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To learn more about the International Center for Biosaline Agriculture (ICBA) and its role in agriculture in marginal environments, please download the ICBA Capability Statement brochure at http://biosaline.org/corporatepublications.aspx

Word from ICBA Director General

West Asia and North Africa (WANA) is one of the most water-scarce areas of the world. Prime irrigated agricultural lands in this region are suffering from increased salinization due to lack of suitable irrigation and drainage methods. Recent changes in climate patterns have further negatively affected the natural and agro-ecosystems in the region and increased the vulnerability of the people dependent on these resources for their livelihood.

The past decades have seen an increasing number of farmers abandon their lands or face very low productivity.

In response to these challenges, the International Center for Biosaline Agriculture (ICBA), along with partners from seven countries (Egypt, Jordan, Oman, Palestine, Syria, Tunisia and Yemen) launched in 2010 the 'Adaptation to Climate Change in Marginal Environments' (ACCME) project that aimed to introduce resilient forage and crop production and management systems that are biologically suitable for use of saline and wastewater, so as to bring back and increase productivity of such degraded and lost lands.

Throughout the project, intensive work was carried out with the farmers to ensure the right selection of seeds and their ability to multiply the adapted crops and to maximize the usage of alternative water resources and apply best farm management practices and improve post-harvest techniques, which enhanced the skills and income of about 2,000 farmers who took part in the ACCME scaling-up activities.

A prime component of the ACCME project was enhancing the skills and knowledge of poor rural women, as previous studies found that due to the social constraints on women in the region, they have limited exposure to new knowledge and techniques. The additional income from the livestock products women generate as a result of Farmers' Field Schools directly contributes to improving poor household livelihoods and women's status within the communities.

We would like to extend our special thanks to our key donors (International Fund for Agricultural Development, Arab Fund for Economic & Social Development, OPEC Fund for International Development, and Islamic Development Bank), whose support was crucial as it provided the resources needed to bring back degraded lands into production in the targeted regions. I look forward to meeting the various stakeholders from this project this September in Cairo, where we shall present the final outcomes of the ACCME project and discuss different options for sustaining this initiative and its positive impact on the region.

ICBA will continue advocating for the use of more resilient agricultural systems appropriate in marginal conditions that improve livelihoods of small-scale farmers dominant in marginal environments in WANA and globally.

Sincerely yours,
Ismahane Elouafi

in this issue...

Editors
Abdumutalib Begmuratov
Setta Tutundjian
Shoaib Ismail

Layout and design
Charbel El Khouri

Illustrations
Charbel El Khouri

Staff writers
Charbel El Khouri
Ghazi Al-Jabri

Photo credits
Charbel El Khouri
Ghazi Al Jabri
Shagufta Gill

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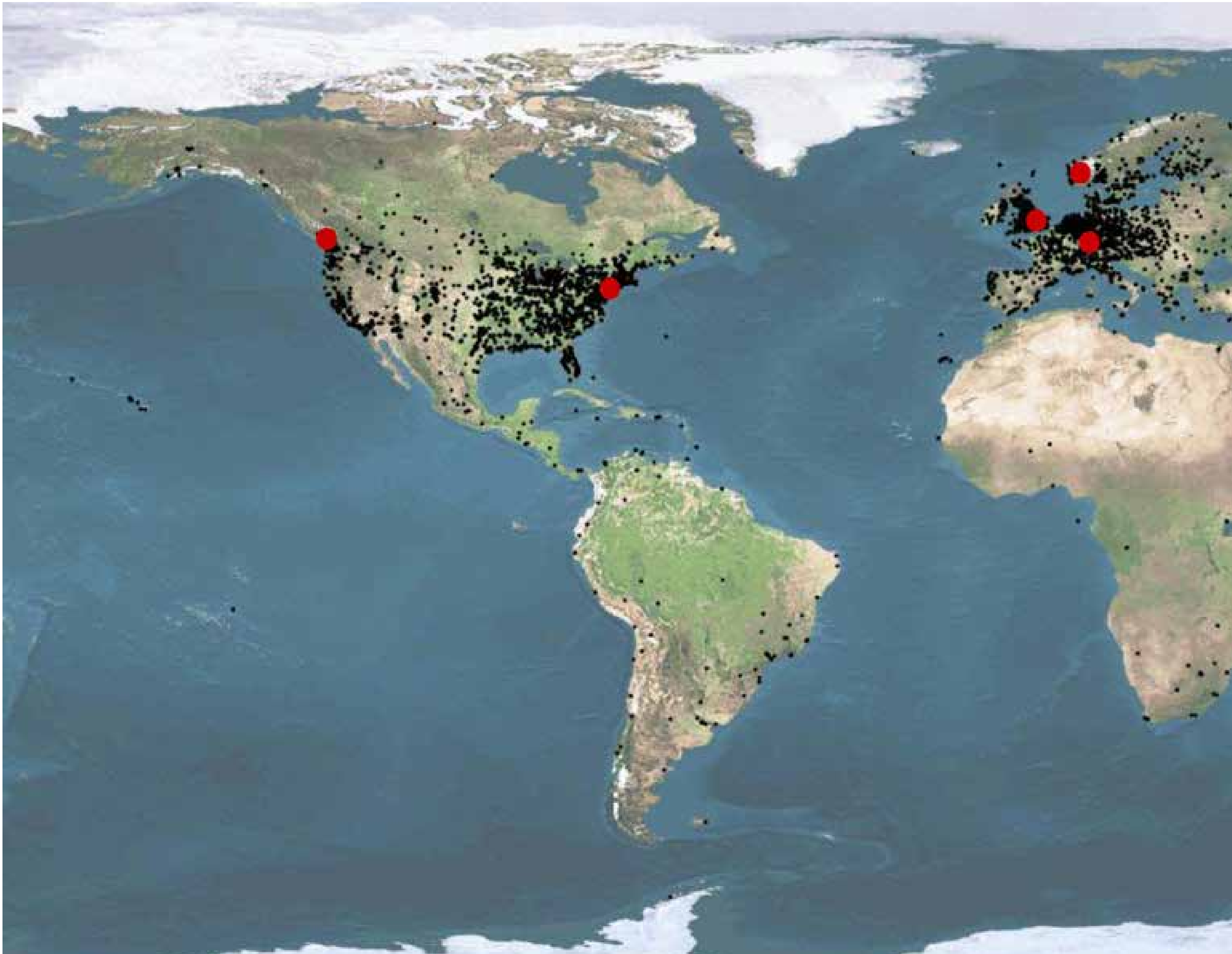
Citizen science sheds light on the role of climate change in the Levant drought of January/February 2014

The discussions on climate change seem to always be about droughts and floods, and changes in temperature and rainfall that will happen in the future. Whilst there is no doubt the impacts are likely to be more severe in the coming years, it is also important to acknowledge that the effects of increased greenhouse gas emissions are happening today as well. The lack of snowfall in Lebanon, the drying up of streams and the early failure of crops in many parts of the region were on-the-ground evidence of the severity of the drought during the critical wet season of January and February.

Scientists at Oxford University's Global Climate Science Program have collaborated with the ICBA Climate Modeling and Adaptation team under the USAID-funded program "Management of Agriculture and Water Resources Development" (MAWRED) to investigate the droughts in the southern Levant region at the end of 2013 and early 2014. The results of the joint research were recently presented at the annual European Geophysical Union in Vienna, Austria, and provide an important insight into current and future drought trends.

To fully understand how the drought varied from the normal climate of the areas, large samples of data are required. All too often direct observational inferences of extreme events are highly uncertain, because the sample size of available data is too small. To overcome this, the researchers used climate models to run many thousands of simulations of 'possible' climate, thereby sampling internal climate variability. This would normally take months or years to complete the model runs but in this work the scientists harnessed the power of the citizen science "weather@home" project at Oxford, which allowed them to run many thousands of simulations for the year 2014 over the



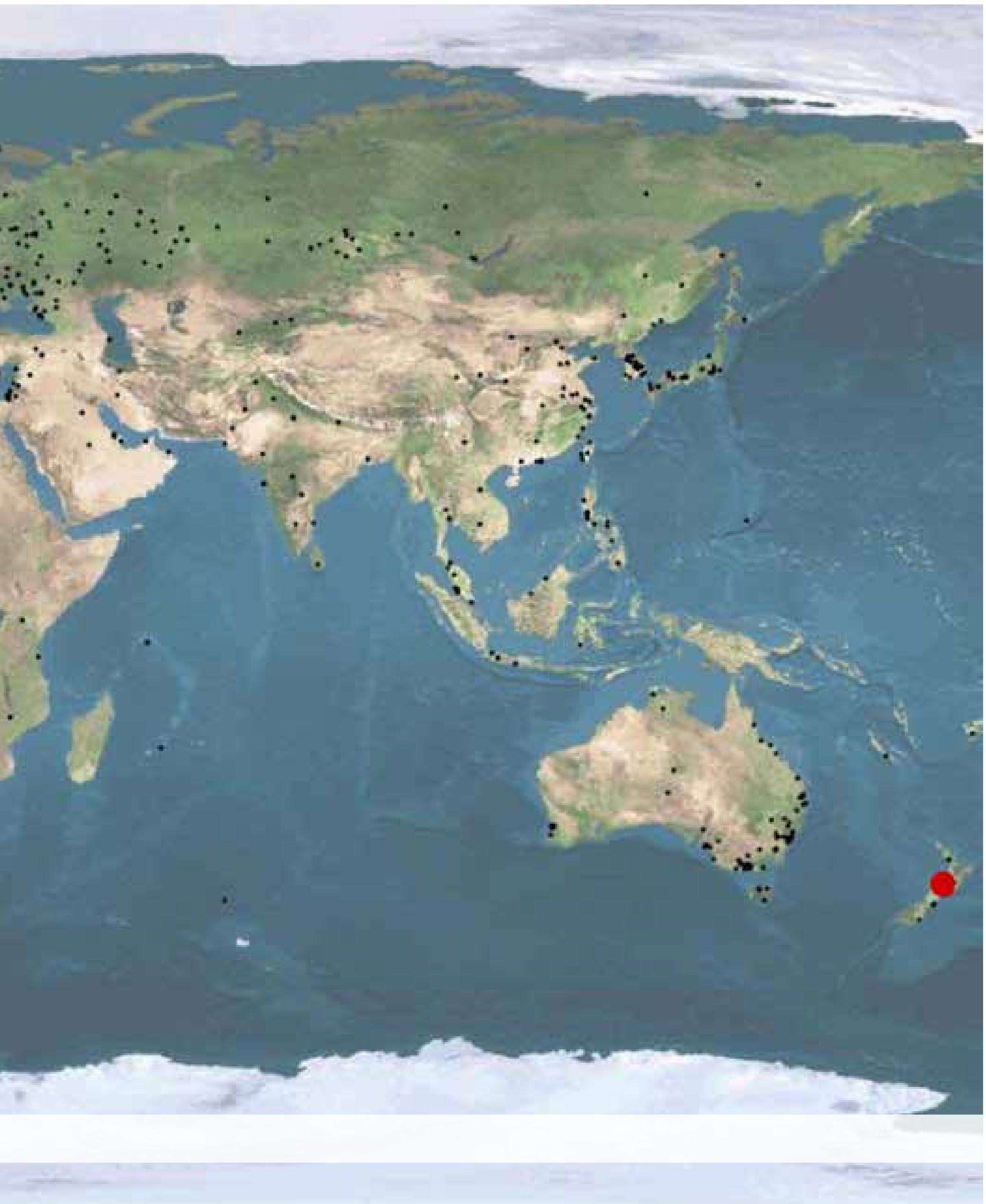
Climateprediction.net: the world's largest climate modeling facility ~ 100,000 volunteers (see black dots on map) in 130 countries; upload servers locations in red.

Levant region (http://www.climateprediction.net).

"Weather@home" is a volunteer computing, climate modeling project where Oxford runs climate models on thousands of people's home computers across the world to help answer questions about how climate change is affecting our world, now and in the future. The black dots on the map show how global the citizen scientist base is. Running the models on computers when people are not using them makes it possible to simulate the climate for the current and future conditions producing predictions of temperature, rainfall and the probability of extreme weather events. The more models that are run, the more evidence may be gathered on climate change. The system in effect creates the world's largest climate modeling experiment.

If you would like to be part of this important work, please register at http://www.climateprediction.net/getting-started/

In the study on the southern Levant, the researchers simulated two possible climates under 2014 conditions: (i) an experiment with all known natural and anthropogenic climate forcings (actual conditions), and (ii) an experiment with only natural climate forcings (natural conditions) so that they could understand how much the drought could be attributed to natural variability or to climate change. All anthropogenic and natural conditions follow the recommendations outlined by the Inter-governmental Panel on Climate Change (IPCC), AR4. For the actual conditions experiment, the sea surface temperatures (SSTs) were taken from the OSTIA observations. For the natural conditions experiment, the anthropogenic signal was taken out of the OSTIA SST patterns, to leave only the naturalized SST pattern.



From the citizen computing more than 5,000 individual model outputs were generated for the natural run (shared between 11 different SSTs from different GCM's) and 2,500 members of the actual runs (using HadRM3P). The data generated was sent to ICBA where various analytical methods were used to compare thousands of model outputs. Of particular use was the technique called Fraction of Attributable Risk (FAR; Allen, 2003), defined as: FAR = 1 - (pnat/pact), where pnat is the probability of rainfall deficit as low as, or lower than the observed 2013/14 monthly values occurring in the natural conditions scenario. And pact is the same but for the actual conditions.

From these analyses the researchers showed that the event was unprecedented for the critical January-February period throughout the length of reliable observations, and through modeling the event they were able to highlight that it was made more likely due to anthropogenic climate change. This wet season is when reservoirs and groundwater systems are recharged and snow pack accumulates to support summer stream flows. The consequent external stresses that came with this drought such as crop failures, degraded grazing land and the over-pumping of non-renewable ground water suggests that water and agriculture authorities in the southern Levant should have additional fail-safe options in place going into the future.

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Written by Dr. Rachael McDonnell

The net house: a sustainable system to improve water and energy use efficiency under marginal conditions of the GCC countries

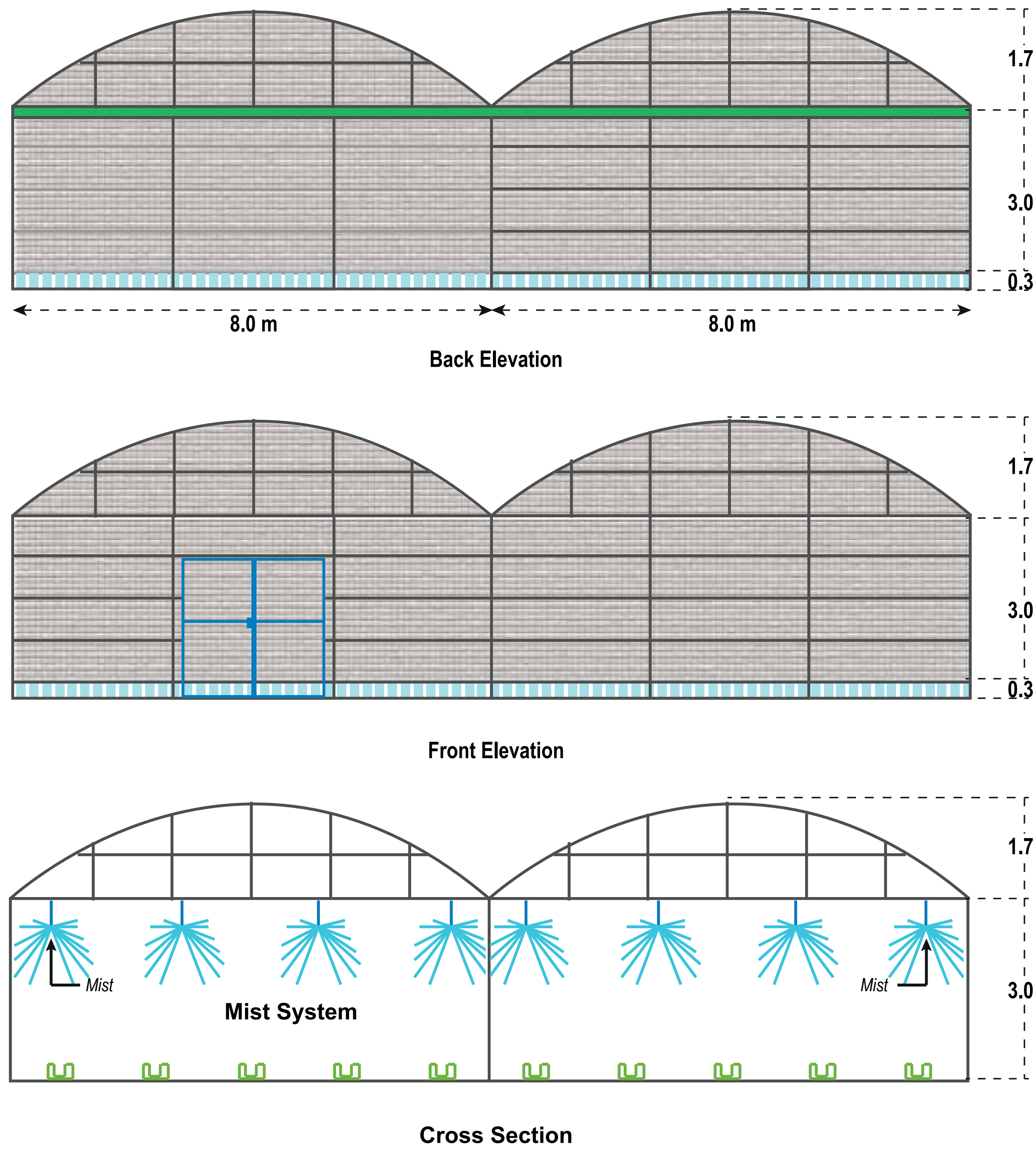

Figure 1: Technical specification of the net house

Due to the region's harsh climate, scarce water resources and poor-quality land resources, protected agriculture (PA) has a significant role in the Gulf Cooperation Council (GCC) countries' agricultural development. Currently the region counts for more than 12,000 ha of PA mainly consisting of greenhouses where fan-pad systems are used as cooling systems which lead to large energy and water consumption (Al-Nasser and Bhat 1998). Moreover, protected cultivation can be environmentally unfriendly, especially in an area with a large concentration of greenhouses. Therefore, the increase in the PA area in GCC countries, the water scarcity and the unsustainable fossil energy has created a need for developing sustainable protected agriculture using low-cost and low-tech systems with less water and energy consumption helping at the same time to have more or less the same productivity than the cooled greenhouse.

Through our research at ICBA, we are trying to develop the net house system as a low-cost alternative of protected agriculture

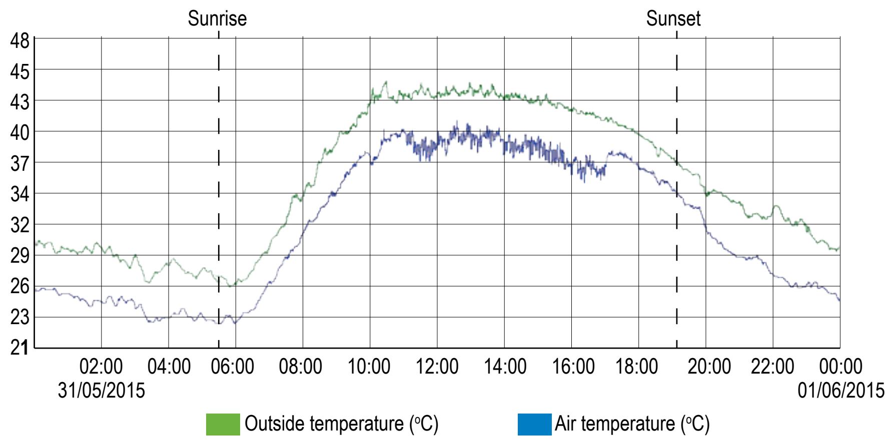

Figure 2: Outside and inside net house temperature (°C)

with less water and energy consumption. An experiment started in March 2015 with cultivating cucumber (Variety ZECO) under soilless conditions (2/3 sand + 1/3 peat as substrate).

The net house area is 560 m² with two spans, each has a width of 8 m, a length of 35 m and a height of 5 m (Figure 1). The net house is equipped with a mist system consisting of nozzles with an hourly discharge of 32 liters. In order to reduce the temperature and evaporation, a shade net was installed above the mist system. The used net is an insect-proof net with dimensions equal to 1 x 0.5 mm. The soilless system consisted of a polyester pot filled with substrates mixing 2/3 sand and 1/3 peat. Irrigation is applied in a close cycle where drainage water is collected, then treated before being reused again. Fertigation is applied through a computer-controlled Hortimax system using a modified HOAGLAND solution as a nutrient solution. The mist or fogging system is controlled by computer where the temperature and humidity are set at 29 °C and 50% respectively. The start conditions of the mist system set in the Hortimax system are:

- Minimum air temperature for fogging: 15 °C
- Minimum fogging duration: 20 seconds
- Maximum fogging duration: 30 seconds
- Minimum pause between 2 fogging cycles: 300 seconds
- Start fogging at 10:00 a.m
- Stop fogging at 17:00 p.m

Figure 2 shows the outside and inside net house temperature variation during the day. It is obvious that during the fogging period (10:00-17:00) the mist system with the shade net reduced temperature by about 6 °C. The shade net without a mist system reduced temperature by only 3 °C. Under hot climate it is the high temperatures which cause more damage to cucumber especially when temperature exceeds 40 °C, which leads to plant wilting and water loss. An appropriate irrigation management technique can reduce heat damage to cucumber plants.

Table 1 presents the results in terms of water and energy consumption, yield, water and energy use efficiency. The data indicates that a cooling system consumes more or less the same amount of water used for irrigation and 34% of total energy whereas an irrigation system consumes 66% of total energy. It was shown that 1 kWh of energy is used to produce about 20.32 kg of cucumber and 1 m^3 of irrigation water and cooling water is required to produce 25.88 and 27.66 kg of cucumber respectively.

Table 1: Energy and water use efficiency of cucumber cultivated under net house

S.N.	Parameter	Unit	Value
1	Total cooling energy	kWh/m²	0.15
2	Total cooling water	l/m²	321.41
3	Total irrigation energy	kWh/m²	0.28
4	Total irrigation water	l/m²	343.49
5	Total consumed energy	kWh/m²	0.44
6	Total consumed water	l/m²	664.90
7	Yield	kg/m²	8.89
8	Energy use efficiency	kg/kWh	20.32
9	Energy water use efficiency	kg/m³	25.88
10	Cooling water use efficiency	kg/m³	27.66

It was estimated that the electrical energy requirements for ventilation of a greenhouse located in the Mediterranean are about 70,000 kWh per greenhouse ha (Baudoin et al. 2013). However, this data is for only a short period where cooling is needed. In the GCC countries for a crop which grows in 3 to 4 months like cucumber, it is estimated that the total energy consumed by a closed cooled greenhouse is equal to 159,000 kWh per greenhouse ha (unpublished data). However, an equivalent hectare of net house consumes only 1,525 kWh, which represents less than 1% compared to a cooled greenhouse.

In the light of the presented data, the net house could be a sustainable protected cultivation system with high water and energy use efficiency in the harsh environment of the GCC countries. However, it is recommended that most vegetables under the net house are cultivated from October to May when temperature is not above 40 °C. Combining the shade net and mist system can serve as an efficient cooling system where inside net house temperature can be reduced by 6 °C avoiding yield and growth reduction.

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Written by: Dr. Choukr-Allah Redouane and Dr. Hirich Abdelazi

Evaluating the efficiency of microbial soil enhancer in improving biomass yield for Quinoa production in sandy soil

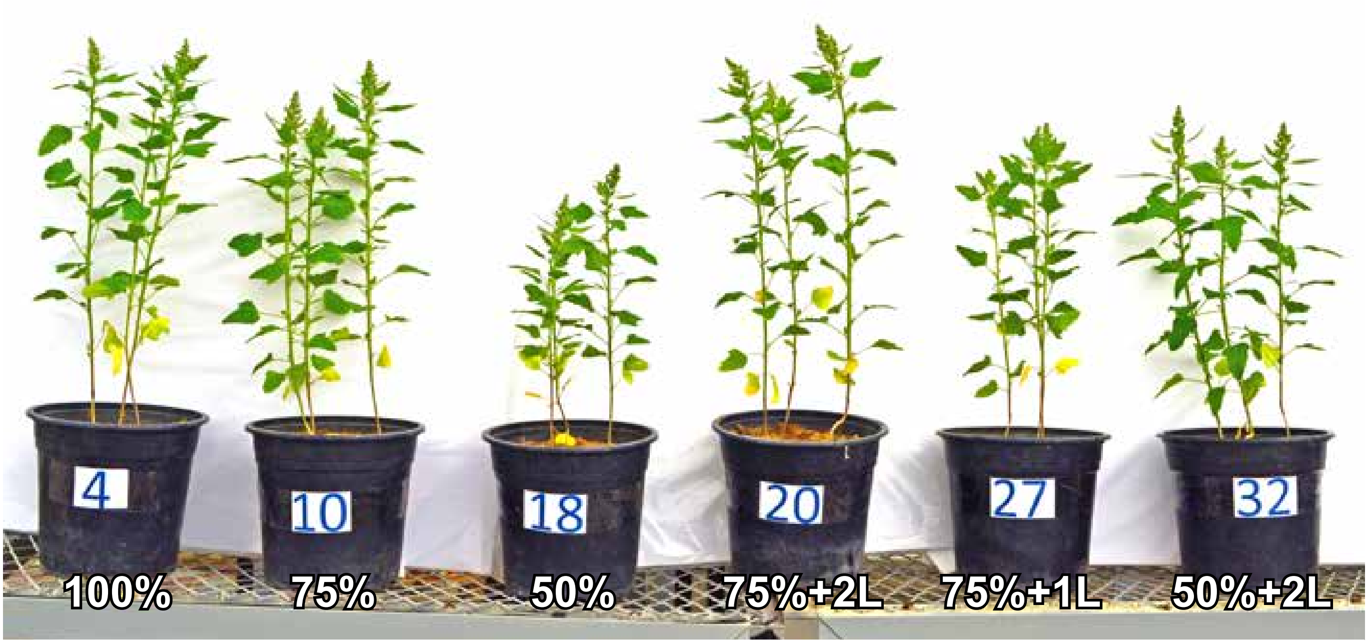

Figure 1: Pot experiment set-up

Soils in the UAE are generally sandy and marginal in terms of supporting plant growth. An important feature of such soils is their lack of appropriate structure, thereby making them amenable to loss of nutrients through leaching. Amendment with organic matter, particularly composts, can help build soil structure, improve use efficiency of fertilizer nutrients, and improve crop productivity while being more environmentally-friendly than through using chemical fertilizers alone. The benefits of organic amendment can significantly be enhanced through the use of effective microorganisms (soils in low organic matter lack the numbers and diversity of microorganisms that is characteristic of a healthy soil) that not only decompose organic matter but produce aggregation-adhesion macro-molecules. The result is an improved soil structure and build-up of stable humus content of the soil.

The microorganisms can be introduced into the soil through the application of biofertilizers or soil enhancers. A variety of such soil enhancers can be found on the market. One such product is Bontera, a liquid product of Flozyme Inc., USA. It contains naturally-occurring microbes along with organic acids that work together to promote plant health and improve soil quality and productivity. This product has been tested under greenhouse and field conditions following a cooperative agreement between ICBA and Flozyme supervised by Dr. A. Alshankiti. Quinoa was selected as the test crop for being protein-rich pseudo-cereal with high nutritional value. The protein quality and quantity in quinoa seed is often superior to that of more common cereal grains. It is higher in lysine than wheat and is considered well-balanced for human and animal nutrition. Besides these characteristics, Quinoa is suited to an arid environment like that prevalent in the United Arab Emirates.

Objective

To assess the effectiveness of Bontera for biomass production and reducing the amount of fertilizer inputs.

Treatments applied were

1. Compost @ 44 t/h + NPK 100% (desired rate of NPK application)
2. Compost @ 44 t/h + NPK 75%
3. Compost @ 44 t/h + NPK 50%
4. Compost @ 44 t/h + NPK 75% + Bontera @ 2L/hectar
5. Compost @ 44 t/h + NPK 50% + Bontera @ 2L/ha
6. Compost @ 44 t/h + NPK 75% + Bontera @ 1L

A pot experiment was conducted in the greenhouse (Nov 2014-Feb 2015) and soil moisture was maintained at field capacity throughout the experiment. There were six treatments and six replications. The plants were sprayed twice a week with 1:500 (Bontera:water) solution. After eight weeks three replications were harvested and data recorded on plant height and fresh/dry biomass including reproductive and vegetative portions. After eight weeks the rest was harvested.

Results and discussion

The results revealed the improvement of fresh biomass of Quinoa with the application of Bontera (Figure 1 and 2). It showed better impact on the spike weight (reproductive part) relative to the stalk and leaves.

It was found that the use of 2L Bontera along with 75% chemical fertilizer can have better results when 100% fertilizer was applied. Under such treatment an increase of 30% biomass was recorded. Bontera is a mixture of naturally-occurring microbes along with organic acids that work together to promote plant health and improve soil quality and productivity, and as a result increase in biomass is expected as microorganisms contained in biofertilizers have multiple beneficial effects on soil

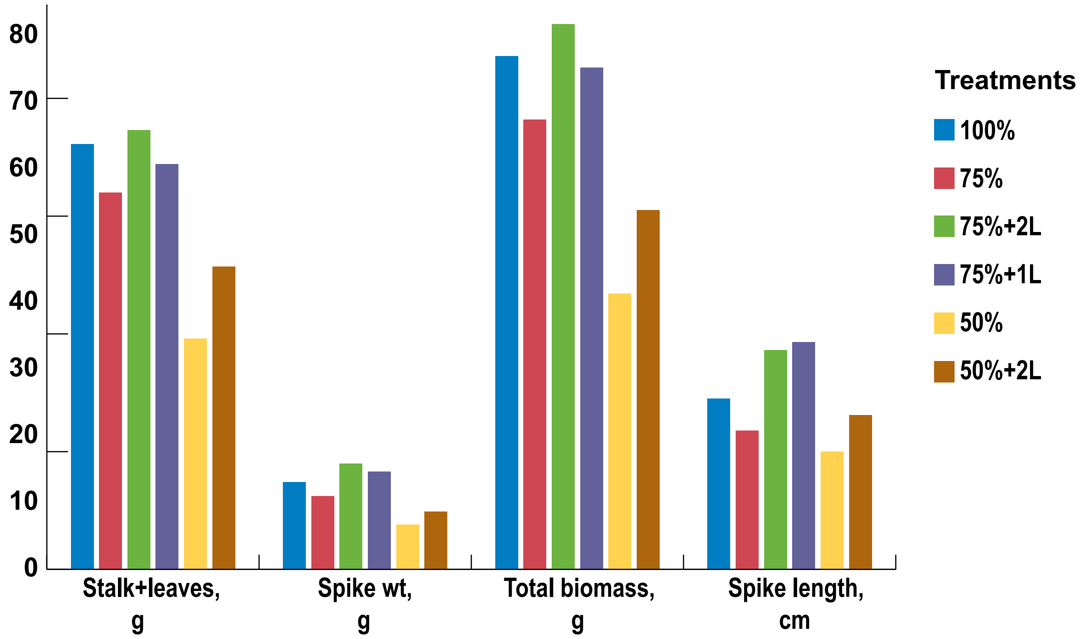

Figure 2: Fresh biomass and spike length as affected by fertilizer application and Bontera. Notations "%" and "L" in the legend define % of standard NPK rate and liters of Bontera applied per hectare equivalent.

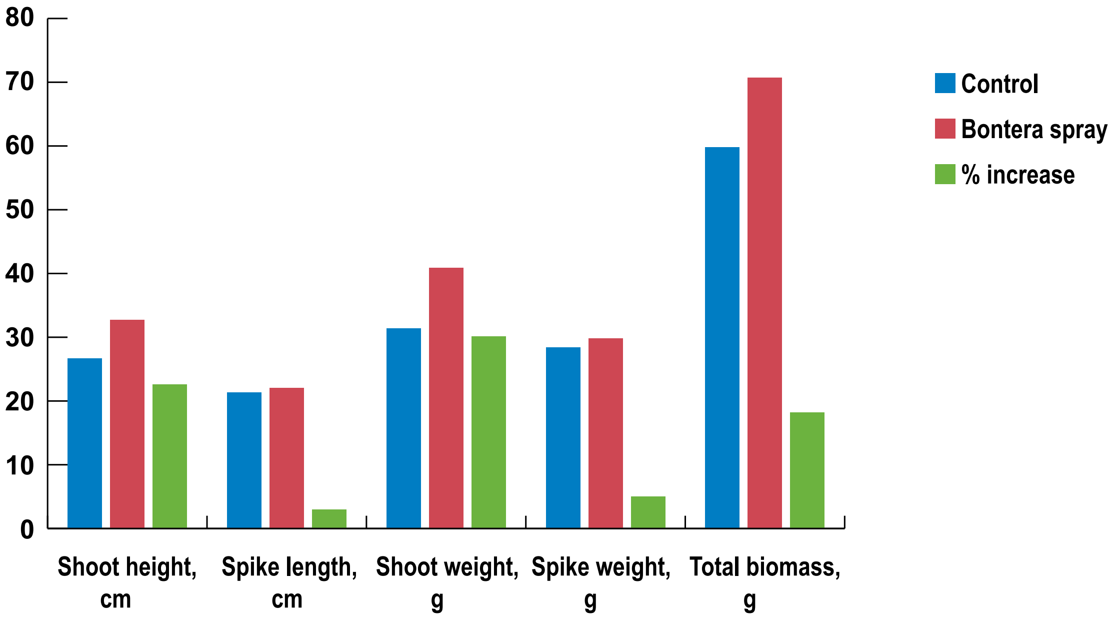

Figure 3. Effect of Bontera foliar spray on different plant growth parameters of Quinoa grown under greenhouse conditions; % increase due to Bontera is also shown

health and crop productivity (Bashan, 1998; Milošević, 2003, Mohammadi and Sohrabi 2012). Gomaa (2013) reported maximum effect on plant height, number of branches, leaves, inflorescence and dry weight of Quinoa with the combined application of chemical fertilizer and microbial fertilizer (nitrobin), which supports the present findings.

From the present study it is concluded that the use of Bontera as a soil enhancer has the potential to improve crop yields under marginal soil conditions. Foliar spray of Bontera was better than soil application. However, under optimum soil conditions, Bontera could prove highly beneficial when applied to soil.

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Written by Dr. Shagufta Gill and Dr. Abdullah Alshankiti

Saving fresh water resources through cultivation of salt-tolerant forage grasses: seasonal and genotypic variations

Salt-tolerant forage grasses, Cenchrus ciliaris *L., experiment at ICBA*

Perennial grasses are one of the most important components of the farming system in the Gulf region. Traditionally, grasses meet a large percentage of the demand for green feed in the region. Rhodes grass (*Chloris gayana*) is the most common perennial forage grass in the region. However, due to their high water requirements and reduced yields caused by increases in soil and irrigation water salinity, perennial grasses are targeted by governments and international research authorities to be replaced by less water-demanding forage grasses. Alternative perennial forages that require less water for irrigation (even low quality saline water) are being recommended as an alternative to the dominant Rhodes grass. Buffel grass (*Cenchrus ciliaris* L.) is an important perennial forage grass which belongs to the family Poaceae. It produces rhizomes and is native to the Arabian Peninsula. It has sufficient salt tolerance potential and can be grown on marginal soils and in water-scare conditions.

Cenchrus ciliaris L. is a very good pasture grass for hot and dry regions in the tropics and sub-tropics and is mainly cultivated for permanent pastures in Africa, Australia and Asia (Arshadullah et al. 2011). It is the most drought-tolerant of the commonly sown grasses in arid areas and can be found in environments with annual rainfall as low as 100 mm. In such places, it gives the best results under irrigation, if it is available, since it has high water use efficiency (Osman et al. 2008). Buffel grass, C_4 species, is nutritious and valued for its production of palatable forage and intermittent grazing. Yield of some genotypes makes it a good forage for the summer and winter cropping season. The grass is fed green and can also be turned into silage. The present work is part of an extensive screening and selection program targeting the identification and evaluation of salt-tolerant *C. ciliaris* accessions (160 accessions were evaluated in a pot trial for salinity tolerance potential; they were screened and selected previously from a global collection of 800 accessions received from the United States Department of Agriculture, local landraces and commercial varieties). An improved salinity tolerance trait of a particular genotype permits the conservation of fresh water and its use for higher value purposes, providing both ecological and economic benefits essential for sustainable agriculture in dry lands (Keating et al. 2010).

The initial step in the development of salt-tolerant cultivars is to identify salinity tolerance potential within the crop and, when available, within its wild relatives. ICBA's program aims to identify superior genotypes for both food and forage production under arid conditions. These genotypes should be characterized by high productivity under saline conditions, thereby improving agricultural productivity and sustainability in marginal environments. Forty genotypes of *Cenchrus ciliaris* L. were evaluated in a field trial laid out in a split-plot design with three replications. The irrigation treatments consisted of three salinity levels with EC_w 5, 10 and 15 dS/m and supplied to the field plots through a drip irrigation system. The plots measuring 0.5 m x 4 m, (for a plot area of 2 m^2) were established and planted manually with a row spacing of 0.5 m to enable manual weeding. The standard agronomic procedure was used to collect growth and yield data from two middle rows within each plot (Al-Dakheel et al. 2015). The plots were harvested at the heading stage and fresh (FW) and dry biomass (DW) yield were obtained and expressed as t/ha. The experiment was carried out for five consecutive years and the average five harvests were achieved per year. Analysis of variance and General Linear Model (GLM) was used to assess the effect of salinity with the limit of statistical significance set as p = 0.05 using the SPSS 17.0 statistical program.

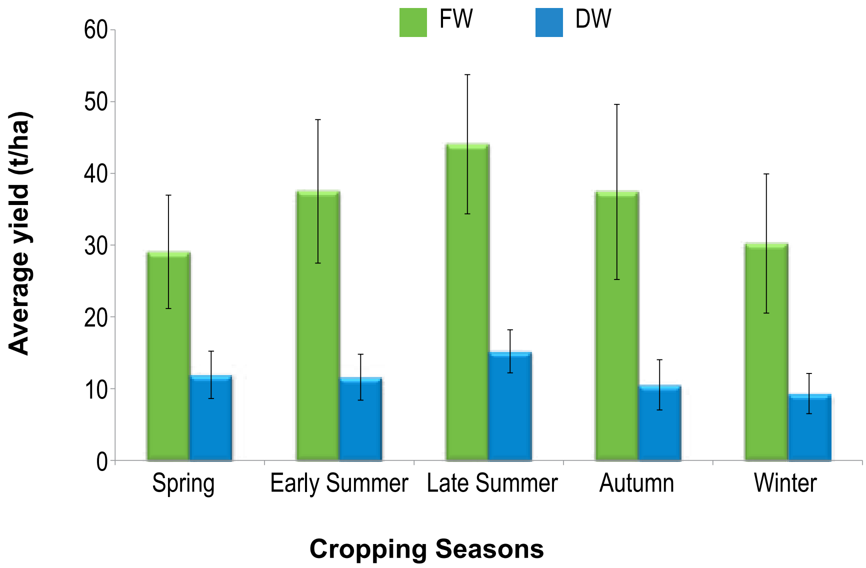

Figure 1: Relationship between season and average yield/harvest (fresh and dry weight, FW, DW) (t/ha) in Cenchrus ciliaris *L. (average yield over all the years at all salinity levels).*

Genotypic performance and yield range: The average total annual yield in *C. ciliaris* genotypes ranged from 98.0 - 353.0 t/ha at low salinity (5 dS/m), 78.0 - 269.0 t/ha at medium (10 dS/m) and 73.5 - 225.5 t/ha at high salinity levels (15 dS/m). The annual DW yield was in the range of 34.5 - 106 t/ha at 5 dS/m salinity level, 26.5 - 90.5 t/ha at medium salinity (10 dS/m) and 24.5 - 73.0 t/ha at high salinity (15 dS/m). Nawazish et al. (2006) found that shoot dry weight was severely affected in the *C. ciliaris* ecotype from Faisalabad, where it decreased from 29.83 to 8.02 g. The ecotype from the Salt Range region showed a considerable increase in its root fresh and dry weights accompanied by much less reduction in shoot fresh and dry weights as compared to that from the Faisalabad region.

Seasonal variation: The mean fresh and dry weights in the highest production season (late summer harvest) were 44.06 and 15.20 t/ha respectively, followed by early summer (37.49 and 11.59 t/ha) and autumn harvest (37.41 and 10.53 t/ha) (Figure 1). Higher fresh and dry biomass yields in the summer season are due to a prolonged growth period and more optimum growth conditions. In winter the biomass production was lowest with mean FW 30.23 t/ha and DW 9.31 t/ha. However, the dry matter percentage in the winter growth (spring harvest), on average, for all genotypes was higher than other seasons (28-34% vs. 41%) (Figure 1). Such high dry matter percentage compensated for the lower total fresh biomass production. Shinde et al. (1998) found that dry matter yield of pasture was highest during winter and lowest during monsoon: the annual mean was 2,276 kg/ha and *Cenchrus ciliaris* constituted 73%, 87% and 36% of the vegetation cover during monsoon, winter and summer respectively. Moreover, Kaleem et al. (2010) reported better capture and utilization of temperature, light, photoperiod and soil moisture during spring than in autumn for crop growth and yield attributes.

Stable and high yield genotypes: The average DW yield in the top 5 best-performing and lower 5 genotypes was 98.9 t/ha and 41.7 t/ha (5 dS/m), 82.5 t/ha and 30.8 t/ha (10 dS/m), 66.8 t/ha and 26.3 t/ha (15 dS/m), respectively (Figure 2b). Within each salinity level, there is a good chance of selecting the genotypes, based on their relative performance (DW). Several accessions from the top 5 selection with high FW yield potential are of particular

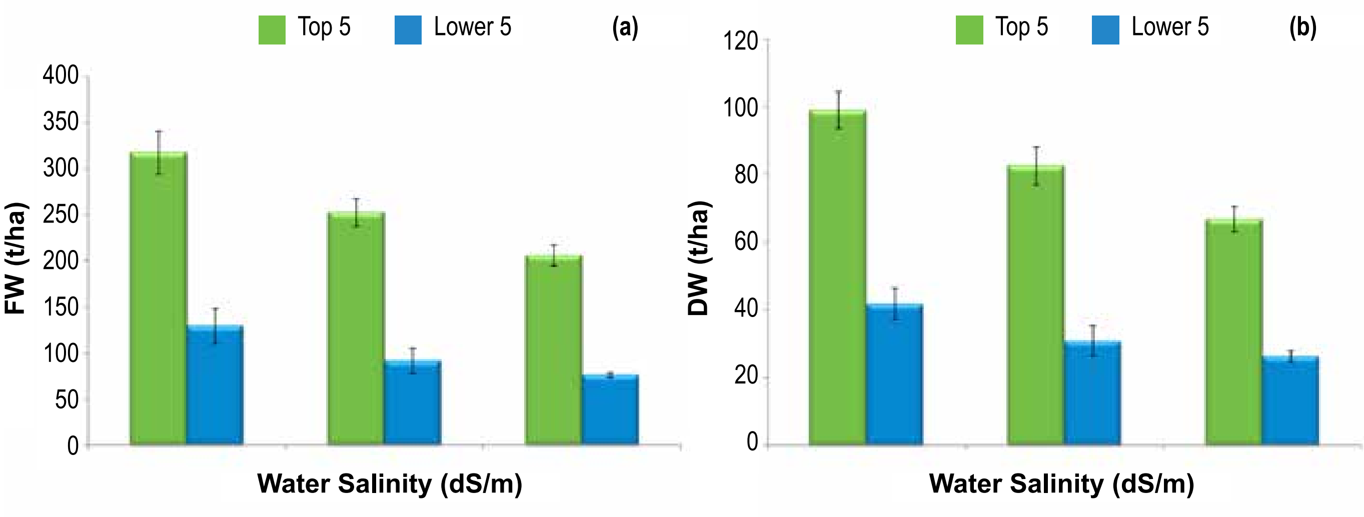

Figure 2: Impact of saline water (5, 10, 15, dS/m) on average annual yield performance (FW, DW) (t/ha) of top 5 and lower 5 performing Cenchrus ciliaris *L. genotypes. *Data is average of top 5 and lower 5 genotypes at each salinity level.*

Harvesting of Cenchrus ciliaris *L. at ICBA research station*

interest as a forage resource in irrigated salt-affected agro-ecosystems for livestock and are highly suitable for arid and semi-arid regions. Genotype 37 (Grif 1619 from Pakistan) was the high DW producing accession at all salinity levels. Other genotypes like 38 was high dry biomass producing at low (103.5 t/ha) and medium (76.5 t/ha) salinity but at high salinity, it was less stable and its dry biomass declined by more than 56% (45.5 t/ha). Another accession "17" was among the top ten genotypes at low salinity (5 dS/m) but its DW yield decreased at medium and high salinity displaying a classical pattern of a salinity sensitive genotype. Contrary to such pattern, genotype 12 was ranked 16 among the forty genotypes at low salinity, while at medium and high salinity it ranked among the top 5 highest genotypes in dry biomass yield displaying better salt-tolerance (data not shown).

In conclusion, the study showed the existence of a wide genetic diversity among the Cenchrus accessions. Among the forty accessions (Accession No 37, 38, 2, 12) were identified as salt-tolerant, high-yielding and stable genotypes at various salinity levels. These genotypes hold good salt tolerance potential and can be grown to enhance farm productivity in saline conditions in arid and semi-arid environments.

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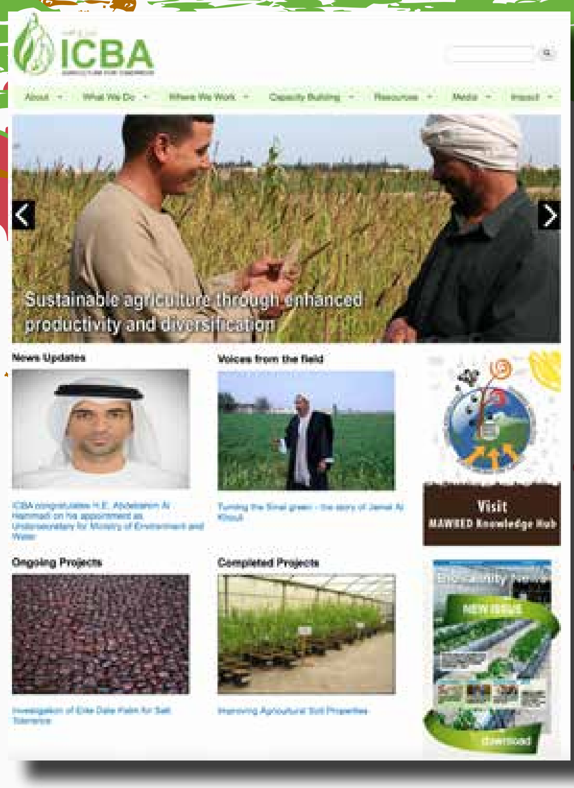
Written by Dr. Abdullah J. Al-Dakheel and Dr. M. Iftikhar Hussain

NEW ICBA **Website**

WWW.BIOSALINE.ORG



The new website highlights the latest projects, findings and advancements for agriculture in marginal environments. ICBA's new website aims to become a useful tool for researchers, extension workers, decision makers, legislators and farmers. It is a gateway to share with you all what we are doing at our research center, making sure that information reaches our stakeholders faster than ever before.

Our ability to work together and to share our knowledge will determine our success.

We would love to hear your feedback and suggestions.

Please visit us at **www.biosaline.org**


CODRA project delegation visiting the ICBA research station in Dubai; archive pricture from February 2015

Partnership base of the CODRA project expanded

In May 2015, partnership agreements were signed with three national agricultural research system (NARS) centers to collaborate on the "Mapping agricultural communities vulnerable to the impact of climate change and enhancing their livelihood in selected countries of MENA and SSA regions (CODRA)" project. These include the National Center for Agricultural Research and Agricultural Development (CNARDA), the Lebanese Agricultural Research Institute (LARI) and the National Office of Meteorology (ONM).

To date the CODRA project, in partnership with the NARS of at least eight countries in West Asia and North Africa (WANA) and with support from various international donors (International Fund for Agricultural Development, Arab Fund for Economic and Social Development, OPEC Fund for International Development and the Islamic Development Bank), has carried out several major projects to develop and advocate for more resilient agricultural systems for marginal conditions. These systems, developed by ICBA, are based on integrated crop and forage-livestock feeding systems and can increase land and livestock productivity. They can also help to sustainably ameliorate animal feed scarcity in small-scale crop-livestock farms and contribute to diversifying on-farm production, expanding farm enterprises and securing farmers' livelihoods.

In addition, with USAID funds and in close partnership with NASA and various US universities, ICBA has extensive experience in downscaling the latest climate change model output at regional and national scales, and modeling impacts on water and crop production. This work has already led to a more enhanced understanding of the likely impacts on food and water security in the MENA region and parts of SSA.

Based on those successful experiences on climate change downscaling and promotion of resilient agricultural systems, ICBA in partnership with NARS from WANA and SSA developed the CODRA project to scale up and expand the successful models and outcomes of previous projects to new regions.

The CODRA project focuses on (i) the identification of most vulnerable agricultural communities to the impacts of climate change in Yemen, Egypt, Lebanon, Senegal and Mauritania - through space-based earth observations, dynamic modeling and identification with local stakeholders - and (ii) on supporting, in some of those countries, the practical enhancement of livelihoods through the development and dissemination of resilient crop production packages. This will include the scaling-up of successful models for enhancement of farm income through value adding to the farm products and facilitation of markets (including forages, milk and animal products, and seed production and marketing), and through capacity building and skill development.

The partner institutes include: in Egypt, the Desert Research Center (DRC) and the Climate Change Information Center and Renewable Energy (CCtCRE); in Lebanon, the Lebanese Agricultural Research Institute (LARI); in Mauritania, the National Center for Agricultural Research and Agricultural Development (CNARDA) and the National Office of Meteorology (ONM); in Senegal, the Senegal Institute for Agricultural Research (ISRA) and the National Agency of Civil Aviation and Meteorology Department of meteorology (ANACID); and in Yemen, the Agricultural Research and Extension Authority (AREA) and the National Water Resources Authority (NWRA).

Inspiring a generation of farming entrepreneurs: The story of Mohammad Al Wali from Yemen

Mohammad Al Wali growing Alfalfa in his field

The farmer, Mohammed Al Wali (on the right), explaining to the project coordinator of the 'Climate Change in West Asia and North Africa Region' about the impact of the new agricultural production systems on his farm

I am Mohammad Al Wali. I live in Lahj District in southern Yemen. This area is known to be one of the oldest agricultural areas in the world. But desertification has started recently due to climate change impacts and my land is classified now among marginal areas.

Back in the 1980s, I started with one cow to feed my family on our small farm. Now, I have around 30 ha of land and more than 50 cows and 60 camels. Achieving this was not easy as I faced losses in many years because of the low rains. To overcome expected losses, I diversified my sources of income through the integration of crop and livestock production and investigated new technologies to enhance my farm productivity. I found most of the solutions with the research team of the climate change project that was coordinated by ICBA. With them, I attended farmers' field schools in Egypt and Yemen. It was a very enriching learning experience; I learned how to select salt-tolerant crops, manage them and use them to feed my animals. As a result, productivity on my farm increased dramatically and it reflected positively on my profits.

Yemen needs more pioneers in the agricultural sector to survive and achieve food security. I hope every farmer in Yemen gets the chance to go through the same learning experience that I had experienced with ICBA.

Climate change adaptation in the context of Post-2015 Sustainable Development Agenda

During the IDB Annual Meeting in Maputo, Mozambique, ICBA organized a panel discussion on climate change adaptation in the context of post-2015 sustainable development agenda

Climate change impacts are likely to affect greatly IDB member countries. So building resilience through well-developed adaptation strategies is vital. In collaboration with the Islamic Development Bank (IDB) and the United Nations Environmental Program (UNEP), ICBA organized a seminar on "Climate change adaptation in the context of Post-2015 Sustainable Development Agenda". The seminar was conducted in Maputo, Mozambique, on 8 June 2015 as a side event of the 40th Annual Meeting of IDB.

The seminar was attended by keynote speakers and panelists, including Dr. Ismahane Elouafi, ICBA Director General; Mr. Ibrahim Thiaw, the UN Assistant-Secretary-General and UNEP Deputy Executive Director; Professor Usman Aminu Umar, Universiti Teknologi Petronas, Malaysia; Mr. Munyaradzi Chenje, Director, Regional Support Office, UNEP; and Dr. Rachael McDonnell, Climate Change Modeling & Adaptation Sectional Head, ICBA. Dr. Hans Hoogeveen, Vice Minister for Agriculture at the Ministry of Economic Affairs in The Netherlands, also gave a video presentation.

The panelists discussed the issues related to responding to climate change in IDB member countries. They also talked about how climate change will affect people in different ways whatever stage of economic development countries are at, and that given the critical consequences of the new environmental conditions, adaptation strategies that encompass sustainable development objectives are a priority. Organizations such as the IDB play an important role in bringing their experience to bear in developing infrastructure and technology as components of those strategies in collaboration with national institutes and regional and international organizations. The IDB has also a vital role in advising on financing climate-smart initiatives. Their wise support in collaboration with international donors will enable member countries to implement various focus areas of their adaptation strategies.

At the same time, ICBA also participated in the exhibition and activities of the IDB annual meeting and distributed publications that aimed at promoting ICBA's initiatives and projects in marginal environments.

2nd Africa Ecosystem-Based Adaptation for Food Security Conference (EBAFoSC2) in Nairobi

As an organizing partner, ICBA supported the 2nd Africa Ecosystem-Based Adaptation for Food Security Conference that took place in Nairobi, Kenya on 30-31 July. The event brought together a couple of hundreds of participants.

The conference focused on unleashing the full potential of the agriculture value chain in the continent through leveraging ecosystems-based approaches and techniques to ensure sustainable on-farm productivity and the application of accessible technologies, including mobile, storage, preservation and other value adding processes to eliminate post-harvest losses, link farmers to markets in a timely manner, facilitate financial transactions, and in the process generate a myriad of jobs along the agro-value chain.

ICBA's Senior Irrigation and Water Management Expert, Dr. Asad Sarwar Qureshi, participated in this conference to inform participants about ICBA's past efforts and on-going work in Africa. He was one of the four main speakers in the session on "Innovations to reduce PHL-EBA role in Africa post-harvest loss and waste". This session focused on ways of reducing post-harvest losses (PHL) in Africa which is wasting about 25-30% of grown food before it reaches the table. The session also deliberated on storage facilities that are needed at the community level to reduce food waste to reduce PHL. ICBA also plans to work with UNEP to take EBAFoSC work forward building on the ICBA's experiences in the region.

EBAFoSC is building climate resilience through a series of projects targeting the climate sensitive, but key agricultural sector. Its main thrust is optimizing the food value chain in Africa by promoting ecosystems/ecological techniques such as conservation agriculture to optimize on-farm productivity by sustainably increasing yields while simultaneously enhancing productive capacity of ecosystems and community climate resilience. It also seeks to promote value addition enterprises along the post-farm gate value chain so as to create job and income opportunities for the youth. Sustainable, clean, accessible and affordable energy will be especially vital in ensuring efficiency of processing and other value adding activities that arise in the value chain, and advancement of the value chain optimization objectives of this programme. This continuum approach seeks to optimize the entire agro-value chain, cutting waste, and ensuring a climate-neutral agriculture value chain.

For more information, please visit: www.ebafos.aaknet.org

Helping to improve soil salinity management in Seychelles

Soil salinization, that is, accumulation of water-soluble salts in the soil, is a pressing issue worldwide. Globally, almost a billion hectares of land is considered saline and around ten hectares of arable land are lost every minute to salinity.

This problem is also particularly acute in Seychelles as the soil on its coastal plateaus where most agricultural activities are concentrated has a pH of 8.5. Among other things, this alkaline soil hinders the uptake of nutrients. What is more, water from boreholes which farmers use for irrigation during the dry season is increasingly being affected by saltwater. So farmers in Seychelles have to deal with both excessive alkalinity and salinity.

In partnership with the International Atomic Energy Agency (IAEA), the International Center for Biosaline Agriculture (ICBA) has been helping farmers in the country to tackle this problem. Building on the success of a program jointly implemented in 2014, IAEA and ICBA signed a practical agreement in March 2015 to continue their work in the country.

As part of this initiative, ICBA is also working to build the capacity of local farmers and researchers. For example, a team of ICBA scientists conducted a specialized training course on soil salinity management at the Seychelles Agricultural Agency (SAA), Seychelles, between 27 and 31 July 2015.

This five-day event brought together 25 participants, including farmers, extension workers, researchers, university students and policymakers. The training course had two modules: one for technical staff and the other for farmers.

During the course, Drs Shabbir Shahid and Henda Mahmoudi, of ICBA, briefed participants on the emerging issues of soil salinity and sodicity in Seychelles in a holistic way. Overall, the course aimed to help farmers to learn how to mitigate the impact of salinity and sodicity and increase productivity. It also aimed to prepare stakeholders to deal with the changing profile of the soils in the country. As Barry Nourrice, the SAA's principal laboratory technologist, noted, it is "difficult to change" the pH of soils. However, there are ways to deal with water salinity, for example, by adding gypsum at the source. "It's about controlling the sodium that enters the soil," Mr Nourrice commented.

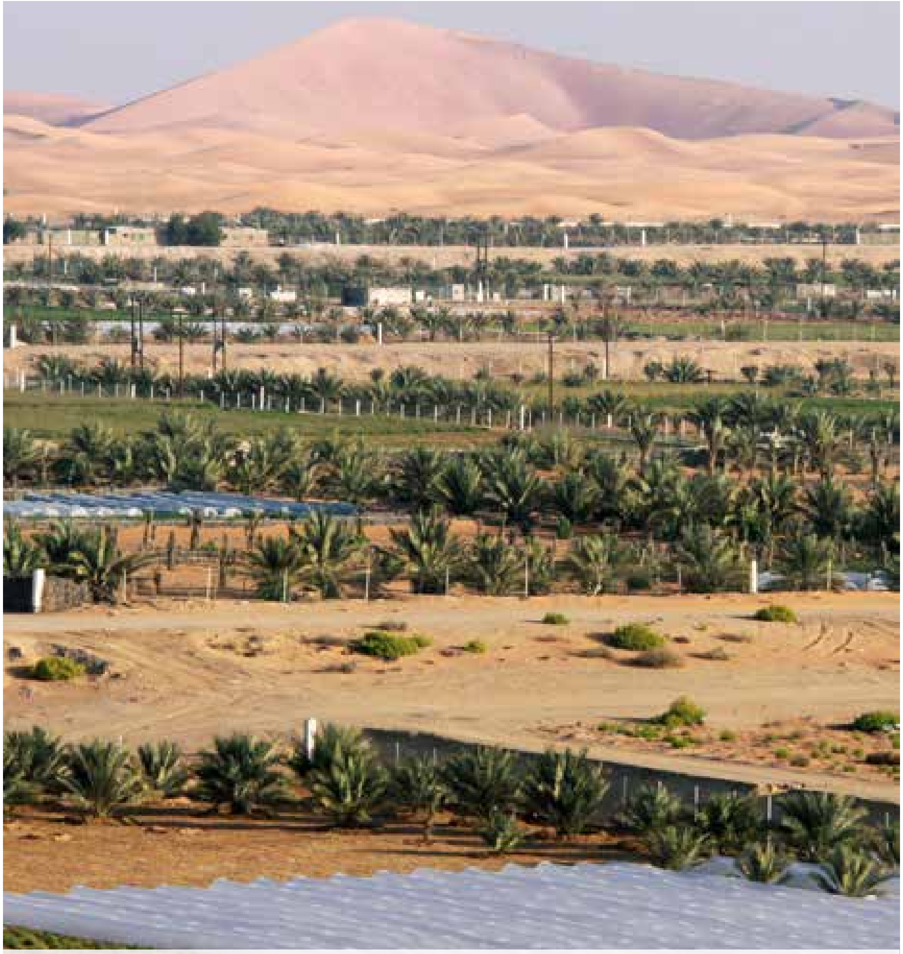
Given that Seychelles already has a sodium adsorption ratio of 20.4, far above the recommended level of 10, relevant knowledge and technology can make a difference. For farmers, this means either profit or loss.

During the course, Dr Shahid also explained an equation that can be used to determine the relationship between yields and the levels of salinity. "Slight increases in salinity can cause significant yield losses. So the initial assessment is very important," he said. This is why farmers must use tools like salinity mapping as this can help choose crops that are best suited to the prevailing soil conditions. Mr Nourrice added: "In Seychelles, soil salinization is linked with water salinity. So water quality must be monitored as it affects the salinity of the root zone and soil in general."

It is hoped that this work will contribute to improving the livelihoods of farmers in the country. Furthermore, this would also help to tackle soil salinity.

On-farm training on soil salinity assessment and management at the Seychelles

Human and environmental demands on nature: current status and future prospects



The challenge of achieving sustainable agriculture in marginal environment

ICBA's latest initiative "ICBA Biosalinity Forums" is a series of events that host experts and scientists from various specialties related to agriculture in marginal and saline environments. It is a monthly event that aims at simplifying the knowledge sharing at the local level through the open forum venues and globally by publishing video recordings of these forums online.

These forums are a way to kick-start early enough the snow ball even before public reports are written or scientific papers published or books compiled. This is a quick way to spread the word and get immediate feedback to the work in progress.

The first seminar "Human and environmental demands on nature: current status and future prospects' was conducted by Dr. Shabbir Shahid, who focused in his presentation on the human and environmental demands on nature, and provided a summary of the ecological footprint (EF)[1] and bio-capacity (BC) data for the Arab region, GCC countries as well as global figures.

Due to continuous and excessive use, resources on the planet are decreasing at an unprecedented level and there is a growing concern that it may not be able to provide needed services to mankind in future. EF and BC are the indices which are usually used to measure resource sustainability. In 2010, Earth's BC was approximately 12 billion global hectares (gha) which is 1.7 gha per capita, whereas the EF was 18 billion gha, equivalent to 2.7 gha per capita. This shows that humanity needs the regenerative capacity of 1.5 Earths to provide the ecological goods and services we use each year. Since 1990 we have reached the overshoot by September each year, and between October-December humanity is on over-draw and pushing up against the Earth's limits.

Under the business as usual scenario, by 2050 agricultural production must increase by 60% globally - and almost 100% in developing countries - in order to meet food demand alone for 9 billion. These targets can be achieved by intensifying land uses to produce more food. However, this may not be feasible because land resources of most developing countries are already stressed and further expansion is virtually not possible. Global data shows that 33% of soils are degraded due to diversity of ailments. Every year we lose more than 20 billion tons of cropland soil because of erosion. Internationally, loss of biodiversity, keeping global warming to 2°C, and reducing greenhouse gas emissions are emphasized on every forum to ensure food security for everyone. On the other hand, soil scientists have warned that these objectives can only be achieved if the soils will remain healthy and productive.

United Nations moderate scenarios suggest that if current trends continue, by 2050 humanity would demand over twice as much as the Earth can renew.

This stresses the need to effectively manage our ecological assets to ensure sustainable economic growth and sustainable development. We need a paradigm shift in soil management and need to adopt innovative ways to use our soil resources to minimize the gap between EF and BC and produce food to meet future demands. In addition, we need to adopt a multi-pronged approach to balance "Agri-food-water-energy-environment" matrix. This requires development and implementation of new agricultural and food policies, and water, environmental and soil protection plans. The concept of "Climate-Smart Agriculture', could be a right step in this direction. This includes evolution of high-yielding salt and drought resistant crop varieties, increasing photosynthetic rates, introducing biological nitrogen fixation (BNF) character in non-legumes, increasing soil, water and nutrient use efficiencies etc.

1 EF is a measure of how much biological productive land and water an individual, population or activity requires to produce all the resources it consumes, and to absorb the waste it generates, using prevailing technology and resource management practices. The Biocapacity (BC) is the capacity of ecosystem to produce useful bilogical materials and absorb waste material. both EF and BC are measured in global hectares (gha)

Horticulture, water and energy use efficiency under greenhouse conditions in marginal environments

The GCC countries are considered one of the most water scarce regions in the world, and facing over the coming years the most severe intensification of water scarcity in history. Agriculture is the sector using by far the majority of available fresh water resources (> 85%). The protected agriculture in the GCC countries is close to 13,000 ha and due to hot climate conditions the greenhouses are cooled, which leads to high energy and water consumption. ICBA has implemented recently a project on protected agriculture aiming to compare between a high technology greenhouse equipped by cooling-pad and sun screen system and a low technology net house equipped by a mist system in terms of crop productivity, water and energy use efficiency and cost-benefit analysis.

Drs. Redouane Choukr-Allah and Abdelaziz Hirich, the team behind the greenhouse experiments at ICBA, presented their findings during their seminar on “Horticulture, water and energy use efficiency under greenhouse conditions in marginal environments”, which was held at ICBA on 10 June 2015.

The presentation was divided in two parts. First, Dr. Redouane gave an overview on the greenhouse development worldwide, and indicated the perspectives and trends of the protected agriculture in different regions, and the recent growing business of these types of agriculture including the hydroponics system within the GCC Countries. He concluded that there is an urgent need to adapt this growing system to the GCC conditions, and due to lack of land and water resources and severe weather conditions, the two systems of production including greenhouse and hydroponics crop production are being addressed in the strategic planning of GCC countries targeting to reduce water consumption and to enhance food security.

Second, Dr. Hirich summarized the aforementioned ICBA project findings. The main goal of this research was to compare these two types of structure (Hi-Tech greenhouse with cooling-pad vs. net house with mist system) in terms of crop productivity, water and energy use efficiency and cost-benefice analysis. Sweet pepper and cucumber were tested under both greenhouse and net house and cherry tomato under greenhouse.

According to the initial findings, Dr. Hirich concluded that net house shows a great potential as an efficient protected system in terms of water and energy further more being low cost system. Thus, the net house equipped with mist system considered as low cost structure is much recommended to cultivate most of horticultural cash crops under GCC region conditions especially during the period from October to May.

Cucumber growing in the net-house experiment at ICBA

A highly prestigious award recognizes Prof. Alsharhan's outstanding contributions

The American Association of Petroleum Geologist (AAPG) presented Professor Abdulrahman Sultan Alsharhan with the Honorary Member Award in recognition of his outstanding contribution to the profession of petroleum geology in the Middle East and for his dedicated services to the Association. This highly prestigious award is presented by AAPG to people who have distinguished themselves by their service and devotion to the science and profession of petroleum geology and to the Association.

The Honorary Member Award has become part of the Association's tradition since 1919, only two years after the founding of AAPG in 1917. The original principles upon which AAPG was established still guide it today; now considered as a pillar in the worldwide scientific community, AAPG has always aimed to foster scientific research, to advance the science of geology, to promote technology, and to inspire high professional conduct. AAPG's membership is made up of more than 40,000 members in 129 countries in the upstream energy industry who collaborate - and compete - to provide the means for people to thrive.

Professor Abdulrahman Sultan Alsharhan is an Emirati who received his secondary education in the UAE and then completed his Bachelor of Science in Geology in Cairo. In 1983, he received his Masters of Science in Geology from the University of South Carolina, where he also received his PhD in Geology two years later.

Prof. Alsharahan has had a long and illustrious career. He has held various teaching positions within the Geology Department of the UAE University between 1980 and 1995. He has held managerial positions in the Ministry of Petroleum and Mineral Resources (1978-1980); Head of Petroleum and Mineral Resources Section, Desert and Marine Environment Research Center at the UAE University (1987-1990); and Director of the Desert and Marine Environment Research Center (1990-1996). During 1992-1994, he was Assistant Dean for Scientific Research at the Faculty of Science of the UAE University. In 1994-1995 he became Assistant Deputy Vice Chancellor for Academic Affairs; following which he was Dean of the Faculty of Science at the UAE University (1995-2003). In addition, Prof. Alsharahan has held the position of Vice-President of the American Association of Petroleum Geologists Middle East Region (2003-2007) and is a member of the Higher Committee for the Zayed International Prize for Environment (1999-Present). Professor Alsharhan has been the Chairman of ICBA Board since March 2014.

New ICBA members

Alma Redillas Dolot
Corporate Services Director

Richard Willem Otto Soppe
Senior Scientist-Marginal Water Management

Imane Boujidane
Executive Assistant - DDG Office

Layla Al Musawi
Monitoring and Evaluation Senior Advisor

Diletta Ciolina
Proposal Development Specialist

Zharkynai Ashirbekova
Administrative Assistant

Bindu Venugopal
Facility Supervisor

Nada Kadhim
Knowledge Hub Specialist

Interview with Dyno Keatinge, DG AVRDC and Chairman of AIRCA

Dr Keatinge, AVRDC is well known as the global leader in promoting vegetables for development and is a member of various networks. What is the added advantage of being part of AIRCA for AVRDC?

Anyone involved with agricultural development issues today knows there are no easy, simple solutions to the complex problems that confront us in the battle against poverty and malnutrition. AVRDC - The World Vegetable Center therefore needs strong allies with a range of disciplinary expertise we lack and with global staff resources on the ground where we have none. Like-minded institutions have much experience from which we can benefit, which will help us better customize our outputs for our very varied stakeholders in the farming communities of the tropics. AIRCA centers such as CABI and icipe help us better protect vegetables through effective IPM and weed management strategies, and to reach a much broader range of farmers whose vegetable crops are challenged by biotic stressors through CABI's worldwide "Plantwise" program and links to hundreds of thousands of farmers through mobile-phone extension assistance programs in South Asia. We benefit from ICBA's knowledge and physical testing facilities in the search for vegetables with better salt and drought tolerance, and specifically for germplasm suitable for our target areas in Central Asia, where we are working closely together and where such stresses are paramount, such as in the Aral Sea region. AVRDC also partners with CATIE in Central America and with ICIMOD in the Hindu Kush region of Asia to bring appropriate vegetable germplasm to specific ecological niches where poverty and malnutrition remain intransigent problems.

Agricultural research has been undertaken for decades, but we are still facing severe challenges in terms of agriculture production and poverty in rural areas. What will it require to feed 9 billion people in 2050?

All the AIRCA centers recognize there is a big challenge ahead to feed the world in 2050 - but we also are convinced that it is not enough to provide only an adequate carbohydrate supply. We need to nourish the world population as well as feed it, or our mission will fail and the burden of human ill-health will be substantially increased. Much research is needed to ensure that healthy, nutrient-dense crops such as fruit and vegetables are available to even the poorest families. These crops need to be grown in healthy, nutrient-rich soils; this vital expertise is provided to AIRCA partners by IFDC. Crop and diet diversity should be exploited fully to ensure that farm enterprises and human health are made as resilient as possible by reducing environmental and associated risks. Crops For the Future, INBAR, CATIE and AVRDC all provide expertise in this specific area. Such risks include regular, heavy over-spraying of pesticides by farmers; all AIRCA allies combine their knowledge to help provide wholesome, economic solutions to this problem. Acting jointly, the AIRCA centers are able to promulgate the concept of healthy landscapes- which are urgently required if we are to sustainably feed and nourish the rapidly growing world population. Lack of coordinated research has been a major failure in the past, and even the AIRCA centers recognize they cannot tackle this huge problem alone. AIRCA thus seeks to ally itself with the CGIAR centers, a diversity of NGOs, public agencies, and the private sector involved in agriculture throughout the world. Although the problems remain large and climate uncertainty makes the challenge more demanding, AIRCA is confident that the necessary solutions can be found through promoting healthy landscapes, if sufficient research investment is made now and made consistently over the following decades.

AIRCA is developing a project for the Lake Victoria Basin - why do you think this project will make a difference to the region? What will be different in this project?

The Lake Victoria Basin remains a hotspot of poverty and malnutrition even though much research effort and investment has been made historically in the region. AIRCA believes that most of the necessary answers to solve the region's agricultural development problems largely exist today, but exist like a jigsaw puzzle in which the pieces have not been properly put together. Seven of the nine AIRCA centers that have joined in this project proposal believe that with their combined substantive expertise, with sufficient long-term investment over the next decade, and with the appropriate political will at a regional level, it will be possible to make a positive difference to many millions of farmers. The basin can indeed become a series of healthy landscapes, but the effort neither must be piecemeal nor imposed from above as in the past. It should rather be built upwards from the village level, with well-tested scientific interventions suitable for and accepted by local farmers and covering the full and necessary dimensions of sustainable and resilient agriculture. CABI's strong managerial experience in Africa and icipe's deep local knowledge and on-site physical infrastructure, combined with germplasm and productive interventions from

AVRDC, IFDC, ICBA, CFF and INBAR, will form AIRCA's scientific nucleus for the region. Together with willing local partners, AIRCA aims to make the Lake Victoria Basin the food basket of the region, to deliver prosperity and good nourishment to the currently disadvantaged population.

About AIRCA

AIRCA (Association of International Research and Development Centers for Agriculture) is a nine-member alliance focused on increasing global food security by supporting smallholder agriculture within healthy sustainable and climate-smart landscapes.

Learn more about AIRCA at: www.airca.org

AIRCA

Association of International Research and Development Centers for Agriculture

AIRCA congratulates Dr. Amit Roy, CEO and President of IFDC

Dr. Amit Roy, the President and CEO of the International Fertilizer Development Center (IFDC), which is a member of AIRCA, has been awarded the 2015 Francis New Memorial Medal in recognition of his commitment to world food security and the global fertilizer industry.

The Council of the International Fertiliser Society (IFS) presented the 2015 Francis New Memorial Medal to Dr. Amit Roy.

The medal acknowledges outstanding contributions to the fertilizer community. Dr. Roy delivered the Francis New Memorial Lecture during the IFS Technical Conference on June 23 in London. His topic was “Global Fertiliser Industry: Transitioning from Volume to Value”.

ABOUT ICBA

International Center for Biosaline Agriculture - ICBA is an international, non-profit agricultural research center established in 1999 that carries out research and development programs focused on improving agricultural productivity and sustainability in marginal and saline environments.

ICBA takes innovation as a core principle and adopts a multi-pronged approach to addressing the closely linked challenges of ensuring water, environment, income, and food security. ICBA's research innovations include assessment of natural resources, climate change adaptation, crop productivity and diversification, aquaculture and bio-energy and policy analysis. The Center is working on a number of technology developments including the use of conventional and non-conventional water (such as saline, treated wastewater, industrial water, agricultural drainage, and seawater); water and land management technologies and remote sensing and modeling for climate change adaptation.

Improving the generation and dissemination of knowledge is an important strategic objective of ICBA and the Center is working to establish itself as a knowledge hub on sustainable management and use of marginal resources for agricultural production and environmental protection in marginal environments. With the help of its partners, ICBA innovates, builds human capital, and encourages learning that is fundamental to change.

ICBA's work reaches many countries around the world, including the Gulf Cooperation Council countries, the Middle East and North Africa, Central Asia and the Caucasus, South and South East Asia, and sub-Saharan Africa.

ICBA is mainly supported by three core donors: the Ministry of Water and Environment of the United Arab Emirates, the Environment Agency - Abu Dhabi, and the Islamic Development Bank. We gratefully acknowledge their contributions as well as that of many other bilateral and multilateral agencies, which have helped us to carry out our mission over the years.

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