# Expert Meeting
on
# Climate Change, Water and Food Security
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# Options for Decision Makers

## Introduction

Climate change is expected to alter hydrological regimes and patterns of freshwater resource availability, with impacts on rainfed and irrigated agriculture, livestock, inland fisheries and aquaculture.

By 2060, projections indicate a general reduction of precipitation in semi-arid areas, higher variability in rainfall distribution, increase in the frequency of extreme events (droughts and foods) and increase in temperature affecting, in particular, agriculture in low latitudes. A significant reduction in river basin runoff and aquifer recharge can be expected to occur in the entire Mediterranean basin and the semi-arid areas of Southern Africa, Australia and part of the American continent. On the other hand, northern temperate latitudes, in which rainfed agriculture is dominant, can expect positive moisture and temperature impacts to boost overall production. Parts of Southeast Asia can anticipate increases in run-off which may allow increased water use, but also exacerbate drainage and water-logging problems.

Globally, agricultural production will have to cope with more variability in water inputs and more competition for bulk water[1]. While climate change does not seem to threaten the overall global food balance during the medium term, food insecure areas dominated by rainfed agriculture (sub-Saharan Africa and peninsular India in particular) may suffer multiple, short-term adverse impacts, especially in densely populated farming systems. These impacts will include reduced production levels, lower agricultural incomes, loss of livelihoods and displacement. It is also anticipated that a combination of reduced river base-flows, flooding and sea-level rise will hit highly productive irrigated systems which currently help maintain the stability of global cereal production. The production risks will be amplified in alluvial plains dependant upon glacier melt (e.g. Punjab) and in lowland deltas in particular (e.g. Indus, Nile, and Ganges).

*Alleviating resource pressure*. Pressure exerted on the natural resource base underlying food production is already stretched and many of the large contiguous irrigated areas are operating at their socio-managerial limits. Any further change will exacerbate already existing water scarcity problems. At regional and national level, this will call for efforts to increase water productivity and strengthen resilience in all water dependant food production systems. A careful review of soils, surface and groundwater storages and an anticipation of future needs will be key in building resilience and reconciling competing demands while also maintaining environmental services.

[1] Other drivers adversely affecting water availability for food production include: rapidly increasing non-agricultural water demand for domestic, industrial and, increasingly, environmental uses; declining water quality levels; and growing water demand for non-food agricultural production.

*Maintaining production capacity.* Reduced food production capacity in rainfed systems will transmit demand into already tight global commodity markets, destabilizing and driving prices higher, and putting further pressure on irrigated production. Adaptation strategies focusing on improved water infiltration, soil moisture retention and management, water harvesting, supplemental irrigation, and small- and dam-based irrigation development will be required to increase the resilience of these highly vulnerable production systems. Critical water-related actions include:

- promoting technical and management measures to reduce non-beneficial consumptive use in both irrigated and rainfed production systems;
- supporting extension services to promote diversification into crops with higher water productivity to adapt to changing markets, and
- updating land and water management development strategies to take account of anticipated climate change impacts.

*Mainstreaming adaptation.* The existing knowledge base is sufficiently precise to warrant mainstreaming. Notwithstanding gaps in data and research, progressive "no regrets" adaptation across land and water systems can provide both a positive response to climate change but also make good environmental and economic sense in its own right. This requires specific national capacity in climate change assessment. In addition, system-based analyses and plans that operate within an integrated water resource management framework need to link with analyses of crops – particularly staples such as wheat and rice – and of ecological regions. At all levels, adaptation and mitigation programmes need to start with an awareness-raising initiative for policy-makers, researchers and opinion leaders focusing on production systems most threatened by climate change impacts. Linking regional centers for water, climate change and food to existing national and international centers of excellence is recommended to support national capacity in copying with climate change. Additional and new financing mechanisms for adaptive water management initiatives will be needed. Farmers access to microcredit has proven to be a positive adaptive strategy. Capacity building must be an integral part of these programs.

**Priorities at national, regional and international levels**

Given the fundamental value of water to all economic sectors, agriculture cannot act alone. Water management actions will need to be focused at national level but supported by regional and international initiatives. Specific options are listed below.

*National level*

Planning approaches:

- Provide support at the national level for collection of data and information for assessing renewable water resources and determining the potential change and impact that could result from climate variability.
- Mainstream adaptation and mitigation measures for agricultural water management into national development plans, employing an integrated water resource management framework.
- Adopt strategic inter-sectoral development planning aimed at increasing resilience, adapting to climate change impacts and maintaining environmental services and biodiversity.
- Update land and water management development strategies and economic plans to account for anticipated impacts of climate change, particularly increased variability and long-term drying or wetting trends.

Institutional development:

- Set the conditions for more flexible and responsive service-oriented water management.
- Develop tools for water-related conflict resolution and prevention at local and district levels.
- Develop and implement economic and financial trade instruments to remove distortion in water allocation.

Management options:

- Revise operating procedures for water storage systems to accommodate climate change impacts on water supply and demand.
- Promote watershed management and soil moisture conservation practices to increase infiltration and soil water storage.
- Increase surface and groundwater storage options at a range of scales including distributed tank rehabilitation and possible new large-scale impoundments.
- Increase water productivity through measures such as intermittent rice irrigation.
- Promote risk management in national policies through better monitoring networks, risk assessment, early warning, risk sharing and participatory response mechanisms.
- Develop alternative sources of water supply, such as treated wastewater streams for peri-urban agriculture and desalination plants for coastal urban supply.

Economic and financial instruments:

- Document and quantify current patterns of water use and water entitlements.
- Develop transparent water allocation mechanisms to protect water use rights while providing greater flexibility to respond to scarcity under anticipated patterns of climate change.
- Develop innovative insurances products.

*Regional level*

- Develop and strengthen transboundary cooperation and institutional mechanisms to anticipate and respond to climate change impacts on transboundary water resources, including mechanisms to optimize water allocation and manage extreme hydrological events (floods and droughts).
- Standardize climate and hydrological data formats and promote exchange of national data to improve operational hydrological forecasting and regional climate prediction/forecasting.

*International level*

- Combine global data sets on water resource balances at basin level with production data to track climate change impacts.
- Focus international research agendas on systemic water productivity gains.
- Promote interlinkage between climate change, water and food security needs in global water meetings, such as the World Water Forum.
- Assess the vulnerability of globally-important food production systems and its potential impact on food security for the low-income food-deficit countries.

**Addressing knowledge gaps**

There are key gaps in data and research related to climate change and water. Many of these have been stipulated in the Fourth Assessment Report of the Inter-Governmental Panel on Climate Change and the forthcoming Technical Paper on Climate Change and Water. In view

of these reports, it is recommended that policy-makers be made aware of current shortcomings and gaps in data and applied research.

Quality-assured local and country data are essential to establish overall water supply and demand balances, track climate change impacts and inform responses. Improved national data collection and verification are widespread needs, requiring international support and coordination. Internationally recognized databases such as AQUASTAT and FAOSTAT are important vehicles for standardizing, organizing, and disseminating improved national and basin-level water data. Key areas requiring attention include:

- improved water supply and water use data that consider both quantity and quality;
- improved data on the frequency and magnitude of extreme events;
- improved estimates of exploitable groundwater reserves.

Information on water resource status needs to be accompanied by enhanced information on water use in all water-using sectors and on the value and productivity of water in the various agricultural sub-sectors. The latter would include rainfed and irrigated agriculture, fisheries, agro-forestry and livestock, and would assess competition, complementarities and relative contributions to food security.

Water management, agriculture and food security databases should be better integrated, with much closer monitoring of irrigated and rainfed production and clearer distinction between the sources of supply (rainfall, surface water, and groundwater). This effort should consider specific food staples, notably rice and wheat, as well as the productivity of water dependent aquatic environments.

Integrated assessments of the impact of climate change and variability on food security will be a priority for applied research. These analyses can serve to underpin development of enhanced adaptation methodologies and strategies and should include assessments of the potential impact on water resources of bioenergy production and of mitigation measures such as minimum-tillage and agro-forestry development. Important factors to consider in impact modelling include climate variability, shifts in seasonality, land use changes, yield responses to temperature rise and increased $CO_2$ concentrations, new crop varieties, and the impact of trade and macro-economic and sectoral policies.

Specific research requirements include:

- Determining potential water productivity increases in crop agriculture, taking into account local production environments, livelihood impacts, technological options and environmental impacts.
- Defining methods for improving linkages between remote-sensing information and ground-based data;
- Downscaling climate projections for use in hydrologic modelling and agricultural water management;
- Assessing the potential impact of bioenergy and other mitigation measures on water availability for food production;
- Determining social, economic, institutional and human resource limitations to adaptive capacity and strategies for easing these constraints.

**Addressing capacity needs**

Because proactive policy and action responses are typically taken at the national level, the capacity of national systems to generate knowledge, inform decision making, build awareness, transfer knowledge and implement effective action is critical to successful adaptation to climate change.

The following immediate steps are required:

- Promoting technical and management measures to reduce non-beneficial consumptive use in both irrigated and rainfed production systems and support extension services to promote diversification from high water-use crop systems into crops with higher water productivity.
- Building skills at the national level in economic planning, demand forecasting, model downscaling and hydrologic impact assessment to supplement current analytical capacities.
- Creating or strengthening regional centers on water, climate change and food, and link them to existing national and international centres of excellence to build local and regional capacity. The centres' key objectives would be producing scaleable solutions to food production under amplified hydrological variability and temperature changes and supporting updated land and water management development strategies to account for anticipated impacts of climate change. Their tasks would include data analysis, research, education, training, policy support and communication.

**Enabling financial mechanisms**

Implementing the technical options identified above would require opening the investment space for agricultural water management. Specific recommendations include:

- Mobilizing adaptation funds to support developing countries investments to build analytical and management capacity to meet the challenges of water and food security under climate change.
- Funding National Adaptation Programmes of Action (NAPAs) in Least Developed Countries to accelerate adaptation in agricultural water management.
- Encouraging national governments to allocate adequate financial resources for adaptation planning in the field of water management for agriculture.
- Enhancing opportunities for small farmers to develop Clean Development Mechanism (CDM) projects and access funds in post-2012 arrangements.
- Enable adaptation/mitigation financing mechanisms to best practices, such as alternate wet-dry rice production systems.
- Developing implementation mechanisms enabling payment for environmental services in watersheds.