Climate Smart Agriculture
The Nexus Approach

Acknowledging that food security is the point of departure for

Climate-Smart Agriculture

In today's world there is enough food produced for all to be well-fed, but one person in eight is suffering from chronic hunger. Population growth is, projected to exceed 9 billion people globally in 2050, and current patterns of consumption and production increase pressure on already scarce natural resources. Climate change represents an additional threat, already undermining agriculture and food systems in many regions, making it more difficult to achieve food security and nutrition goals and reduce poverty. Smallholder farmers, including livestock keepers, fishers and foresters, especially women and indigenous peoples, are the most vulnerable to climate change. To enable people to achieve food security and for food producers to improve their livelihoods, there is a need for sustainable increases in agricultural productivity; for reducing food losses and waste; for all food systems to be more resilient and able to adapt to climate change; and for enabling agriculture to contribute to the reduction and removal of greenhouse gas emissions, where possible. The successes and failures of crops have always been subject to prevailing environmental factors, and the mechanisms for managing the stresses created by these factors continue to be the subject of extensive studies in a variety of disciplines. Crop production is increasingly vulnerable to risks associated with new and evolving climatic changes. These are variations in environmental conditions that pose significant challenges to farmers, over and beyond those that are experienced 'normally.' The planet is facing more extreme weather events, such as heavy precipitation, higher coastal waters, geographic shifts in storm and drought patterns, and warmer temperatures.

To achieve food security and agricultural development goals, adaptation to climate change and lower emission intensities per output will be necessary. This transformation must be accomplished without depletion of the natural resource base. Climate change is already having an impact on agriculture and food security as a result of increased prevalence of extreme events and increased unpredictability of weather patterns. This can lead to reductions in production and lower incomes in vulnerable areas. These changes can also affect global food prices. Developing countries and smallholder farmers and pastoralists in particular are being especially hard hit by these changes. Many of these small-scale producers are already coping with a degraded natural resource base. They often lack knowledge about potential options for

adapting their production systems and have limited assets and risk-taking capacity to access and use technologies and financial services.

Climate change is a complex topic involving many inter-related sectors. Experts and practitioners in different sectors often lack access to vital information and knowledge-sharing platforms to exchange ideas, seek advice and focus research efforts as well as policies. Across the agricultural sectors, this limited access to information is compounded by highly technical themes that require constant learning. To overcome these communities of practice can serve as an efficient and easily accessible way for information sharing and learning.

The Water-Energy-Food Nexus, A new approach in support of food security and sustainable agriculture This approach also aims to strengthen livelihoods and food security, especially of smallholders, by improving the management and use of natural resources and adopting appropriate methods and technologies for the production, processing and marketing of agricultural goods. To maximize the benefits and minimize the trade-offs CSA takes into consideration the social, economic, and environmental context where it will be applied. Repercussions on energy and local resources are also assessed. A key component is the integrated landscape approach that follows the principles of ecosystem management and sustainable land and water use.

To achieve its multiple objectives, CSA promotes the application and scaling up of proven practices and approaches. It follows a holistic pathway that brings together a number of areas of expertise. An enabling environment and institutional partnerships are vital for achieving CSA.

This blended approach provides the evidence-base to help countries at the national or local level to design holistic CSA policies, strategies and practices.

In this context, the Water-Energy-Food Nexus has emerged as a useful concept to describe and address the complex and interrelated nature of our global resource systems, on which we depend to achieve different social, economic and environmental goals. In practical terms, it presents a conceptual approach to better understand and systematically analyse the interactions between the natural environment and human activities, and to work towards a more coordinated management and use of natural resources across sectors and scales. This can help us to identify and manage trade-offs and to build synergies through our responses, allowing for more integrated and cost-effective planning, decision-making, implementation, monitoring and evaluation.

Options for adaptation to climate change will necessarily combine investments, improved or adaptive management, and modifications in or development of policies, institutions and capacity development. Such options will need to be applied at different scales: on fields and farms; in irrigation schemes (particularly in large schemes); in watersheds or aquifers; in river

basins (including transboundary river basins); and at the national level. Although there are overlaps between climate change adaptation and development, activities with an explicit focus on adaptation and climate change will also be required. Many farm-level adaptations will be spontaneous and will be done in response to change but not necessarily designed for climate. Others adaptations will need to be planned, often with external support. Farmers will favour more efficient irrigation technologies that reduce evaporation losses. These actions can be combined with deficit irrigation approaches to maximize productivity per volume of water applied rather than per area of land. Crop selection and changes in crop calendars will help farmers adapt to new temperatures and rainfall patterns. The use of crops or varieties with better resilience to dry spells will be preferred. (It should be noted however that there is little prospect for breakthroughs in developing 'drought resistant' crops in the near future.) Increased agricultural diversification, including better integration of trees, crops, fish and livestock will reduce risk and increase the resilience of farming systems. In particular, the farming and fishing of aquatic species that do not require extensive migrations and that have wide environmental tolerances will help aquaculture and capture fisheries adapt to new climatic conditions. Farmers will also need to adopt more systematically measures to respond to increased frequency of floods and more intensive rainfalls. A combination of erosion control actions and better drainage capacities will be needed.

Climate change adaptation at higher levels will involve a combination of policy adjustments and investments in infrastructure and management. In river basins, increased frequency and intensity of extreme weather events will require adjustments in the storage capacity and management of dams and river protection works. More than in the past, flood management plans will need to combine infrastructure upgrades with non-structural, information-rich approaches that can better mitigate the impact of floods through a combination of land planning, early warning and insurance schemes. Similarly, there will be a need to shift from drought emergency response to drought management plans that include prevention, preparedness, relief and rehabilitation and long-term measures to mitigate the impacts of droughts (FAO and NDMC, 2008).

Climate-Smart Land Use, Water, and Food Security

1. CSA & Water

Most of the impacts of climate change agriculture and rural livelihoods are expected to result from changes in the water cycle. Rainfall variability and the subsequent increase in frequency of extreme weather events, including droughts and floods, combined with an increasing acceleration of the water cycle through increased evapotranspiration, will have an impact on every element in agricultural ecosystems: crops, livestock, trees, fish, rural communities and

physical infrastructure. For this reason, climate change adaptation strategies for agriculture will need to be viewed though a 'water lens'.

CSA & Soil

With global warming, rainfall levels are expected to decline in many places, and/or to occur in more intense events, and evaporation and transpiration rates are projected to increase. These changes will reduce the availability of soil moisture for plant growth. The higher temperatures will also increase the rate of SOM decomposition (mineralization), especially near the soil surface, which will affect the soil's potential capacity to sequester carbon and retain water. In the scientific literature, there is common consensus that the effect of higher concentrations of carbon dioxide (CO2) in the atmosphere and increases in temperature on photosynthesis and net primary production, and hence on carbon fixation in the biomass, will not be sufficient to counterbalance the GHG emissions due to the mineralization of SOM. Soils that have been degraded are at much greater risk from the damaging impacts of climate change. Degraded soils are vulnerable due to serious losses of SOM and soil biodiversity, greater soil compaction and increased rates of soil erosion and landslides.

Knowing the status and condition of soils and their properties is fundamental for making decisions about Sustainable soil management practices that contribute to climate-smart land use. In this respect, it is crucial to carry out soil assessments and undertake the analysis and mapping of data and information through soil surveys, including in-situ visual soil assessments (FAO, 2008). These surveys should involve land users and be supported by technical experts. In addition, they need to be backed up by laboratory testing for specific properties. Various conventional and digital mapping tools should be used to extrapolate the findings across a range of soil and terrain units, vegetation types, and/or agro-ecological zones. Ideally, soil information will be made available as continuous maps that emphasise soil's attributes. Visual soil assessments should also involve land users and be supported by technical experts to assess physical properties (texture, structure, water holding capacity, dispersion) and chemical properties (ph., nutrients, salinity).

One of the most important aspects of effectively implementing CSA is the use of evidence-based information to identify best options for changes in agricultural systems and the investments at farm, local institutional and national level to support scaling up implementation. Essentially this requires the development of a set of proposed changes in agricultural systems (e.g. from national agricultural planning) and screening them for their potential adaptation and mitigation benefits as well as agricultural benefits related to food security.

Building an evidence base, arise from data collection and analysis. These can range from large-scale quantitative survey data collection and analysis, to participatory approaches using simple tools. Improved weather forecasting and hydrological monitoring will become a critical element of modern adaptation strategies (Faurès *et al*., 2010). Currently reliable weather forecasting is still limited to a few days. However, progressive improvements in the timing and reliability of seasonal forecasts offer new opportunities for farming communities. As efforts focus on improving the accuracy of these forecasts, more emphasis should now be given to improving

the way information is conveyed to farmers and building their capacity to make best use of climate information (Gommes *et al.*, 2010). Monitoring and early warning during the cropping season remain a priority to help farmers make informed decisions.

Monitoring, as a base for adaptive decision making, on agricultural resources can be made by utilizing a varieties of modern technologies in all levels. Remote sensing, Proximity sensing and direct measurements will aggregate and produce quality information and evidence. Data-driven farming would bring a better understanding of Climate change and better mitigation to the impacts. Creating an interface between science, planning and policy is essential for achieving CSA. Efforts to develop simple and robust scientific tools, that can guide decision making of farmers on a seasonal and long-term basis.

The ultimate goal of the work shop is to introduce Concepts, evidence and options for a climate-smart approach to improving the performance of irrigated cropping systems.

Agenda

Day	Event	**Topics**
Day One	**CSA&CSI Concepts**	CSA , Nexus Approach Definition
Day Two	**CSA Agro meteorology**	Macro, Meso & Micro Scales
Third Day	**CSA Water Management** **CSI Irrigation**	Assessing risk, preparing responses & Water management for climate change mitigation
Day four	**CSA Land scape Approach**	Setting the stage for a landscape approach
Final day	**CSA & Farmers**	Reaching Farmers & Eco System Services

Contents

- **CSA - Agro Meteorology**

  I. *Development of complex data collection systems and speedy processing and interpretation of large spatial data collections*
  II. *Management in microclimate, Preparation for environmental risk and disaster mitigation.*
  III. *Macro Scale Prediction of El-Nino and other rainfall variability for agricultural*
  IV. *Meteorological information for planning, scheduling and guiding irrigation and drainage.*
  V. *Information on weather based pesticides/insecticides applications*
  VI. *Geographical information systems and their use for crop planning at smaller than present scales.*
  VII. *The use of Remote sensing technologies to generate information & Evidence*

- **CSA - CSI Water Management &Irrigation**

  I. *CSA Water Lens*
  II. *Coping with water scarcity*
  III. *Adaptation at field/farm level*
  IV. *Adaptation at irrigation scheme level*
  V. *Adaptation at watershed, river basin and national levels*

- **CSA - Setting the stage for Land scape Approach**

  I. *Land use planning and decision making process*
  II. *Landscape management and implementation*
  III. *Promoting landscape governance through policy and finance options*
  IV. *Measuring and monitoring landscapes for multiple objectives*

- **CSA & Farmers**

  I. *Farmer First Paradigm*
  II. *Sustainably increased productivity and income for better livelihoods*
  III. *Resilient systems & Mitigation co-benefits*

References

- **FAO - "Climate Smart Agriculture "Source book. 2013**
- **GACSA – Compendium on Climate Smart Irrigation 2018**
- **FAO- "WATER Accounting Source Book " 2107**
- **INBO-GWP "Integrated Water resource management in Basins"**
- **WWC – "Integrate water Resource management"**
- **WMO 134 "GAMP "**
- **OECD - Sustainable Management of Water Resources in Agriculture**
- **World Bank- "Beyond Crop per Drop" Assessing Agricultural Water Productivity & Efficiency in a Maturing Water Economy**