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

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APPENDIX TO THE

AGRICULTURE AND FOOD SECURITY EXEMPLAR

TO THE USER INTERFACE PLATFORM

OF THE

GLOBAL FRAMEWORK FOR CLIMATE SERVICES

Box 1 – LEAP Food Security Early Warning- Early Response Tool in Ethiopia

The Livelihoods, Early Assessment and Protection (LEAP) system is an innovative food security early warning – early action tool. Developed in 2008 by the Government of Ethiopia in collaboration with WFP, LEAP prompts the timely scale-up of Ethiopia's national safety-net programme, in anticipation of severe droughts or floods, to ensure early and well-targeted response to an impending food crisis.

The LEAP software uses agrometeorological monitoring data to estimate future crop yields and rangeland production. Meteorological data is provided both by satellites and a network of automated and conventional weather stations. Crop and rangeland production estimates are then used to calculate the number of people, by district and region, projected to be in need of assistance due to anticipated production reductions. This can in turn trigger the immediate release of a contingent fund administered by the World Bank to scale-up the national safety net programme and save not only lives but also livelihoods. LEAP thus provides a transparent and verifiable way to trigger early assistance to the people in need in case of major climate shocks.

LEAP is an excellent example of how WFP is using climate services to help the Government of Ethiopia shift from disaster management to climate risk management. In particular, it is a powerful illustration of how WFP can help improve the effectiveness of disaster response by integrating agrometeorological early warning systems with risk transfer mechanisms (including contingent finance, but also potentially index-insurance) and conventional safety net programmes.

In addition to its use as a national-level food security response tool, LEAP is also a key provider of agrometeorological information used for risk management by a range of governmental and non-governmental actors at the sub-national level. The crop and weather data produced by LEAP on an ongoing-basis–including rainfall, crop-specific yield reductions and water balance index- has been used since 2008 by the National Meteorological Agency and the Ministry of Agriculture for regular regional early warning bulletins and seasonal agricultural assessments.

Promising new projects are also exploring the use of LEAP for household-level climate risk management. This includes applying LEAP to weather-index insurance for small-scale farmers, by using the software's rainfall or crop water balance index to trigger insurance payouts. Another project is currently piloting the use of LEAP to support decision-making processes amongst pastoralists. LEAP's satellite-based vegetation greenness (NDVI) data will be used to identify areas with available pasture and water sources, especially during the dry season and periods of drought, and this information will be transmitted directly to individual pastoralists through the traditional communication mechanisms.

The extensive capacity building and infrastructure development work carried out in the context of LEAP has played a key role in strengthening Ethiopia's meteorological and climate risk management system. A strong emphasis was placed from the start on ensuring that the government fully owns LEAP and coordinates its operationalization. Since 2011, over 200 people, including many government staff, have been trained in how to use the LEAP software and its various outputs. In addition, in order to improve the quality of the meteorological data fed into the LEAP software, 47 automated weather stations having been installed throughout the country as part of the LEAP project, as of 2013.

Building on the success of LEAP, WFP is committed to continue providing support to other countries to build comprehensive risk management frameworks which use climate services to address food insecurity in a more cost-effective and sustainable manner.

Box 2 - Roving Seminars

Weather and climate are some of the biggest risk factors impacting on farming performance and management. Recent weather and climate research efforts have demonstrated the importance of targeted forecasting and scenario analyses in increasing overall preparedness of farmers and farm business managers, leading to substantially better outcomes overall. These, along with improved data collection and use will be needed to assist farmers to further develop their adaptive capacity with improved planning and better management decisions. Examples of decisions that can be aided by targeted weather and climate information include strategic and tactical crop management options, agricultural commodity marketing, and policy decisions about future agricultural land use.

Roving Seminars is a project of the Agricultural Meteorology Programme (AgMP) of the WMO.[1] The main objective of these seminars is to make farmers more self-reliant by helping them become better informed about effective weather and climate risk management for the sustainable use of natural resources for agricultural production. Another objective is to increase the interactions between the farmers and the National Meteorological and Hydrological Services of the world. Organizers have used the seminars as an opportunity to expand data collection by farmers in the field.

Expected outcomes of Roving Seminars:

- The Roving Seminars will help educate farmers about advances in the provision of weather and climate information to help them make decisions on the farm;
- Feedback obtained from the farmers will help the personnel from the Meteorological Services and the Agricultural Extension Agencies to design improved products for use by farmers and to improve the channels of communication to provide information to the farmers;
- Summary reports from the seminars will help the global farming community to understand the current methods of weather and climate risk management at the farm level in different parts of the world and help introduce improved risk management tools for the farming community.

Based on the Roving Seminar Concept, the METAGRI project was funded by the State Agency for Meteorology in Spain (AEMET). The four-year pilot METAGRI project involved the NMHSs of 15 West African countries that organized 159 roving seminars with the participation of 7,000 farmers. NMHSs involved in the project distributed over 3,300 rain gauges to over 2,800 villages, providing farmers with a simple and invaluable crop management and planning tool. The Norwegian Government funded the new phase of the project entitled METAGRI-OPS in 2012 and over 120 Roving Seminars were held in 16 Western African countries: Benin, Burkina Faso, Cape Verde, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, and Togo. Over 2400 plastic raingauges were distributed and an estimated 7000-8000 people, including farmers and others, participated in the Roving Seminars and learned about the use of climate and weather information. A draft Basic Manual of Roving Seminar procedures was produced in French and English.

[1] http://www.wmo.int/pages/prog/wcp/agm/roving_seminars

Box 3 - Improving Data Collection and Use by Linking Climate Service Users with Researchers and Service Providers

The south eastern states of Florida, Georgia and Alabama of the USA make important contributions to the nation's agricultural output, particularly for row crops, livestock, forage, small and tropical fruits and vegetables. The climate of the region is complex and varied and is strongly impacted by the El Niño Southern Oscillation (ENSO). The challenge was to improve the management of this climate risk.

The Southeast Climate Consortium (SECC), which includes major universities from Florida, Georgia and Alabama, provides scientific research to the study of climate and climate variability in relation to agriculture. The SECC has made cooperative extension services a primary responsibility, and in each state has established extensive extension networks through county coordinators and agents whose main goal is to act as an interface between researchers, service providers and local farmers and growers.

A programme to improve operational services was initiated through small group meetings with county agents and extension specialists. A company was then hired for the research prototypes and developed a rather generic service delivery system design which allowed for easy modification and updates of the website. County agents expressed a need for local climate forecasts for the coming three to six months and a clear prescription for management decisions involving which crop and cultivar to plant and pest management applications. The SECC implemented an evaluation and impact assessment team that relayed the needs and requests from stakeholders to the research teams. AgroClimate (www.agroclimate.org) now provides seasonal climate forecasts developed by climatologists working with the Southeast Climate Consortium (SECC) to meet the precise needs of farmers with the best science and technology currently available.

Box 4 - Farmer Field Schools

Text from "The Farmer Field School Approach – History, Global Assessment and Success Stories by Arnoud Braun and Deborah Duveskog (IFAD). PDF

In 1989, the first group of Farmer Field Schools were conducted in the rice fields of Indonesia and involved 200 FFSs in four districts of Yogyakarta. These were initiated by the Indonesian National Integrated Pest Management (IPM) Programme with funds from the Government of Indonesia – United States Agency for International Development (GoI-USAID) and technical assistance from FAO. By 1990, the Indonesian National IPM Programme scaled up and launched over 1,800 FFSs for rice IPM in six provinces in Java, Sumatra and South Sulawesi. In 1991, the pilot FFSs in IPM for rotation crops (mainly soybeans) was initiated while the FFS Programme was used in different countries in Asia.

The key to the popularity of FFS programmes is an appropriate topic and methodological training of the people who can organize and facilitate farmer field schools. A successful FFS trainer/facilitator must have skills in managing participatory, discovery-based learning as well as technical knowledge to guide the groups' learning and action process. Without an adequate training of trainers (ToT) programme, the subsequent FFS programme will not be successful.

In general, FFS consist of groups of people with a common interest, who get together on a regular basis to study the *"how and wh*y" of a particular topic. The FFS is particularly suited and specifically developed for field studies, where hands-on management skills and conceptual understanding (based on non-formal adult education principles) is required. So what are the essential and original elements of a farmer field school?

Box 5 - Climate Field Schools

Case Study on “Climate Field School for Farmers” adapted from summary by Nelly Florida Riama from Meteorological Climatological and Geophysical Agency (BMKG), Jakarta, Indonesia

Farmers need to know how to deal with climate variability, which affects their crop productivity. Climate information products are difficult to understand, especially among the farmers who are expected to directly apply the information. Hence, a closer collaboration between BMKG as the climate service provider and the extension workers from Ministry of Agriculture (MoA) as the user interface is needed. Climate Field School (CFS) for Farmers plays this strategic role. The main objective of the CFS is to transform technical climate information into the practical language of farmers, with extension workers as facilitators.

CFS proceeds in three stages. The first stage is training for trainers in which representatives from local government and regional office of MoA are trained to better understand the climate information provided by BMKG. In the second stage those trainees expected to directly deal with farmers receive further training. Both first and second stages last 4 days each. In the third stage trained extension workers deliver information to the farmers. This lasts 3-4 months, during which farmers adjust their planting calendar, plant and decide proper inputs based on local climate characteristics.

CFS activity encompasses three purposes as follows:

- Improving farmers’ climate knowledge and their ability to anticipate climate events in their farming activities;
- Assisting farmers in observing climatic parameters and using applications in their farming activities and strategy;
- Helping farmers to translate and understand the climate (forecast) information for supporting farming activities, especially for planting decisions and cropping strategy.

CHALLENGES

Although CFS has proven itself to directly and significantly improve farmers’ ability to adapt to climate variability, extending the activity may pose some challenges. Several foreseen challenges that may become a hindrance for CFS–among others are:

- Lack of coordination between government agencies at the regional level;
- Finding an effective method of scaling up the projects;
- Combining the traditional way of farming based on the local wisdom with the new climate information services;
- Extending the activity beyond agricultural sectors, such as fisheries, health and other climate sensitive development sectors is recommended.

Based on the accumulated experience and dialogues with the final users, much of the information produced by BMKG does not directly address farmers’ needs: further interpretation is needed. CFS tackles this underlying problem to ensure clearer understanding and greater benefit to the farmers.

Box 6 - Creating and Accessing Climate Service Information Products

The Food and Agriculture Organization of the United Nations (FAO) and the International Institute for Applied Systems Analysis (IIASA) have developed the Agro-Ecological Zones (AEZ) methodology over the past 30 years for assessing agricultural resources and potential. The Global Agro-Ecological Zoning (GAEZ) based on the AEZ methodology creates information products to assists with rational land-use planning on the basis of an inventory of land resources and evaluation of the biophysical limitations and production potentials of land. GAEZ uses the land resources inventory to assess, for specified management conditions and levels of inputs, all feasible agricultural land-use options and to quantify anticipated production of cropping activities relevant in the specific agro-ecological context.

The new online data portal developed by FAO and the International Institute for Applied Systems Analysis (IIASA) seeks to enhance planners' and decision-makers' capacity to estimate agricultural production potentials and variability under different environmental and management scenarios, including climatic conditions, management regimes, water availability and levels of inputs. In particular, given the scarcity of suitable resources in some regions, future demand and expected negative impacts of climate change, GAEZ allows users to evaluate options for more widespread adoption of sustainable land and water management practices in agricultural systems at risk, recently highlighted in FAO's report The State of the World's Land and Water Resources for Food and Agriculture

The GAEZ Data Portal www.fao.org/nr/gaez, is an interactive data access facility, which not only provides free access to data and information and allows visualization of data, but also provides the user with various analysis outputs and download options. The GAEZ programme provides a global assessment to support strategy, management, planning, rational use and sustainable development addressing food security – facilitating access to data, information and knowledge. GAEZ outputs enable the evaluation and assessment of the world's agricultural resources and potential, becoming a fundamental tool for land use planning and management and sustainable development addressing food security.

Box 7 – RCOFs and Other Activities Strengthening Climate and Agricultural Services

Regional Climate Outlook Forums (RCOFs) bring together local climate experts in a region with a common climate to analyse seasonal climate indicators and predictions to provide a basis for regional agriculture and food security outlooks.[1] Conceived and developed by WMO, NMHSs and other organizations, RCOFs produce regional climate outlook products.[2] In East Africa, the Food Security Outlook (FSO) process links output from the Greater Horn of Africa COF to deliver early warning of risks that could affect food security in the coming six months.[3] This process uses meteorological and seasonal climate projections based on ENSO, sea surface temperatures of the Indian and Atlantic oceans and other influences of rainfall in the Greater Horn of Africa. The input data comes from a variety of sources including the IGAD ICPAC, NMHSs, and FEWS NET partners including NOAA and the UK Met Office. The data is fed into dynamic and statistical models to produce rainfall forecasts, analysed and interpreted by experts. The rainfall forecasts are then related to food security and vulnerability data provided by WFP, FAO, and NGOs to produce the FSO reports, which provide decision-makers with crucial early insights for food security risk reduction. The FSO and RCOF processes include development of user capacity to understand and use the information.

In Queensland, Australia, scientists developed an agricultural risk management tool called WhopperCropper that allows agronomists and farmers to model the effects of different crop inputs given different pre-existing soil and water conditions and how these parameters interact with the different phases of ENSO. Output can be expressed in graphic form and in terms of gross margins.[4]

With support from WMO and the UK Met Office, the University of Reading in the UK has developed a web-based course on Statistics in Applied Climatology (e-SIAC) designed to teach users of climate data how to effectively use publicly available historical climate datasets to produce custom climate statistical products to meet their needs.[6] Designed to be taken part-time, online, the course is targeted at climate data users and producers who cannot attend such a course physically.

[1] Managing Climatic Risks for Enhanced Food Security: Key Information Capabilities, Balaghi et al.
[2] http://www.wmo.int/pages/prog/wcp/wcasp/clips/outlooks/climate_forecasts.html
[3] WFP Case Study: Early Warning Systems for Food Security in Africa: Linking the Food Security Outlook with the Climate Outlook Forum
[4] http://www.daff.qld.gov.au/26_14184.htm
[5] http://www.reading.ac.uk/ssc/n/esiac.htm

Box 8 - Case Study Improving water productivity of crop-livestock systems of the Sub-Saharan Africa

The purpose of this project is to optimize productive use of water to help increase incomes of small-scale farmers. It also seeks to improve the environment within crop livestock systems in the semi-arid areas of Southern Africa and the Blue Nile Basin.

Water productivity can be increased through more appropriate livestock management in crop livestock systems. Livestock represent a huge potential for increased income due to the rapidly growing demand for livestock products. However, there is a profound lack of understanding of how animals interact with water resources. This leads to a clear and urgent need to demonstrate the intervention options from the farm to the policy scale that can result in improved water productivity and prevent land degradation. The project targets users at all levels including farmers, national research agencies, water managers, irrigation planners, development and extension authorities by providing planning and management tools to improve productivity of scarce water resources. The project will produce public goods for the global research community in agriculture and development.

Objectives:

- Produce strategies for farmers, water managers, irrigation planners and development and extension authorities;
- Produce public goods for the global research community in agriculture and development;
- Provide an evaluation tool for local planning and agricultural extension officers, district agricultural officers and farmer and livestock owners.

http://www.ilri.org/node/299

Box 9 - Building long-term community resilience in Kenya

For the past two decades, the World Food Programme has worked with vulnerable communities in Kenya to improve food security by enhancing resilience to climate-related hazards. These efforts had previously been incorporated into emergency response operations, but a series of devastating droughts led to greater attention to longer-term relief and recovery programmes emphasizing capacity building within communities to mitigate future drought.

In 2006, community members in the district of Taita Taveta, Kenya voiced concerns about the district's food security problems. They suggested that their community was experiencing a regular cycle of drought, more frequent and severe in recent years that limited people's ability to lift themselves out of poverty. Changes in seasonal rainfall patterns and more erratic rainfall had also made it difficult to rely on traditional rain-fed farming methods.

The District Steering Group, responsible for food security issues at the local level, consulted with the Arid Lands Resource Management Programme to verify the issues. The government's historical records, documenting monthly rainfall totals as well as precipitation patterns during the planting season, supported the observations. As a result, the World Food Programme joined with the Government of Kenya, World Vision and the community to institute a Food for Assets programme, allowing people hardest hit by chronic food shortages to be given food while participating in risk-reduction and resilience building projects.

In one major project, the community rehabilitated the Njoro Kubwa irrigation canal, built in 1948, which had become blocked over the years. The programme also extended the canal network deeper into farmland where irrigation water had not previously been available. Over three years, more than 4500 people were provided with food while they worked on irrigation canal improvements. 460 households have at least 230 hectares of land between them that can now be irrigated. Time spent finding water has been reduced by up to two hours each day

A functioning canal network buffers the community against direct climate impacts. During heavy rainfall, runoff is captured in the canals and saved for drier periods, and farmers have a source of water for their crops and animals should the rains fail. Since the project's inception, the community's food security levels and ability to withstand weather-related hazards has significantly improved, crop production have increased by 33 per cent and household income has increased by an average of 45 per cent. By understanding and addressing climate risks, including changes in seasonal rainfall and its increased variability, the World Food Programme, World Vision and the Government of Kenya have helped part of the district to gradually decrease their vulnerability to climate shocks and their need for repeated food assistance (WFP, 2010).

Box 10 - Managing uncertainty: innovation systems for coping with climate variability and change

For agricultural communities and agricultural stakeholders in East and Central Africa (ECA) to adjust to climate change and the predicted increases in temperature and in rainfall variability, their ability to cope better with the constraints and opportunities of current climate must first be enhanced. Information, tools and approaches are now available that allow for a far better understanding, characterization and mapping of the agricultural and pastoral implications of long-term climate variability and change and the development of climate risk management strategies specifically tailored to stakeholders needs.

ILRI is responsible to avail knowledge and disseminate to researchers and planners, to guide managers in making optimal choices with respect to direct and indirect impacts of climate variability and climate change for the agricultural sector in ECA. Through a literature review knowledge will be made available of the current state of knowledge of both the exogenous and endogenous agricultural and pastoral implications of current climate variability and future climate change within ECA. This study will consider evidence of such implications at a range of scales ranging from impacts at the household and community level to those at district, national and regional levels, and will include an evaluation of the current tools and approaches available to assist in the development of 'climate risk assessment and management frameworks' designed to assist the decision making by key stakeholders at all scales.

Project Objectives/Goals: The project's purpose is to develop strategies and an institutional innovation system for coping with risks and opportunities associated with climate variability and change in ECA. It addresses the hypothesis that "An integrated set of activities comprised of knowledge review and synthesis, development of strategic learning alliances and 'proof of concept' case studies will provide the foundation for and help build an innovation system for addressing long-term climate variability and change in ECA." **Location:** East and Central Africa.

Box 11 - The R4 Initiative: Effectively combining climate information and insurance for food security

In 2010, WFP and Oxfam America partnered to scale up an innovative approach to strengthen poor farmers' resilience to climate-related shocks. The Rural Resilience Initiative (R4) combines improved resource management (risk reduction), insurance (risk transfer), microcredit (prudent risk taking), and savings (risk reserves). The initiative builds upon the "Horn of Africa Risk Transfer for Adaptation" (HARITA) programme, which was successfully implemented in Ethiopia's Tigray region by Oxfam America with funding from the Rockefeller Foundation and Swiss Re.

R4 allows poor, food insecure households who already benefit from food-for-asset or public works schemes such as Ethiopia's Productive Safety Nets Programme (PSNP) to pay for weather-index insurance with their labour. Through "insurance-for-work" (IFW) poor farmers work on small-scale, community-identified public projects in return for insurance cover. Farmers with more cash can also purchase this insurance outright.

The insurance reduces uncertainty from climate variability and allows the poorest and most vulnerable farmers to make investments that increase their productivity. In case of a drought, farmers receive automatic insurance pay-outs if rainfall drops below a predetermined threshold. With the insurance pay-out, the farmers do not have to sell off livestock, tools or other productive assets to survive and will be able to afford the seeds and inputs necessary to plant in the following season.

Accurate climate and weather information is crucial in R4 for two reasons. First, historical climate information is needed to set up the index-insurance system work, determining the drought risk and setting up the insurance premiums for the farmer, which will be paid through IFW. Second, once the index is set, timely weather information from both satellites and weather stations is required to calculate whether and where the pay-outs will be triggered.

R4 is now targeting nearly 20,000 households in the Tigray region of Ethiopia. The initiative reached a major milestone in 2012 when more than 12,000 drought-affected households received an insurance pay-out of over US$ 320,000. This is the first time that a weather index insurance programme in Ethiopia has delivered pay-outs at such a large scale directly to small farmers. In addition, farmers received the funds when they needed them the most, thanks to an early warning system based on advanced satellite technology that calculates when the crops begin to suffer and triggers the pay-outs.

In 2012, R4 began expanding to Senegal where it expects to reach 18,000 farmers by 2015. In 2013, R4 is further scaling up in Ethiopia and is expected to be piloted to two additional countries by 2015.

http://www.wfp.org/news/news-release/scaling-innovative-climate-change-adaptation-and-insurance-solutions-senegal

Box 12 – GEO Global Agricultural Monitoring (GEOGLAM)

GEOGLAM, the GEO Global Agricultural Monitoring initiative was initially launched by the Group of Twenty (G20) Agriculture Ministers in June 2011, in Paris. The initiative forms part of the G20 Action Plan on Food Price Volatility, which also includes the Agricultural Market Information System (AMIS, http://www.amis-outlook.org), another inter-institutional initiative hosted by the UN Food and Agriculture Organization (FAO). The G20 Ministerial Declaration states that GEOGLAM "will strengthen global agricultural monitoring by improving the use of remote sensing tools for crop production projections and weather forecasting". By providing coordinated Earth observations from satellites and integrating them with ground-based and other in-situ measurements, the initiative will contribute to generating reliable, accurate, timely and sustained crop monitoring information and yield forecasts.

The Geo-Global Agricultural Monitoring Initiative (GEOGLAM), builds on GEO's Agricultural Community of Practice (AG COP) agenda and implementation actions in GEO's Agriculture's Societal Benefit Area. Established in 2007, this global network now has over 300 members. The first coordinated effort of the AG CoP was JECAM, the Joint experiment of Crop Assessment and Monitoring (www.jecam.org). The overarching goal of JECAM is to reach a convergence of approaches, develop monitoring and reporting protocols and best practices for a variety of global agricultural systems. The JECAM experiments will facilitate international standards for data products and reporting, eventually supporting the development of a global system of systems for agricultural crop assessment and monitoring. As such, JECAM is now fully integrated into GEOGLAM as its R&D component.

The main objective of GEOGLAM is to reinforce the international community's capacity to produce and disseminate relevant, timely and accurate forecasts of agricultural production at national, regional and global scales by using Earth Observation data. This will be achieved by: enhancing national agricultural reporting systems, including through a geo-spatial education curriculum to enable training of participants worldwide establishing a sustained international network of agricultural monitoring and research organizations and practitioners; and harmonizing the operational global agricultural monitoring systems based on both satellite and in situ observations, including through improved coordination of satellite observations.

Beginning in August 2013, GEOGLAM started delivering monthly global crop outlooks to the Agriculture Market Information Systems (AMIS) Market Monitor publication, hosted by the Food and Agriculture Organization of the United Nations (FAO). http://www.amis-outlook.org/amis-monitoring

The crop outlooks are based on the GEOGLAM Crop Monitor, a global initiative developed in response to the G20 Agricultural Ministers' concerns about reducing market volatility for the world's major crops. GEOGLAM draws on regional expertise, ground observations and analysis of meteorological and satellite data, the latter provided by the Committee on Earth Observation Satellites (CEOS) to assess the growing conditions of four major crops – maize, rice, soybeans and wheat. These crops account for 70 per cent of the calories consumed by humans worldwide.

The Global Crop Monitor (http://www.geoglam-crop-monitor.org/crop-monitorassessments) is coordinated by the University of Maryland with contributions from the GEOGLAM Community of Practice, including Argentina (INTA), ASEAN (ASIA RiCE and AFSIS), Australia (ABARES/DAFF, CSIRO), Brazil (CONAB), Canada (AAFC), China (RADI-CAS CropWatch), European Commission (JRC-MARS), India (ISRO), Japan (JAXA, RESTEC), Mexico (SiAP), Russia (IKI-RAS), South Africa (ARC), Thailand (GISTDA), Ukraine (Hydromet Center, Space Research Institute), United States (NASA, USDA), CEOS, FAO and WMO.

Box 13: Agricultural drought monitoring based on remote sensing data

Drought is one of the main causes of food insecurity on the world. In 2011, the Horn of Africa faced the worst drought in 60 years. An estimated 12.4 million people suffered from a massive food shortage. To mitigate the impact of agricultural drought, it is of high importance to dispose of timely and reliable information of the condition of food crops in all regions and countries in the world. The Global Information and Early Warning System (GIEWS) and Climate, Energy and Tenure Division (NRC) of FAO aim to develop an "Agricultural Stress Index System" (ASIS) for detecting agricultural areas with a high likelihood of water stress (drought) on a global scale. This system is being implemented on behalf of FAO by the Flemish Institute for Technological Research (VITO-TAP) with the technical support of the Monitoring Agricultural Resources (MARS) unit of the Joint Research Centre of the European Commission (JRC). The ASIS is based on the Vegetation Health Index (VHI), derived from NDVI and developed by Kogan from the Center for Satellite Applications and Research (STAR) of the National Environmental Satellite, Data and Information Service (NESDIS). This index was successfully applied in many different environmental conditions around the globe, including Asia, Africa, Europe, North America and South America. VHI can detect drought conditions at any time of the year. For agriculture, however, we are only interested in the period most sensitive for crop growth (temporal integration), so the analysis is performed only between the start (SOS) and end (EOS) of the crop season. The main challenge consists in the extrapolation of the system to the global scale and in the near real-time application on the dekadal 1 km resolution data of METOP-AVHRR. ASIS assess the severity (intensity, duration and spatial extent) of the agricultural drought and express the final results at administrative level (GAUL 2) given the possibility to compare it with the agricultural statistics of the country.

The standalone version of ASIS is designed to be deployed at the national level in different institutions (Ministries of Agriculture, National Meteorological Services, Ministries of Environment, etc.) that can strengthen National Early Warning Systems for food security.

The ASIS development is funded by the European Union (EU) programme: "Improved Global Governance for Hunger Reduction".

www.fao.org/climatechange/ASIS

Box 14: MOSAICC: An inter-disciplinary system of models to evaluate the impact of climate change on agriculture

The Food and Agriculture Organization of the United Nations (FAO) in partnership with European research institutes, has developed an integrated suite of models for assessing the impact of climate change on agriculture at a national level. The Modelling System for Agricultural Impacts of Climate Change (acronym: MOSAICC) is based on a generic methodology defined to assess the impact of climate change on agriculture, covering climate data downscaling, crop yield projections, water resource estimations and an economic model. The economic model is a Computable General Equilibrium model (CGE) aimed to assess the impacts of changing in yields on the economy at national level. All models are connected through common spatial database architecture and interconnected in terms of input and output. All models and databases are platform independent and can be hosted on a central server. Multiple users can access the MOSAICC toolbox simultaneously through a common web interface, making data exchange easier, transparent and more efficient for the users.

MOSAICC is unique and innovative as it combines a web-based interactive and integrated modelling environment together with tools and materials for capacity building and technology transfer to (government) institutions and scientists. The specific design allows for inter-disciplinary working groups to stimulate cooperation and foster knowledge exchange. Currently, the MOSAICC toolbox is under validation in Morocco and will be implemented afterwards in other countries. The model development is funded by the European Union (EU) programme: "Improved Global Governance for Hunger Reduction".

http://www.fao.org/climatechange/mosaicc/en/

Box 15: Feasibility of using the FAO-Agricultural Stress Index System (ASIS) as a Remote Sensing based Index for Crop Insurance

Weather index-based insurance can help secure the income of smallholders who are particularly vulnerable to climate variability. It can improve rural livelihoods and reduce food insecurity. A commonly used weather-based index is rainfall data from local weather stations; however, other measures can also serve as weather-based indexes. For example, the Normalized Difference Vegetation Index (NDVI), which is derived from data collected by satellites, gives an indication of vegetation health and thus potential crop yields, and has been used to provide index-based drought insurance. Weather stations have traditionally been the primary data source for weather index insurance programmes. However, in many developing countries the number of weather stations is often very limited and their distribution in relation to the agricultural areas poor. Furthermore, spatial interpolation techniques that can be used in some situations to solve the problem of low density of stations prove to systematically underestimate the extreme values; precisely those extreme events that the insurance programme intends to cover. Due to this fact, a potential alternative could be the use of rainfall estimates from satellite data or climate simulation models. However, rainfall estimates when compared with ground measurements (rain gauges) generally over or under estimate rainfall amounts quite significantly depending of the geographical position and topography of the area under analysis. Up to the present, these difficulties in estimating rainfall have prevented the development of weather index based insurance.

One feasible alternative for developing countries could be the use of vegetation indices even if those indices still have some technical limitations that can affect the accuracy of the data captured by satellite (amount of humidity in atmosphere/soil, position of satellite relative to Earth surface and the time series is composed of data from several different sensors). The use of NDVI has so far been applied mainly in pastoralist areas. Nevertheless, it offers a high potential for use also in cropping areas if analysis is restricted to the growing period and the areas where crops are believed to be grown. Improvement of land use maps to better define agricultural cropping areas could contribute to produce much better results with this technique.

The proposed remote sensing index bases on ASIS has the potential to be used for a crop insurance scheme in developing countries, but the ASIS would need to be carefully calibrated at country level locally and tested before becoming operational. Capacity building among local stakeholders would also be necessary. The proposed remote sensing index will work better in countries with semi-arid conditions where water stress is the main limiting factor of agriculture production.

With respect to weather station-based indices, a remote sensing-based index presents the advantage of exhaustive ground coverage. On the other hand, rainfall estimates derived from remote sensing or general climate circulation models present the disadvantage of over/underestimating rainfall; in this case, we prefer to consider the NDVI as a proxy for assessing the crop condition (which itself depends on the water available to the crop). However, there are some well-known limitations to remote sensing as the NDVI is affected by soil humidity and surface anisotropy. Composite products used in most applications tend to limit these effects that cannot be ignored completely.

http://www.agriskmanagementforum.org/content/feasibility-using-fao-agricultural-stress-index-system-asis-remote-sensing-based-index-crop-

Box 16: Crop yield forecasting tool to supporting national early warning for food security

The incidence of drought-induced famine in many countries continues to be a global concern. Even in a good year farmers in some pockets of a country may incur devastating crop losses. In times of civil strife or extensive floods, for example, some groups may experience a sharp reduction in their access to food supplies for reasons of physical exclusion from markets.

Many warning systems target both individual and institutional users, although the main target of warnings for food security is usually governments. In many developing countries, farmers mainly practice subsistence farming, i.e. they grow their own food, and depend directly on their own food production for their livelihood. Surpluses are usually small; they are mostly commercialized in urban areas (the urban population constitutes about 30% of the total population in Africa). Yields tend to be low: in Sahelian countries, for instance, the yields of the main staples (millet and sorghum) are usually in the range of 600 to 700 Kg/Ha during good years. Inter-annual fluctuations are such that the national food supply can be halved in bad years or drop to zero production in some areas. This is the general context in which food surveillance and monitoring systems were first established in 1978. Currently, about one hundred countries on all continents operate food security warning systems; their name varies, but they are generally known as (Food) Early Warning Systems (EWS). They contribute to:

- Informing national decision-makers in advance of the magnitude of any impending food production deficit or surplus;
- Improving the planning of food trade, marketing and distribution;
- Establishing coordination mechanisms between relevant government agencies;
- Reducing the risks and suffering associated with the poverty spiral.

EWS cover all aspects from food production to marketing, storage, national imports and exports down to consumption at the household level. Monitoring weather and estimating production have been essential components of the system from the onset, with a direct and active involvement of National Meteorological Services.

Over the years, the methodology has kept evolving, but crop monitoring and forecasting remain central activities:

- Operational forecasts are now mostly based on readily available;
- Agrometeorological or satellite data, sometimes a combination of both. They do not depend on expensive and labour intensive ground surveys and are easily revisable as new data become available;
- Forecasts can be issued early and at regular intervals from the time of planting until harvest. As such, they constitute a more meaningful monitoring tool than the monitoring of environmental variables (e.g. rainfall monitoring);
- Forecasts can often achieve a high spatial resolution, thus leading to an accurate estimation of areas and number of people affected.

http://www.fao.org/nr/climpag/

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