Project Brief

Monitoring Systems for Optimizing Irrigated Agriculture

Farmers, young researchers, graduate students, and extension staff installing equipments as part of the series on-farm trials carried by ICBA and its partners for better on-farm water management.

Thematic Area: Climate Change Impacts and management

Purpose: Water conservation and productivity

Geographic Scope: Middle East and North Africa

Timeline: 2014 - 2016

Funding Agency: United States Agency for International Development (USAID) under the Middle East North Africa Network of Water Centers

Partners:
- National Center for Agricultural Research and Extension, (NCARE), Jordan
- Sultan Qaboos University, (SQU), Oman
- Institut National de Recherches en Génie Rural, Eaux et Forêts, (INRGREF), Tunisia
- Water and Environment Center, (WEC), Yemen

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Irrigated agriculture is a major user of water resources in the Middle East and North Africa (MENA) region, often accounting for most of the fresh water consumed. However, within the various irrigated agricultural production systems in the region, there is often potential for substantial improvements in on-farm irrigation practices to maximize water productivity. Monitoring crops and their environments is a powerful tool to improve on-farm irrigation management. Specifically, an integrated system of electronic sensors, data loggers and remote communication via cellular networks will enable near-continuous and near-real-time remote monitoring that can substantially improve irrigation water use.

In its pursuit of better irrigation management, provision of quantitative data supporting enabling policies, and building the capacity of various stakeholders in tools and techniques that improve water and food security, the International Center for Biosaline Agriculture (ICBA) with support from the United States Agency for International Development launched the "Application of near-real time monitoring systems for irrigated agriculture in MENA" project in 2014. The project aims to introduce innovative approaches to irrigation water conservation and productivity through establishing an innovative knowledge and data sharing platform that promotes collaboration and knowledge sharing among investigators and stakeholders in the region especially, young entrepreneurs. First phase of the project targets United Arab Emirates, Jordan, Tunisia and Yemen.

Activities and Outcomes

Work under the project is divided into six individual work packages that together form an integrated program to achieve project objectives. Figure 1 summarizes the work package and their integration. Initial project activities focused on establishing a technology platform in each country to test and demonstrate innovative approaches to irrigation management based on measurements of the plant-soil-weather system in near-real-time under field conditions. To-date, 32 field sites were retrofitted in the targeted countries with a weather station and soil sensors with direct upload to the internet using the cellular telephone networks. Accordingly, the sites represent climatic conditions ranging from desert to sub-humid with an annual rainfall of 60 to 600 mm and ETo from 1,200 to 3,200 mm/year, representing 86% of the climate of the MENA region. Additionally, the selected sites

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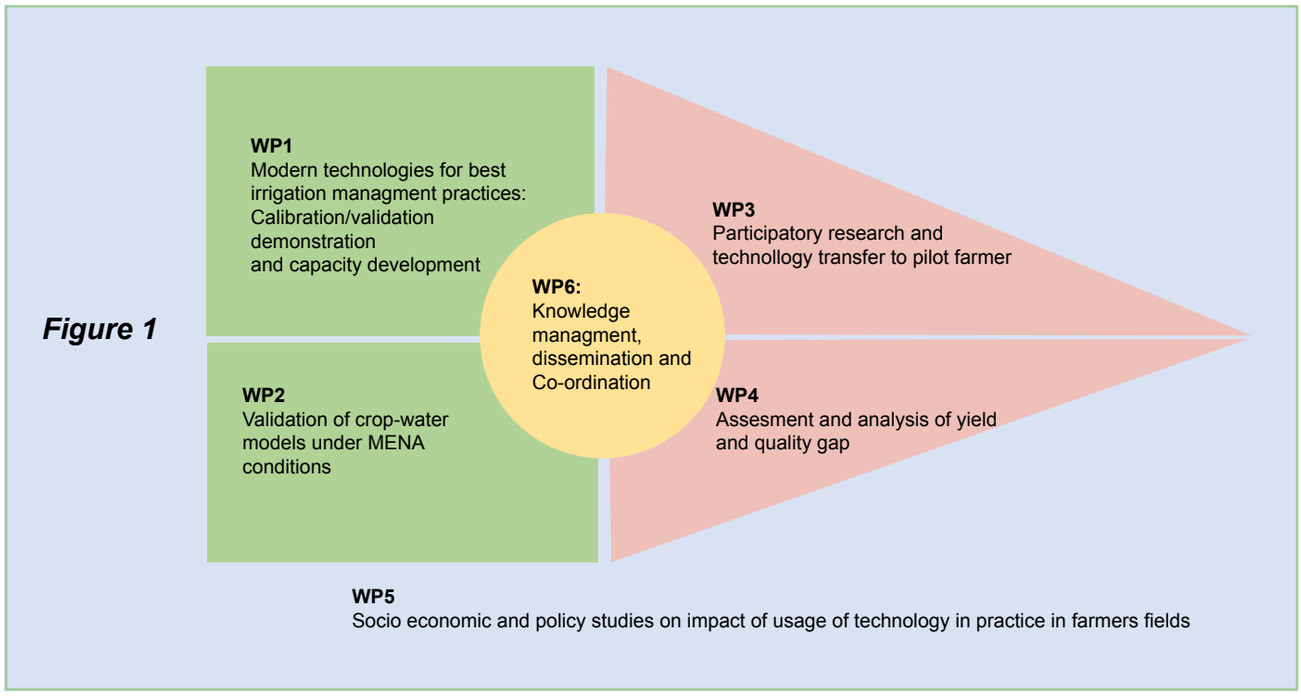


Figure 1

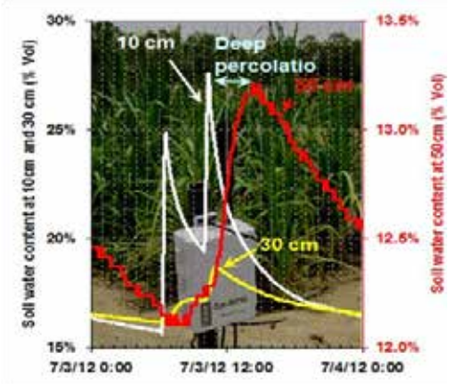
represent 70% of the soils of the region with ten soil classes being represented: Arenosol, Calcisol, Calcic Yermosol, Cambisol, Eutric Verstisol, Fluvisol, Gleysol, Kastanozems, Leptosol, and Vertic Cambisol.

The 32 field sites are composed of actual on-farm site of 13 agri-businesses with a total area of 2597 hectares (ha) of which 141 ha designated for project experiments. Individual field plots cover 0.05 ha to 67 ha, and the irrigation water sources used are: on-site well (depths of 10 - 700 m); water distribution networks; and traditional Falaj systems. Field plots were equipped with different irrigation systems, mainly drip (58%) and bubbler (15%) with the remaining irrigated using micro-sprinkler, center pivot and surface (Falaj).

The electronic sensors installed by the project activities measure soil water content, salinity, leaf water potential and sap flow (transpiration) and can assess water status and flow through the entire continuum of soil, plant and atmosphere. These sensors where then linked to the data loggers installed by the project and to the local cellular networks, which enabled the remote provision of near-continuous and near-real-time data that is then used to schedule and improve irrigation water use.
Thus far, 16 annual and perennial crops grown at a commercial scale are being monitored. These include; cereals (barley and wheat); forages (buffel grass); open field vegetables (tomato and potato); greenhouse vegetables (cherry tomato, cucumber and pepper); in addition to various tree crops (date palm, citrus, peach, grapes, guava, mango, olives, almonds and lime).
Knowledge management, dissemination and co-ordination is an important component of this project and so far more the 50 people have been trained including farm staff, engineers, technical project staff, young scientists, extension services personnel, and researchers. Special emphasis was placed to actively involve young people, women, and the private sector to establish an enduring community of practice that enhances competitiveness and fosters entrepreneurship.

Future Directions

Going forward, project activities will focus on validating crop and water models under MENA conditions and sharing these with the scientific community at large for validating Land Information Systems (LIS) and products. Comparison analysis between conventional irrigation scheduling practices with those using the new sensor/ communication based technologies will be carried to evaluate water savings and reduction of the yield gap. Crop yield and quality gap analysis as well as agronomic and quality analyses will be carried in all the centers to characterize social, educational, political and economic needs, using both interview methods and reviews of existing information from appropriate sources. An open access website that involves both the private and public sectors is schedule to launch in June 2015.



Soil water content measured with 5TE sensors in 2012 at 30 ,10 and 50 cm depth at 5 minute intervals over a 24 hour period in a sandy soil.

International Center for Biosaline Agriculture - ICBA is an international, non-profit organization that aims to strengthen agricultural productivity in marginal and saline environments through identifying, testing and facilitating access to sustainable solutions for food, nutrition and income security.