service users' perspectives to the Regional Climate Outlook Forums. Similarly the Agriculture and Food Security Exemplar will highlight the role in bringing the users' perspectives to the managers of operational observing networks and to researchers and other decision makers developing climate-related research programmes. Since many of the activities highlighted here will be directed towards developing capacity to deliver and use climate services in the most vulnerable communities, it is inevitable that strong linkages will be required with the key stakeholders involved in setting capacity building priorities, such as, will there be more need for capacity building in observation systems that can be used for crop risk insurance, or more need in product development?

Although the Framework focuses on the development of climate services, agriculture and food security users also have experience with, and need for, functioning and applied weather services that are particularly critical for risk and preparedness management and short-range planning. Common, but not exclusive, decisions that benefit from the use of information about the weather and climate include:

- Identification of extreme weather and climate hazards that pose risks to agriculture and food security;
- Identification of populations vulnerable to weather and climate hazards;
- Plant and animal pest and disease control strategies;
- Regulation and laws;
- Pesticide and herbicide applications, fertilizer management, farm and irrigation management;
- Weather and climate sensitive decisions in the agriculture and food security value chains;
- Decisions on export and import of agricultural inputs and products;
- Decisions related to marketing of agriculture and food security products.

The agriculture and food security community supports identifying of a range of needs, enabling agriculture and food security partners to augment and improve decision-making in agriculture and food security policy, research, and practice. From the Global Framework meeting for Agricultural and Food Security, these needs include those for shorter term weather services and for longer term climate services. The needs vary on physical spatial scales, from local to global, and on time scales from daily, monthly, seasonal, and longer:

- Data (climate, biological, phenological); metadata; data quality;
- Data Rescue (DARE) and digitization;
- Downscaled information from global and regional climate models including temporal resolution;
- Build linkages between climate and weather information;
- Rainfall distribution, information on rainfall onset and cessation;
- Climate forecasts at seasonal and longer scales;
- Information on extremes and forecasts of extremes;
- Early Warning Services;
- Seasonal livelihood programming with pastoral/farmer communities;
- Integrated Phase Classification (IPC) / Food security monitoring (FEWSNET);
- Crop-related agroclimatic indices;
- Information on ENSO and other global/regional indices;
- Crop and yield model outputs;
- Special data needs for pest and disease forecasts and for storage;
- Techniques for operating systems (e.g. irrigation, reservoirs) under changing climate conditions; models of groundwater availability under changing climate conditions;
- Improved knowledge of the interactions between climate and fertilization, and other interdisciplinary applied climate research;
- Holistic assessment of climate impacts.

There will also be significant linkages, as well as joint operations and services with the other Global Framework priority areas in water, disaster risk reduction, and health. An interdisciplinary community can help integrate advancing work and share the responsibility among parties with shared interests.

1.4 Relevant existing activities and priority categories of activities GFCS

This section groups relevant existing activities into the following four categories from the paper "Understanding user needs for climate services in agriculture"[16]: improved data collection and use, increased farm productivity, strengthened climate and agriculture services, and capacity development. Under each of these categories below, samples of existing activities appear as case studies presented in the Annex to this Exemplar. The four categories also serve as action areas where climate services for the Agricultural and Food Security sector can be developed further as presented in the Section 3.1 work plan for priority action areas. Several of these examples can be found in Annex 1 to this Exemplar.

1) Improve data collection and use (meteorological, agrometeorological climatic, agronomic, pest and disease)

This priority category includes activities aimed at upgrading the monitoring and data collection network in rural areas, increasing the sharing of data from existing networks, and improving systematic data archival and management. It also includes widening the use of modern information products, and implementation of forecasts from regional and international centres at the national level, and improvements in the reporting of yield, area and production statistics in countries, as well as of other data (i.e. pest and diseases).

[16] Bernardi , 2011

An excellent example of an existing activity that is improving the use of meteorological and climate data is the LEAP food security early warning tool in use in Ethiopia. Such early warning systems for drought, famine and climate extremes have great potential for improving food security.

Another good example in this category is Roving Seminars, a project of the Agricultural Meteorology Programme of the WMO. These seminars help educate farmers in the use of climate data and also served as a mechanism to distribute thousands of rain gauges to farmers in West Africa.

In the United States the Southeast Climate Consortium links climate service users with researchers and service providers to improve data use by providing online access to three to six month forecasts and clear advice for management decisions

Other on-going activities in this category include gathering and managing evidence on the impacts of climate variability and change on the various aspects of the agriculture and food security sector for improved surveillance, evaluation, preparation and response activities (impacts assessment, impacts modelling, etc.) (Africa, Americas, Europe, Asia).

2) Increase farm level productivity to bridge yield gaps and reduce risks.

Farmers should be at the centre of the analysis of the climate impacts and response strategies. Numerous projects across the world aim to deliver reliable, timely, locally understandable climate information with response options to farmers, considering inputs, credit, market and financial aspects. They include interdisciplinary training, knowledge building and awareness raising. Examples of existing activities in this category include climate and agriculture working groups in Africa and Indonesia such as the Farmer Field Schools of Indonesia and resilience building initiatives focused on weather indexed insurance, micro credit and risk reduction activities.

The Food and Agriculture Organization of the UN and the International Institute for Applied Systems Analysis developed the Global Agro-Ecological Zoning (GAEZ) methodology, which enhances planners and decision-makers ability to make rational agriculture land-use decisions based on myriad inputs, including climate scenarios.

3) Strengthen climate and agriculture services.

Activities in this category include integration of climate information into insurance, credit provision, crop monitoring and yield forecasting, and humanitarian response, such as found in the LEAP example discussed above. It also includes agriculture and food security sector-driven outlook forums such as the Regional Climate Outlook Forums (RCOFs) conceived and developed by WMO, NMHSs, and other partners. One example is the Greater Horn of Africa Climate Outlook Forum and how it feeds into the Food Security Outlook process. Other examples of existing activities including agricultural and climate software in Queensland, Australia, and online training in climate statistics targeted at climate data users in Africa.

Other activities in this category include detailed food security and climate risk analyses for a number of countries, multi-hazard early warning systems at regional, national and local scales, National Adaptation Plans of Action, for the agriculture sector, and National Communications to UNFCCC, Vulnerability and Adaptation Assessments.

4) Strengthen the capacity of farmers and institutions

Important activities falling under this category include some mentioned above: Roving Seminars, Farmer Field Schools and Climate Field Schools. Research into how to improve the water productivity of crop-livestock systems in the semi-arid regions of the Sub-Saharan Africa.

An excellent example of a capacity building activity that increased the resilience and productivity of the Taita Taveta district in Kenya is the World Food Programme project that supported that community as thousands of people worked to restore and expand the local canal network, increasing crop production and household income drastically after it was finished.

Another project led by the International Livestock Research Institute seeks to address the risks and opportunities posed by climate variability and climate change to East and Central Africa.

1.5 Identification of Gaps

Although there are many excellent examples from the above section on the effective use of climate information, all too often they remain isolated in one location or sector and are not supported by a routine, more widely available service. This is a gap the Framework aims to fill.

There are gaps at three different levels: policy, institutions and community (national, regional, local). Weather and climate information are not explicitly considered for robust policy decisions in agriculture and food security mainly due to gaps in policy advocacy and policy relevant information products and services.

National policy needed to be implemented to better coordinate national strategies to cope with and manage climate change impacts on all sectors. Currently, all National Adaptation Programmes of Action (NAPAs) recognize the impact of climate change on food security and agriculture, and have prioritized adaptation plans for food security and agriculture interventions. Yet, these plans for agriculture can be significantly improved with climate information, and direct coupling with the Agriculture and Food Security activities highlighted in this document.

Preparedness is urgently needed to improve the effectiveness of response and recovery, such as establishing early-warning systems to shift from crisis management to risk management for long-term planning strategies to cope with climate extremes and climate change. Effective delivery of climate services can also help inform decision-making in adaptation planning. Linking climate service development to adaptation planning will therefore be critical.

Based on the User Interface Platform meeting for Agriculture and Food Security, the following gaps or areas of improvement were further elaborated upon:

- Better decision support systems;
- More effective use of indigenous knowledge;
- Improved reliability and credibility of climate information and products to build trust;
- Expanded and enhanced RCOFs and NCOFs;
- Awareness programmes on climate variability and climate change (for users) and on users and their requirements (for providers);
- Extension and intermediary services maintained and enhanced through training;
- Interpretation of climate information to be understandable to users;
- Data analysis and model calibration; interpolation methods;
- Use of additional data sources (e.g. remote sensing);
- Packaging of information to suit users;
- Engaging in contingency planning for seed and forage banks;
- Ensuring the most vulnerable receive all services, including warnings;
- Training of the media in climate reporting;
- Educating farmers (through farmer and climate field schools and outreach);
- Obtaining and acting on feedback from users.

2 IMPLEMENTATION OF AGRICULTURE AND FOOD SECURITY ACTIVITIES

2.1 Necessary and sufficient conditions for successful implementation

The effectiveness and benefits of climate services depend upon how they are used. A practical picture of the benefits that this priority area should expect from participating in the Framework is shown in Table 2. Though not definitive or exhaustive, these examples were gathered through inter-agency consultations and illustrate some potential outcomes from the Framework regarding climate-informed decision-making. Reduction in yields due to lower rainfall or water shortages for irrigated land may lead to decisions in alternative cultivars species. New climate services may be used in matching pasture production with numbers of livestock foraging, or decisions to move to more suitable livestock breeds, small ruminants in place of cattle, or to reduce livestock holdings in favour of cropping. The projects in this Exemplar should all lead to better decisions. They are also relevant to the other GFCS priority sectors (DRR, Health and Water). There should be mechanism in the UIP to improve the synergies between the sectors and their activities. In addition, there needs to be a "two-way" communication between providers of climate services and agricultural users. The climate providers range from National Weather Services, regional institutions, and the private sector. Likewise the agricultural users vary from staff of International Agencies, Ministries at the country level, extension services (public and private), famers associations, famers, fishers, and ranchers.

Table 2 Necessary and sufficient conditions for monitoring and evaluating successful implementation for priority area Agriculture and Food Security

A wide array of agricultural and food security decision-makers use the Platform, including government policy makers, agricultural extension services, farmers, research and university institutions, agribusiness and crop insurance industry, and farm management groups;
Decision-makers receive accurate and timely climate information for daily short-term tactical decisions or long-term strategic decisions to mitigate the impact of extreme climate events and to adapt to climate changes and climate variability;
Seasonal climate forecasts reduce the sensitivity of rural communities and industries to climate risk. Probabilistic forecasts are translated into easily understandable language for farmers;
Key climate variables (rainfall, temperature and solar radiation, humidity and wind speed) are available and understood by agricultural communities and rural communities who use them to optimize decisions;
Climate information is used in monitoring food supply and demand and to issue outlooks on crop prospects, and early warning of impending food crisis;
Climate information helps improve early action and early warnings resulting from migratory pests and diseases;
Needs that were met in an ad hoc fashion by a growing pool of sources of data products, services and information continue to be met in a more routine manner;
Currently available databases increase climate knowledge and improve prediction capabilities in order to facilitate agricultural and food security decision-making from international policy level to local operational farm management strategies;
Agricultural and food security users fully understand and appreciate how to use the technology in their decision-making activities. Essential scientific and technical capabilities of the climate services are effectively linked to the urgent needs of the agricultural and food security decision-makers;
Established 4-way communication amongst climate scientists, agricultural and food security researchers, extension services and the decision-making community, ensures that applied research is refined and expanded to meet the appropriate needs of the user communities;
Improved decisions can depend on effective communication from sources agriculture and food security users already know and trust (farmer associations, NGOs, village leaders, etc.);
Government agencies that manage food stocks, national authorities, and private grain traders have information as derived from seasonal climate forecasts of a poor harvest is in the offing, sufficient to initiate grain purchases from abroad to build buffer stocks.

2.2 Engagement in the working mechanisms of potential partners

This section describes some of the notable, but not exhaustive list of partnerships at global, national, and regional levels. Moreover, many partners already collaborate in global mechanisms which provide structure and direction for partners and governments on various development priorities, all of which can be climate informed and benefit from climate services. Section 4.1 introduces some synergies within existing partner activities.

Global Level Partnerships

Engaging through cross-collaboration with global level partnerships through the UN system, will be a key consideration. These include such agencies as the Food and Agriculture Organization, the World Food Programme, the World Meteorological Organization, UNCCD, and UNISDR that support Member States in protecting them against climate-related risks, by providing normative and technical frameworks, as well as the International Federation of Red Cross and Red Crescent Societies.

The World Meteorological Organization (WMO) is taking a proactive leadership role in the implementation of the activities for agriculture and food security. Co-sponsored programmes use an integrated approach to drought and flood management as one strategy to adapt climate change. A part of this work is to assist the development of national climate policies based upon a clear set of principles and operating guidelines to better manage climate issues and their impacts on society. The overriding principle of climate policy adopted by the WMO is an emphasis on risk management through the application of preparedness and mitigation measures. WMO has developed a number of longstanding relationships with international partners. The International Research Institute for Climate and Society (IRI) at Columbia University is also a collaborating centre for climate and agriculture.

The Food and Agriculture Organization's (FAO) mandate is to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy. Widespread degradation and deepening scarcity of land and water resources have placed key food production systems around the globe at risk, posing a profound challenge to the task of feeding a world population that they expect to reach 9 billion people by 2050. It is anticipated that collaborating in the Framework and implementing activities for agriculture and food security will be undertaken in a number of ways. First, at the organizational level, broad endorsement of engagement with the Framework is expected. At the level of programmes and activities it is hoped that an increasing use of relevant climate services can be integrated into the decision-making processes. The aim will be to use these activities in these areas to facilitate uptake of climate services, increase the use of standards and protocols for data and information exchange and gather feedback on the performance of all components of the Global Framework. The Food and Agriculture Organization also coordinates the Regional Fishery Body Secretariats Network, which reviews participants' focus on regional fishery financial structures, climate change, recreational fisheries, decision-making procedures, the establishment of vulnerable marine ecosystems and child labour and other human rights issues in fisheries. This Network could be asked for the needs and requirements of the fisheries sector in relation to climate services. The fisheries sector has not been adequately consulted on this issue.

The World Food Programme (WFP) assists more than 90 million people in more than 70 countries each year and has an unparalleled deep field presence. The organization works with governments, international partners and local communities to assist people who are most at risk, most food insecure and have the least capacity to respond or adapt to extreme weather events and environmental degradation. In 2010 the WFP assisted tens of millions of people in 56 countries to enhance their resilience to climate-related risks, mostly through food and cash-based safety nets allowing food insecure communities to invest in creating assets and infrastructure, rehabilitate degraded lands and reforest and transform landscapes. Often these efforts incorporated innovative

solutions for managing risk, including weather insurance schemes for farmers or early warning systems linked with national social protection schemes. WFP is already a producer, translator, and user of climate services and works in close collaboration with governments, National Hydrological and Meteorological Services, and vulnerable communities. WFP is engaged in work relating to the four priority areas of the Framework and will be a vital partner in the implementation of the Framework over the next decade.

The Group on Earth Observations (GEO) is another global level partnership, which proposes that an integrated, comprehensive, and sustained earth observation system can support the agriculture sector, and is currently advancing a number of research and early warning system pilots. These technical or information based approaches are bringing communities of practice together to enhance access to timely, comprehensive information to make real-time agriculture decisions. WMO, FAO, USDA and EU-JRC are working on the GEO Global Agricultural Monitoring (GEOGLAM) project.

Beyond the UN system are many intermediaries that assist the flow of climate information to individual users. The media, in all its forms (the printed media, the electronic media, Internet and telephone) plays a role. This then means that the private sector, through its heavy involvement in all major forms of media content, is a critical intermediary in the consumption of climate services. Many non-governmental organizations working in disaster and humanitarian relief are consumers of climate services and act as intermediaries passing on advice and warnings to other users. Local and provincial governments, with planning and disaster management response responsibilities, are consumers of climate services and also act as intermediaries, passing on climate information to end-users.

Other organizations at the international level that are representing climate service user communities in all four priority areas are: Doctors Without Borders, International Federation of Red Cross and Red Crescent Societies and their National Societies in 187 countries, International Union for the Conservation of Nature, etc. While the engagement of any particular International Non-Governmental Organizations may not be essential for success where there is a strong relevance of their work to that of the Framework, they must be able to participate in its work and they should be encouraged to join in the dialogues promoted by the User Interface Platform. The Implementation Plan must include criteria for their participation and process for encouraging the participation of those that meet these criteria.

Non-Governmental Organizations (NGOs) are now instrumental in promoting the use of a range of robust, yet simple, communication mechanisms to enable the effective use of Information and Communication Technology (ICT) in agriculture and food security initiatives. Tools for communication are improving, web-based storage of agricultural information is increasing, and, connectivity for rural communities is cheaper and more efficient. The Global Framework, through the User Interface Platform, will identify unmet needs in these areas and use capacity building resources to assist in addressing them.

The private sector has a role in developing demand-driven products that are often considered as a specialized service. The key role of the User Interface Platform is to facilitate a dialogue with users and the CSIS to consider how to develop and consistently use common language in presentation of the climate data and information. The Platform will develop standard ways of producing information using language comfortable to the user, link science-based information and traditional knowledge, and identify the simplest information that can be delivered to meet user's requirements. In addition to national governments, there are many stakeholders whose engagement with the Framework will be needed if it is to be successful. As one case in point, The African Agricultural Technology Foundation (AATF), for example, is leading a public-private partnership called Water Efficient Maize for Africa (WEMA) to develop drought-tolerant African maize.

Regional Level Partnerships and approaches

Farmers increasingly need tailor-made, quality answers to their questions. The UIP will assist in directing these questions to those best placed to answer them in an on-going, operational basis. Relevant information may be available but from multiple sources; for example, from the national perspective the products may have to be received from Regional Climate Centres and, in some cases, Global Producing Centres. Regional Climate Centres (RCCs) are designed to manage the complex flow of information from climate data collectors to the end-users of climate information. Their purpose is to both alleviate the burden of climate information management for people that require climate information to make management decisions and to manipulate data for basic and applied research.

Regional level partnerships are important in the developing country context to support regionally appropriate national and community level contributors. National Meteorological Services (NMSs) often struggle to perform a full range of functions, analyses, and climate services. Regional level organizations can help fill gaps and build capacity through shared mechanisms with a block of countries. Thus regional meteorological centres and Regional Climate Outlook Forums are particularly important. To take the example of Africa, active regional networks include: the African Centre of Meteorological Application for Development (ACMAD), AGRHYMET, ICPAC, and the Drought Monitoring Centre (Botswana). The regional climate centres have been established under the auspices of the WMO and the Regional Climate Outlook Forums (RCOFs). At regional level, stakeholder dialogues will undoubtedly be established using existing regional mechanisms such as the economic groupings: (for example, the Common Market for Eastern and Southern Africa (COMESA), the Community of Sahel-Saharan States (CEN-SAD); the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS), the Inter-Governmental Authority on Development (IGAD) and the Southern Africa Development Community (SADC), APEC, ASEAN, etc.).

National level partnerships and approaches

National and local level partnerships in climate and agriculture and food security are essential for climate risk management of natural hazards (such as extreme weather) and decision-making for agriculture and food security. It is at the national and local level where policy, planning and risk management decisions, as well as emergency preparedness measures, are taken.

All nations will benefit by participating in the Framework. It is expected that governments will identify centres and agencies that can identify needs and contribute programmes that meet needs. One US national programme used in forest management decisions, for example, is a tool called ForWarn[17]. With archives of seasonal vegetation phenology maps, climate conditions, and a satellite-based forest disturbance monitoring system, this tool delivers new products about forest conditions every eight days and attributes changes to insects, disease, wildfire, storms, human development or unusual weather. Locally relevant user information and services, and capacity building, are the essential keys to useful climate services. Some examples and models exist from projects supported by WMO in Africa (Roving Seminars on Weather, Climate and Farmers), and the Caribbean AgroMeteorological Initiative).

At the local level, the User Interface Platform will address the gaps between the potentially very useful information residing in agricultural knowledge centres and the need for this information in rural communities. In many countries the farmers obtain climate information from extension services through daily radio, television, newspapers and through community interactions, although

[17] Forwarn is a programme of the US Department of Agriculture and Interior, the Forest Service's Eastern Forest and Western Wildland Environmental Threat Assessment Centers, in partnership with NASA Stennis Space Center, the US Geological Survey, the US Department of Energy, and the National Environmental Modeling and Analysis Center Asheville.

more can be done through advocacy supported by the UIP to make operators of these services aware of the wide range of relevant services and where there are gaps encourage service providers to step in. The member National Societies of the International Federation of Red Cross and Red Crescent Societies can provide support for reaching out to the communities through their volunteer networks and established branches at different sub-national levels.

The following institutions (not an exclusive list) could support Governments in the implementation of GFCS in agriculture and food security sector:

2.2.1 WMO Members, constituent bodies and co-sponsored programmes

National Meteorological and National Hydrological Services
Climate & Agriculture Working Groups
Regional Climate Centres
Regional Climate Outlook Forums (RCOFs)
Commission for Agricultural Meteorology
Commission for Basic Systems
Commission for Climatology
Commission for Hydrology
World Climate Research Programme (WCRP)

2.2.2 Other UN agencies and programmes

UN Food and Agriculture Organization (FAO)
UN World Food Programme (WFP)
International Strategy for Disaster Reduction (ISDR)
UNCCD
UNFCCC
UNCBD
UNEP
UNDP
UNESCO
UN-Water
United Nations University (UNU)

2.2.3 Non-Governmental Organizations and International organizations

Humanitarian organizations (CARE, OXFAM, MSF, etc.)
International Federation of Red Cross and Red Crescent Societies (including National Societies)

2.2.4 Universities and research institutions

2.2.5 Private sector

Media - newspaper, radio journalists, Social Media
Technology and Infrastructure companies
Telecommunications
Insurance – Reinsurance Sector

2.2.6 Others

International Partners
GEO – Group on Earth Observations
ACMAD – Climate and Agriculture Service
ICPAC – Climate and Agriculture Service
AGRHYMET – Regional Center of CLISS
Famine Early Warning System Network (FEWSNET)

Governmental Agencies

Other Inter-governmental Organizations and Donors
Economic Community of the Central African States (ECCAS)
Economic Community of West African States (ECOWAS)
Intergovernmental Authority on Development (IGAD)
APEC
ASEAN
SADC
Development Banks: IMF, World Bank, ADB, African Development Bank, Inter-American Development Bank
Gates Foundation

2.3 Criteria for identification of activities

Based on past work and feedback with users, the Agriculture and Food Security Exemplar will focus on choosing activities keeping in mind lessons learnt from the past. In particular, to encourage user participation, partnerships between climate and agriculture and food security sectors should support the achievement of existing agriculture and food security priorities, work plans, and agendas. To make available services useful, the project should recognize the diverse demands for climate information and services among the distinct agriculture and food security sector user-groups, and design climate services, which respond to those needs in a timely manner. Any new climate services developed should not only provide information, but jointly develop and manage information products and processes that enhance agriculture and food security risk management. For the holistic risk management of the agriculture and food security sector, it is vital to bridge and unite risk management resources and information to other sectors which impact agriculture and food security.

Projects should focus on strengthening national capacity, including strengthening agriculture and food security systems especially information systems that are fundamental to the effective use of climate information and services. They should likewise, strengthen coordination of data from different sectors (multi-disciplinary data sets) for applying to complex environment-agriculture issues, including solutions for privacy and ownership, clean data, at the appropriate format and scale. The projects should develop methods to better integrate food security, agriculture, climate, and vulnerability data to better understand the relationships between these sectors, while developing a greater understanding of crop phenology, cropping patterns, food security issues and the linkages to environment and climate.

Access to both climate and agriculture and food security surveillance data is not always easy and openly available. Trust must be built between both communities to enable data sharing and collaboration. Although many information products are underutilized, it cannot be assumed products are ready off the shelf to be used. Research and development still need to build reliable models, methods and tools that can produce consistent and reliable products. Lastly, these products need to be operational in nature, complete for the purposes at hand, and easily understood.

Besides delivering the kinds of outcomes listed in section 2.1, proposed activities within the Agriculture and Food Security Exemplar should aim to meet the following criteria:

- Protect food insecure, climate vulnerable populations;
- Support the achievement of existing agriculture and food security sector goals;
- Address climate sensitive agricultural and food security conditions;
- Address major gaps identified at regional and/or national levels in climate-agriculture partnership and project delivery;
- Engage a range of agriculture, food security, DRR, and meteorological stakeholders in partnership with the aim of sustainable agriculture and food security;
- Include effective monitoring and evaluation functions;

- Have a risk communication function;
- Serve to develop the capacity of national agriculture and meteorological users;
- Be cost-effective;
- Strengthen the evidence base for policy and programmatic decision-making;
- Include sustainability or mainstreaming plan.

3 WORK PLAN FOR PRIORITY ACTIVITIES FOR AGRICULTURE AND FOOD SECURITY

The priority activities of the Agriculture and Food Security Exemplar will encourage cross-sectoral interaction including cooperation in the development of decision-support tools and systems for the agriculture and food security community, increasing data sharing and collection, and capacity building and advisory services for the agriculture and food security sector. The Agriculture and Food Security Exemplar can start to facilitate this evaluation by promoting recognized good practices, and bring partners together to innovatively respond to agriculture and food security partner needs to manage climate risks.

The priority activities of the Agriculture and Food Security Exemplar are organized into four priority action areas of data collection, increasing farm productivity, strengthen climate and agriculture and food security services and capacity building. The proposed activities within the Agriculture and Food Security Exemplar are those that respond to identified needs, and can augment and enhance agriculture and food security planning and practice by interfacing and collaborating with Climate Services. Simultaneous efforts in the four areas should advance with the aim to improve engagement of agriculture, food security and climate users, particularly at the national level to agriculture-enhanced operations. These action areas were developed by exemplar partners or groups of partners. Efforts were made to have a standard presentation but this can be done with further discussions among the partners. These action areas are not presented as a complete list of activities but as activities that can be the staring point for collaboration and further elaboration.

3.1 Work Plan for Priority Action Areas

This section outlines the proposed activities within each of the four priority action areas. These are based on successful projects introduced earlier in Section 1.4. It is suggested that a mechanism be developed to guide these activities forward. It is proposed that the main partners in this meet to further develop these plans. The activities of the Exemplar will progress in several phases: Initial - Phase I (2013-2015), Implementation - Phase II (2015-2018) and Consolidation – Phase III (2018-2023). Actions proposed for the Initial Phase would identify existing gaps to be addressed, focus on establishing institutional structures, and prioritize learning from strengthening or scaling up existing initiatives at either global, regional or national levels.

The success of the Agriculture and Food Security activities will be a function of the effectiveness of communicating the benefits of such an initiative, and leveraging existing and new resources and partnerships. The actual implementation will depend on the availability of resources. Mobilization of resources will be the responsibility of the Framework and the identified stakeholders and partners who benefit from and contribute to the partnership and action.

3.1.1 Priority Action Area 1: Improve data collection and use (meteorological, agrometeorological, climatic, agronomic, pest and disease)

- Share data from existing networks;
- Upgrade the monitoring and data collection network in rural areas, as well as systematic data archival and management;
- Use modern information products and implement forecasts from regional and international centres at the national level;
- Improve the reporting of yield, area and production statistics in countries as well as of other data (i.e. pest and diseases).

AG&FS Project 1: Increased Weather, Climate and Agriculture Data Collection

Data collection and sharing is an important task in determining weather and climate impacts to agriculture and food security outlooks. This project would upon build existing projects including the

GEOGLAM and the successful example of the Roving Seminars project where simple raingauges were given to rural farmers to be used for crop advice.

This project aims to engage the climate community and the agriculture and food security sector in coordinated efforts to address needs for climate and related food security data, consistent with the high-level recommendation to the Committee on World Food Security and Nutrition to "facilitate a dialogue on improved global data collection efforts for climate change and food security." As indicated in the Exemplar on Food Security, effective delivery of climate services critically depends on the two communities working together and learning from each other.

This project is similar to GFCS Compendium project 7 and further discussions are needed to combine these projects.

The objectives of this project would be to:

- Achieve enhanced, better coordinated collection and international exchange of climate and food security data and derived products;
- Coordinate meteorological and agricultural data sharing among existing networks;
- Explore possible synergies through the adoption of agreed data and metadata standards and improved data analysis and exchange capacities (i.e. WMO Information System (WIS), FAO STAT);
- Link to existing information portals;
- Explore ways to use simple raingauges to expand data collection networks.

Deliverables
High quality observations of the climate system, related socioeconomic data and derived products are collected and exchanged, enabling the agriculture/food security sector to plan for and adapt to climatic variations, climatic extremes, and changes in climate.

Inputs
To provide sustained high-level engagement and commitment by the climate and agriculture and food security communities to addressing the challenges associated with improving coordination between the sectors; Provision of adequate resources and expertise to develop and authority to implement an effective coordination mechanism.

Year 1 Cost estimate **CHF 50,000**

Includes meetings and workshops

Total 3 Year Cost Estimate **CHF 150,000**

This would include cost sharing from existing projects. See section 6 for an overall summary of activities/project costs.

3.1.2 Priority Action Area 2: Increase farm level productivity to bridge yield gaps and reduce risks

- Farmers should be at the centre of the analysis of the climate impacts and response strategies;
- Deliver reliable, timely, locally understandable climate information with response options to farmers, considering inputs, credit, market and financial aspects.

AG&FS Project 2: Climate Information to Increase Yields and Reduce Risks

Scope
This project aims to support the global understanding of ways in which climate risks and climate change affect the determinants of nutrition security in different contexts. This project will also

strengthen contextual analysis of nutrition security and climate change by examining pathways between health and climate change and between food security and climate change, and to further understand the extent to which these pathways may impact nutritional outcomes in different contexts.

Objectives
The overall aim of the proposed programme is to improve the provision of climate services to help build resilience and enhance the food security of the most vulnerable households.

This aim will be achieved through the following objectives:

- ✓ Deliver and scale up operational climate services in the food security sector;
- ✓ Develop capacity at community, national and international levels to implement and scale up climate services for food security;
- ✓ Develop new tools and models for improved climate services;
- ✓ Strengthen the knowledge base on the effect of climate change on nutrition security and malnutrition and identification of adaptation needs linked to these affects;
- ✓ Develop cross-sector climate services that link food security, nutrition and health sectors;
- ✓ Develop mechanisms to provide climate services to selected communities for enhanced planning and decision making on resilience building efforts.

The project will build upon its relationship with local partners, communities and specific government institutions to build capacities and strengthen community and district-level planning that incorporates climate information and its relevance regarding programme activity areas such as nutrition, livelihood assets creation and preparedness work.

Year 1 Cost estimate **CHF 470,000**

Total 3 Year Cost Estimate **CHF 1,400,000**

This would include cost sharing from existing projects. See section 6 for an overall summary of activities/project costs. More details on this project are provided in GFCS Compendium project 5 and further discussions are needed with partners to elaborate on future activities.

3.1.3 Priority Action Area 3: Strengthen climate and agriculture services

- Integrate climate information into insurance, credit provision, crop monitoring and yield forecasting, and humanitarian response;
- Establish reliable communication mechanisms to provide needs-based information and feedback to National Meteorological and Hydrological Services and agronomic research and extension services.

The Agriculture and Food Security activities will develop information channels that the farming community (including farmer associations, NGOs, Red Cross and Red Crescent village leaders etc.) can easily understand and grow to trust.

To facilitate dialogue across disciplines to understand information requirements of the different users and to develop effective climate service applications, the user interface programme needs to facilitate an effective flow of information from weather and climate service providers to decision-makers in a timely manner for appropriate use. It will differentiate between the different types of decision-makers; recognizing that the needs and abilities vary amongst the farming community, research community, governmental bodies, private industry, and international agencies.

This comprehensive understanding will assist in categorizing the users into different groups based on their vulnerability to impacts of climate events, develop suitable climate products targeted to those who are in a position to benefit from them and decide on the best feedback mechanisms to

be put in place to evaluate the products provided to them. An essential element in this process is user feedback from the beginning of this collaborative partnership at all levels.

The UIP Agriculture and Food Security Meeting proposed ways to improve communication between climate service providers and users:

- Develop and consistently use common language (in packaging);
- Use local (indigenous) languages;
- Develop standardized ways of producing information (using language comfortable to the user);
- Link science-based information and traditional knowledge;
- Encourage youth interest in climate and agriculture issues;
- Engage policy in communications;
- Identify the simplest information that can be delivered to meet user's requirements;
- Produce information at times needed for user decisions, especially for extreme events (decision processes of users may not currently align with development of climate products);
- Improve and disseminate information (case studies) related to the value of the climate information (e.g. the potential economic return from effective use of climate information);
- Improve communication channels: web portals, social media, dedicated web links;
- Get feedback from users and act on it;
- Improve communication and understanding of uncertainty and probabilities;
- Publish verification results to increase confidence in products;
- Help users to manage their expectations (e.g. to understand the limitations of climate science).

AG&FS Project 3: GFCS/World AgroMeteorological Information Service (WAMIS-DSS)

Activity objective
The World AgroMeteorological Information Service Decision Support System (WAMIS-DSS) will offer a full suite of decision-support tools and resources to strengthen integrated and participatory early warning systems for sustainable agriculture and food security. The objectives will be to harness the power of Information Communication Technologies (ICT) to improve agricultural performance and to empower small holders to increase their productivity by facilitating the flow of accurate, timely and cost-effective information from agrometeorological and climate service providers to the user communities.

Deliverables to stakeholders
WAMIS-DSS will be a demand-driven interactive computing platform that can access a library of resources to support a community-based agro-weather management and decision-support system. This system will deliver real-time agrometeorological advisory products and information to farmers, extension services and policy-makers by way of ICTs as well as decision-support system (DSS) services to local and national decision-makers. Deliverables will include a suite of daily farm management decisions derived from such products as Agro-Climate from the Southeast Climate Consortium (SECC), based on local weather and climate data; or long-term planning indicators based on seasonal outlooks and climate forecasts. Output can be used for policy recommendations on crop yield projections and can alter crop risk management decisions.

Indicators and assessment measures
The service will be driven by the needs of the user community, products are tailored for local use, and resources are based on collaboration and consultation with partners and stakeholders. Extension services are often the bridge between the scientific community and the agricultural users, and WAMIS-DSS can serve a vital role in strengthening this bridge. Farmers and agriculturalists need quality information and technical advice, and WAMIS -DSS offers a DSS computing platform for key decision-making. First, a needs-assessment workshop will be conducted in selected pilot project locations with all available stakeholders. On-going collaboration

with stakeholders will be essential throughout the project implementation for feedback and verification. Online training modules will also be set up on the WAMIS.

Background

The current WAMIS server hosts agrometeorological bulletins and advisories issued by WMO Members, aiding user evaluation of various bulletins and sharing insight into improving their own bulletins. Over 50 countries and institutions participate in this service (www.wamis.org). The current WAMIS servers are being coordinated and administered by WMO with the assistance of the Italian Institute of Biometeorology (IBIMET) and the National Center for Agrometeorology (NCAM) in the Republic of Korea. The current WAMIS also host a tools and resources section, which includes data, information, dissemination, and feedback. These links include software, web portals, training resources, and tutorials.

GFCS/WAMIS-DSS /UIP Pilot Project

The UIP will help establish effective communication between climate scientists, climate and agricultural researchers, agricultural extension services and the decision-making community, to ensure that application science meets operational needs of the user communities. The UIP will also promote development of information channels with the farming community (including farmer associations, NGOs, village leaders, etc.) to help training and capacity building development.

A comprehensive profile will provide an understanding of the different types of users. The profile will place emphasis on the quantitative understanding of the climate risks in which the users operate, the nature of climate risk management strategies they currently use (if any), their access to inputs, and information on the nature of climate products and forecast information they need for management decisions. This comprehensive understanding will assist in categorizing the users into different groups based on their vulnerability to impacts of climate events, develop suitable climate products targeted to those who are in a position to benefit from them and decide on the best feedback mechanisms to be put in place to evaluate the products provided to them. An essential element is this process is user feedback from the beginning of this collaborative partnership at all levels. Figure 2 illustrates the types of UIP products for decision-makers.

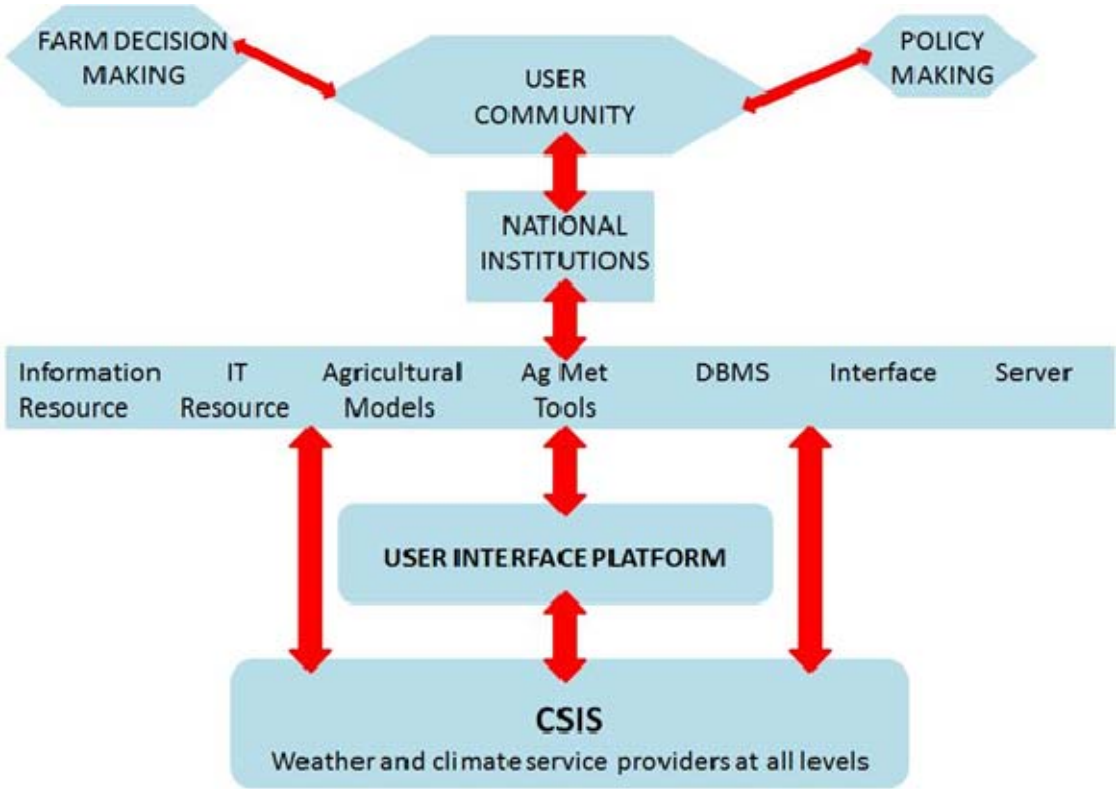

Figure 2. Climate products, agro-climate models and decision-support tools needed by agricultural decision makers.

The UIP in Figure 1 are WAMIS Application Servers, located in the selected African countries, such as Kenya and South Africa, for example, that will serve as pilot projects in this study. These regional servers would link to the updated WAMIS-DSS servers in the United States, Italy and the Republic of Korea that would offer a full-suite of demand-driven DSS tools to the WAMIS-DSS Application Servers. This proposed project builds on the successful operation of the current WAMIS servers across several institutions for almost 10 years. The new project will also involve the George Mason University (GMU) in the eastern United States.

Based on a needs assessment, deliverables from the WAMIS suite of services would be made available in a timely and user-friendly format in an ICT mode (radio, mobile phone) for appropriate decision-making and promote train-the-trainer sessions following the first two pilot projects to expand the use of the pilot project activity in additional countries for greater operational use.

Cost estimate (Year 1)

(Two proposed countries)	
Application Servers (2): Hardware @$15K	CHF 15,000
WAMIS DSS Development (WMO:GMU/IBIMET/NCAM)	CHF 75,000
ICT Development	CHF 50,000
Training & Capacity Building (Workshops/Seminars)	CHF 75,000
Year 1 Total	**CHF 215,000**

Total 3 Year Cost Estimate	**CHF 645,000**

3.1.4 Priority Action Area 4: Strengthen Capacity of Farmers and institutions

- Build social capital and raise awareness. These are key to enhancing trust at the community level;
- Pre-requisites must be in place, such as capacity.

A predominant challenge for all sectors, including Agriculture and Food Security, is the ability of users, particularly at the national and subnational levels, to recognize, understand, appropriately interpret and apply available climate information. Educating and reaching out to the agriculture sector to address this gap is a paramount priority, and will require joint action between climate and agriculture partners.

One recent example of capacity development is an effort to focus on enhancing inter-disciplinary academic and research programmes in natural resources, which collaborate with a number of international institutions. These centers are currently recognized as either existing or potential “Centers of Research and Excellence in AgroMeteorology (CREAMs)”. These centers are mainly located at universities and are listed below with their focus area:

- Republic of Korea – Interdisciplinary Agricultural and Forest Meteorology;
- Italy – University of Florence – Ecophysiology, Climate Adaptation;
- China – Nanjing University – WMO Regional Training Center;
- USA – George Mason University – Science, Technology and Policy;
- India – Indian Meteorological Department – Agricultural Advisory Services to Farmers;
- Australia – University of Southern Queensland – Land and water management;
- Brazil – University of Campinas – Forecast System for Decision-Makers;
- Southern Africa – University of Free State – Early Warning Service & Communication.

These centers will aid in providing training and capacity building to staff from various organizations on the subjects of using weather and climate for agriculture and food security applications. While the main emphasis of these centers will be national regional capacity building, it is envisioned that South-South collaboration and training would occur through these centres. The strength of this network would be to share training experiences and ideas.

- Famine early warning systems (FEWS-NET);
- Agriculture-sector participation in RCOFs/NCOFs (Africa);
- Development and use of agro-climate indices relevant to drought;
- Interdisciplinary training, knowledge building and awareness raising (Americas, Africa);
- Gathering and managing evidence on the impacts of climate variability and change on the various aspects of the agriculture sector for improved surveillance, evaluation, preparation and response activities (impacts assessment, impacts modelling, etc.) (Africa, Americas, Europe, Asia);
- Multi-hazard early warning systems at national and municipal scale;
- National Communications to UNFCCC, Vulnerability and Adaptation Assessments.

AG&FS Project 4: Improving communications between the climate and agriculture and food security communities

WMO, FAO, IFRC and other international organizations have several existing projects that disseminate weather and climate information to the farming community. This project would coordinate and expand on the Roving Seminars, Farmer Field Schools, and Climate Field Schools that have already been implemented over past 10 years.

Scope
Communication is a vital area of work necessary to maximize the uptake, translation, and partnerships for agriculture and food security and available climate services. The Agriculture and Food Security priority actions for communications outline actions to support the agriculture and climate partners to communicate climate risks to agriculture, raise awareness of the availability and benefits of climate services, attain buy-in from agriculture users, advocate for partnership and sponsorship, and build trust amongst communities of practice. Investment in communication is essential to create demand for climate services from within the agriculture sector, and motivate engagement in dialog. The Agriculture and Food Security activities will try to establish a four-way communication between climate scientists, climate and agricultural researchers, agricultural extension services and the decision making community, to ensure that applied research is refined and expanded to meet community needs. The Agriculture and Food Security activities will develop information channels that the farming community (including farmer associations, NGOs, village leaders, etc.) can easily understand and grow to trust.

To facilitate dialogue across disciplines to understand information requirements of the different users and to develop effective climate service applications, the user interface programme needs to facilitate an effective flow of information from weather and climate service providers to decision-makers in a timely manner for appropriate use. It will differentiate between the different types of decision-makers; recognizing that the needs and abilities vary amongst the farming community, research community, governmental bodies, private industry, and international agencies.

Objectives
1. To support the agriculture and climate partners to increase participation and demand by communicating: climate risks to agriculture and food security, the availability and benefits of climate services for agriculture policy, planning and operations;

2. To build, maintain, and facilitate an active community of practice, and network of partners and experts supporting and implementing climate and agriculture activities (possibly within the WMO Commission for Agricultural Meteorology);

3. To facilitate and support dialogue and partnerships between agriculture and climate partners, which can build trust and success between disciplines.

Activities
A comprehensive profile will be developed to provide an understanding of these different types of users. The profile will place emphasis on the quantitative understanding of the climate risks in which the users operate, the nature of climate risk management strategies they currently use (if

any), their access to inputs, and information on the nature of climate products and forecast information they need for management decisions.

This comprehensive understanding will assist in categorizing the users into different groups based on their vulnerability to impacts of climate events, develop suitable climate products targeted to those who are in a position to benefit from them and decide on the best feedback mechanisms to be put in place to evaluate the products provided to them. An essential element in this process is user feedback from the beginning of this collaborative partnership at all levels.

Deliverables and assessment measures
Collaborative partnerships between WMO, FAO, NGOs and other partner agencies, policymakers and NMHSs; established and functional systems for disseminating information and evaluating the benefits; organization of roving seminars and farmer field days. The initial target region will be West Africa, with expansion to other African regions.

Benefits
Communities and farmer organizations are strengthened with knowledge obtained by using Information and Communication Technology; tools for communication are extended by improving web-based storage of agricultural information and by increasing connectivity in rural communities.

Cost estimate (Year 1)

Coordination Meetings	CHF 50,000
Preparation of guidance material	CHF 20,000
Training & Capacity Building (Workshops/Seminars)	CHF 330,000
Year 1 Total	**CHF 400,000**
Total 3 Year Cost Estimate	**CHF 1,200,000**

3.2 Implementation approach

The Agriculture and Food Security activities will be implemented in three phases, spanning 3, 5, and 10 year time frames: Phase I (2013-2015), Phase II (2015-2019), and Phase III (2019-2023). The following timelines provide a more strategic approach to the implementation of the workplan activities and are general in nature. While they may not specifically align with the projects at this time, further work will be needed to harmonize the various timelines.

Timeframes for Implementation

Phase 1: 2013-2015
3yr targets & types of activities

- Establish institutional mechanisms
- Establish work plans
- Develop first technical guidance
- Expand/continue existing projects
- Build awareness and partnerships

Phase 2: 2015-2019
5yr targets & types of activities

- Maintain and improve engagement in institutional mechanisms
- Develop more refined technical guidance & training curricula
- Develop new projects and processes
- Expand/continue existing projects

Phase 3: 2019-2023
10yr targets &types of activities

- Maintain and sustain institutional mechanisms
- Spread the use of technical guidance & training curricula, deploy expanded refinements
- Review learning

An agriculture and food security secretariat for climate services should be created at the global level to engage with the GFCS, to support and oversee the implementation of the Agriculture and Food Security activities, to bring together partners, and maintain the requirements for success of Framework activities within and for the agriculture and food security sector. This function could be jointly managed by the WMO, NMHS representatives, Ministries of Agriculture and the Environment and Emergency Risk Management (ERM). A technical committee within the GFCS UIP should be established under the UIP Management committee. However, further discussions are needed to develop a suitable working arrangement for all partner organizations.

3.3 Monitoring and evaluation of the implementation of activities

In order to monitor and evaluate the progress and success of implementation, it is advised to:

1. Establish a results-based monitoring and evaluation framework for Agriculture and Food Security activities that connects with agriculture and food security outcomes;

2. Establish monitoring and evaluation standards for new interventions, and the development of indicators, particularly related to economic costs-damages-and benefits;

3. Integrate reporting on delivery of the GFCS into the existing governance mechanisms for meteorological agencies, and agriculture agencies, such as WMO Commission for Agricultural Meteorology and the FAO Council and WFP governance bodies.

3.4 Risk management in the implementation of activities

Two major risks exist to the implementation of the work plans for many sectors. One, if there is not significant and genuine buy in and ownership from the user community, then partnerships and actions to apply climate services to the user community will remain marginal and climate services will not become a standard and mainstreamed application for the application sector. Therefore, communication is a priority area of work to improve understanding and buy-in, as well as justification for the pre-requisite conditions for engagement in the Framework.

Two, without mobilizing and sustaining financial resources at global, regional, and national levels, engagement of the agriculture and food security and other sectors, implementation will not be possible.

A third risk that is perhaps unique to this sector is measuring the effectiveness of projects. Agriculture and food security are sensitive to many extra-environmental factors. Improvements in food productivity, for example, can be ascribed to technological advances in machinery, seed stock, and farm practices, external to any improvements in better climate outlooks. On the other hand, food insecurity can result due to other factors, despite improvements in climate services. The range of agriculture and food security related risks sensitive to changes in weather and climate conditions is extensive. The direct impacts of climate variability and change include agricultural productivity, water and food security, land degradation and mismanagement, among others. Extreme meteorological conditions like droughts, heat and cold waves, floods, storms and cyclones have enormous consequence on society. Coupled with population growth, increasing vulnerability of urban concentrations, greater demands for diminishing land and water supplies, and competition with biofuels for agriculture production, climate extremes and climate change have contributed not only to food security crises around the world, but also led to economic and social

turmoil. Against this backdrop, measuring the success of projects in this Exemplar will be a challenge.

4 ENABLING MECHANISMS

4.1 Synergies with existing activities

Among the plethora of existing activities introduced in section 1.4, and new projects proposed for action areas in section 3.1, are synergies within existing partner programmes. At their base, are the common mandates and goals that have served to guide work for the betterment of humankind. Among them, the Millennium Development Goals and Post-2015 Sustainable development goals, Hyogo Framework of Action, and the United Nations Convention to Combat Desertification (UNCCD). These synergies encourage collaborative research-to-applications programmes like the ones managed by Climate Change, Agriculture and Food Security (CGIAR). In all these, synergies and linkages are: (1) directly relevant to the management of climate sensitive agriculture and food security outcomes; (2) can practically enhance and improve the performance of existing agriculture and food security priorities, goals, and technical agendas; and (3) explicitly connect with the operational mechanisms of the agriculture and food security community.

4.2 Building national, regional and global partnerships

The strength of future partnerships will depend upon multiple factors including the political support for the Framework by government and agriculture and food security partners, the flexibility to advertise successful experience to encourage dynamic engagement with the UIP, the ability to secure adequate financing, and the effective establishment of a functional and communicative secretariat. Importantly, the UIP workplan must offer concrete incentives, opportunities and advantages for partners to engage.

4.3 Review mechanisms

A Technical Committee for Agriculture and Food Security should be established and be responsible to review progress, report needs and issues, and inform members of changes and opportunities. There needs to be further discussion among the partner agencies and organizations on how exactly this could be established. Various proposals include secondment of staff to the GFCS Office in Geneva; the establishment of a joint Expert Team under the WMO Commission for Agricultural Meteorology, or a Working Group under FAO or WFP.

5 RESOURCE MOBILIZATION

One key aspect to the success of the Agriculture and Food Security activities will be obtaining sufficient resources. For Phase I, existing project funds could be used by the participating agencies to start some of these activities. Since a significant number of these activities are the expansion of current ones, this should not be extremely difficult. However, integrating the proposed activities among the participating agencies will be a challenge.

Quoting the recent Exemplar-related conference white paper[18], "For a holistic management of climatic risks in agriculture, new and innovative models of cooperation and partnerships are needed between three groups- a) WMO and the National Meteorological and Hydrological Services dealing with climate issues; b) Climate Change, Agriculture and Food Security (CGIAR) National Agricultural Research Systems and Extension Services, United Nations Convention to Combat Desertification (UNCCD), and Soil Conservation Services dealing with land degradation and agriculture technologies; and c) Food and Agriculture Organization and National Entities dealing with agriculture, food security and policy issues. Such partnerships should explore securing global adaptation funds for research and development activities relating to reducing exposure of agriculture to multiple risks, providing incentives to farmers for resource conservation, ensuring food security and poverty alleviation, and other associated local, national and global benefits." Likewise, entities such as the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), which has climate adaptation resources, would be welcomed partners.

It should be noted that further discussions needed to take place with the GFCS Office on resource mobilization strategies and on how exemplar partners will allocate their own resources and coordinate to target/approach donors.

[18] Aggarwal, P.K, et al. 2010

6 COSTED SUMMARY OF ACTIVITIES/PROJECTS

	Estimated Costs (CHF)		
Activity area	2013-2015	2015-2019	2019-2023
AG&FS Project 1	150,000	500,000	1,000,000
AG&FS Project 2	1,400,000	2,000,000	3,000,000
AG&FS Project 3	645,000	1,500,000	2,000,000
AG&FS Project 4	1,200,000	1,800,000	2,000,000
Total	3,395,000	5,000,000	12,000,000

Note that these costs are based on section 3.1 above and are provisional estimates subject to change and further discussions by exemplar partners.

APPENDIX

Acronyms

AARINENA	Association of Agricultural Research Institutions in the Near East and North Africa
ACMAD	African Centre of Meteorological Applications for Development
ACPC	Africa Climate Policy Center
AfDB	African Development Bank
AGRHYMET	Regional Center of CILSS
APN	Asia-Pacific Network for Global Change Research
ASEAN	Association of Southeast Asian Nations
AUC	The African Union Commission
CCFAS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CGIAR	Consultative Group on International Agricultural Research
Clim-Dev	Climate for Development Programme for Africa
CLISS	Permanent Interstate Committee for Drought Control in the Sahel
CRM	Climate Risk Management
CREAM	Centers of Research and Excellence in AgroMeteorology
CSF	Climate Services Framework
CSIS	Climate Services Information System
CTA	Technical Centre for Agricultural and Rural Cooperation
DNP	Department of National Planning
ENSO	El Niño-Southern Oscillation
EWS	Early Warning Systems
FAO	Food and Agricultural Organization of the United Nations
FEWSNET	Famine Early Warning System Network
FSIEWS	Food Security Information and Early Warning System
GEO	Group on Earth Observations
GEOGLAM	GEO Global Agricultural Monitoring project
GCOS	Global Climate Observing System
ICARDA	International Center for Agricultural Research in the Dry Areas
ICPAC	IGAD Climate Prediction and Application Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFRC	International Federation of the Red Cross and Red Crescent Societies
IFAP	International Federation of Agricultural Producers
ILRI	International Livestock Research Institute
IGAD	Intergovernmental Authority on Development
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society
LDC	Least Developed Country
MDG	Millennium Development Goals
NMHS	National Meteorological and Hydrological Service
NOAA	National Oceanic and Atmospheric Administration - USA
PPP	Public-Private Partnerships
RCOF	Regional Climate Outlook Forums
RMP	Research, Modelling, and Prediction
SADC	Southern Africa Development Community
UIP	User Interface Platform
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNISDR	United Nations International Strategy for Disaster Reduction

USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WCC-3	World Climate Conference-3
VIGIRISC	African Early Warning and Advisory Climate Services
WFO	World Farmer's Organization
WFP	World Food Programme
WMO	World Meteorological Organization

For more information, please contact:

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