Climate Related Risks and Extreme Events

FAO Contribution to

"The Nairobi Work Programme (NWP) on impacts, vulnerability and adaptation to climate change"

On invitation of SBSTA to submit to the secretariat, by 23 February 2007, information on the relevant programmes, activities and views on the issues listed under item 34 of the Conclusions of the Nairobi work programme on impacts, vulnerability and adaptation to climate change

Context and mandate of FAO to work on Climate related Risks and Extreme events

The Strategic Framework for FAO 2000-2015 provides an overall framework for FAO programmes related to climate risks and extreme events. Under strategy A3, namely "Preparedness for, and effective and sustainable response to food and agriculture emergencies". The challenge is to increase the resilience and capacity of countries and their populations to cope with the impacts of disasters that affect national and household food security and, when disasters do occur, to contribute to emergency operations that foster the transition from relief to recovery of the food and agricultural sectors. The components include:

- Strengthening disaster preparedness and the ability to mitigate the impact of emergencies that affect food security and the productive capacities of the rural population;
- Forecasting and providing early warning of adverse conditions in the food and agricultural sectors and of impending food emergencies, including monitoring plant and animal pests and diseases;
- Assessing needs and formulating and implementing programmes for agricultural relief and rehabilitation, and formulating policies and investment frameworks favouring the transition from emergency relief to reconstruction and development in food and agriculture; and
- Strengthening local capacities and coping mechanisms through guiding the choice of agricultural practices, technologies and support services, to reduce vulnerability and enhance resilience.

The Committee on Agriculture (COAG) in 2001 stressed the need for the Organization to continue to be a neutral forum on this issue. It underlined that the role of the Organization is to provide technical inputs, focusing on such issues as data, definitions and methodologies related to agriculture and climate change. Caution should be exercised when dealing with subjects such as carbon sinks, where differing positions were expressed by the Members.

COAG supported the proposal to develop an integrated climate change programme based on current activities, within Regular Budget provisions, and consistent with the legal and political framework of the UN Framework Convention on Climate Change (UNFCCC) and the technical work of the IPCC. This includes the promotion of practices for climate change mitigation, the adaptation of agricultural systems to climate change, the reduction of emissions from the agricultural sector as far as it is carefully considered within the major objective of ensuring food security, the development of practices aimed at increasing the resilience of agricultural production systems to the vagaries of weather and climate change, national and regional observing systems, as well as data and information collection and dissemination.

The Committee called on FAO to assist Members, in particular developing countries, which are vulnerable to climate change, to enhance their capacities to confront the negative impacts of climate variability and change on agriculture. An Interdepartmental Working Group on Climate Change was established and mandated to coordinate FAO's cross departmental, multi-disciplinary work on climate change crosscutting all technical departments.

The issues of climate change mitigation and adaptation were specifically addressed and prioritized as a key area of FAO's future work by FAO's governing bodies at sessions of the Committee on Agriculture (COAG), the Committee on Food Security (CFS), and the Committee on Forestry (COFO). In the context of FAO's internal reform 2006/07, a new division "Environment, climate change and bioenergy" was created reflecting the importance given to the subject in FAO's new structure.

According to the outline provided by UNFCCC we report on FAO programmes and activities relating to the 5 sub- heading provided by SBSTA under the main topic "Climate change risks and extreme events":

a) Experience with assessment and management of current and future climate-related risks and impacts, including those related to extreme events and in specific sectors

The knowledge and technology required for adaptation includes understanding the patterns of variability of current and projected climate,

seasonal forecasts, hazard impact mitigation methods, land use planning, risk management, and resource management.

Adaptation practices require extensive high quality data and information on climate, and on agricultural, environmental and social systems affected by climate, with a view to carrying out realistic vulnerability assessments and looking towards the near future. Vulnerability assessment observes impacts of variability and changes in mean climate (inter-annual and intra-seasonal variability) on agricultural systems. However, agricultural production systems have their own dynamics and adaptation has a particular emphasis on future agriculture.

Early warning and risk management systems are obvious and efficient contributors that can facilitate adaptation to climate variability and change, including:

- A historical climate data archive; an archive on climate impacts on agriculture;
- Monitoring tools using systematic meteorological observations;
- climate data analysis (to determine the patterns of inter-annual and intra-seasonal variability and extremes);
- Information on the characteristics of system vulnerability and adaptation effectiveness such as resilience, critical thresholds and coping mechanisms (this information is required to identify opportunities for adaptation measures, and the potential of particular practices);
- Crop weather insurance indices to reduce the risk of climate impacts for lower-income farmers.

FAO has build-up a strong knowledge in crop forecasting and monitoring technology based on field data, satellite based indices and software. Since 1974, FAO Agrometeorology has developed and improved its crop forecasting methodology to supply updated information on crop conditions mainly in sub-Saharan countries through the Global Information and Early Warning System on Food and Agriculture and to various national Food Security Information and Early Warning Systems worldwide. Building from such national systems, which are known and used by countries is a more effective starting point than trying to launch new, possibly improved but largely untested, analytical tools.

FAO has been a leader in the use of new data types (in particular rainfall, crop phenology and remotely sensed data) and specific tools (methods and software) such as crop specific water balance, data interpolation in time and space and analysis tools either at continental / regional level or national, district and local levels. FAO agrometeorological tools are designed with scale independence in mind to monitor patterns of climate variability at global, continental, regional, national, sub national and farm level. They have been tested and used extensively by countries and are appropriate for vulnerability risk assessment and to define best practices for climate change adaptation.

Adaptation activities need also to focus on securing agricultural productivity in a sustainable manner. The improved use of Early Warning and Information Systems (EWIS) and Disaster Information Management Systems (DIMS), the short- and long-term impact of (extreme) events on agriculture livelihoods can be assessed while contributing to disaster preparedness and mitigation of potential risks.

Accurate information and forecast systems as well as impact analysis in the aftermath of a disaster is a critical building block for well targeted and demand driven emergency responses as well as for longer term adaptation programs. FAO is investing in a number of initiatives to improve pre and post hazard needs assessments and the design of rehabilitation programmes to translate the principle of *building back better* into improved agricultural practices. In the case of response to disasters related climate hazards this includes piloting and replication of tested adaptive agricultural practices, identification of livelihood diversification strategies and institutional capacity building.

Information systems, early warning and food insecurity forecast systems

FAO has gathered a comprehensive assortment of data and information for the Agricultural, Forestry and Fisheries sectors. Examples are the Global Information Early Warning System on Food and Agriculture (GIEWS), information and data under the Global Terrestrial Observation System (GTOS) and the Terrestrial Carbon Observation Initiative (TCOI), the Agro-ecological Zoning (AEZ), the Global Forest Resources Assessment (FRA) which is now repeated every five years, the Forest Products Yearbook, ECOLEX, the databank on national laws and regulations on food, agriculture and renewable natural resources, FAOSTAT, FAOCLIM, AGDAT and other databanks, CLIM-FO and AGROMET-L listservers on different aspects of climate change, and the website, only to name some. (*A more detailed report on these information systems will be provided to SBSTA in September 2007, related to the NWP topic "Data and observation").*

Impact assessment tools for agriculture

FAO has been assessing and modeling of climate related risks and impacts on crop yields for several decades. FAO has been developing several tools to assess the influence of weather and weather variability on crop yields. The tools were originally designed to carry out agrometeorological crop-yield forecasts: they proved to be capable of describing the link between weather and crop yields for many different climate regimes in many countries world wide on the basis of observed meteorological data and the FAO crop-specific soil water balance model.

Droughts are the most common agronomic weather-related extremes. The impact of a meteorological drought on agriculture depends on a combination of factors, specifically crop type, weather, soil and farm management. FAO has the experience to deal with this combination of factors under real-world conditions. A range of information gathering tools are being developed by FAO to enhance its role in crisis response. Information collected within this process may be highly relevant for improved understanding of impact of extreme climate related events on the agriculture based livelihoods and agriculture production.

Rapid Agricultural Disaster Assessment Routine (RADAR)

Agricultural disaster impact analyses are based mainly on empirical in situ analysis, and largely dependent on access to the area affected and expert professional experience. Evaluation of disaster impact follows no defined methodology in most cases. This due to several factors, among others the fact that disaster impacts are difficult to model, and because emergency situations prevent sufficiently detailed and georeferenced information to be collected, that would allow the calibration of impact models. Somehow, the urgency of relief operations prevents necessary normative tools to be developed.

RADAR proposes to move from empirical assessments towards model approaches. Once an event strikes a region, the user of the procedure should rapidly collect all available georeferenced and quantitative data on the event and the region. Then, using a Disaster Information Management System (DIMS), the short- and long-term agricultural impact of the event can be assessed with the help of a conceptual model for structuring the impact assessment.

The procedure combines model analysis, based on physical simulation of the disaster, and empirical analysis, using the people's record of the environmental disruption after the event. Both analyses may be used alone or concurrently; they can be updated in real time to improve the assessment. The output of the analyses is the **map of the intensity of the event**, which is then used to compute the impact (the loss) to agriculture produced by the disaster.

Integrated Rapid Livelihood Assessment Guidelines (IRLAG)

This is a collaborative effort between FAO and the ILO to provide timely and accurate information about how the ability of people to make a living after a disaster has been affected by sudden onset natural disasters (climate related or geological hazards).

Integrated Food Security and Humanitarian Phase Classification Scheme (IPC)

The IPC tool is a standardised scale that integrates food security, nutrition and livelihood information into a clear statement about the severity of a crisis and implications for response. Based on clear indicators, situations are classified into

one of five main phases: (1) Generally Food Secure (2) Chronically food insecure (3) Acute food and livelihood crisis (4) Humanitarian Emergency and (5) Famine / humanitarian catastrophe. The IPC is being applied in countries affected by extreme drought events in the Horn of Africa.

Sector specific emergency needs assessment tools

FAO provides a set of specific assessment tools, including seed systems, fisheries, livestock, pesticides management etc which improve the understanding of how disasters affect specific elements of the agriculture production systems.

b) Ability, gaps, needs, opportunities, barriers and constraints to predicting climate variability, impacts and extreme events across regions and hazards

Long time series of crop yields under climate change conditions are needed to assess the effect of agricultural production variability and extreme events on food security. If only short observed records of meteorological variables are available, a stochastic weather generator must be resorted to create artificial time series of weather variables with the same statistical/climatic features as the observed records, and subsequently derive corresponding crop yields. This allows performing a crop-yield risk assessment based on the empirical experience acquired under current climate conditions. A stochastic weather generator (SWG) is currently under development at FAO. It is an improvement of an already existing weather generator which proved to be adequate for the purposes under discussion.

SWG provides long time series of a complete set of weather data required to run the crop-specific soil water balance model of FAO. This allows for the transformation of local weather statistics into local crop-specific yield statistics. It therefore extends the classical FAO approach to transform some observed weather realizations to crop yield. The output of the SWG will be used in statistical crop forecasting. In order to investigate potential effects of natural and anthropogenic climate change in the frame of climate change adaptation applications the software will allow the user to change the estimated statistical features of all weather variables.

The combination of tools available/currently under development at FAO allows carrying out significant work on local crop-specific climate change impacts as well as coping strategies of vulnerable groups and the role of local institutional mechanisms and structures in climate-induced hazards throughout the disaster management cycle (including preparedness, response, rehabilitation and development).

As regards crop aspects, next to crop-specific sensitivity studies, changes in average crop yields and risk analyses can be performed on the basis of local climate change scenarios. The latter can be taken from outputs of combined global atmospheric-oceanic circulation models (GCMs).

The overall methodology: (i) derives and validates weather-yield functions based on current local conditions and farmers' management practices; (ii) generates "future weather" based on current weather, climate change scenarios; and (iii) uses "future" weather with the yield functions to asses the variability of future food production outputs and their impact on food security. The major advantages of this strategy are listed below:

- It is based on existing, well-known and well tested FAO tools and methods that are actually used operationally for weather impact assessments on food security;
- Actual local observations of crop management and crop yields as well as local weather are used in order to establish the weather-yield relations;
- It does not deal with pure weather-based indices (like standardized precipitation index, SPI) but with crop-soil specific water balance indices (like the water requirements satisfaction index, WSI) and crop yields;
- It has a proven record of good performance in the major agroclimatic zones;
- It can be used to compare the sensitivity of different crops to climate change;
- It can be used to interpret different scenarios of climate change in terms of impacts on food security due to changes in crop-yield statistics, risk of bad harvests and crop losses.

c) Contribution of traditional knowledge to understanding and managing climate-related risks

Vulnerable groups often living in areas highly exposed to the impacts of extreme climatic events have often developed complex indigenous coping strategies. However a rapid change of the vulnerability context does not always allow for traditional coping mechanisms to take place and results often in an overall loss or severe ineffectiveness in the adaptive capacity of the communities. Ongoing monitoring, documentation and dissemination of good agricultural practices, indigenous and newly developed ones, is an essential part of FAO's work.

<u>Examples</u>

- The FAO crop-specific soil-water balance model is flexible and suited to describe local agricultural conditions. Important information on traditional adaptation strategies of farmers can be described in terms of planting dates and their variability, irrigation practices, treatment of false starts of growing seasons, choice of varieties with different lengths of growing cycle. The FAO

model is usually tuned to the local conditions by national staff participating in crop forecasting projects. This optimizes the use of information on local peculiarities and traditional knowledge. The FAO model allows for experiments not only under different climatic conditions but also under different crop management practices.

- Within the context of a Comparative Study on the Role of Local Institutions in Reducing Vulnerability to Recurrent Natural Disasters FAO has been collecting concrete examples of local knowledge and experiences of local action before, during and after extreme climate events in nine different countries (Argentina, Burkina Faso. Honduras, Iran, Mozambique, Niger, Philippines, South Africa, Vietnam). Key findings of the study are being shared and applied in the design of community based disaster risk management inititives for the agricultural sector. In the Caribbean FAO is facilitating through a regional project the identification, sharing and adaptation of good agricultural practices for improved climate risk preparedness in agriculture, fishery and forestry.

- FAO has also undertaken inititives to improve the undersatnding and support the adaptation of traditional pastoral systems in arid and semi-arid regions. Traditional pastoral systems used to cope effectively and in an environmentally sustainable manner with the prevailing harsh and erratic ecological conditions of those regions. However a numbers of factors, including changing climatic patterns, are constraining traditional coping strategies resulting in an increased need for changes in pastoral production systems. Among others this issue is being tackled by the Livestock, Environment and Development Initiative, which promotes research on livestock environment interactions, and creates awareness on the complex interactions of human needs, animal production and the sustainability of global natural resources.

- FAO has also gained knowledge on positive and negative traditional coping strategies, in particular through work on:
    - Regional plan of action for drought mitigation in the Horn of Africa;
    - Response to drought in the Sahel (regional consultation);
    - E-conference on pastoral mobility;
    - Pastoral risk management planning in several countries, e.g. Mongolia, China, Niger, Somalia Syria, Jordan etc.

d) Implications for sustainable development in relation to (a) to (c) above

Global data show that disasters related to climate hazards are increasing in frequency and intensity. Recurrent natural disasters such as droughts, floods, and tropical storms have devastating impacts on the agriculture, livestock and fisheries, threatening the livelihoods of hundred thousands of rural people. FAO has the technical and operational capacity to actively contribute to streamlining

disaster risk reduction into national agriculture and food development policies and a key role to play in reducing the vulnerability of agricultural-based livelihoods to extreme climatic events.

Examples of ongoing FAO programmes aiming gat the interface between Climate risk management, Disaster risk reduction and sustainable development

- FAO has developed a cross-departmentral program to enhance natural hazard risk management capacities and approches in agriculture, fisheries and forestry sectors. The program builds on the premises that the sound understanding of existing institutional capacities is crucial for shifting from reactive emergency relief operations towards long-term disaster risk prevention and preparedness strategies. The key entry points of the proposed programs are the two closely interrelated questions of what are the best operational and technical practices to strengthen existing DRM and linkages with the agricultural sectors and who (actor) within national and local contexts has comparative strengths and would be best placed to act on and coordinate between specific aspects of DRM relevant for the agricultural sectors. The program focuses on climate related hazards (such as floods, tropical cyclones and storm surges, droughts) and their impacts on agricultural-based livelihoods. Country level activities implemented within the framework of this umbrella programme include:
    - Local Capacity Building for Disaster Risk Management in Agriculture for Department of Agriculture and Extension in Bangladesh;
    - Strengthening Disaster Preparedness in the Agricultural Sector In Juye County, Shandong province of China;
    - Flood management and related micro regional planning related land use and environmental planning in North East Hungary;
    - Assistance to restore winter wheat crop production and strengthen capacities to cope with the effects of adverse climatic events in Moldova;
    - Projects on pastoral risk management in Mongolia and China;
    - Regional Project on Exchange of good practices on climate risk management in Agriculture and Forestry the Caribbean;
    - Project about to start in Pakistan to implement a post earthquake livelihoods-based rehabilitation strategy;

- In Bangladesh FAO is piloting adaptive measures to climate variability and change including agricultural practices, livelihood diversification strategies and institutional capacity building to enhance the adaptive capacity of rural livelihoods systems and to integrate these actions into rural development planning. Within this context an operational approach to work with farmers on climate change has been designed tested; a set of tools have been developed jointly with the Asian Disaster Preparedness Centre (ADPC) including:

- Training Modules for climate & Food applications in agriculture. Enhancing early warning systems for disaster preparedness and mitigation in the agriculture sector;
- Vulnerable groups profiling and livelihood adaptation options development to increase community resilience against climate hazards in drought prone areas;
- A Plan of Action to strengthen the role and capacities of the Department of Agricultural Extension as partner in Climate Change Adaptation and Natural Hazard Risk Reduction;

- The FAO crop-specific soil water model is a versatile tool that has been implemented for actual crop forecasting under many different climatic conditions. Together with a stochastic weather generator it can be used to perform multiple runs under different climate and agricultural conditions. It therefore is an adequate empirical tool to assess the vulnerability of food security to climate change on the basis of different scenarios, and to derive adequate strategies from an economic and socioeconomic point of view.

e) Promoting understanding of impacts of, and vulnerability to, climate change

The current local climate is the statistics of the current local weather. Local climate change means a change in the statistical features (averages, variances, shapes of distributions, co-variances, etc.) of the local weather. Therefore climate change can be transformed into weather change if the changed climate features are fed to a stochastic weather generator. The weather generator of FAO is specially designed to allow for changes in the statistical features of the variables and thus allows to model weather under different climate-change scenarios. Together with the FAO crop-specific soil water model it constitutes the bridge between climate change and crop-yield change.

Conclusion

Many FAO activities are directly or indirectly in line with the objective of "Promoting understanding of impacts of, and vulnerability to climate change, current and future climate variability and extreme events, and the implications for sustainable development".

FAO's work on climate change mitigation has been complemented during 2006 by significant activities related to climate change adaptation in with agriculture, forestry and fisheries, combined with institutional strengthening as core aspects of the latter. FAO has a long standing experience in natural hazard risk management and in all phases of the emergency cycle.