INTERNATIONAL CENTER FOR BIOSALINE AGRICULTURE

ANNUAL REPORT 2011

Above: Buffel grass field at ICBA research station in Dubai
Front cover: Alfalfa field irrigated with wastewater in Jordan

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Mission

To demonstrate the value of marginal and saline water resources for the production of economically and environmentally useful plants, and to transfer the results of our research to national services and communities.

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Researching genetic diversity of sunflowers for salinity tolerance

Foreword

Commonly defined as a situation where water availability in a country or in a region is below 1000 m^3 per person per year, water scarcity affects almost one-fifth of the world's population. Many regions in the world and particularly in the Arab region experience much more severe scarcity, living with less than 500 m^3 per person per year. These extremes are mitigated in some Arab countries by the use of desalination, of non-renewable groundwater resources and recycled water to compensate for this scarcity of renewable water. However, the long-term sustainability of water resources remain a challenge exacerbated by climate change and the increasing needs of all sectors (domestic, industrial and agricultural).

For more than eleven years, the International Center for Biosaline Agriculture (ICBA) has continued to fulfill its mandate most recently outlined in its Strategic Plan 2008-2012. Its aim is to help water-scarce countries improve the productivity, social equity and environmental sustainability of water use through an integrated water resource systems approach, with special emphasis on saline and marginal quality water. The success of ICBA's three major programs of Integrated Water Resource System, Marginal Quality Water and Capacity development was acknowledged in March 2011 when ICBA was recognized during the Khalifa Date Palm Awards. ICBA was one of the eight winners chosen out of 131 regional and international participants with its research on the potential of Arbuscular Mycorrhizal Technology for Date Palms, which was awarded second place in the 1st category of Distinguished Research and Studies.

The ongoing research and development program of the International Center for Biosaline Agriculture is made possible through the support of its investors and donors. The host country, the United Arab Emirates (UAE) government, and the Islamic Development Bank Group, the main driver of the establishment of ICBA, have enabled the Center to develop its research facilities and programs in Dubai and transfer its research findings and technology to more than twenty countries in which ICBA fulfils its strategic mandate. This ongoing financial and in-kind support is further strengthened by strong partnerships with donors, the private sector and national research and

development programs. The major donors are the UAE Ministry of Environment and Water, the Islamic Development Bank Group, International Fund for Agricultural Development (IFAD), the World Bank, USAID, the Sultanate of Oman, the Arab Bank for Economic Development in Africa (BADEA), the Arab Fund for Economic and Social Development (AFESD), OPEC, the Australian Centre for International Agricultural Research (ACIAR), the European Union, Farmers' Service Center (Abu Dhabi), and the local and international private sector.

ICBA has continued to incorporate a significant component of capacity development into project design wherever possible. By the end of 2011, over 1000 individuals from 44 countries had been trained. Indirectly many more have been able to enhance their knowledge as ICBA scientists shared their scientific findings in refereed journals, conference proceedings and technical reports.

This year witnessed the appointment of new members to the Board as an outcome of the revised and extended agreement regarding the Center's financial support which was signed in 2010. The eight-member Board chaired by Mr Fawzi AlSultan include senior officials from the UAE Ministry of Environment and Water, Environment Agency – Abu Dhabi, Islamic Development Bank, Abu Dhabi Fund for Development, International Fund for Agricultural Development (IFAD), World Bank, International Center for Agricultural Research in the Dry Areas (ICARDA), International Water Management Institute (IWMI) and ICBA (*ex officio*).The strong combination of a Board with members representing both financial and scientific agencies and the talented hardworking team at ICBA will ensure that the coming years are fruitful.

Fawzi AlSultan
Chairman, Board of Directors, ICBA

Dr Shawki Barghouti
Director General, ICBA

Water Scarcity: Addressing the Challenges

Much has been written about the lack of freshwater in the Middle East and North Africa (MENA) region. The facts are clear:

- Parts of the MENA area are amongst the most water-scarce areas of the world
- The amount of renewable water available per person is continuing to decline
- Water scarcity is the major constraint to food production
- Eighty-five percent of the water in the MENA region is used for irrigation.

Throughout 2011 ICBA has been steadily increasing its role in applied research and technology transfer in the water sector to address these challenges confronting water security at the regional, local and international level. This has been accomplished by improving water data collection and dissemination in order to inform water sector decision-makers, and by addressing how water is used through water productivity research to optimize irrigation management and enhancing the use of alternative water resources. ICBA's research efforts are undertaken at the regional and country level and often in partnership with national agricultural research systems (NARS) and public or private sector institutions.

Determining regional data for decision-making and research in the Middle East and North Africa region

ICBA has established a modeling and remote sensing hub to develop new data and insight on water resources and agricultural water use, at both the regional and country scales, for MENA decision-makers. The program, named MAWRED (Modeling and Monitoring Agriculture and Water Resources Development, and meaning the 'source' in Arabic) is being developed in partnership with NASA Goddard Space Flight Center under funding from USAID. The regional-scale water and land analysis uses a new model developed by NASA, the Middle East North Africa-Land Data Assimilation System (MENA-LDAS). Integrating the groundwater and surface water data and monitoring drought as well as water use, irrigation intensity mapping and potential crop yield will form the basis for modeling the possible impacts on water resources and agricultural water use of climate change over the next decades. Using the latest predicted atmospheric conditions from the international General Circulation Modeling community, invaluable new insight is being developed that will be of great use to ministries of economy, water, agriculture and environment across the region.

A three-day technical workshop was held in October, which brought representatives from USAID, NASA Goddard Center, the World Bank and scientists from Morocco, Lebanon, Jordan, Egypt and Tunisia to ICBA headquarters in Dubai. The workshop highlighted the program's ability to harness cutting edge space-based earth observations and modeling to help solve water issues in the MENA region. (*For further details, contact* **Dr Rachael McDonnell** r.mcdonnell@biosaline.org.ae)

Improving the collection and use of weather data

In 2011, ICBA extended its capability to collect, store, analyze and disseminate weather data and expanded its research on the use of such data for irrigation management in arid areas.

The key to successfully using weather data for agricultural production is its reliability, easy availability, and ease of processing into useful information that can be used at the appropriate level (such as in research or on-farm). Many research studies at ICBA use reference or potential evapotranspiration (ET_0) and actual crop water use (ET_a) estimates as irrigation guidelines. These are in turn increasingly used in models for irrigation scheduling and management. However, correctly estimating ET_0 in an arid environment such as the UAE in general and ICBA in particular, is challenging. There is the issue of the "oasis" effect in which hot dry air from non-transpiring areas (desert) increases ET_0 in the cropped areas through advection. Another issue is the prevalence, particularly in summer, of higher wind speeds in the afternoon, when ET_0 is highest, which may result in higher daily ET_0 than is estimated using daily averages of weather. It may therefore be more accurate to use hourly weather data summed over a day.

Detailed data from a weighing lysimeter is a valuable component in developing accurate values of the crop coefficient used to estimate Eta under such arid conditions. Analysis of daily weather patterns showed that ET_0 is low (less than 5 mm/day) and relatively consistent in winter. However, in summer, ET_0 values can exceed 12 mm/day (and likely higher if advection is accounted for), and are more variable from day to day.

Daily weather and ET data (both tabular and graphs of weekly and longer periods) have been updated regularly on the ICBA website www.biosaline.org. (*For further details, contact* **Dr Ian McCann** i.mccann@biosaline.org.ae)

Optimizing irrigation usage through water productivity research (crop per drop)

Good irrigation management is essential for water conservation under arid and saline conditions. This requires maintaining soil water content in the root zone within a range sufficiently high that the crop can easily use the water but without incurring wastage due to unnecessary downward movement below the root zone. Weather-based estimates of ET_0 and ET_a have been used for many years in irrigation scheduling, but only more recently has sensor technology developed sufficiently to enable cost effective near-continuous monitoring of water content and movement in the soil as an additional tool for irrigation management.

Water sensor usage at ICBA research farm – crops grown before and after usage

During 2011, ICBA furthered its water productivity research program with the use of sensor technology to monitor near- continuously soil water content and movement in the soil. Soil water content was monitored at depths of 10, 30 and 50 cm every 10 minutes in a control plot as part of the Water Productivity Research program. Low-salinity irrigation water (2 dS m^{-1}) was applied at two day intervals using a drip system. Decagon® 10HS soil water sensors were used with a logger that communicates over the GSM mobile phone network to send the data to a server from where it can be retrieved over the internet as required. In addition, weather data were used to estimate daily and hourly reference crop evapotranspiration. Irrigations were adjusted during the season to maintain soil water content within a target range. (*For further details, contact* **Dr Ian McCann** i.mccann@biosaline.org.ae)

The water productivity of small grain cereals (pearl millet, sorghum, barley and triticale) was evaluated under three salinity levels in the irrigation water and under four different irrigation amounts. Pearl millet and sorghum plants in two growing seasons (summer and late summer) were harvested and data collected.

The sensors provided valuable information on soil water content, its use by the crop, and its movement within and below the root zone. Research was also initiated on the use of a sensor that measures the electrical conductivity and temperature of the soil in addition to soil water content (Decagon® 5TE).

Another kind of irrigation technology (DuPont pervaporation irrigation technology in which the growing medium is humidified by water vapor movement through a polymer) was also trialed throughout the year. Subsurface pipes made from the polymer can desalinate saline water and enable its use for irrigation. Small-scale experiments were initiated in the ICBA greenhouse for initial observation of results of the pipes being used to grow plants using saline water. (*For further details, contact* **Dr Nurul Akhand** n.akhand@biosaline.org.ae)

Enhancing the use of alternative water resources

Seawater resources in the United Arab Emirates

For arid and semi-arid regions that have access to seawater, such as the United Arab Emirates (UAE), its use in agriculture seems a very attractive concept. However, in practice, producing a product that is economically viable and environmentally sound has been limited to mangroves and a few other wild/domesticated plant species that have proved successful under field conditions.

Researchers at the Masdar Institute (MI), along with several companies such as Boeing, Etihad Airways, and UOP Honeywell, are looking at the potential of growing the halophyte *Salicornia bigelovii* with seawater for use as a biofuel and for carbon sequestration. The obvious partner for such research was ICBA with its extensive experience in the evaluation of genetic material and optimizing different types of production systems. During 2011, an experiment involving the impact of salinity on *Salicornia* was conducted at ICBA with the following findings:

- Seeding time is very crucial for a good establishment of *Salicornia* plants. During 2011, the trial was planted late in the growing season resulting in

poor establishment when the seeds were planted directly, as compared to seedlings raised in Jiffy-7 pots and transplanted in the field.

- All growth parameters and biomass productivity showed better performance in the transplanted plots. Since this was an experimental trial, plants were grown at a distance of 25 cm and hence less fertilizer was needed. In the case of seed broadcast, a higher level of nitrogen will be required.

Salicornia plants were also grown in a greenhouse at 35 °C and relative humidity of 65-75% in a 5 m^2 area for seed production under low saline condition (5 dS m^{-1}). A second genotype from ICBA was also tested for comparison. Both the genotypes produced seeds, though in lower quantities. Genotypes provided by MI showed better vegetative growth (biomass) but lower seed production (3.17 g/plant) as compared to the ICBA seed source (11.93 g/plant). The next phase of the research will be a field trial on the Abu Dhabi coast. (*For further details, contact* **Dr Shoaib Ismail** s.ismail@biosaline.org.ae)

Recycled Water in Jordan, Oman and Tunisia

In arid and semi-arid agro-ecosystems of MENA, using treated wastewater (TWW) in agriculture is a valuable option to save fresh water for other purposes that may have higher economic and social value, such as municipal, industry, and tourism. In the last decade several countries have expanded production of TWW in order to recycle it for agricultural use. Jordan, Oman and Tunisia are three countries participating in a three-year study on the sustainable use of TWW.

The research focuses on the evaluation of methods to safely use TWW in agriculture in order to save fresh water resources and enhance the productivity of resource-limited farmers in the region.

During the year, the country partners undertook extensive field evaluations and data collection to determine the extent and availability of municipal TWW resources, the optimal management of agricultural production systems (soil, water and crop) and the socio-economic benefits to farmers of using TWW.

Salicornia seedlings in the greenhouse at ICBA

The study identified the number and management structure of TWW plants in Jordan, Tunisia and Oman. The highest use of TWW in agriculture was recorded in Tunisia. It was predicted that TWW production in the countries under study would double by 2025, and consequently the use of this resource could be increased with the implementation of production systems in marginal agricultural lands.

Across all of the countries, there were eight experiments of crop management systems designed to meet the specific needs of each country in order to evaluate the added value of the use of TWW for economically viable production. Demonstration fields were identified in order to encourage more farmers in the production basins targeted by the project. Consequently, several field days were organized in all the countries. Seminars and other capacity building events were conducted for more than 200 farmers and extension officers with access to TWW irrigation networks.

A series of 81 on-farm trials totaling 60 ha was set up to determine the socio-economic returns of TWW reuse in irrigation compared to the existing methods. Annual fodders, jatropha, shrubs, olives, citrus, pomegranate, and Medicago spp. were grown. An economically viable production and sustainable practice was possible for sorghum through seed production. In addition, the yield and quality of orchards in Tunisia did not significantly decrease when irrigated using TWW. The study findings related to the environmental impact of TWW irrigation will be used to assess the acceptance of its use. An additional economic survey was conducted for all farms to evaluate farmer acceptance of the new production systems irrigated using TWW. (*For further details, contact* **Dr A Dakheel** a.dakheel@biosaline.org.ae)

Implementation of field experiments for yield performance studies: irrigation systems installation (A and B), fodder and orchards (C and D)

Food Security: Improving Poor Farmers' Livelihoods in Marginal Environments

The accelerating pace of climate change, and burgeoning population growth, threatens global food security. Sustained growth in the agricultural sector (crops, livestock, fisheries, forests, biomass, and commodities) is key to feed the world, enhance rural livelihoods, stimulate economic growth and maintain and restore ecosystem functions/services. Coping with the impact of climate change on agriculture will require careful management of resources like soil, water and biodiversity and making the most efficient use of the environmental goods and services.

Food security is inextricably linked to water security because water is the major limitation to agricultural production. Water at the high end of the quality spectrum is very limited, but there are substantially higher reserves at the lower quality end, and the ability to use these lower quality (saline) reserves for food production is vital to the effort to increase food security. While achieving complete food security in the staple crops is unlikely in arid and semi-arid parts of the world, improving productivity in some crops, such as high value, high nutrition and heritage crops through increased adaptation to the environment and water constraints is an important goal.

Addressing food security through the use of salt-tolerant plant genetic resources

Plant genetic resources are the biological basis of food security and, directly or indirectly, support the livelihoods of every person on Earth. The erosion of these resources poses a severe threat to the world's food security in the long term. Therefore, conservation and sustainable use of these resources is necessary to sustain agricultural production and meet growing environmental challenges and climate change.

Germplasm acquisition, characterization and multiplication

Genetic diversity contained in the germplasm assembled at ICBA provides the basis to improve the productivity of salt-affected areas. During 2011, forage cowpea (*Vigna unguiculata*) and forage maize (*Zea mays*) germplasm accessions were acquired from the International Livestock Research Institute (ILRI), and the International Maize and Wheat Improvement Center (CIMMYT) respectively, to study and identify salt-tolerant genotypes with adaptation to the local environment. Large quantities of seeds of three salt-tolerant forage sorghum (*Sorghum bicolor*) genotypes were also acquired from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) for use in ongoing research.

Morpho-agronomic characterization and preliminary evaluation for adaptation, yield potential and salinity-tolerance help in the identification of promising germplasm for further utilization through applied research. significant variation was observed, especially for fruit characteristics during the morpho-agronomic characterization of cucumber and squash germplasm accessions. To ensure continued supply of seeds of salt-tolerant germplasm for research and other uses, seed

multiplication was undertaken in eight crops, including cucumber and squash which were acquired in the previous year.

Hybrid maize evaluation

Evaluation of the forage yield of an Australian maize x teosinte hybrid (perennial) under saline conditions showed that the biomass yields of hybrid were lower than those of local maize and pearl millet. However, the study showed that local maize has considerable potential as a fast-growing catch-crop, ready for utilization within a few weeks from sowing.

Salt-tolerance of the native rhizobial isolates

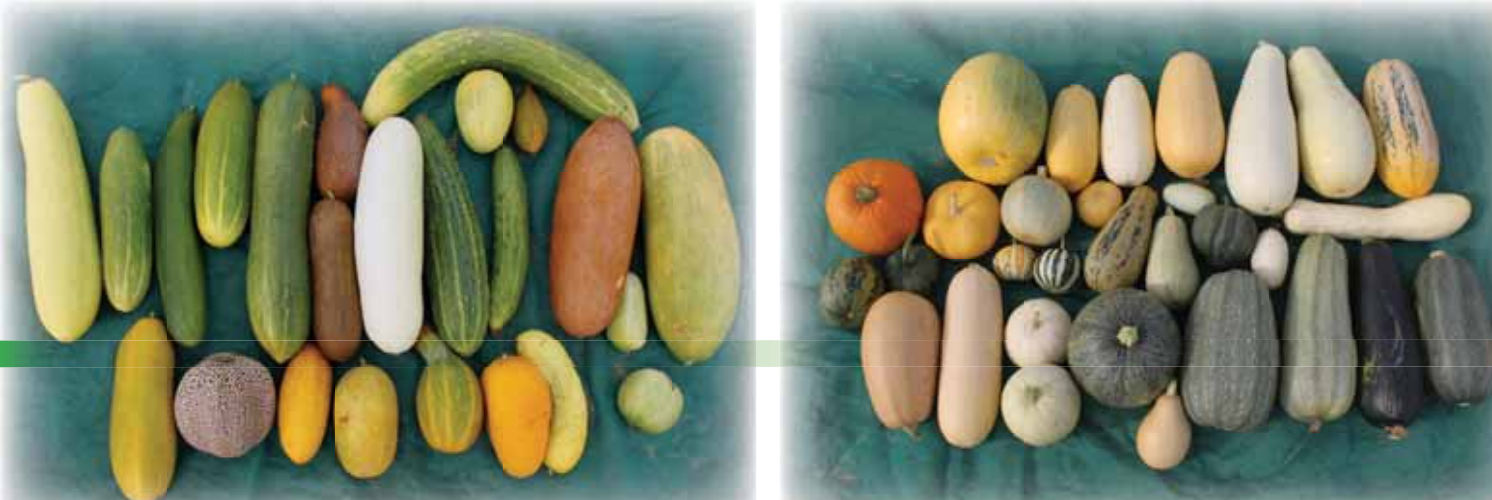
Leguminous species enrich soil through symbiotic nitrogen fixation by Rhizobium. A study of the salinity tolerance of naturally occurring rhizobia, isolated from the root nodules of leguminous crops, namely sesbania, cowpea, lablab and pigeonpea showed that the rhizobial isolates have high levels of tolerance to salinity. Thus, rhizobial isolates produced colonies even at salinities as high as 40 dS m^{-1} when cultured on yeast extract-mannitol agar (YEMA) medium supplemented with different concentration of sodium chloride (NaCl). The tolerance to high levels of salinity and the survival and persistence in severe and harsh desert conditions make these rhizobia highly valuable inoculums to improve productivity of the leguminous crops cultivated under extreme environment and further studies are under way to evaluate their tolerance to heat stress, pH and other biotic stresses. (*For further details, contact* **Dr NK Rao** n.rao@biosaline.org.ae)

Addressing food security through forage improvement

Evaluating different genotypes of the key forage crops

The evaluation of salt tolerance and threshold levels of key forage crops such as barley, safflower and triticale continued in 2011. With funding from IFAD and AFESD, ICBA, in collaboration with ICARDA, is working on the improvement of salt tolerance among barley, safflower and triticale germplasm. The findings of this research will result in the development of salt-tolerant genotypes for use in sustainable production systems in saline and dry areas. Improved forage crops will bring economic benefits to farmers. (*For further details, contact* **Dr A Dakheel** a.dakheel@biosaline.org.ae)

Variation in fruit characteristics of cucumber (left) and squash (right)



Climate Change: Developing Resilence through Adaptation and Diversification Strategies

Research into adaptation to climate change

The problems of lack of freshwater are exacerbated by climate change, whether it is dry areas becoming drier or other changing weather patterns such as temperatures, humidity, and wind; all of which directly affect crop water use. Adapting to these long-term climate changes requires many different policy and technology approaches including crop and livestock production diversification and improving natural rangelands management. Above all there needs to be an emphasis placed on capacity development to ensure adoption and implementation of the alternative strategies.

Diversifying crop and livestock production to adapt to climate change in Middle East and North Africa

Funded by the International Fund for Agricultural Development (IFAD) and the Arab Fund for Economic and Social Development (AFESD), ICBA and the National Agricultural Research Systems (NARS) in Jordan, Oman, Egypt, Palestine, Syria, Tunisia and United Arab Emirates have collaborated on climate change adaptation strategies. The partnership is equipping farmers with the knowledge and skills to become more efficient in farmer-based seed production technologies and delivery systems for wide-scale cultivar adoption and efficient forage production. The team will lead the evaluation and introduction of environmentally and economically feasible forage production systems suitable for the use of treated wastewater. The team is also tasked to assess and quantify the profitability and impact of the introduced forage-livestock production packages on the livelihood of poor farmers in marginal environments, and develop the skills of NARS and women and men farmers in stress-tolerant forages improvement, and crop and water management.

ICBA and partnering NARS met in April in Cairo to update the respective work plans; standardize production package components among the NARS (including all elements of the production and management practices from pre-planting to harvest and postharvest); update on linkages with other IFAD-supported projects in the countries; and identify capacity building needs and proposed events. Subsequently each country held national meetings to review the work plan with the implementation team. Throughout the year each country held several in-country capacity building events and farmers' and field days. (*For further details, contact* **Dr A Dakheel** a.dakheel@biosaline.org.ae)

Successful crop diversification in Egypt

Improving natural rangelands management in Uzbekistan

Crop diversification, value chain creation and an increase in the forage production are critical to sustain agricultural production, food security and the income level of local communities. Integrated local climate change adaptation strategies, which include the identification of necessary skills to adapt to climate change and favorable areas for collective action on improving local environment and prevent hazards, should increase resilience of a rural population in Uzbekistan.

The foothill rangelands near the Papanaya settlement, Nurata district, have areas with high biodiversity, which are threatened by desertification spreading from the Kyzylkum desert. Without adaptation measures these natural habitats will be lost due to land degradation exacerbated by climate change. ICBA's collaboration with ICARDA and NARS will mitigate the spread of the desert into the areas with high biodiversity by establishing forage production on degraded lands, thus contributing to the targets of all three Rio conventions (Biodiversity, Climate Change and Desertification) by impacting on livelihoods and mitigate poverty of the poorest people.

In particular, the Papanaya Project focuses on improving natural rangelands resource management, enhancing water harvesting, strengthening rainfed agriculture systems and awareness-raising in improving incomes and livelihood systems. Two target women's groups were established in Kadok (a household trial of one of the poorest women amongst the group) and Papanaya (a collective field demonstration trial on marginalized land). Fifty formal interviews in both Kadok and in Papanaya clearly showed that local communities are highly affected by the degradation of natural resources (water scarcity, desertification and mudflows exacerbated by climate change); water shortage that does not allow an increase of agriculture with presently used crops and technology; and forage shortage, although currently water shortage and mudflows affect them worse. Two field inventories on each rangelands, foothills and rainfed agriculture were conducted which showed that the mismanagement of water resources, unregulated over-grazing, up-rooting and cutting of trees and shrubs for fuel, soil erosion and mudflows from the slopes onto the plains were the main problems. More than 160 wild and underutilized plants species, including native endemic trees, shrubs and perennial herbs, were identified and documented.

Seed collection for *ex-situ* and *in-situ* conservation of 28 drought- and salt-tolerant fodder, medicinal and plants for dyeing was conducted in the transect between the Aratau and Nuratau mountain ranges. New germplasm from ICARDA headquarters were planted as seedlings in April at both sites; by September 50% had survived. Local perennial wild shrubs such as *Kochia prostrata, Salsola orientalis, Halothamnus subaphylla, Ceratoides ewersmanniana, Rosa canina* and *Berberis oblonga* were considered as an alternative drought- and salt-tolerant plant genetic resource for rehabilitation of degraded pastures.

Native drought and salt-tolerant 8 fruit trees were planted as seedlings in early March by using a subsurface deep irrigation system. Simple water harvesting construction (locally called 'hauz') as a source of supplemental irrigation in hot season (July-September) was established at the Kodak site. Dual-purpose crops were intercropped between rows of fruit trees and evaluated with participatory work of women. *For further details, contact* **Dr S Ismail** s.ismail@biosaline.org.ae)

Partnerships: Demonstrating the Power of Synergy

United Arab Emirates

Farmers' Services Centers

Enhancing water and food security in the UAE

ICBA's efforts in the United Arab Emirates will enhance water and food security and enable adaptation to the impacts of climate change. In a long-term collaboration with the Farmers' Services Centre (FSC) – the intermediary between ADFCA and the UAE farming community - the ICBA scientific team are researching improved varieties and non-conventional forages for replacing Rhodes grass in the Western Region of Abu Dhabi Emirate, improved farming management practices, and developing capacity development for extension services and farmers.

Recognizing that on-farm trials with farmers' participation will speed up the selection and introduction of new crops to diversify the production systems, the ICBA/FSC team developed farms which had been selected after a survey and soil and water analyses by ICBA, at two levels: (i) Demonstration; and (ii) Model. The Demonstration farms were developed in small areas to represent different agricultural regions (Liwa, Madinat Zayed and Ghayathi) and different salinity levels.

Three Demonstration farms were planted with different accessions of five winter forages and a summer trial was also carried out using salt-tolerant varieties and irrigated water. Soil salinity in the demonstration farms is regularly monitored through sampling the rootzone and analyses at CAL (ICBA Central Analytical Laboratory).

The Model farms were also proposed for the same regions and salinity levels, but on the whole farm-level (excluding date palm growing and livestock areas).

Ministry of Environment and Water

Selecting salt-tolerant date palm varieties for the UAE

In collaboration with the Ministry of Environment and Water (MOEW), ICBA continued its long-term research in date palms that are a key component of production systems in the Arabian Peninsula that are characterized by drought and salinity stresses. The goal of this research is to identify high-yielding, salt-tolerant date palm varieties and to improve crop management techniques to maintain optimal functioning of the agro-production system and survival of the plants under stressed environments.

Demonstration of non-conventional grasses in Madinat Zayed, Abu Dhabi

During 2011 date palm canopy attributes and yield parameters were recorded for each local and imported variety reaching maturity stage. Taking the experiment as a whole, there were significant variety, salinity and variety x salinity effects for all parameters. Local varieties, Shahla and Lulu, can be recommended for intermediate and highly saline irrigation water, respectively. Indeed, these varieties performed the same during the previous years, thus showing inter-year stability. In contrast, varieties such as Nabatet Sultan, Um Al Hamam and Ajwa-Tul-Madinah seemed to be less adapted to the environment and showed high inter-year variation in yield.

In March 2011 ICBA was recognized during the Khalifa Date Palm Awards when it was one of the eight winners chosen out of 131 regional and international participants with its research on the potential of Arbuscular Mycorrhizal Technology for Date Palms. The research was awarded second place in the 1st category of Distinguished Research and Studies. (*For further details, contact* **Dr A Dakheel** a.dakheel@biosaline.org.ae)

In another partnership with MOEW, ICBA contributed to the successful conduct of the soil survey of the northern emirates as a member of the technical committee and through analyzing soil samples to support field survey and soil classification. (*For further details, contact* **Dr S Shahid** s.shahid@biosaline.org.ae)

Date palm trees at ICBA research station

Iraq

Improving management practices leads to increased productivity in Iraq

The Australian Centre for International Agricultural Research (ACIAR) is funding a partnership between the International Center for Agricultural Research in the Dry Areas (ICARDA), International Water Management Institute (IWMI) and Iraqi representatives. The scope of the collaboration is to address the salinity problems impacting on agriculture in central and southern Iraq; however, trial sites have been established in similar areas in Syria. ICBA's role in the project is to focus on crop improvement and production system management at the farm-level and as well to supply germplasm of salt-tolerant plants.

In 2011, two trials were initiated at mirror sites in Deir-Azzor and Al-Dujaila in Syria:

1. Activity E1 researched the impact of salinity and boron content of irrigation water on the growth of winter cereals (wheat and barley) in Deir-Azzor in Syria as part of the Mirror Trial in Iraq. The trial focused on the need to improve production in wheat and barley cropping systems in marginal soils. Preliminary results show that the plants exposed to the highest level of salinity indicated symptoms of boron toxicity on the first leaf of two of the cultivars of the tested

crops, and the damage was greater for barley than wheat.

2. Activity E1(B) and E2 evaluated summer forages (sorghum and pearl millet – ICBA-supplied salt-tolerant varieties and two local varieties), sesbania, guar and cowpea at Wasit (Al-Dujaila) at the salinity range of 10-20 dS m^{-1}.

By assessing the salt distribution and its drivers, irrigation water salinity at different levels (farm, irrigation district, and river basin) at representative sites such as Wasit (Al-Dujaila), Babil (Al-Musaib), and Basra (Abu Al-Khaseeb), the research will inform methodologies for salinity control and productivity enhancement of saline water and salt-affected soils. In the long-term, funding of additional research and mitigation strategies could be provided by ACIAR and a broader set of interested donors.

West Asia and North Africa

Enhancing crop-livestock productivity through the use of sorghum and pearl millet in WANA

Saline soils cover 5-10% of the world's arable land; a percentage that continues to expand. Salinity is a major constraint to crop production, especially in the arid and semi-arid regions of the world, where low precipitation, high surface evaporation, irrigation with saline water, rising water tables, and poor irrigation practices generally increase the levels of soluble salts. A strategically important objective is to improve forage yield in harsh environments where the salinity of irrigation water is increasing. Crop options provide less expensive, more sustainable solutions for enhancing the crop-livestock productivity of salinity-affected lands.

Both pearl millet and sorghum are two main fodder crops in the MENA region that have the potential role to fill the gaps in farm productivity and in a crop livestock system. In many salt-affected areas with reduced potential for the production of high value cash crops, the most viable option is to shift production to a forage livestock production system that can maintain farm productivity and improve income through the integration of forage production and a livestock system. Defining the salinity tolerance of pearl millet (*Pennisetum glaucum* (L). R. Br.) and sorghum (*Sorghum bicolor* L. Moench) and establishing crop management systems can facilitate more productive and eco-efficient agriculture. The current project is a major selection program where ICBA and ICRISAT are following similar environments of selection on a large amount of genetic diversity. Through extensive screening and evaluation of more than 800 landraces, breeding lines, and varieties of the two

Field trial in Deir-Azzor, Syria and Symptoms of boron toxicity

crops for salinity tolerance and yield potential (both grain and fodder) under various levels of irrigation water with salinity up to 15 dS m^{-1} (11,000 ppm), a nursery of each crop species containing 25-30 genotypes with high potential for yield under saline conditions was identified and distributed to partnering countries.

The achievements in phase I in Egypt, Jordan, Oman, Syria and Tunisia have laid the foundation for larger on-farm trials, increased seed production, release and adoption of identified high-yielding and salinity-tolerant sorghum and pearl millet varieties and also set up the efficiency of genetic improvement for salinity tolerance for Phase II. During the second phase, ICBA, ICRISAT and the NARS of Egypt, Jordan, Oman, Syria and Yemen have achieved on-farm evaluation and optimization of crop management systems.

Sub-Saharan Africa

Improving Integrated crop and seed production systems in SSA

An inter-disciplinary approach to improve the performance of irrigated farming systems in Sub-Saharan Africa (SSA) (Burkina Faso, Gambia, Mali, Mauritania, Niger, Nigeria and Senegal) should consider water availability and quality, irrigation technologies/ management, genetic diversification, appropriate soil, water and nutrient management practices, and rural socio-economic aspects such as market linkage and value-chain development.

The multiple benefits for the SSA countries generated from such an approach would include more sustainable agricultural production, and improved water management for seed production for commercialization and diversification. By achieving a dependable supply of basic agricultural products, food security will be improved and sub-optimal migration from the farming communities minimized.

The NARS of the seven SSA countries and the Islamic Development Bank launched the endeavor in December and the first phase, establishing a water resources database, commenced.

Central Asia and Caucasus

Developing sustainable water, rangelands and livestock management in CAC

Crop diversification and sustainable management of marginal land resources in three Central Asian countries (Tajikistan, Kazakhstan and Uzbekistan) is the focus of a four-year partnership involving ICBA, ICRISAT and ICARDA commencing in 2011.

To improve land productivity and livelihood of poor farmers living in salt-affected and degraded areas, dual-purpose pearl millet (*Pennisetum glaucum* [L.] R. Br.) and sorghum (*Sorghum bicolor* [L.] Moench), two highly productive, nutritional early spring and summer crops, were introduced to fill existing gaps in grain and forage production in the Central Asian region. Socio-economic studies to provide sound cost/benefit estimates for all interventions, under realistic conditions of small farms, will be conducted.

In the second stage of desk studies the project team will evaluate the necessary institutional and legal changes to allow for production and marketing of sorghum and pearl millet. These measures will benefit small, remote, rural communities with limited land/water resources to ensure sustainable land use and provide

additional income. Collaboration with farmer associations and the NARS will guarantee implementation, whereas collaboration with academic research institutions will ensure the necessary data acquisition to allow out-scaling of project results to other Central Asian and Caucasus countries.

A Project Inception Workshop was held in Uzbekistan during June 14-16, 2011 to discuss the work plan and finalize first-year activities to commence July 1, 2011 in 2-3 sites in each country. The seed of sorghum and pearl millet were produced by ICBA in collaboration with ICRISAT and sent to the CAC partners. In addition, local varieties of the same forage crops were also included in the trial.

Improving Livelihoods of Rural Communities in Saline Desert Environments in Turkmenistan

Extreme drought and high temperatures coupled with rapid expansion of irrigated agriculture and intensification of human activities have severely impacted the dryland ecosystem of Turkmenistan. These impacts include major deterioration of the fertile arable lands, natural pastures, riparian and foothills forest leading to desertification including soil salinization and waterlogging; a situation exacerbated by climate change. Currently huge areas of long-term irrigated agricultural lands and sandy desert rangelands in Turkmenistan have deteriorated into marginal salinized/ unproductive lands. The availability of fresh irrigation water in these marginal areas has inevitably declined because of increasing demand from agricultural and non-agricultural users.

Partnering with the Institute of Desert Flora and Fauna and Ministry of Nature Protection, in Turkmenistan, ICBA investigated in 2011 the efficiency of non-conventional water use in agri-silvi-horticultural and silvi-pastoral systems to meet the food and feed demands and develop adaptation strategies for farming communities vulnerable to climate change and water resources shortage. For farmers to generate additional income, the project team considered alternative uses of land such as the reclamation of marginal lands by using non-conventional water for irrigation (drainage, rainfall, salinized ground water) and the introduction and evaluation of biosaline technologies.

Capacity Development

A core component of ICBA's applied research and development programs is developing capacity through the operation of two formal networks: the Global Biosalinity Network (GBN) that promotes collaboration between individuals involved in research and development on biosaline agriculture, and the Inter-Islamic Network for Biosaline Agriculture (INBA), which is a forum for mutual collaboration and cooperation among the members of the Organization of Islamic Countries (OIC) in the field of biosaline agriculture. As well, ICBA incorporates opportunities that include participation in global events such as the World Water Forum, collaborating with other scientists to share expertise in scientific fields in fora such as workshops, and sharing knowledge through publications and conference presentations.

Three training sessions on the technology of cultivation of new dual-purpose crops, methods of their multiplication and utilization at the farm level were conducted during the year in Uzbekistan as part of ICBA's efforts to improve natural rangeland management.

To build capacity among local farmers in the United Arab Emirates, ICBA conducted the first training course, an introductory course for extension officers, during April 4-6. Attended by 24 staff of the Western Regional Agricultural Centers, the training course covered topics on biosaline agriculture, agronomy, irrigation and soil salinity management, thus familiarizing the trainees with topics such as management, salinity, scientific measurements, and new crops. A one-day hands-on training on soil and water measurements was also held in the field.

During the year over 105 people from the Middle East, North Africa, Sub-Saharan Africa, and the Central Asia and Caucasus benefited from ICBA's emphasis on capacity building.

ICBA experts in wastewater management hosted in Dubai their counterparts from Egypt, Jordan, Iraq, Saudi Arabia, UAE, Oman, Kuwait, Tunisia, Algeria and Morocco, the World Bank, the International Development Research Center, the UN Secretary-General's

Field day at Madinat Zayed, Abu Dhabi

Advisory Board on Water and Sanitation and the Singapore National Water Company in a workshop organized by ICBA, the Arab Water Council and the Islamic Development Bank.

ICBA organized in late 2011 at its headquarters in Dubai a training course on Biosaline Agriculture Technologies and its Role in the Mitigation of Climate Change in Africa. The course was attended by 22 participants from 12 African countries: Eritrea, Kenya, Liberia, Mauritius, Mozambique, Namibia, Nigeria, Seychelles, Swaziland, Tanzania, Uganda and Zambia.

This two-week course was the third in a series of capacity development programs for African countries organized by ICBA since 2007. These programs are funded by the Arab Bank for Economic Development in Africa (BADEA) which provides financial and technical support for the non-Arab African countries, including capacity development. His Excellency Engineer Sultan Alwan, Assistant Undersecretary for External Audit, Ministry of Environment and Water, attended the opening ceremony and Engineer Abdul Majid Al-Burawi, BADEA, attended the closing ceremony.

During the training program, the participants visited Sharjah Plants and Natural History Museum, Dibba Research Station of the Ministry of Environment and Water and the Date Palm Tissue Culture Laboratory of the United Arab Emirates University in Al Ain.

In collaboration with the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), ICBA organized in Amman, Jordan, a training course on Techniques for the use of treated wastewater in agricultural production and its role in food security in the Arab world. The course was hosted by the National Center for Agricultural Research and Extension (NCARE) in Jordan.

Thirty-one participants from 14 Arab countries: Jordan, UAE, Bahrain, Tunisia, Algeria, Syria, Iraq, Oman, Palestine, Kuwait, Lebanon, Egypt, Morocco and Yemen attended the course. The course was conducted as part of the capacity development of the program on the safe use of treated wastewater in agriculture in the Arab world, which is being implemented by ICBA in collaboration with ACSAD and the national agricultural research systems (NARS) in Jordan, Tunisia and Oman. This project represents one theme of the regional project on *Adaptation to climate change in WANA marginal environments through sustainable crop and livestock diversification* which is implemented by ICBA in collaboration with NARS in Jordan, UAE, Tunisia, Syria, Oman, Egypt, Palestine and Yemen. This regional collaboration is funded by the International

His Excellency Dr Rashid Ahmed Bin Fahad Minister of Environment and Water, UAE (second from right) at the opening ceremony of the wastewater management experts meeting in Dubai

Fund for Agricultural Development (IFAD), the Arab Fund for Economic and Social Development (AFESD), the Islamic Development Bank Group (IDB), and the OPEC Fund for International Development (OFID).

ICBA and the Desert Research Center in Egypt organized the annual coordination meeting of the technical committee of the project *Adaptation to climate change in WANA marginal environments through sustainable crop and livestock diversification*. Members of the committee, who came from Egypt, Jordan, Oman and Syria, met in Cairo from 12 to 14 April, to progress the major project, which is funded by IFAD, AFESD, the OPEC Fund for International Development, IDB and the NARS of Egypt, Jordan, Oman, Palestine, Syria and Tunisia.

The importance of marginal quality water in agriculture and food security in the Kingdom of Saudi Arabia was the well-received topic at a seminar sponsored by the Islamic Development Bank Group. ICBA, in cooperation with King Abdulaziz University and the King Abdullah University of Science and Technology, convened the seminar at the 36th Annual Meeting of the Board of Governors of the IDB in Jeddah, Saudi Arabia.

Focusing on solutions to improve food security in the Arab region, the First Arab Symposium that was held in Kuwait was co-organized by the AFESD and the World Bank. ICBA outlined how research and innovation could be harnessed for Arab food security aspirations.

Mr Fawzi AlSultan, ICBA Chairman, at the IDB/ICBA seminar in Jeddah

During the first year of the project to diversify crop and livestock to adaptation to climate change, there were 7 farmer training events, 3 specialist workshops and 5 field days and

Participants, MOEW representative and ICBA staff at the training workshop

the project review meeting in Cairo (April). All the project staff and 170 farmers were trained in the selection of stress-adapted forage cultivars, determination of optimal seed production procedure, and crop management given climate change constraints.

In partnership with USAID, NASA and the World Bank, ICBA hosted a regional workshop on the Middle East and North Africa - Land Data Assimilation System (MENA-LDAS). Joining representatives of the World Bank, USAID, NASA and the Arab Water Council were the ICBA MAWRED project team and scientists from Morocco, Lebanon, Jordan, Egypt and Tunisia.

A workshop to initiate a project focusing on crop diversification and sustainable management of marginal land resources in three countries (Uzbekistan, Kazakhstan, and Tajikistan) in Central Asia took place in June in Uzbekistan. The goal of the project is to improve land productivity and livelihoods of poor farmers living in salt-affected and degraded areas. Representatives from two to three institutes from each country that will be working in different field areas that are affected by the various salinity problems participated in the workshop. The project is funded by the Islamic Development Bank and is being led and coordinated by ICBA. In addition to the NARS of the partnering countries, the international research centers ICRISAT and ICARDA are also participating.

In the global water sector ICBA is working towards water solutions by coordinating a Target and Solutions Group for the 6th World Water Forum in Marseilles in March 2012. The Forum, which has been held every three years since 1997, seeks to develop global awareness of water issues and promote the importance of water on the political agenda. ICBA has convened a group of water experts located in international and national centers in Australia, India, Italy, Morocco, Sri Lanka, Syria and the United States of America, who are formulating practical solutions to increase the safe use of non-conventional waters, either treated wastewater or other marginal quality water.

Participants of ICBA-ACSAD training on safe use of treated wastewater technologies in Jordan

Appendices

Sorghum field at ICBA research station in Dubai

Appendix I - 2011 Publications

Papers in refereed journals and proceedings

Khujanazarov T, **Toderich K**, Oishi S, Myagkov S, and Wegerich K. 2011. A Comprehensive Assessment of Water Resources Management of Aral Sea Basin: Challenges and ecosystem based adaptations. Proceedings of the International Symposium on Water Resources Management for Developing Countries due to Climate Change, Water Resources Research Centre, Kyoto University: 2011. 3 (29): 9-25.

Noorka IR, **Shahid SA**, Rauf S. 2011. Principal component analysis for soil conservation tillage vs conventional tillage in semi arid region of Punjab province of Pakistan. Iranian Journal of Earth Sciences 3:204-208.

Rao NK and **Shahid M**. 2011. Potential of cowpea [*Vigna unguiculata* (L.) Walp.] and guar [*Cyamopsis tetragonoloba* (L.) Taub.] as alternative forage legumes for the United Arab Emirates. Emirates Journal of Food and Agriculture 23 (2): 147-156.

Shahid SA, Taha FK, Ismail S, Dakheel A and Abdelfattah M. 2011. Turning adversity into an advantage for food security through improving soil quality and providing production systems for marginal saline lands: ICBA perspectives and approach. *In* Behnassi M, Shahid SA and D'Silva J (eds) Sustainable Agricultural Development "Recent Approaches in Resources Management and Environmentally-Balanced Production Enhancement, pp. 43-67.

Toderich K, **Ismail S** and Squires V. 2011. Participatory management of desert rangelands to improve food security and sustain the natural resource base in Uzbekistan. Proceedings of the International Conference "The pastures of Tajikistan: Challenges and perspectives", pp. 26-28.

Toderich K, **Ismail S**, Turok J and Nepesov M. 2011.Utilization of marginal quality water for agriculture in dryland areas of Turkmenistan. *In*: Science achievements and advanced technologies on reclamation of saline lands and improvement of exploitation of irrigation facilities, pp, 177-181.

Toderich K, Massino IV, Mavlyanova RF, Safarov KS, Begdullaeva T and Aralova DB. 2011. Introduction of nontraditional bioenergy crops under saline environments". *In*: Introduction of plants: achievements and perspectives. Materials of the V Republic Conference (13-14 May, 2011), pp. 18-24 (in Russian).

Books

Behnassi M, **Shahid SA** and D'Silva J (eds.). 2011. Sustainable Agricultural Development – Recent Approaches in Resources Management and Environmentally-Balanced Production Enhancement. Heidelberg: Springer.

Other publications

ICBA Annual Report 2010, Biosalinity News Vol. 12 No. 1 and 2 (English and Arabic) and project and topic brochures.

Rao NK and **Shahid M**. 2011. Asparagus: A high-value potential vegetable. Farming Outlook. 10 (1): 14-17.

Shahid M and **Rao NK**. 2011. *Salicornia bigelovii*; A versatile crop for the seawater agriculture. Biosalinity News 12 (1): 6.

Shahid SA. 2011. Food Security – Farmland Investment in Developing Countries, An Issue or Opportunity, Win-win Scenario. Farming Outlook 10(3):7-10.

Shahid SA. 2011. Food security, livestock related GHGs and world ecological footprint. Newsletter of World Forum on Climate Change, Agriculture and Food Security (WFCCAFS) 1(3):2.

Shahid SA. 2011. Linking Biosaline Agriculture to Food Security in the Gulf States. Newsletter of World Forum on Climate Change, Agriculture and Food Security (WFCCAFS) 1(2):3.

Toderich K and Massino IV. 2011. Varieties and Improved high productive lines of sorghum tested in Central Asia., 2011 CGIAR - Program Facilitation Unit (PFU), Tashkent, Uzbekistan 21p. www.icarda.org.cac

Appendix II - Audited Financial Statements

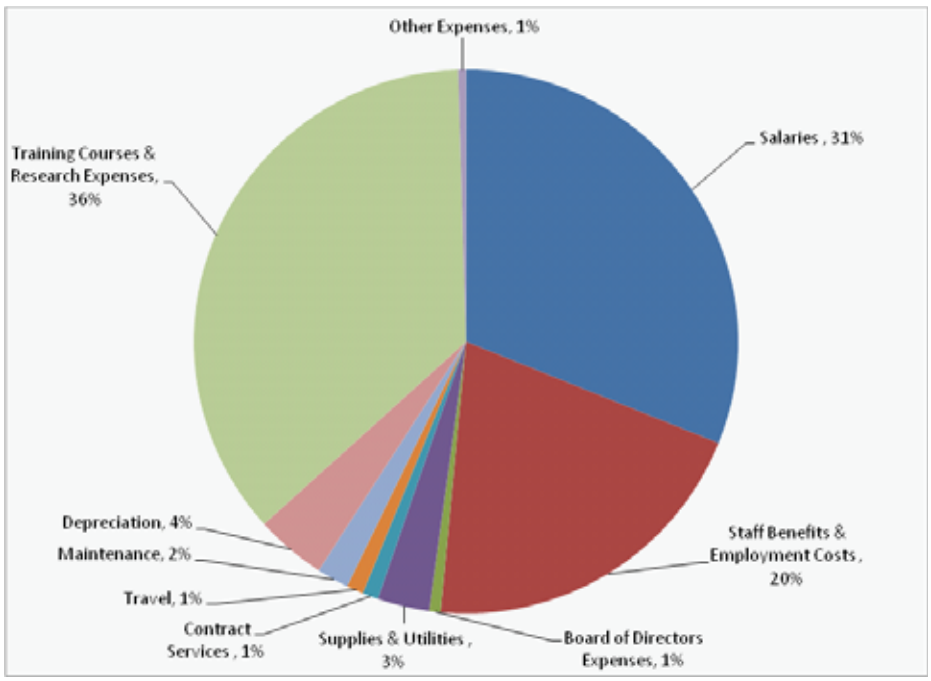
Statement of Activities

	2011	2010
Grants and contributions		
Grants unrestricted	4,623,736	4,444,081
Contributions for training courses & research	2,657,984	2,385,869
Other income	54,635	23,694
Total grants and contributions	**7,336,355**	**6,856,644**
Programs and other expenses		
Employees salaries and benefits	3,777,780	3,603,526
Expenses on training courses and research	2,657,984	2,385,869
Travel	73,438	114,958
Depreciation of property & equipment	308,471	320,729
Supplies & utilities	226,714	207,310
Maintenance	139,488	105,090
Contract services	69,087	49,969
Board of directors expenses	49,452	47,809
Other expenses	33,941	18,384
Total programs & other expenses	**7,336,355**	**6,853,644**
Excess of revenues over expenses	-	-

Statement of Financial Position

	2011	2010
Assets		
Current Assets	11,988,384	9,662,460
Property & Equipment	5,767,229	5,825,311
Total Assets	**17,755,613**	**15,487,771**
Liabilities and Net Assets		
Current Liabilities	576,264	502,355
Non-Current Liabilities	354,338	266,467
Total Liabilities	930,602	768,822
Net Assets Unrestricted	761,880	122,189
Net Assets Unrestricted Unappropriated-		
Property and Equipment	5,767,264	5,825,311
Net Assets Unrestricted Appropriated	5,760,687	4,950,882
Temporarily Restricted	4,535,215	3,820,567
Total Net Assets	16,825,011	14,718,949
Total Liabilities & Net Assets	**17,755,613**	**15,487,771**

Expenditures by Category



APPENDIX III - Major Donors

Major donors (unrestricted funding)

Ministry of Environment and Water, United Arab Emirates(MOEW)
The Ministry of Environment and Water (MOEW) endeavors to provide an optimal environment for the inhabitants of the United Arab Emirates through balanced and sustainable development.

Environment Agency-Abu Dhabi (EAD)
The Environment Agency-Abu Dhabi (EAD) is a governmental agency established in 1996 with an overall mission to protect and conserve the environment and promote sustainable development of Abu Dhabi Emirate, the capital of the United Arab Emirates.

Islamic Development Bank (IDB)
The Islamic Development Bank (IDB), established in 1975, is an international development finance institution whose purpose is to foster the economic development and social progress of member countries and Muslim communities, individually and jointly, in accordance with the principles of Islamic law.

Other donors (restricted funding)

Arab Bank for Economic Development in Africa (BADEA)
Arab Fund for Economic and Social Development (AFESD)
Australian Agency for International Development (AUSAid)
Australian Center for International Agricultural Research (ACIAR)
Dutch Ministry of Foreign Affairs (MFA)
European Union (EU)
Farmers' Services Center in Abu Dhabi (FSC)
International Fund for Agricultural Development (IFAD)
Ministry of Agriculture and Fisheries in Oman (MAF)
OPEC Fund for International Development (OFID)
United States Agency for International Development (USAID)
World Bank (WB)

Appendix IV - Board of Directors

The Board of Directors is a eight-member committee appointed by the Islamic Development Bank and the Center's host country, the United Arab Emirates.

Chairman
Mr Fawzi AlSultan
Consultant
F& N Consultancy
Safat Kuwait

Mr Abdelrahim Mohammad Alhammadi
Assistant Undersecretary
Support Services
Ministry of Environment & Water
Dubai UAE

Mr Mohammad Jamal Al-Saati
Director
Operations Policy and Services Department
Islamic Development Bank
Jeddah Kingdom of Saudi Arabia

Dr Mahmoud Solh
Director General
International Center for Agricultural Research in the Dry Areas
Aleppo Syria

Ex-officio:
Dr Shawki Barghouti
Director General
International Center for Biosaline Agriculture
Dubai UAE

H.E. Razan Khalifa Al Mubarak
Secretary General
Environment Agency-Abu Dhabi
Abu Dhabi UAE

Mr Adel Abdulla Alhosani
Director
Projects Department
Abu Dhabi Fund for Development
Abu Dhabi UAE

Dr David J Molden
Deputy Director-General – Research
International Water Management Institute
Colombo Sri Lanka

From left to right (front): Mr Abdelrahim Mohammad Alhammadi, Mr Fawzi AlSultan, Mr Mohammad Jamal Al-Saati and Her Excellency Razan Khalifa Al Mubarak; (back): Dr David J Molden, Dr William Sutton, Mr Adel Abdulla Alhosani, Dr Mahmoud Solh and Dr Shawki Barghouti

APPENDIX V - PARTNERS

Collaboration with advanced research institutes and regional/ international organizations

Abu Dhabi Food Control Authority, UAE
Arab Center for the Study of Arid Zones and Dry Lands
Centre for Built Environment, India
Centre for Ecology and Hydrology, United Kingdom
Centre of Ecohydrology, University of Western Australia, Australia
Commission for Scientific Agricultural Research, Ministry of Agriculture and Agrarian Reform, Syria
Desert Research Center, Ministry of Agriculture and Land Reclamation, Egypt
Directorate General of Agriculture and Livestock Research, Oman
Emirates Institute of Advanced Science and Technology, UAE
Food and Agriculture Organization, Italy
GRM International, Australia
Institute of Desert, Flora and Fauna, Turkmenistan
International Center for Agricultural Research in the Dry Areas
International Crops Research Institute for the Semi-Arid Tropics
International Water Management Institute
Masdar Institute, UAE
Ministry of Agriculture, Iraq
Ministry of Agriculture, Palestine
Ministry of Education, Iraq
Ministry of Environment, Iraq
Ministry of Water, Iraq
National Aeronautics and Space Administration, USA
National Center for Agricultural Research and Extension, Jordan
National Organizations
National Research Institute for Rural Engineering, Water & Forest, Ministry of Agriculture and Hydraulic Resources, Tunisia
Palestinian Water Authority, Gaza, Palestine
Private Sector
Salinity and Plant Nutrition Laboratory, Department of Horticulture, Institut Agronomique et Vétérinaire Hassan II, Morocco
Suez Environnement, France
Sultan Qaboos University, Oman
Tajikistan Academy for Agricultural Sciences, Tajikistan
U.S. Salinity Laboratory USDA-ARS
United Arab Emirates University, UAE

APPENDIX VI - Senior Staff

(as at 31 December 2011)

Director General

Dr Shawki Barghouti, Director General

Senior Technical Staff

Prof. Dr Faisal Taha, Director of Technical Programs
Dr Abdullah Dakheel, Field and Forage Crops Scientist
Dr Adla Khalaf, Research – MENA LDAS Project
Dr Berhanu Degefa, Scientist – Socio-Economist*
Dr Henda Mahmoudi, Visiting Scientist
Dr Ian McCann, Research Scientist, Irrigation & Water Management
Mr Karim Bergaoui, Modeling Researcher – MAWRED
Dr Khalil Ammar, Hydrogeologist
Dr Kristina Toderich, Plant Scientist (Tashkent, Uzbekistan)
Dr Makram Belhaj Fraj, Visiting Scientist, Agronomy
Dr Mohammad Shahid, Agricultural Engineer
Dr Nanduri K Rao, Plant Genetic Resource Scientist
Dr Nurul Akhand, Irrigation Management Scientist
Dr Rachael McDonnell, Visiting Scientist – Water Policy & Governance
Dr Shabbir A Shahid, Salinity Management Scientist/A/Manager Central Analytical Laboratory
Dr Shoaib Ismail, Halophyte Agronomist

Senior Support Staff

Ms Carla Mellor, Library Specialist/Acting Communications Specialist
Mr Ghazi Al Jabri, Communications Coordinator
Mr Ibrahim bin Taher, Government Liaison Officer
Ms Irene Galang Bolus, Senior Accountant
Mr Jamal Telmesani, Facilities Supervisor
Mr Tarek Attia Ali, IT Specialist

* Started in 2011

APPENDIX VII - ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
ACSAD	Arab Center for the Study of Arid zones and Drylands (Syria)
ADFCA	Abu Dhabi Food Control Authority (United Arab Emirates)
AFESD	Arab Fund for Economic and Social Development
BADEA	Arab Bank for Economic Development in Africa (Khartoum, Sudan)
CAC	Central Asia and Caucasus
CAL	Central Analytical Laboratory (ICBA)
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo/International Maize and Wheat Improvement Center (Mexico)
CK	Capacity Building and Knowledge-sharing (ICBA program)
EAD	Environment Agency - Abu Dhabi
FSC	Farmers' Service Center (UAE)
GBN	Global Biosaline Network
GIS	Geographical Information System
GR	Genetic Resources Program (ICBA Program prior to 2008)
GRACE	Gravity Recovery and Climate Experiment (UAE)
GRM	GRM International Pty Ltd (Australia)
GSM	Mobile Phone Network
ICARDA	International Center for Agricultural Research in the Dry Areas (Syria)
ICBA	International Center for Biosaline Agriculture (UAE)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (India)
IDB	Islamic Development Bank (Kingdom of Saudi Arabia)
IFAD	International Fund for Agricultural Development (Italy)
ILRI	International Livestock Research Center (Kenya)
INBA	Inter-Islamic Network for Biosline Agriculture
IWMI	International Water Management Institute (Sri Lanka)
IWS	Integrated Water Resource System (ICBA program)
LDAS	Land Data Assimilation Systems
MASDAR	Abu Dhabi Future Energy Company (UAE)
MAWRED	Modeling and Monitoring Agriculure and Water Resources Department
MI	Masdar Institute (United Arab Emirates)
MENA	Middle East and North Africa region
MOEW	Ministry of Environment and Water (UAE)
MQ	Marginal Quality Water Program (ICBA program)
NARS	National Agricultural Research System

NASA	National Aeronautics and Space Administration (USA)
NCARE	National Center for Agriculture Research and Extension (Jordan)
OIC	Organization of the Islamic Conference
OFID	OPEC Fund for International Development
OSS	Oman Salinity Strategy
OPEC	Organization of the Petroleum Exporting Countries
PMS	Production & Management Systems Program (ICBA Program until 2008)
SSA	Sub-Saharan Africa
SQU	Sultan Qaboos University (Oman)
TWW	Treated Wastewater
UAE	United Arab Emirates
WANA	West Asia and North Africa
YEMA	Yeast extract-mannitol water

Above: Collection of field crops seeds
Back cover: Date palm trees at ICBA research station in Dubai

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