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ICBA

AGRICULTURE FOR TOMORROW

International Center
for Biosaline Agriculture

Annual Report

2017

Innovation

Impact

Partnership

Inside

Acronyms and Abbreviations

ADFD
Abu Dhabi Fund for Development

BADEA
Arab Bank for Economic Development in Africa

CODRA
Creating Opportunities to Develop Resilient Agriculture

CORDEX
Coordinated Regional Downscaling Experiment

CPET
Collaborative Program for Euphrates and Tigris

CIMMYT
International Maize and Wheat Improvement Center

EAD
Environment Agency – Abu Dhabi

FAO
Food and Agriculture Organization of the United Nations

GCC
Gulf Cooperation Council

IAAS
Integrated Aqua-Agriculture System

IAEA
International Atomic Energy Agency

ICARDA
International Center for Agricultural Research in the Dry Areas

ICBA
International Center for Biosaline Agriculture

IsDB
Islamic Development Bank

IFAD
International Fund for Agricultural Development

IWMI
International Water Management Institute

KAUST
King Abdallah University of Science and Technology

MAWRED
Modeling and Monitoring Agriculture and Water Resources for Development

MENA
Middle East and North Africa

MENA-RDMS
Middle East North Africa Regional Drought Management System

MoCCaE
Ministry of Climate Change and Environment [formerly Ministry of Environment and Water]

NARS
National Agricultural Research System

OCP
Office Chérifien des Phosphates

OFID
OPEC Fund for International Development

OPEC
Organization of the Petroleum Exporting Countries

QNRF
Qatar National Research Foundation

RAMSAP
Rehabilitation and Management of Salt-affected Soils to Improve Agricultural Productivity

SDG
Sustainable Development Goal

Sida
Swedish International Development Cooperation Agency

SSA
Sub-Saharan Africa

UAE
United Arab Emirates

USAID
United States Agency for International Development

USAID PEER
USAID Partnerships for Enhanced Engagement in Research

WANA
West Asia and North Africa

WHO
World Health Organization

Message from the President of the Islamic Development Bank Group

H.E. Dr. Bandar M. H. Hajjar
President of the Islamic Development Bank Group

> “We have taken interest in many new innovations from ICBA that can be deployed to build the productivity and resilience of agricultural systems in marginal areas. For example, the wide range of salt-tolerant crops, including forage for livestock, that can be grown using saline and brackish water.”

I wish to commend the International Center for Biosaline Agriculture (ICBA) for its unrelenting efforts in contributing to the Islamic Development Bank (IsDB) Group’s mission through its wide range of activities and operations. IsDB Group member countries are benefitting from ICBA’s research and development in agriculture and water sectors in marginal environments. We are proud to be associated with ICBA as one of its founding members and is now one of its core technical partners of excellence.

IsDB has, throughout its development journey, been pursing sustainable solutions that meet the growing demands and challenges of the agricultural sector, including the threat of climate change, within our member countries. This requires increasing access to new science, technologies and innovations that can be adapted to the socio-economic conditions of each country. It also requires an increasingly collaborative effort among all our strategic partners – including the private sector – to attract the required levels of investment and build capacity among the agricultural industry to a level that will ensure a long and sustainable impact among local communities. ICBA can, indeed, play a pivotal role in this endeavor. We have taken interest in many new innovations from ICBA that can be deployed to build the productivity and resilience of agricultural systems in marginal areas. For example, the wide range of salt-tolerant crops, including forage for livestock, that can be grown using saline and brackish water. Or greenhouses that require less energy to cool and can be deployed profitably by farmers in dry and hot regions. There is also a wide range of quinoa (nutritious human food) and sorghum varieties (fodder for livestock) that are adapted to saline soils and water in drylands. These innovations will no doubt contribute significantly to IsDB Group’s core objectives, namely, alleviating poverty, providing food security, reducing inequalities and unemployment, developing infrastructure and promoting South-South cooperation as well as connectivity for growth in line with IsDB Group’s 10-year strategy (2016-2025).

Our partnership with ICBA is the extension of this objective to foster connectivity, transfer knowledge, and strengthen capacity and research in agriculture and marginal environments to our member countries.

I would like to highly applaud the UAE Government’s continued patronage and contribution that has led to the successful growth of ICBA’s wide-ranging research and development programs. The IsDB Group views the center’s achievements as a unique example of successful partnership with the UAE Government and international organizations.

On behalf of the IsDB Group, I would like to congratulate ICBA’s Board of Directors and management for their efforts towards fulfilling the center’s mission and vision. The IsDB Group is proud to be associated with ICBA and wishes it all the best as it advances its research for development agenda in the coming years.

Message from the Board Chair and the Director General

Prof. Abdulrahman Sultan Alsharhan
Chair of the Board of Directors

> “Towards these goals, our scientists worked with farmers in Central Asia, Middle East, North Africa and sub-Saharan Africa to help them better cope with agricultural risks and improve their food security and incomes.”

2017 was the first year of our new three-year Business Plan which builds on the successes and lessons of its predecessor. We began the year with great gusto as a lot of thinking and preparation went into the plan. But early in the year we had to significantly slow down as our center was faced with an uncertainty about the continuation of core funding. As a bulk of the core funding we budgeted for our activities in 2017 was delayed, the future of some strategic programs and even that of our center itself remained in limbo until early December when a positive decision was reached. It was a tough and turbulent period as the management and board were trying to find a way out of the unforeseen budget impasse.

This meant we had to put on hold most of the ambitious targets we set ourselves for the year. But as the going got tough, our center got going.

As we reflect on the past year, we realize that there were many lessons. Perhaps the most important lesson is that our greatest assets are our people and due diligence. We navigated the financial crisis and fared well because our staff persisted with their projects and efforts to make a difference on the ground and continued to support our stakeholders in different countries and because we never deviated from our robust internal procedures.

Dr. Ismahane Elouafi
Director General

And we are proud to say that we managed to deliver on many of our initial plans and our center emerged from this experience stronger and more efficient and focused. We reconsidered our priorities and streamlined our operations, which resulted in significant savings and efficiencies.

Throughout the year, all of our activities were geared towards the achievement of the Sustainable

Development Goals (SDGs) that our center contributes to. A lot of our work focused on SDG 1 (No Poverty) and SDG 2 (Zero Hunger).

Towards these goals, our scientists worked with farmers in Central Asia, Middle East, North Africa and sub-Saharan Africa to help them better cope with agricultural risks and improve their food security and incomes. To tackle water and energy shortages for farming in Burkina Faso and Mali, they installed affordable solar-powered irrigation systems for more than 100 small-scale vegetable growers. These systems save about 40 percent of irrigation water compared with traditional surface irrigation systems.

In Ethiopia and South Sudan, our center provided smallholder farmers with seed of salt- and drought-tolerant crops to help them adjust to soil salinization, a major cause of declining farm and livestock productivity in these communities. Our researchers also assisted in establishing six seed production clusters for climate-resilient crops like sorghum and pearl millet in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, and trained 149 farmers in best practice in seed multiplication.

They also continued to promote quinoa cultivation on marginal soils in Central Asia. This work led to an increase in the number of farmers who grew quinoa in 2017, and as a result, quinoa seed-producing farmers in Kyrgyzstan, Tajikistan and Uzbekistan reported a 20 percent increase in their incomes.

Our scientists also worked extensively to make quinoa part of local diets in Morocco and Egypt. In Egypt, for example, the crop became popular with women in some rural areas after 120 women leaders had been trained in preparing dishes from quinoa.

We also continued to share seed samples from our gene bank with partners in different countries for research, breeding and introduction. Last year alone we sent 1,574 seed samples of 17 crops to 14 countries.

As part of our contribution to SDG 4 (Quality Education), we also put a lot of resources into capacity development in our target countries. Our scientists organized 18 specialized capacity-building events in Algeria, Ethiopia, Jordan, Morocco, Tunisia and the UAE for a total of 270 participants from 18 countries from the Gulf region, Middle East and North Africa and sub-Saharan African regions.

We also built partnerships with universities around the world to offer fellowships and internships to undergraduate and graduate students. Our center hosted 14 interns from universities in France, Jordan, Morocco, Serbia, the UAE and the USA.

Finally, we piloted a training course for a group of Arab women researchers under our Tamkeen program, which aims to address a wide range of challenges facing Arab women scientists and empower them to become future leaders in science.

Research Innovations

Assessment of Natural Resources in Saline and Marginal Environments

ICBA's efforts under this theme contribute to SDGs

Some 10 technical experts from Iraq and Turkey attended a training workshop on the HYPE model in Dubai, the UAE, in June 2017. Delivered by ICBA and the Swedish Meteorological and Hydrological Institute (SMHI), the workshop was the third in a training series on the HYPE model, which had been attended by over 50 participants.

Natural resources like fresh water and arable land are a rare asset in arid and semi-arid regions like much of the Middle East and North Africa and parts of Central Asia. So it is a must for farmers, researchers and policymakers alike to see to it that such resources are put to good use and are not wasted. What is also important though is to make better use of salt-affected and degraded soils as well as low-quality water resources, of which there are plenty. As an applied research-for-development center uniquely focused on marginal environments, ICBA works towards both goals at regional and national levels.

This focus continued to inform the center's activities in 2017 as well. At the regional scale, ICBA organized several events to foster collaboration in transboundary and marginal water resources management.

As part of the Collaborative Program for Euphrates and Tigris (CPET) funded by the Swedish International Development Cooperation Agency (Sida), a series of training workshops took place on the Hydrological Predictions for the Environment (HYPE) model. Bringing together partners from Iraq, Iran, Syria and Turkey under its umbrella, CPET encourages them to find common ground and work together to address challenges such as climate change, salinity and land degradation.

As the program is nearing completion, the center also worked with partner institutions to prepare six technical reports. The reports present detailed information on hydrology and climate change, hydropower, agricultural water productivity, water quality and salinity, marshlands, and socioeconomic assessment in the Euphrates and Tigris River Basin. It is hoped that the findings will guide and inform future national and regional actions.

ICBA set up solar-powered irrigation systems in Burkina Faso and Mali for more than 100 smallholders. The system saves about 40 percent of irrigation water compared with traditional surface irrigation systems.

ICBA also convened an international forum on use of low-quality water, including saline water and wastewater, in farming in Central Asia, an arid region where irrigated agriculture forms the backbone of most economies. The main outputs were a proposal and an action plan for long-term regional cooperation in marginal water management. The documents call for strategic investments in use of marginal water resources to boost food security and incomes of rural populations, while preserving ecosystems.

At the national scale, ICBA supported smallholder farmers in coping with water shortage, drought, soil and water salinity. As crop failure is a persistent threat, smallholders need innovative yet economical solutions to manage risks to farming - the main source of their families' livelihoods. And this type of solutions is one of the main offerings shared by the center with farmers. Through low-cost alternative technologies and

More than 75 decision-makers, scientists, experts and professionals from over 16 countries met in Tashkent, Uzbekistan, in December 2017 to discuss a way forward to promote marginal water use for agriculture in Central Asia.

The RAMSAP project will reach 5,000 smallholder farmers directly in 10 locations in Ethiopia and South Sudan, covering a total of about 300,000 ha (directly and indirectly) of the farmlands.

crops, ICBA helps farmers to turn challenges into opportunities and grow more with less.

In 2017 the center, for example, carried out two projects to improve food security in sub-Saharan Africa through cultivation of salt- and heat-tolerant crops and use of more efficient irrigation systems.

Under the project funded by the OPEC Fund for International Development (OFID), the center started a series of activities to tackle the twin problems of water and energy shortages for agriculture in Burkina Faso, Mali, Niger and Senegal. Due to a continued decline in precipitation, most smallholders in these countries rely on irrigation water through pumps running on diesel, which is not affordable for many, or electricity, which is not often available in rural areas.

So as a first step, scientists installed low-cost solar-powered irrigation systems for small-scale vegetable growers in an area of 2,500 sq. m. in Burkina Faso and Mali. In Mali, the system is jointly managed by a group of 100 farmers, including 77 women and 23 men, while in Burkina Faso, the system is shared by a group of five farmers. More importantly, excess energy is used to light the farmers' homes.

To determine how salinity affects date palm trees, ICBA began in 2001 a major program using ten date palm varieties from the UAE and eight from Saudi Arabia in an area of nearly 2.5 ha. The purpose is to evaluate the impact of three levels of salinity (5, 10 and 15 dS/m ECw) on date palm growth, productivity, fruit mineral and sugar contents, and water use.

> "At the national scale, ICBA supported smallholder farmers in coping with water shortage, drought, soil and water salinity. As crop failure is a persistent threat, smallholders need innovative yet economical solutions to manage risks to farming - the main source of their families' livelihoods."

As part of the four-year project financed by the International Fund for Agricultural Development (IFAD), ICBA supplied seed of over 10 varieties of different salt- and drought-tolerant crops to research institutions and farmers in Ethiopia and South Sudan. Researchers also completed baseline socioeconomic and soil surveys in both countries. Named "Rehabilitation and management of salt-affected soils to improve agricultural productivity (RAMSAP)", the project aims to introduce salt-tolerant crops to help smallholders cope with soil salinization, a major cause of declining farm and livestock productivity in both countries.

In the UAE, scientists continued long-term studies to determine the effect of salinity on date palms. They completed a three-year study together with the Environment Agency – Abu Dhabi (EAD) and Plant & Food Research, New Zealand, to measure date palm water use and improve irrigation management and efficiency. The study found that date palm trees use, on average, 50 liters of water per day in winter and 150 liters per day in summer. It showed that large water savings are possible if irrigation supply is matched with actual water requirements of the date palm trees. Published in Science and policy: nutrient management challenges for the next generation, the findings will inform a decision support tool for sustainable irrigation allocation in the country.

Researchers found a way to turn municipal waste into a soil conditioner in the UAE. As the amount of solid waste generated annually in the country stands at around 4.9 million tonnes, recycling this waste for agricultural production would mean hitting many targets with one shot. Not only does the process improve soil health that leads to higher agricultural productivity, but also protects the environment from pollution.

As part of research on organic and inorganic soil amendments, scientists also completed a study on the effect of the AustraBlend multi-mineral soil conditioner on forage barley production under local conditions. The results showed that using 10 tonnes per ha of AustraBlend and compost can increase fresh biomass of barley by 50 percent and help to save 20 percent of water.

Another project investigated the potential of sewage sludge as a source of organic matter in the UAE. Scientists discovered that co-composting of sewage sludge with green waste significantly dilutes heavy metals and improves quality of the final product called "co-compost sludge". This process produces an

In 2015 ICBA started long-running experiments with biochar, an organic soil amendment produced from green waste. Studies showed that biochar significantly improves soil fertility, helps to save 30-35 percent of water and soil nutrients, and sequester soil carbon.

organically rich soil conditioner that doubles biomass of leguminous crops such as cowpea, pigeon pea, lablab and Sesbania, and helps to protect the environment.

Under a program on protected agriculture, ICBA also completed a study which found that horticultural production can become more resource-efficient and profitable under UAE conditions thanks to a low-cost net-house technology. Researchers carried out an extensive agronomic and economic analysis of growing cherry tomato and cucumber in a common model of greenhouse with a fan-pad cooling system and a net-house model equipped with a misting system and a shade net. They found that greenhouse cooling is the most water-intensive process as it consumed 3.5 times more water than the amount required to irrigate cherry tomato. In contrast, the misting system in the net-house used about 75 percent of the water to irrigate cucumber. Data also showed that the greenhouse consumed 32 times more energy than the misting system in the net-house.

A low-cost net-house technology was shown to considerably reduce energy and water consumption in UAE conditions. The findings were presented to the Khalifa Fund for Enterprise Development and the Ministry of Climate Change and Environment (MoCCaE). As a result, the net-house system was adopted by the Khalifa Fund for Enterprise Development for dissemination in the UAE.

Climate Change Impacts and Management

ICBA's efforts under this theme contribute to SDGs

Tunisian researchers attended a two-day training workshop on validating the country's drought monitoring system in October 2017.

As climate is changing, the prospect of food insecurity looms large in many countries. Scientific evidence as to the extent of climate change from the consolidated analysis of 2017 by the World Meteorological Organization (WMO) shows the scale of the earth's warming. WMO confirmed the past three years - 2015, 2016 and 2017 - as the warmest years on record. While 2016 still holds the global record, 2017 was the warmest year without El Niño contributions. Farmers the world over are already bearing the brunt of climatic extremes. The hotter and drier the weather becomes, the higher are the chances of crop yield reduction or failure and livestock loss. Extreme events such as droughts, heat waves and floods, for example, are becoming more frequent and intense in many Middle Eastern and African countries, causing immense economic damage.

This means agriculture needs to be one step ahead of climate change and become much more climate-aware. Climate-smart agriculture is an approach that helps farmers to adapt effectively to a changing climate. It informs ICBA's programs on climate change adaptation. To this end the center works at two levels. One is helping countries better manage and plan current and future risks at the national level. The other is equipping farmers, researchers and policymakers with knowledge and technology to address a range of environmental challenges.

Understanding future climate conditions is the starting point for adaptation work, and to this end the center continued in 2017 to convert global climate model data sets into national and regional information in different countries. Under the United States Agency for International Development-funded (USAID) Middle East and North Africa Regional Drought Management System (MENA-RDMS), scientists finished

> 66
> The drought monitoring system was re-written for a Windows operating environment using open-source software to support easy technology transfer. Capacity development and software transfer was undertaken in all four countries, leading to monthly drought data being generated by the stakeholders.
> 99

With financial assistance from the IsDB, scientists conducted a training course in drought monitoring for a group of technical specialists from four North African countries in September 2017.

Under the center's breeding program, scientists facilitated two patent applications for a quinoa variety called Vatan in Tajikistan and a promising saltbush ecotype (Atriplex undulata) in Uzbekistan.

ICBA continued to work with Central Asian farmers to establish quinoa production on marginal soils. As a result, the number of farmers who grew quinoa increased in 2017. What is more, quinoa seed-producing farmers in Kyrgyzstan, Tajikistan and Uzbekistan saw a 20 percent increase in their incomes.

the downscaling of climate change data for the four countries - Jordan, Lebanon, Morocco and Tunisia – and analyzed the likely future drought conditions.

At the same time, important steps were also taken towards establishing operational drought monitoring in the four countries to help in the management of current and future droughts under long-running collaboration with the University of Nebraska – Lincoln, the National Aeronautics and Space Administration (NASA), the United Nations Food and Agriculture Organization (FAO) and national partners. The drought monitoring system was re-written for a Windows operating environment using open-source software to support easy technology transfer.

Capacity development and software transfer was undertaken in all four countries, leading to monthly drought data being generated by the stakeholders. In Tunisia, for example, ICBA scientists trained more than 90 people in generating real-time drought maps using the special open-source program. This training was part of the ongoing validation process to ensure the monitoring captures the drought characteristics, severity and extent for the country.

The center also assisted climate change specialists in Kuwait and Bahrain in preparing their submissions to the United Nations Framework Convention on Climate Change. Scientists assessed and produced maps and timeseries of climate projections (rainfall and temperature) for both countries. They also worked with experts in Bahrain to develop their skills and capabilities so that the future data could be generated in-country.

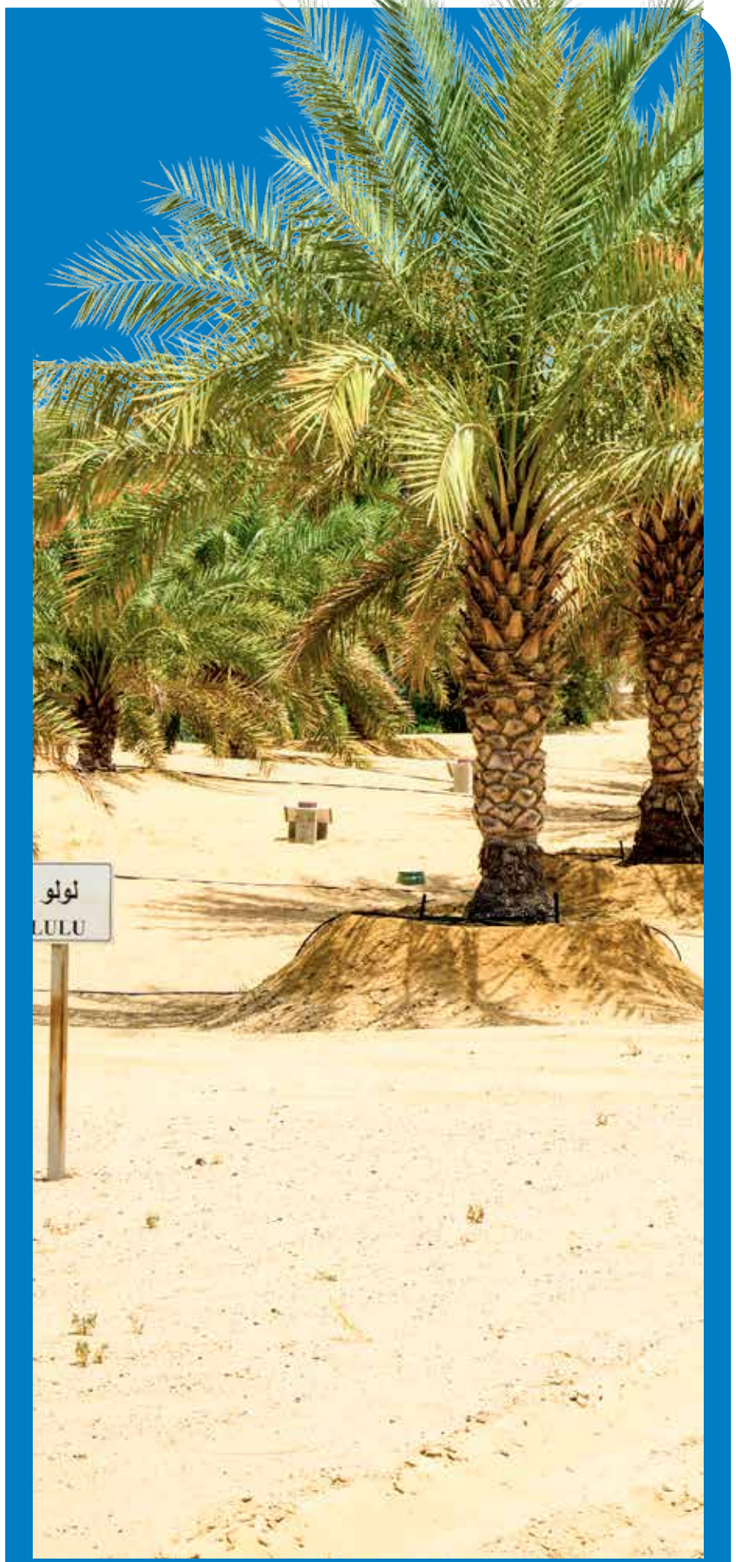
Further capacity development in climate change modeling took place in collaboration with the Algerian Ministry of Agriculture, Rural Development and Fisheries. The IsDB-funded training course for 20 specialists from Algeria, Mauritania, Morocco and Tunisia focused on downscaling global climate change data and creating monthly maps to monitor drought using software and analyzing and comparing current and previous droughts.

Climate change adaptation requires improving water use efficiency in all sectors, including agriculture. In the UAE, ICBA launched a new project aimed at improving water management jointly with the country's Ministry of Energy and Industry. The project will assess daily groundwater abstraction levels across the country for 2016, using satellite imagery, energy balance modelling and climate data generation. Once this proof of concept has been completed, the system will be used for managing current water use.

In Central Asia, many activities focused on the problem of salinization. For example, researchers introduced a perennial sorghum variety called Azamat to 22 farmers and 14 herders in Karakalpakstan, Uzbekistan, each of whom planted it in about 12 ha of highly saline abandoned lands.

ICBA also helped to establish six seed production clusters in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. As part of this work, 149 farmers, including 82 men and 67 women, were trained in best practice in seed multiplication. As a result, farmers produced high-quality seed of a pearl millet variety called Hashaki on 84 ha of marginal lands; the alfalfa variety Kyzylkesek on 240 ha; the sorghum variety Keshen on 96 ha; and a triticale variety on 150 ha.

In Kyrgyzstan, the center also formed a local network of quinoa seed growers who produced more than 70 tonnes of good quality quinoa seed for domestic use and export. It was shown that quinoa cultivation significantly increased farmers' incomes.



Crop Productivity and Diversification

ICBA's efforts under this theme contribute to SDGs

Crop diversification is an effective strategy to deal with such problems as water shortage, drought and salinity. Farmers need to diversify into crops that are better suited to harsh environments, as well as learn to make better use of available land and water.

By developing, testing and introducing technologies and crops that fit the bill, ICBA supports smallholder farmers in coping with different problems. Drought-, heat- and salt-tolerant crops like quinoa, barley, sorghum and pearl millet are some of the offerings. The center also gears farmers up for minimizing agricultural risks. Capacity development cuts across all initiatives.

In 2017 ICBA finished a major IFAD-financed project called "Creating Opportunities to Develop Resilient Agriculture" (CODRA) to map agricultural communities vulnerable to the impact of climate change in several MENA and sub-Saharan African countries and enhance their livelihoods. Scientists produced detailed maps of the most vulnerable agricultural areas in Egypt, Lebanon, Mauritania, Senegal and Yemen and shared them with national partners. In Egypt, CODRA reached more than 360 farmers directly and 1,670 farmers indirectly through seed distribution and extension services while in Yemen and Lebanon the project benefitted 320 farmers and 20 farmers respectively.

Another project in Egypt aimed to establish a model of production of salt-tolerant crops' seed. As part of this project funded by USAID, Sida and the Dutch Ministry of Foreign Affairs, ICBA scientists organized several farmer field schools for more than 160 farmers and extension staff, including 70 women, on alternative climate-smart crops and technologies.

Under a similar project with the Office Chérifien des Phosphates (OCP) Phosboucraa Foundation in Morocco, ICBA provided technical assistance to the Laayoune Cooperative and Institute National de la Recherche Agronomique to improve forage production on salt-affected farms in Laayoune Province. Researchers conducted several training courses for engineers, technicians and farmers from the province. The project team also established field trials on several farms to study the potential for cultivating quinoa, Sesbania, pearl millet and blue panicum in local conditions instead of traditional crops like forage corn and alfalfa.

ICBA held a series of capacity-building events in Egypt to promote climate-smart crops and technologies.

ICBA arranged a trip to Dubai in December 2017 for nine farmers and researchers from Laayoune Province, Morocco. The group visited ICBA's head office, the Swing Fish Farm, an integrated model farm including crops, livestock and aquaculture, and Camelicious, a camel milk-producing farm.

Mr. Azamat Kaseev is one of several pioneer farmers in Kyrgyzstan with whom ICBA worked to introduce quinoa. On his farm in eastern Issyk-Kul Region, he began growing a quinoa line developed by ICBA.

Preliminary results showed that the four crops fared much better than forage corn and alfalfa.

As part of its global program on quinoa, ICBA also achieved considerable progress in introducing the crop to farmers from the Middle East to Central Asia. The number of farmers cultivating quinoa continued to grow as a result. For example, eight farmers of Issyk-Kul Region, Kyrgyzstan, and four farmers in Khatlon Region, Tajikistan, multiplied seed of three improved lines of quinoa on 18 ha. What is more, Kyrgyz quinoa growers started cooking cakes, preparing salads and drinks from quinoa seed and offering these to neighboring farmers. They also started supplying quinoa seeds to local restaurants.
In Spain, the center collaborated with the Instituto Tecnológico Agrario de

Quinoa is slowly entering the rural Egyptian diet as an increasing number of women learn of its nutritional benefits and other qualities.

S. N.	Crop/wild plant	# of Samples	Recipient
1	Aerva	2	UAE
2	Asparagus	1	South Korea
3	Barley	159	Ethiopia, Morocco, Palestine, South Korea, South Sudan, UAE
4	Cowpea	11	Ethiopia, Morocco, Palestine, South Korea, South Sudan
5	Ghaf	1	Morocco
6	Miswak tree	1	Morocco
7	Mustard	3	Morocco, South Korea, UAE
8	Pearl millet	18	Ethiopia, Kuwait, Morocco, Somalia, South Korea, South Sudan
9	Pigeon pea	1	Ethiopia
10	Pepper	1	UAE
11	Quinoa	1352	Ethiopia, Japan, Kuwait, Morocco, Saudi Arabia, Spain, South Korea, Somalia, Tunisia, UAE
12	Sesbania	9	Ethiopia, Morocco, Pakistan, South Sudan
13	Sorghum	13	Ethiopia, Kuwait, Morocco, Pakistan, South Sudan
14	Sunflower	1	South Korea
15	Triticale	2	Kuwait
16	Vigna	2	UAE
17	Wild cotton	1	USA

In 2017 ICBA distributed seed samples to 14 countries from its gene bank, which serves as a unique repository of salt-, heat- and drought-tolerant plant species from over 150 countries.

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Another project in Egypt aimed to establish a model of production of salt-tolerant crops' seed. As part of this project funded by USAID, Sida and the Dutch Ministry of Foreign Affairs, ICBA scientists organized several farmer field schools for more than 160 farmers and extension staff, including 70 women, on alternative climate-smart crops and technologies.

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Scientists carried out a major study which showed that certain fodder grasses can grow well with highly saline water in UAE conditions and contribute to rehabilitating salt-affected farms in the country.

Castilla y León and provided its lines for trials in local conditions. Scientists obtained good results on growth and maturation of grains and plan to share seed with local farmers.
In Morocco, the center joined forces with local researchers to study quinoa cultivation in saline conditions of southern regions. They found that it was possible to produce up to 3.8 tonnes per ha with water as saline as 12 dS/m.

ICBA also worked extensively to make quinoa part of local diets. In Egypt, for example, the crop became popular with many women in rural areas. Under a project funded through the Securing Water for Food program by the USAID, Sida and the Dutch Ministry of Foreign Affairs, ICBA held a course for over 150 people, including 120 women, in December 2017 to train them in preparing food and feed from quinoa and other salt-tolerant crops.

On a different front, the center also continued to share seed samples from its gene bank with different countries for research, breeding and introduction. At the request of various partner institutions, ICBA supplied 1,574 seed samples of 17 crops.

In the UAE, ICBA completed a three-year study that looked at the feasibility of growing animal feed with highly saline water. Scientists carried out a series of experiments on three abandoned salt-affected farms in the emirate of Abu Dhabi to evaluate four salt-tolerant perennial plant species irrigated with highly saline water. The farms were abandoned when they became unproductive due to high water salinity.
The team studied the performance of such species as Distichlis spicata, Paspalum vaginatum, Sporobolus virginicus and S. arabicus at water salinity levels ranging from 14.1 to 17.4 dS/m. The plants were harvested three times a year and produced, when averaged over locations and species, dry biomass yields of 32.64 to 40.68 tonnes per ha per year. The highest biomass yield was recorded for Sporobolus virginicus.

As part of the conservation of plant genetic resources in the UAE, scientists also conducted several studies and expeditions. One study, for example, investigated the effect of grazing animals, especially goats, on the biodiversity in the mountainous areas of Ras al-Khaimah. The results, which were published in Tribulus, a journal of the Emirates Natural History Group, showed that goats are a serious threat to the biodiversity in the country.

ICBA's work in this field also helped to preserve Halfa grass, scientifically known as Desmostachya bipinnata, from possible extinction. In a study published in Tribulus, scientists found that the grass, which had been previously recorded in Kalba in the emirate of Sharjah and in the coastal zone of Ras al-Khaimah, no longer existed in these areas, believed to be the only places in the country where it used to grow.

Luckily, the scientists had collected one plant of the grass from Ras al-Khaimah during one of their earlier scientific expeditions and planted it at the center's research facilities in Dubai for propagation where it performed very well. Thanks to their efforts, the plant species is now well-preserved at ICBA and can be used for reintroduction to the wild.

Thanks to efforts of scientists at ICBA, Halfa grass, a rare plant species in the UAE, was saved from possible extinction. The plant is a rhizomatous perennial grass which is important for stabilizing soils. It can be used as fodder and for medicinal purposes.

Aquaculture and Bioenergy

ICBA's efforts under this theme contribute to SDGs

While fresh water is scarce in coastal desert regions, there is plenty of reject brine, a by-product of desalination, and sea water. Every day more than 8.7m cu. m. of desalinated water is used for irrigation and around 3.5m cu. m. of reject brine is produced globally. Largely discarded as wastewater, if not disposed of or managed safely, reject brine is a serious environmental threat.

ICBA, however, views reject brine and sea water as alternative sources for irrigation. The center operates inland and coastal modular farms, also known as integrated aqua-agriculture systems (IAAS), to study the use of reject brine and sea water for aquaculture. The inland modular farm uses desalinated water for vegetables, reject brine for tilapia and seabream, and aquaculture effluents for halophytic plants, while the coastal modular farm uses sea water for fish and aquaculture effluents for halophytic plants.

Modular farming approaches focus on exploiting reject brine for fish farming and production of halophytes (salt-loving plants) on inland farms, and sea water and aquaculture effluents for cultivation of halophytes in coastal desert areas, bringing into production degraded or barren lands with economic benefits for local communities.

ICBA won an Expo 2020 Dubai grant for an innovative IAAS project.

The goal is to develop a cost-effective production model that transforms reject brine into a source of profit for farmers. Under the IAAS program, scientists continued to research on Salicornia production. In line with previous results, the team found that aquaculture effluents significantly increase Salicornia yields. Fresh biomass of Salicornia was shown to go up from 8 tonnes per ha with reject brine to 24 tonnes per ha with aquaculture effluents. Researchers also discovered that use of aquaculture effluents on coastal farms resulted in Salicornia seed yields of 3.25 tonnes per ha – the highest yield obtained for domesticated Salicornia germplasm. This research was conducted at an experimental station of the Marine Environment Research Center in Umm Al Quwain in collaboration with the MoCCaE.

ICBA manages a seawater-based IAAS at the Marine Environment Research Center in a coastal area of Umm Al Quwain, where aquaculture effluent goes to the cultivation of Salicornia, a halophytic crop used as a vegetable and a forage and in biofuel production.

The IAAS program was also recognized for its innovative approach by AGRAME, a trade exhibition, and Expo 2020 Dubai. The program was a finalist in the category "Farm Innovation Award–Agriculture" at the AGRAME exhibition in 2017.

Moreover, ICBA was awarded a grant to the tune of 100,000 USD from the Expo 2020 Dubai's Expo Live Innovation Impact Grant Program to conduct an innovative research project on inland and coastal modular farms in the UAE. The center was among only three organizations in the UAE and 29 from around the world to have won the grant.

In brief: ICBA in UAE

During 2017 ICBA carried out a wide range of activities benefitting local stakeholders in the UAE. From research to capacity development, the center's efforts aimed to strengthen bilateral and multilateral cooperation, and facilitate knowledge and technology exchange.

Scientists worked, for example, with their counterparts from EAD and Plant & Food Research, New Zealand, on a three-year study to determine actual date palm water use in UAE conditions and thus improve irrigation management and efficiency in the country.

In another three-year study, researchers managed to successfully grow salt-tolerant perennial plants for animal feed with highly saline water on three abandoned salt-affected farms in the emirate of Abu Dhabi.

The center also initiated a new project with the Ministry of Energy and Industry to assess daily groundwater abstraction levels across the country for 2016 and then develop a system to enhance water management.

Scientists completed a long-term study which found that a low-cost net-house technology could make local horticulture more resource-efficient and profitable thanks to its low energy and water consumption. Impressed by the results, the Khalifa Fund for Enterprise Development adopted the system for dissemination in the country.

Under a separate project, they found a way to turn sewage sludge into a soil conditioner through co-composting it with green waste. They also achieved a breakthrough in increasing yield potential of Salicornia, a multi-purpose halophyte, in local conditions. Working closely with local partners, they recorded a bumper seed yield of 3.25 tonnes per ha using seawater passing through an aquaculture system.

The center's program on the preservation of plant genetic resources also made it possible to save Halfa grass, a rare plant species in the country, from possible extinction.

All this work formed part of the center's continued contributions to the national initiatives on food security and environmental protection.

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In brief: ICBA in IsDB member countries

In 2017 ICBA conducted many programs in IsDB member countries with most of them being dedicated to strengthening individual and institutional capacities of different stakeholders from farmers to technical specialists. This work covered countries in Central Asia, MENA and sub-Saharan Africa and benefitted many in-country partners.

In collaboration with the Algerian Ministry of Agriculture, Rural Development and Fisheries, ICBA, for example, organized an IsDB-funded training course for 20 specialists from Algeria, Mauritania, Morocco and Tunisia, which focused on downscaling global climate change data and creating monthly maps to monitor drought.

In Tunisia, the center conducted a workshop to train local researchers in validating the national drought monitoring system. Furthermore, scientists assisted climate change specialists in Kuwait and Bahrain in preparing their submissions to the United Nations Framework Convention on Climate Change.

Under the Sida-funded CPET initiative, scientists ran a series of training workshops on the HYPE model for over 50 technical experts from Iraq, Iran, Syria and Turkey.

The center also hosted a pilot training course under its flagship leadership program called Tamkeen for a group of Arab women scientists. Tamkeen is an initiative focused on addressing a wide range of challenges facing Arab women scientists and empowering them to become future leaders in science.

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> In Central Asia, many activities focused on addressing salinization. Researchers introduced a perennial sorghum variety called Azamat to 22 farmers and 14 herders in Karakalpakstan, Uzbekistan, for cultivation on highly saline soils.
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Scientists also worked extensively with farmers. In Burkina Faso and Mali, for example, they established low-cost solar-powered irrigation systems for more than 100 smallholders to help them tackle water and energy shortages in agriculture.

In Central Asia, many activities focused on addressing salinization. Researchers introduced a perennial sorghum variety called Azamat to 22 farmers and 14 herders in Karakalpakstan, Uzbekistan, for cultivation on highly saline soils. They also helped to establish six seed production clusters in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, and trained 149 farmers in best practice in seed multiplication.

ICBA also organized several farmer field schools for more than 160 farmers and extension staff, including 70 women, to promote alternative climate-smart crops and technologies in Egypt. As part of the center's global quinoa program, scientists also held a course for over 150 people, including 120 women, to train them in preparing food and feed from the crop.

This work was a result of the center's close partnership with the IsDB and aimed to support the bank's sustainable development efforts in member countries.

Enabling Innovations

Strategic Alliances

More than 100 delegates from different countries gathered at a special high-level seminar on the sidelines of the IsDB 42nd Annual Meeting in Jeddah, Saudi Arabia, to discuss approaches to making agricultural production more attractive to the younger generation. Titled "Youth engagement in agriculture production: Developing technologies that appeal to youth to make farming an attractive career option", the seminar looked at the challenges and problems facing rural young people and what should be done to overcome them.

ICBA and AOAD agreed to step up collaboration on agricultural climate resilience and food security in the Arab region. The agreement provides a solid framework for joint efforts to address major problems, including water scarcity and salinity, facing the agricultural sectors of Arab countries.

Partnership is the backbone of ICBA's work. It is key to achieving impact on the ground. In 2017 the center continued to cement relationships with strategic partners and form new ones. ICBA, for example, co-organized side events with IsDB on the sidelines of the IsDB 42nd Annual Meeting in Jeddah, Saudi Arabia. The events focused on youth engagement in agriculture as a means to fight unemployment and food insecurity and a program to empower young Arab women scientists in the MENA region.

During the year, the center also worked to establish new partnerships with several organizations, including the Federal Electricity and Water Authority (FEWA), the Khalifa International Award for Date Palm and Agricultural Innovation, and the Arab Organization for Agricultural Development (AOAD).

In recognition of ICBA's extensive research on date palms, the General Secretariat of the Khalifa International Award for Date Palm and Agricultural Innovation signed a memorandum of understanding with the center to step up efforts in date palm research and production.

At a high-level seminar attended by over 150 participants on the sidelines of the IsDB 42nd Annual Meeting in Jeddah, Saudi Arabia, ICBA also presented the Tamkeen program, a novel initiative to empower Arab women scientists.

ICBA and FEWA agreed to work together on advancing technology transfer in safe reuse of treated wastewater in agriculture, reuse of brine water and other areas of agricultural development through collaborative technical assistance and capacity building.

The memorandum of understanding with the Khalifa International Award for Date Palm and Agricultural Innovation provides a framework for cooperation for three years in research on date palm production and salinity and knowledge sharing.

ICBA signed agreements of cooperation with a wide range of partners in 2017. They include:

- Arab Authority for Agricultural Investment and Development
- Arab Organization for Agricultural Development
- Bill & Melinda Gates Foundation
- El Reef Al Masry (an Egyptian countryside development company)
- Federal Electricity and Water Authority
- Green Technology (a private company in Kazakhstan)
- Khalifa International Award for Date Palm and Agricultural Innovation
- King Abdullah University of Science and Technology
- Masader Renewable Energy, Water and Environment Security Ltd.
- Swing Fish Company
- UAE Ministry of Energy and Industry
- University of Nebraska – Lincoln

Knowledge Hub

ICBA's drought management work was featured in Newsweek.

ICBA contributed to the manual on management of salt-affected soils. The manual was published in Russian for a wide range of stakeholders in Central Asia and elsewhere.

As knowledge is one of ICBA's key products, the center places strong emphasis on delivering it to various stakeholders. In 2017 it continued to communicate its research and development work to different audiences by means of a mix of communication tools, including the website and social media.

As a result of external communication, the center secured extensive media coverage throughout the year. ICBA received 180 media mentions in national, regional and international media outlets, including the Nature Middle East, Newsweek, Reuters, Associated Press, China Central Television and others.

The center also released and contributed to a number of knowledge products jointly with national and international partners. For example, a set of guidelines on the documentation of best biosaline practices was published in a manual in collaboration with the FAO, the Eurasian Center for Food Security and the Global Soil Partnership Program.

Moreover, four best biosaline practices were documented by the World Overview of Conservation Approaches and Technologies, a global network of soil and water conservation specialists, contributing to sustainable land management. To improve content delivery, the center's website was revamped. It was rebuilt with a new information architecture and responsive design. The improvement and increased quality content helped to ensure a considerable growth in website traffic and social media engagement during the year.

Website Sessions

Year	Sessions
2016	65,532
2017	76,299

YouTube Views

Year	Views
2016	14,666
2017	60,029

Facebook Followers

Year	Followers
2016	1,880
2017	2,200

Capacity Building

Capacity development is an integral part of ICBA's programs. In 2017 the center focused considerable efforts and resources on identifying capacity-building needs of different stakeholders and catering to these needs.

ICBA continued to work on strengthening the capacities of institutions, researchers, students and farmers through short- and medium-term training courses, workshops, farmer field schools, internships, master's, doctoral and post-doctoral research programs.

During the year, the center worked with universities around the world to offer internships to undergraduate and graduate students. ICBA attracted interns from universities in France, Jordan, Morocco, Serbia, the UAE and the USA who worked under the supervision of scientists and gained practical experience in experimental fields and state-of-the-art laboratories. Scientists also provided support to three PhD students from Kazakhstan and Uzbekistan and advised them on their theses.

University	Country
Al-Balqa' Applied University	Jordan
BITS Pilani Dubai	UAE
Columbia University	USA
EMINES - School of Industrial Management	Morocco
Istom University	France
UAE University	UAE
University of Belgrade	Serbia
Zayed University	UAE

ICBA received 14 interns (eight men and six women) in 2017.

ICBA's internship program brought together students from around the world. The program helped them to gain practical research experience and collaborate and network with their peers.

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> During the year, the center worked with universities around the world to offer internships to undergraduate and graduate students.
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The center also worked with national partners to improve the capabilities of their specialists. ICBA organized 18 capacity-building courses in Algeria, Ethiopia, Jordan, Morocco, Tunisia and the UAE for a total of 270 participants from 18 countries from the Gulf region, MENA and sub-Saharan African regions.

Ms. Hamda Al-Masoum is one of several interns who benefitted from ICBA's internship program. A bachelor's student at Zayed University, the UAE, she conducted a comparative analysis of crop production under greenhouse and net-house conditions as part of her internship.

Moreover, ICBA carried out several activities aimed at enhancing institutional capacities of country partners. In Jordan, for example, the center teamed up with FAO, USAID, the United Nations Development Program (UNDP) and the University of Nebraska - Lincoln to establish the country's first-ever operational drought monitoring system. The system uses open-source and free-of-charge software developed by the climate change and adaptation research team at ICBA and the University of Nebraska - Lincoln's National Drought Mitigation Center.

ICBA also continued efforts to empower Arab women scientists. As part of a research grant competition with CRDF Global, a US non-governmental organization, four teams of Arab women researchers from the MENA region and US scientists were awarded grants of 100,000 USD each to conduct research projects over three years. Under a leadership program called Tamkeen, supported by the IsDB and the Bill and Melinda Gates Foundation, ICBA joined forces with the African Women in Agriculture Research and Development program to conduct a five-day pilot leadership training course for women scientists from Algeria, Egypt, Jordan, Lebanon, Morocco, Oman, Palestine and Tunisia.

Year	Men	Women	Total
2016	77	41	118
2017	164	106	270

Participants who attended ICBA-organized specialized training courses by gender.

ICBA organized a USAID-funded three-day practical workshop at the Ministry of Water and Irrigation of Jordan in Amman in April 2017. The workshop provided over 18 participants with hands-on training in how to create monthly maps to monitor droughts using a custom-built program.

ICBA hosted the first-of-its-kind drone training course in remote sensing in the Gulf region in March 2017. Over 25 participants representing four countries, including 16 from the UAE, received hands-on training in remote sensing and photogrammetry techniques using aerial images from drones.

In April 2017 ICBA organized a training course in coping with salinity for more than 25 Ethiopian agricultural officers and extension workers under the IFAD-funded RAMSAP project. During the course organized jointly with the International Livestock Research Institute (ILRI) and the Ministry of Agriculture and Natural Resources of Ethiopia, participants learned how to identify and manage different types of salt-affected lands and which legumes and fodders they can plant to rehabilitate these lands.

Publications

Research publications are an important element of ICBA's knowledge output. They form the center's core contribution to the progress of agricultural science. In 2017 scientists produced a total of 45 research papers, including 18 in peer-reviewed journals.

A. Published in Peer-Reviewed Journals

1. Chamekh, Z., Karmous, C., Ayadi, S., Sahli, A., Belhaj Fraj, M., Yousfi, S., Rezgui, S., Ben Aissa, N., Serret, M. D., McCann, I., Trifa, Y., Amara, H. & Araus, J. L. (2017) Comparative performance of δ13C, ion accumulation and agronomic parameters for phenotyping durum wheat genotypes under various irrigation water salinities. Annals of Applied Biology, pp. 229-239. doi: 10.1111/aab.12332.

2. Filali, K., Hirich, A., Ouafae, B., Choukr-Allah, R., & Ragab, R. (2017) Yield and dry matter simulation using the SALTMED model for five quinoa (Chenopodium quinoa) accessions under deficit irrigation in south Morocco. Irrigation and Drainage, 66 (3), pp. 340-350.

3. Hammami, Z., Gauffreteau, A., Belhaj Fraj, M., Sahli, M. A., Jeuffroy, H., Rezgui, S., Bergaoui, K., McDonnell, R. & Trifa, Y. (2017) Predicting yield reduction in improved barley (Hordeum vulgare L.) varieties and landraces under salinity using selected tolerance traits. Field Crop Research, pp. 10-18.

4. Malki, M., Bouchaou, L., Hirich, A., Ait Brahim, Y. & Choukr-Allah, R. (2017) Impact of agricultural practices on groundwater quality in intensive irrigated area of Chtouka-Massa, Morocco. Science of the Total Environment, 574, pp. 760-770.

5. Mitchell, D., AchutaRao, K., Allen, M., Bethke, I., Beyerle, U., Ciavarella, A., Forster, P. M., Fuglestvedt, J., Gillett, N., Haustein, K., Ingram, W., Iversen, T., Kharin, V., Klingaman, N., Massey, N., Fischer, E., Schleussner, C. F., Scinocca, J., Seland, Ø., Shiogama, H., Shuckburgh, E., Sparrow, S., Stone, D., Uhe, P., Wallom, D., Wehner, M. & Zaaboul, R. (2017) Half a degree additional warming, prognosis and projected impacts (HAPPI): background and experimental design. Geoscientific Model Development, 10, pp. 571-583.

6. Qureshi, A. S. (2017) Sustainable use of marginals lands to improve food security in the United Arab Emirates. Journal of Experimental Biology and Agricultural Sciences, 5, pp. 41-49.

7. Rao, N. K., McCann, I., Shahid, S. A., Bull, K., Al Araj, B. & Smail, I. (2017) Sustainable use of salt-degraded and abandoned farms for forage production using halophytic grasses. Crop & Pasture Science, 68, pp. 483-492.

8. Shahid, M. (2017) Goats: a threat to the biodiversity in the United Arab Emirates. Tribulus, 25, pp. 4-12.

9. Shahid, M. (2017) Two populations of Salicornia europaea in the United Arab Emirates. Tribulus, 25, pp. 71-75.

10. Shahid, M. & Rao, N. K. (2017) Saving UAE's halfa grass. Tribulus, 25, pp. 69-70.

11. Shuyskaya, E. V., Rakhmankulova, Z. F., Lebedeva, M. P., Kolesnikov, A. V., Safarova, A., Borisochkina, T. I. & Toderich, K. N. (2017) Different mechanisms of ion homeostasis are dominant in the recretohalophyte Tamarix ramosissima under different soil salinity. Acta Physiologiae Plantarum, 39 (3), p. 81.

12. Shuyskaya, E. V., Toderich, K. N., Gismatullina, L., Rajabov, T. & Khohlov, S. (2017) Genetic diversity of two annual Salsola species (Chenopodiaceae) among habitat types in desert plant communities. Biologia, 72 (3) pp. 267-276.

13. Vahamidis, P., Stefopoulou, A., Kotoulas, V., Lyra, D., Dercas, N. & Economou, G. (2017) Yield, quality and water use efficiency of Null-LOX malt barley in a semiarid Mediterranean agroecosystem: estimating the effects of supplemental irrigation. Field Crops Research, 206, pp. 115-127.

14. Razali, R., Bougouffa, S., Morton, M. J. L., Lightfoot, D. J., Alam, I., Essack, M., Arold, S. T., Kamau, A., Schmöckel, S., Pailles, Y., Shahid, M., Michell, C. T., Ho, Y. S., Al-Babili, S., Tester, M., Bajic, V. B. & Negrão, S. (2017) The genome sequence of the wild tomato Solanum pimpinellifolium provides insights into salinity tolerance. bioRxiv 215517. doi: https://doi.org/10.1101/215517

B. Accepted in Peer-Reviewed Journals

1. Shuyskaya, E. V., Rakhmankulova, Z. F., Bukarev, R. V., Toderich, K. N., Khujanazarov, T. M., Gupta, K., Ismail, Sh., Zhapaev, A. R., Boboev, F. & Kalashnikov, P. (2017) Effect of ionic and osmotic stress on physiological and biochemical parameters of two newly identified high biomass breeding materials of pearl millet (Pennisetum glaucum (L.) R.Br). Journal of Agricultural Science and Technology.

2. Rodriguez, J. P., Andreasen, C., Sørensen, M. & Jacobsen, S. E. (2017) Cañahua (Chenopodium pallidicaule) – a promising new crop for arid areas. In: A. Hirich, R. Choukr-Allah, R. Ragab R (eds.) Emerging research in alternative crops under marginal environment. Springer: Switzerland. (In press)

3. Rodriguez, J. P., Ono, E., Al Mousa's, S. A., Choukr-Allah, R. & Hirich, A. (2017) Cultivation of quinoa (Chenopodium quinoa) in desert ecoregion. In: A. Hirich, R. Choukr-Allah, R. Ragab (eds.) Emerging research in alternative crops under marginal environment. Springer: Switzerland. (In press)

4. Gill, S., Alshankiti, A., Shahid, S. A. & Rodriguez, J. P. (2017) Amending soil health to improve productivity of alternate crops in marginal sandy soils of the United Arab Emirates. In: A. Hirich, R. Choukr-Allah, R. Ragab (eds.) Emerging research in alternative crops under marginal environment. Springer: Switzerland. (In press)

C. Published in Conference Proceedings/Book Chapters

1. Aralova, D., Kariyeva, J., Menzel, L., Khujanazarov, T., Toderich. K., Halik, U. & Gofurov, D. (2017) Assessment of land degradation processes and identification of long-term trends in vegetation dynamics in the drylands of Greater Central Asia. In: Victor Squires and Lu Qi (eds.) Sustainable land management in Greater Central Asia – integrated and regional perspectives.

2. Aralova, D., Jarihani, B., Khujanazarov, T., Toderich, K., Gafurov, D. & Gismatulina, L. (2017) Monitoring of spatiotemporal patterns of Net and Gross Primary Productivity (NPP & GPP) and their ratios (NPP/GPP) derived from MODIS data: assessment of natural drivers and their effects on NDVI anomalies in arid and semi-arid zones of Central Asia. Geophysical Research Abstracts, 19.

3. Bannari, A., Shahid, S. A., El-Battay, A., Alshankiti, A., Hameid, N. A. & Tashtoush, F. (2017) Potential of WorldView-3 for soil salinity modeling and mapping in an arid environment. Proceedings of the 2017 IEEE International Geoscience and Remote Sensing Symposium, Fort Worth, Texas, USA, July 23-28, 2017, pp. 1585-1588.

4. Bergaoui, K., Belhaj Fraj, M., Zaaboul, R., Allen, M., Mitchell, D., Schleussner, C-F., Saeed, F. & McDonnell, R. (2017) Assessment of 1.5°C and 2°C climate change scenarios impact on wheat production in Tunisia. Proceedings of 19th EGU General Assembly, Vienna, Austria, 23-28 April 2017, p. 7518.


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5. Bouchaou, L., Choukr-Allah, R., Hirich, A., Ennasr, M. S., Malki, M., Abahous, H., Bouaakaz, B. & Nrhira, A. (2017) Climate change and water valuation in Souss-Massa region: Management and adaptive measures. In: G. Tsakiris, V. A. Tsihrintzis, H. Vangelis & D. Tigkas (eds.). Proceedings of the 10th World Congress of EWRA on Water Resources and Environment, European Water Resources Association, pp. 835-843.

6. Burundukova, O., Shuyskaya, E., Rakhmankulova, Z., Burkovskaya, E., Chubar, E., Gismatulina, L. & Toderich, K. (2017) Kali komarovii (Amaranthaceae) is a xero-halophyte with facultative NADP-ME subtype of C4 photosynthesis. Flora: Morphology, Distribution, Functional Ecology of Plants, 227, pp. 25-35.

7. Choukr-Allah, R. & Hirich, A. (2017) Integrated smart decision support tool for eco-efficient inputs management of MENA region farming systems (ECO-FARM). CIHEAM-Watch Letter, 38, pp. 1-5.

8. Choukr-Allah, R., Shahid, S. A., Hirich, A. & Raghia, E. (2017) Forage Production System on Salt-Affected Farms in Foum El Oued – Laayoune. Proceedings of 4th International Symposium on Innovation and Technology in the Phosphate Industry (SYMPHOS 4), Ben Guérir, Morocco.

9. Hirich, A. & Choukr-Allah, R. (2017) Water and Energy Use Efficiency of Greenhouse and Nethouse Under Desert Conditions of UAE: Agronomic and Economic Analysis. In: Abdalla O., Kacimov A., Chen M., Al-Maktoumi A., Al-Hosni T., Clark I. (eds.) Water Resources in Arid Areas: The Way Forward. Springer Water. Springer: Cham, pp. 481-499.

10. Khujanazarov, T., Touge, Y., Tanaka, K. & Toderich, K. (2017) Water resources regulation and crops diversification analysis to solve transboundary water sharing: a case study from Zeravshan River Basin. Proceedings of XVI World Water Congress, International Water Resources Association, Cancun, Quintana Roo, Mexico, 29-3 June 2017.

11. Khujanazarov, T. M., Toderich, K. N., Touge, Y., Tanaka, K., Mbugua, J. M., Boboev, H. O., Abdushukurov, D. A. & Aralova, D. B. (2017) Marginal Water Resources Use for Resilient Agriculture and Food Security (with reference to Central Asia). Proceedings of International Conference on Water Management in Arid and Semi-Arid Land, Irbid, Jordan, 7-10 October 2017, pp. 32-36.

12. Seif-Ennasr, M., Hirich, A., El Morjani, Z. A., Choukr-Allah, R., Zaaboul, R., Abdessadek, N., Malki, M., Bouchaou, L. & Beraaouz, E. (2017) Assessment of Global Change Impacts on Groundwater Resources in Souss-Massa Basin. In: Abdalla O., Kacimov A., Chen M., Al-Maktoumi A., Al-Hosni T., Clark I. (eds.) Water Resources in Arid Areas: The Way Forward. Springer Water. Springer: Cham, pp. 115-140.

13. Toderich, K., Khujanazarov, T., Aralova, D., Shuyskaya, E., Gismatulina, L. & Boboev, H. (2017) Ecosystem Services and Community-Based Approaches to Wastewater and Saline Soils Reclamation in the Drylands of Uzbekistan. Geophysical Research Abstracts, EGU General Assembly 2017, 19.

D. Accepted in Conference Proceedings/Book Chapters

1. Elouafi, I., Hirich, A., Shahid, M. & Begmuratov, A. (2017) The contribution of alternative crops in food security under marginal environments.

2. Hirich, A., Choukr-Allah, R. & Ragab, R. (2017) Emerging Research in Alternative Crops under Marginal Environment (Edited book). Springer.

3. Mamedov, A. I., Gasimova, Kh., Husiyev, E. K., Farzaliyev, V., Alizade, V. M. & Toderich, K. (2017) Root and shoot relation of the quinoa and forage plants in salt-affected clay soil.

4. Qureshi, A. S. & Shoaib, I. (2017) Prospects of agroforestry for the marginal environments: evidences from the United Arab Emirates. In: J. C. Dagar and V. P. Tewari (eds.) Agroforestry - Anecdotal to Modern Science. Springer.

5. Qureshi, A. S. (2017) Challenges and opportunities for sustainable groundwater management in Pakistan. In: Mukherjee, A. (ed.) Groundwater of South-Asia. Springer.

6. Gelaw, A. M. & Qureshi, A. S. (2017). Tef (Eragrostis tef): a potential food crop for the marginal lands of Ethiopia. In: Emerging Research in Alternative Crops under Marginal Environment (Edited book). Springer.

7. Qureshi, A. S. (2017) Managing surface water for irrigation. In: T. Oweis (ed.) Water management for sustainable agriculture. Burleigh Dodds Science Publishing.

8. Qureshi, A. S. (2017) Increasing water productivity in the agriculture sector. In: S. I. Khan and T. Adams (eds.) Indus River Basin: Security and Sustainability. Elsevier Publishing.

9. Shahid, M., Jaradat, A. & Rao, N. K. (2017) Safflower: a multipurpose crop for the marginal lands.

10. Shahid, S. A., Abdelaziz, M., Ezzaiar, R., Lyamani, A. & Choukr-Allah, R. (2017) Groundwater salinity mapping of Foum El Oued – Laayoune agricultural perimeter and proposed management. Proceedings of 4th International Symposium on Innovation and Technology in the Phosphate Industry, 2017, Benguerir, Morocco.

E. Published in Scientific Newsletters/Magazines

1. Shahid, S. A. & Gill, S. (2017) Environmental Impact Assessment of Soil Projects. Farming Outlook, 16 (1), pp. 18-21.

2. Shahid, S. A. & Gill, S. (2017) Pakistan's Demand on Nature – Where Do We Stand vis-à-vis World Scenario. Farming Outlook, 16 (3), pp. 16-20.

F. Manuals

1. Toderich, K. N., Ismail, S., Khujanazarov, T. & Khasankhanova, G. (2017) Biosaline technologies and approaches to salinity management of different agro-landscapes in arid climate (with reference to Central Asia and Caucasus). In: R. Vergas, E. I. Pankova, S. A. Baliyuk, P. V. Krasilnikov and Khasankhanova G. M. Guidelines on soil salinity management (Implementation of Work Plan of Global Soil Partnership), pp. 65-78.

G. Abstracts

1. Lyra, D., Soppe, R. & Ismail S. (2017) Produced oilfield water: A resource for non-food chain agriculture. Proceedings of oil & gas water management summit in MENA. Dubai, UAE, 26-27 April 2017.

Where We Worked in 2017

List of Projects in 2017

Externally funded

Project	Country	Period
Collaborative Program for Euphrates and Tigris (CPET)	Turkey, Iran, Iraq, Syria	2013-2018
Feasibility of nano-filtration for desalinization of saline/sea water used for irrigating vegetable crops in greenhouse under Qatari conditions	Qatar, UAE	2015-2018
Soil salinity and properties mapping using remote sensing, geographical information system and field validation – a case study of Bahrain and UAE	Bahrain, UAE	2015-2017
Rehabilitation and management of salt-affected soils to improve agricultural productivity	Ethiopia, South Sudan	2015-2019
Tree planting demonstration project using Cocoon	UAE	2016-2017
Scaling up small-scale irrigation technologies for improving food security in sub-Saharan Africa	Burkina Faso, Mali, Niger, Senegal	2016-2020
Water Innovations Technologies	Jordan	2017-2021
Assessing soil amendments for agricultural intensification in marginal lands/urban landscape	UAE	2014-2017
Food for the future: producing more per drop of water, saving resources, increasing food security – Phase II	UAE	2017-2018
Feasibility of investments in Afghan saffron	Afghanistan	2016-2017
Model for seed production of resilient salt-tolerant crop species for climate-smart agriculture in Egypt	Egypt	2015-2018
Technical assistance to PHOSBOUCRAA for Foum El Oued – Laayoune: improvement of forage production system on salt-affected farms	Laayoune – Morocco	2015-2018
The impact of the rhizosphere microbiota on root system development and tolerance to environmental constraints in cereals	UAE	2014-2018
Technical Assistance to OCP Group for Model Farm: Rehabilitation of phosphate mining land and introduction of new agro-system to improve farmers' income	Morocco	2017-2020
Inland and coastal modular farms for climate change adaptation in desert environments	UAE	2017-2018
Identifying genotypic variability in tropical maize for salinity tolerance	UAE	2017-2018
Scaling up quinoa value chain to improve food and nutritional security in poor rural communities of Morocco	Morocco	2017-2020
Mapping agricultural communities vulnerable to the impact of climate change and enhancing their livelihood in selected countries of MENA and SSA Regions	Yemen, Egypt, Lebanon, Senegal, Mauritania	2014-2017
Investing in vegetable production under protected agriculture in UAE	UAE	2017
Genetic studies of salinity tolerance in barley in field conditions	UAE, Saudi Arabia	2013-2017
Date palm water use monitoring project (date palm sap flow): estimation of water demands in three varieties under different salinity and irrigation levels	UAE	2015-2017
Cross-regional partnerships for improving food and nutritional security in marginal environments of Central Asia	Uzbekistan, Tajikistan, Kyrgyzstan	2015-2017
Promotion of high yield forage crops in short-farming rotation system under sprinkler irrigation in marginal lands	Kazakhstan	2015-2018
Use of non-conventional agricultural water resources to strengthen water and food security in transboundary watersheds of the Amu Darya river basin	Uzbekistan, Turkmenistan, Tajikistan	2015-2018
Development of the MENA Regional Drought Management System	Jordan, Morocco, Lebanon, Tunisia	2015-2018
Using data innovations to understand groundwater abstraction in the United Arab Emirates	UAE	2017-2018
Drought impacts from climate variability in the MENA region from El Nino to climate change	Tunisia, Morocco, Lebanon	2016-2017
Young Arab Women Scientists Leadership Program (Tamkeen) inception and design phase	UAE	2016-2017
Soil Museum	UAE	2016-2018

Core funded

Project	Country
Long-term evaluation of biochar application rate on field crop irrigated with saline water	UAE
Plant genetic resources for marginal environments: identification, multiplication & dissemination	UAE
Potential benefits and environmental risks associated with using treated municipal wastewater on vegetables, landscaping plants, forages and fruit trees in UAE	UAE
Protected agricultural production for maximum water and energy use efficiency in hot arid climates	UAE
On-farm demonstration of seed production and adaptation to biosaline agriculture production systems (aquaculture)	UAE
Molecular mechanisms involved in tolerance to salinity: towards selection of candidate genes for plant breeding in two cereals	UAE
Evaluation of elite date palm varieties for salt tolerance at various salinity levels at ICBA	UAE
Evaluation of Salicornia bigelovii under high salinity levels and management practices in UAE	UAE
Evaluation and development of quinoa as an alternative crop for marginal environments of UAE	UAE
Automated sensor-based control and monitoring of irrigation for research, demonstration and capacity-building	UAE
Nutrient management trial using Acacia ampliceps, Sporobolous arabicus and Paspalum vaginatum at different salinity levels	UAE

Sustainability

ICBA's research and development efforts are supported by a large number of financial contributors and partners. This support helps the center to continue to create and share necessary knowledge and technology in different countries. Many donors contributed to the center's initiatives during the year. Most of the allocations were provided by ICBA's core partners: the UAE Government (through MoCCaE and EAD) and the IsDB. This funding made it possible for the center to make considerable progress on different fronts.

We wish to thank all our financial contributors and partners for making this happen. In particular, we would like to say thanks to the following organizations for their contributions in 2017:

1. Abu Dhabi Fund for Development (ADFD)
2. American University in Cairo
3. Arab Bank for Economic Development in Africa (BADEA)
4. Arab Fund for Economic and Social Development
5. Austrablend Pty
6. Bill and Melinda Gates Foundation
7. Development Alternatives, Inc.
8. Flozyme Corporation
9. FAO
10. Green Good Ecotech
11. Gulf Perlite LLC
12. International Atomic Energy Agency (IAEA)
13. International Center for Agricultural Research in the Dry Areas (ICARDA)
14. IFAD
15. International Water Management Institute (IWMI)
16. Kazakh Research Institute of Water Management
17. King Abdullah University of Science and Technology (KAUST)
18. Landlife Company
19. Qatar Ministry of Environment
20. National Academy of Sciences, USA
21. OFID
22. Phosboucraa Foundation
23. Sida
24. USAID
25. Zeoplant
26. The World Bank
27. Arabian Gulf University
28. Noryx General Trading LLC
29. Expo Dubai 2020
30. International Maize and Wheat Improvement Center (CIMMYT)
31. International Development Research Centre (IDRC)

Financial Statement

STATEMENT OF FINANCIAL POSITION AS AT 31 DECEMBER 2017 (In US Dollars '000')

	2017	2016
ASSETS		
Current assets		
Cash and cash equivalents	5,724	9,800
Short term investments	10,896	5,448
Accounts receivables		
Donors	480	282
Employees	2	39
Other	426	325
Inventories - net	14	-
Prepaid expenses	14	10
Total current assets	17,555	15,905
Non-current assets		
Property and equipment	5,290	6,618
Total non-current assets	5,290	6,618
TOTAL ASSETS	**22,845**	**22,522**
LIABILITIES AND NET ASSETS		
Current liabilities		
Accounts payable		
Donors	3,845	3,692
Employees	163	170
Other	177	917
Accruals	659	350
Total current liabilities	**4,844**	**5,128**
Non-current liabilities		
Accounts payable		
Employees	565	442
Total Non-current liabilities	**565**	**442**
TOTAL LIABILITIES	**5,409**	**5,570**
NET ASSETS		
Designated	15,397	15,397
Undesignated	2,038	1,555
	17,435	16,952
TOTAL LIABILITIES AND NET ASSETS	**22,844**	**22,522**

STATEMENT OF ACTIVITIES FOR THE YEAR ENDED 31 DECEMBER 2017 (In US Dollars '000)

	2017			2016		
	Unrestricted	Restricted	Total 2017	Unrestricted	Restricted	Total 2016
Revenue and Gains						
Grant Revenue						
Bilateral	7,000	3,827	10,827	7,000	4,193	11,193
Total Grant Revenue	**7,000**	**3,827**	**10,827**	**7,000**	**4,193**	**11,193**
Other Revenue and Gains/(Losses)	6	-	6	7	-	7
Total Revenue and Gains	**7,006**	**3,827**	**10,833**	**7,007**	**4,193**	**11,200**
Expenses and Losses						
Research Expenses	3,842	2,810	6,653	4,473	2,902	7,375
Collaborator Expenses	106	1,017	1,122	222	1,259	1,482
General and Administration Expenses	2,725	-	2,725	3,179	-	3,179
Other Expenses and Losses	-	-	-	(7)	-	(7)
Total Expenses and Losses	**6,673**	**3,827**	**10,500**	**7,867**	**4,162**	**12,028**
Financial Income	162		162	196		196
Financial Expenses	(12)	0	(12)	(11)	(32)	(43)
(Deficit)/Surplus	**483**	**0**	**483**	**(675)**	**0**	**(675)**

Performance Indicators

Publications	Number of externally peer-reviewed publications in 2017	14 publications in peer- reviewed journals
	Number of externally peer-reviewed publications accepted in 2017	4 publications in peer- reviewed journals accepted
	Percentage of scientific papers published with developing country partners in refereed journals, conference and workshop proceedings in 2017	69% of the total
Institutional Health	Percentage of women in senior management	50%
Financial Health	Long-term financial stability (adequacy of reserves)	483 days where the minimum benchmark is 90 days
	Cash management on restricted operations	0.12 where the benchmark is less than 1.00

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ABOUT ICBA

ICBA is a unique applied agricultural research center in the world that is focused on marginal areas where an estimated 1.7 billion people live. It identifies, tests and introduces resource-efficient, climate-smart crops and technologies that are best suited to different regions affected by salinity, water scarcity and drought. Through its work, ICBA helps to improve food security and livelihoods for some of the poorest rural communities around the world.

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