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ICBA
AGRICULTURE FOR TOMORROW

A Year in Focus: Impact Report | 2018

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2018

Contents

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Message from the **Minister of State for Food Security** of the United Arab Emirates

2018 was a particularly important year for the UAE's food security agenda, as November saw my colleagues and I launch the country's first National Food Security Strategy. Devised to establish the necessary infrastructure and frameworks to achieve the country's food security goals in line with the UAE Centennial 2071 Plan, the strategy has the overarching objective of enabling all citizens and residents to have access to sufficient, safe and nutritious food for an active and healthy life at affordable prices at all times, including emergencies and crises.

My office drew up the National Food Security Strategy in response to the UAE's heavy reliance on food imports, which have reached 90% of the country's total food. It was created in recognition that we needed to prioritize reducing this dependency if we are to meet the food security needs for a UAE population projected to increase from its current figure of 9.8 million to 10.7 million by 2032. Through its various pillars, the strategy has an ambitious goal of taking the UAE from 31st place in the Global Food Security Index to be within the top 10 by 2021 and number one by 2051.
Significantly, the National Food Security Strategy goes beyond delivering sustainable food solutions for the UAE and has an important role to play in helping other countries meet their own food security needs. One of its key pillars is enabling technology-based food production, which has a target of increasing domestic yield by 30% by 2021. It also effectively opens up a new agricultural sub-sector in the UAE 'Ag-Tech,' which aims to see the development of a niche sector that will create investment opportunities for entrepreneurs and attract global talent to be at the cutting-edge of food production.

Research and development (R&D) is a bedrock of this pillar. Through institutions such as the International Center for Biosaline Agriculture (ICBA), the UAE is leading efforts to promote agriculture in marginal environments. ICBA focuses on identifying, testing and piloting resource-efficient, climate-smart crops and technologies in salt-affected, water-scarce and drought-vulnerable regions. Over the years, the center has acquired extensive applied experience and knowledge and has developed tailor-made solutions to the problems of salinity, water scarcity and drought. Uniquely positioned to introduce much-needed climate-smart crops and technologies in different parts of the world to alleviate projected food and water crises, ICBA is proving instrumental in enhancing the UAE's food security agenda.

The challenges to future food security are growing in number and complexity worldwide, meaning that the solutions that ICBA has been working on for years will be very much needed in countries where future food production is likely to be undermined by climate change and other factors. For this reason, the UAE Government through the Food Security Office is committed to continuing its support for the center. By working hand-in-hand with the center to increase its capacity, not only our nation, but other countries as well, can benefit from its advanced research and innovation, thereby helping to achieve the United Nations' SDG 2 – Zero Hunger by 2030.

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

Message from the **President** of the Islamic Development Bank Group

It gives me a pleasure to write this opening message for ICBA's 2018 impact report. Being one of the founding organizations of ICBA, we at the Islamic Development Bank are delighted to witness ICBA's growth from strength to strength with each passing year and 2018 was no exception. The Islamic Development Bank envisioned a great role for the center in tackling poverty and hunger in its member countries through research, innovation and development. In 2018 ICBA conducted research-for-development activities in 26 of our member countries. But the center's work reached other countries too. Many countries in Africa and elsewhere also benefited from the center's research-for-development programs. Today ICBA is a truly international center serving people in marginal environments around the world.

Guided by its science-based innovations, ICBA helped vulnerable rural communities to farm better and earn more from agriculture in unfavorable conditions like soil and water salinity, and water scarcity. Additionally, as a center with a mandate for marginal environments, which are present in most of our member countries, ICBA introduced food and forage crops which grow well on saline soils and can be irrigated with saline water. For example, the center carried out several activities to support pastoralists and livestock farmers in Ethiopia and Uzbekistan by promoting the cultivation of salt-tolerant forages. As the livestock sector is an agricultural mainstay in many of our member countries, it is important that pastoralists and livestock farmers have access to forages all year round. The lessons learnt from this work stand to benefit many more member countries of the bank.

As smallholder farmers are still the main producers of food in many developing countries, it is crucially important that they have skills and technologies for sustainable food production in the face of climate change and water scarcity. So ICBA's work with smallholder farmers is worth a special mention. This is also in line with our bank's mission to ensure that no-one is left behind as we work towards the achievement of the Sustainable Development Goals, especially the two goals targeting poverty and hunger. For instance, ICBA's program on quinoa is already bearing fruit as more and more smallholder farmers are taking to this nutritious crop. In 2018 there were positive results of this work in Kyrgyzstan, Morocco, Tajikistan and the United Arab Emirates. Climate-resilient and nutritious crops like quinoa, sorghum and others help smallholders better adapt to climate change.

I am also glad to note ICBA's work on knowledge and technology transfer. Over the years ICBA has established itself as a reliable and authoritative source of knowledge on sustainable solutions for agriculture in marginal environments. To help disseminate this knowledge among various stakeholders, I am delighted to note the bank's support for many of the center's capacity-building activities in our member countries. As a result of this support, ICBA provided technical training programs to 179 agricultural specialists from 43 countries in 2018.

Lastly, I would like to commend ICBA's management and staff for their successful exercise to refresh the center's strategy. The five-year strategy clearly maps out how ICBA will contribute to seven Sustainable Development Goals that are relevant to the center's mandate.

We are proud of ICBA's continued progress on different fronts. And I would like to congratulate the center's Board of Directors, management and staff on another successful year of work.

H.E. Razan Khalifa Al Mubarak
Chair of the Board of Directors

Dr. Ismahane Elouafi
Director General

Foreword from the **Board Chair and the Director General**

In 2018 we refreshed our strategy 2013-2023. The result is a refocused operational guide for the next five years, which is fully aligned with the Sustainable Development Goals (SDGs). This was only made possible by taking stock of advances in global agricultural research and development, as well as our recent successes and lessons learned and formal consultations with internal and external stakeholders. This refreshed strategy will help us to better gauge our contributions to the seven SDGs that are relevant to our mandate.

Many of our efforts last year were geared towards SDG 1 (No Poverty) and SDG 2 (Zero Hunger).

To tackle poverty, our scientists worked with pastoralists and livestock farmers in Ethiopia, Morocco and Uzbekistan, where many rural communities depend on their ruminants for food and income. As yields of traditional forages are severely affected by soil degradation and salinization, our scientists promoted salt-tolerant alternatives that show

great potential in these degraded areas. In southwestern Morocco, for example, farmers adopted blue panicum and Sesbania because their fresh biomass yields can be as high as 130 tonnes per hectare per year. As a result, they switched from forage corn varieties to the salt-tolerant species introduced by our scientists.

To improve food security and nutrition, our scientists continued to introduce nutritious drought- and salt-tolerant crops like quinoa so that small-scale farmers can grow and earn more in the face of increasing threats to agriculture. Our quinoa-focused projects in Kyrgyzstan, Tajikistan, Morocco and the United Arab Emirates produced positive results and many farmers realized higher profits. Under our quinoa program, we also launched a new project funded by the International Development Research Centre to popularize the crop in Morocco's Rehamna Province.

Our research work provided fresh insights into the science of crop production in marginal environments. Our scientists achieved a major breakthrough in increasing yield potential of Salicornia, a multi-purpose halophyte, under the difficult environmental conditions of the United Arab Emirates. They recorded a bumper seed yield of 3 tonnes per hectare by using seawater passed through an aquaculture system. They also, for the first time, successfully started growing halophytic vegetables in the local conditions by using reject brine from desalination units treated with fish effluents.

Our scientists also contributed to three World Bank studies that underscored the growing risks of drought in Lebanon, Morocco and Tunisia. Notably, our scientists together with their national partners in Kazakhstan and Kyrgyzstan obtained four patents - two on sorghum genotypes and two on quinoa-based foods and drinks respectively.

In 2018 individual and institutional capacity development continued to be geared towards empowering scientists from LICs and MICs with new knowledge and new networks. Through a joint research grant program with CRDF Global, we supported the collaboration between Arab women scientists and scientists in the United States. Our scientists also conducted nine technical training courses benefiting 179 specialists from 43 countries and we hosted 39 students from seven countries for short-term internships.

ICBA initiated a new venture with a private-sector company on the use of unmanned aerial vehicles (UAVs) in agriculture. In doing so, we co-organized the first edition of Drone Synergies, a global conference focused on building the capacity of different stakeholders in applying drone technology to agriculture. The conference attracted over 150 participants and showcased the role of UAVs in agriculture and other sectors.

As part of our commitment to the SDGs, we built new partnerships and strengthened existing ones to improve biosaline agriculture globally. Last year marked the beginning of our strategic partnership with BGI, the world's largest genomics institution. ICBA and BGI agreed to establish the Desert Life Sciences Center in the United Arab Emirates. ICBA also entered into a partnership with the Ministry of Innovative Development of Uzbekistan as their technical partner to set up the International Innovation Center for the Aral Sea Basin in Uzbekistan.

Our progress in different countries was possible thanks to unwavering support of the many donor and development agencies and partner organizations with whom we work. We are particularly grateful for the continued support of our founders - the Government of the United Arab Emirates (through the Food Security Office and the Environment Agency – Abu Dhabi) and the Islamic Development Bank.

Lastly, we owe much of our success to all the members of our staff. We wholeheartedly thank everyone for their hard work and dedication to our shared mission and vision.


ICBA

ICBA at a glance

ICBA is a unique, not-for-profit applied agricultural research center with a focus 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.

Since its formation in 1999, the center has implemented programs in over 30 countries in the Middle East, North Africa, sub-Saharan Africa, South Asia, Central Asia and the Caucasus.

ICBA has also expanded its network of partners around the world to increase the reach and impact of its programs. It has partners in more than 50 countries, enabling it to leverage a vast and diverse pool of expertise to achieve a greater impact on the ground.

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

AIRCA
Association of International Research and Development Centers for Agriculture

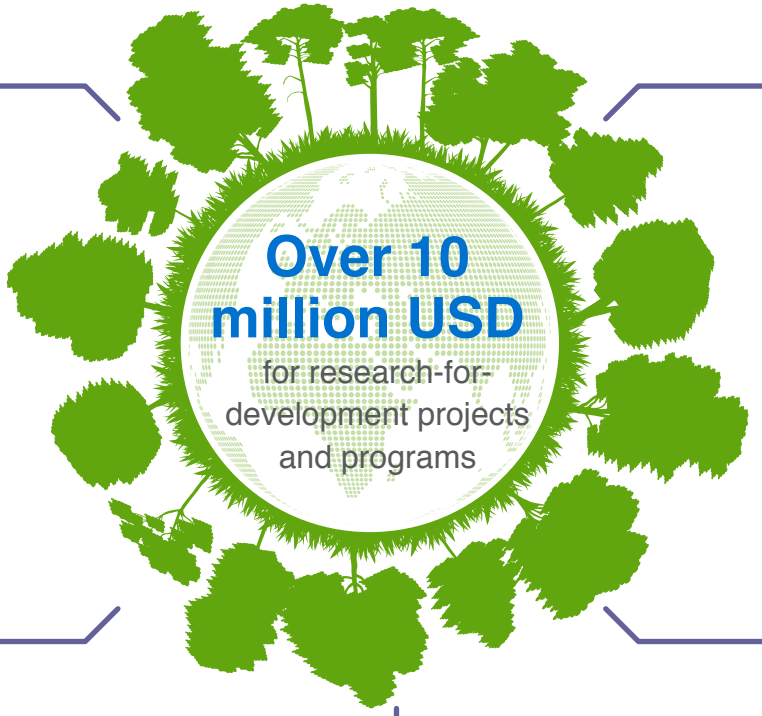
Through its work, ICBA helps to create jobs and improve food security and nutrition for some of the poorest rural communities around the world.

ICBA contributes to the achievement of seven Sustainable Development Goals (SDGs):

2018 in numbers

56

research-for-development projects and programs



4

patents

18

new partnerships

274

mentions in leading news outlets

179

beneficiaries of technical training programs, including 63 women, from 43 countries

29 countries


Today
around
736
million
people
still live in
extreme
poverty.

1 NO POVERTY

End poverty in all its forms everywhere

The pace of poverty reduction is slowing down. And extreme poverty is becoming more concentrated in sub-Saharan Africa and South Asia.

Most of the extremely poor rely on smallholder or subsistence farming. By one estimate, there are around 500 million smallholder farming households globally, and many of them live on less than 2 USD a day.

Lacking adequate skills and resources, these people are most vulnerable to climate change and other risks to agriculture.

To help them lift themselves out of poverty, it is important to equip them with necessary skills, crops and technologies so that they can better manage risks and produce enough food to eat and sell.

Over 11m hectares are degraded by salinity in Ethiopia – the largest area in Africa.

How salt-tolerant forages help pastoralists and livestock farmers

Many of the poor people in rural areas depend on their livestock for food and income. Forage means everything to them. But many parts of the world today face a double whammy of soil and water salinization. Water scarcity and climate change only add to the problem. This leads to a shortage of suitable pastures and rangelands, undermining the only source of livelihood for pastoralists and livestock farmers. Rangelands cover at least 34 percent of the global land area. They are among the ecosystems most affected by land degradation.

To tackle these problems, ICBA promotes salt-tolerant forage and food crops in salt-affected and other degraded areas, helping to improve the resilience of rural communities.

Combating soil salinity in Ethiopia

Smallholders dominate Ethiopia's agricultural sector and number in millions. Agriculture accounts for roughly 40 percent of the country's GDP, 80 percent of the total employment and 70 percent of the exports. However, they face a range of increasing risks to the main source of their livelihood such as recurrent droughts and salinization. Salinity is a growing problem in irrigated areas due to poor on-farm irrigation practices and lack of adequate drainage facilities. As staple crops fare badly in saline conditions, it is becoming more important to find alternative solutions to make the most of salt-affected lands which are otherwise normally abandoned.

It is also crucial that degraded lands are restored, and newly reclaimed areas are protected from the spread of salinity across the country as it reduces natural biodiversity and farm productivity.

The cultivation of salt- and drought-tolerant forages and halophytes, or salt-loving plants, is one way to bring these lands back into use. It is also important given a sizeable livestock sector in the country; there are over 120m head of cattle, sheep, goats, camels, horses and donkeys.

This is the purpose of a project implemented by ICBA and funded by the International Fund for Agricultural Development.

As part of the project called the Rehabilitation and Management of Salt-affected Soils to Improve Agricultural Productivity, scientists are studying the performance of stress-tolerant varieties of sorghum, pearl millet, cowpea, barley, quinoa and Sesbania in local conditions. The project aims to help reclaim more than 100,000 hectares of salt-affected lands in Ethiopia.

In 2018 ICBA completed a major study with national partners within the project's framework. The study confirmed that the cultivation of salt-tolerant and halophytic plants can help to address soil and water salinity in Ethiopia.

It noted that this approach is particularly suited to regions where technical solutions to soil reclamation are expensive and time-consuming and the growth of traditional field crops is restricted.

The study suggested that in highly saline soil conditions, planting salt-tolerant forage grasses such as *Diplachne fusca, Chloris gayana, Brachiaria mutica and Cynodon dactylon* and leguminous crops is more practical, whereas in areas where both waterlogging and soil salinity are present, the cultivation of trees like *Eucalyptus hybrid, Prosopis juliflora and Acacia nilotica* for biodrainage can be useful.

Supporting smallholder dairy farmers in Morocco

Foum El Oued, an area in Laayoune Province, Morocco, is home to many small-scale livestock farmers. Most of them make a living from dairy production. But rising soil and water salinity is negatively impacting traditional forages they grow. Yields of forage corn and alfalfa - the main feed in the area - are falling. Their main source of income is thus at risk. Some even choose to abandon lands that have been affected by salinity. Scientists point to overexploitation of aquifers and inefficient management of agricultural inputs as the chief causes of worsening salinity.

In 2015 ICBA launched a four-year project funded by the Phosboucraa Foundation to introduce salt-tolerant plants in the area

Blue panicum has proven itself to be a great alternative forage plant under saline conditions in Foum El Oued, Laayoune Province, Morocco.

as a means to tackle the decline in forage production.

To implement the project, the center joined forces with Morocco's Ministry of Agriculture, Fisheries, Rural Development, Water and Forests and the National Institute of Agricultural Research. The project selected the Halib Sakia El Hamra Cooperative, a local association of 52 livestock farmers who produce 22 tonnes of milk daily, as the main recipients of technical and other support.

After small-scale pilot trials in the first year, scientists tested several salt-tolerant plants on six farms and at experimental plots of the National Institute of Agricultural Research in Foum El Oued. They compared the performance of Sesbania, blue panicum, quinoa, fodder beet, quinoa, pearl millet, sorghum, barley and triticale with that of forage corn and alfalfa.

They found that the alternative crops did much better than their traditional counterparts at low salinity levels (below 3 grams per liter) and high salinity levels (between 8 and 10 grams per liter). Results indicated that blue panicum and Sesbania were the top performers and their potential fresh biomass yields could reach up to 130 tonnes per hectare per year. Barley and quinoa also showed a lot of promise for cultivation for feed and food in local conditions. Blue panicum, Sesbania, quinoa and fodder beet were determined to be highly salt-tolerant, while barley and triticale exhibited medium tolerance to salinity and pearl millet and sorghum low tolerance.

Dr. Abdelaziz Hirich, a horticulture scientist at ICBA, says: "Our findings are quite encouraging. Our project demonstrated that there are effective low-cost solutions to soil and water salinity. If these salt-tolerant plants are grown, farmers will have enough feed for their livestock."

Under the project which ended in 2018, scientists also trained over 30 smallholder farmers and extension specialists in cultivation of alternative crops. They also supported the National Institute of Agricultural Research in assessing the feasibility of transforming the institute's experimental station in Laayoune Province into a laboratory for soil and water tests.

To take these results further, it is important to establish a seed production and processing unit so that local farmers have a continuous supply of high-quality seeds of the new crops. As many farmers extract groundwater, they also need solar-powered irrigation systems.

Sowing seeds of hope in Uzbek rangelands

Livestock production is a mainstay of Uzbekistan's agricultural sector. Yet most of it is concentrated on smallholdings. Roughly 4.7m smallholders depend on livestock for their livelihoods. As many smallholders cannot afford to buy enough feed or do not own enough land for forage production, they take their livestock to rangelands. This has, however, caused another problem: overgrazing. It alone accounts for 50 percent of the total degradation of pasturelands.

Unsustainable agricultural practices and climate change are exacerbating the problem, reducing rangeland productivity and ecosystem resilience, especially in semi-desert foothill pastures where large numbers of livestock have caused a shortage of green fodder.

Since 2015, ICBA has worked with the United Nations Development Programme and the United States Agency for International Development to rehabilitate rangelands by using a seed isle technology to cultivate drought- and salt-tolerant plants like Atriplex, forage kochia, sagebrush, saltbush, winterfat and common sainfoin.

When the seed isle technology is used, the seeds of plants are spread to uncovered areas by the wind within three to five years, leading to rangeland rehabilitation.

During the first year, plants produce 150 kg of dry mass per hectare, increasing in the second year to 220 kg of dry mass and 40 kg of seed per hectare. By the third year, dry mass and seed yields reach 800 kg and 100 kg per hectare respectively.

It costs around 100 USD to restore one hectare of pasture; half of this amount is spent on soil treatment, and the other half is used to purchase seed and plant it.

This relatively cheap technology is helping smallholder livestock producers like Mr. Rustam Abdusattorov, who lives in central Jizzakh Region. As he owns 300 head of sheep and 34 head of cattle, he struggles to find enough fodder when there is little precipitation and has to purchase feed on the market, spending over 7,500 USD per season.

But this is changing slowly as the seeds of drought- and salt-tolerant plants are covering more and more rangelands.

There are around 23m hectares of rangelands in Uzbekistan - about 50 percent of the country's land mass. These rangelands provide food and shelter for more than 2m rural people.

Central Asian smallholder farmers slowly warm to quinoa

Most smallholder farmers in Central Asia are no strangers to water shortages and salinization. Staple crops they grow fare badly in times of drought, a phenomenon made increasingly more likely in the region by climate change. Their livelihoods are at risk when crops fail.

So ICBA promotes nutritious drought- and salt-tolerant crops like quinoa to help them produce and earn more in the face of growing threats to agriculture.

Dr. Ismahane Elouafi, Director General of ICBA, says: "Since 2007 our center has implemented a global program on quinoa in collaboration with national, regional and international research, government and donor organizations to introduce the crop in the Middle East and North Africa region, as well as Central Asia. We have developed five high-yielding salt- and heat-tolerant quinoa genotypes which are being adopted by smallholder farmers in such countries as Egypt, Kyrgyzstan, Morocco, Tajikistan and the United Arab Emirates."

Kyrgyz-grown quinoa makes its way into global markets

A few years ago, no-one knew about quinoa in Tong District in Issyk-Kul Region, Kyrgyzstan. But today the village of Bokonbaevo in the district is regarded as the birthplace of Kyrgyz quinoa cultivation.

The man behind this drive is 44-year-old agronomist Azamat Kaseev.

"The yield of this crop is quite high; 2.5 kilogram of seed sown on one hectare of land can produce up to 3 tonnes of quinoa," he says.

This brings in a handsome profit as the retail price of quinoa goes up to 700 Kyrgyz soms per kilogram (1 USD is around 70 Kyrgyz soms), while pure seed can fetch up to 2,000 Kyrgyz soms per kilogram.

He supplies quinoa to local farmers, as well as shops and restaurants specializing in organic food products. What is more, he began recently exporting it to Ukraine and is exploring other markets.

ICBA started distributing seeds of five improved drought- and salt-resistant quinoa genotypes from its genebank to Kyrgyz scientists and farmers in 2015 with financial support from the Islamic Development Bank. Since then quinoa has been sown in all regions: Chui, Talas, Jalal-Abad, Batken and others. More and more farmers are also jumping on the quinoa bandwagon as the crop offers high profits. Quinoa fields have expanded across Kyrgyzstan: 14 hectares on highlands in Issyk-Kul Region, and 56 and 80 hectares in Talas and Jalal-Abad regions respectively. This is no mean feat given that only a few years ago quinoa was literally unknown in the country.

Kyrgyz researchers are also upbeat about the crop's future in the country, so much so that a research team from the National Academy of Sciences and the Kyrgyz National Agrarian University patented recipes for a quinoa-based drink and muffin cake.

Mr. Azamat Kaseev, a smallholder farmer in Kyrgyzstan's eastern Issyk-Kul Region, started growing quinoa back in 2012. With the help of ICBA and the Food and Agriculture Organization of the United Nations, it has taken him some five years to adapt quinoa to local conditions and turn his small company AgroLead into a major producer of the crop in the region.

Quinoa takes off in Tajikistan

ICBA initiated quinoa trials in Tajikistan in 2015 with financial support of the Islamic Development Bank. The center provided local scientists and farmers with seeds of five improved drought- and salt-resistant quinoa genotypes from its genebank.

One of them is Dr. Mavlon Pulodov, a quinoa aficionado who first encountered the crop back in 1985 but lost track of. But 2018 marked the end of his 33-year-long quest for quinoa. Today he knows almost everything about the crop and has enough seed for experimentation and cultivation.

Jointly with ICBA and the Food and Agriculture Organization of the United Nations, he helps several smallholder farmers produce quinoa and advises a number of international development and aid organizations on quinoa cultivation.

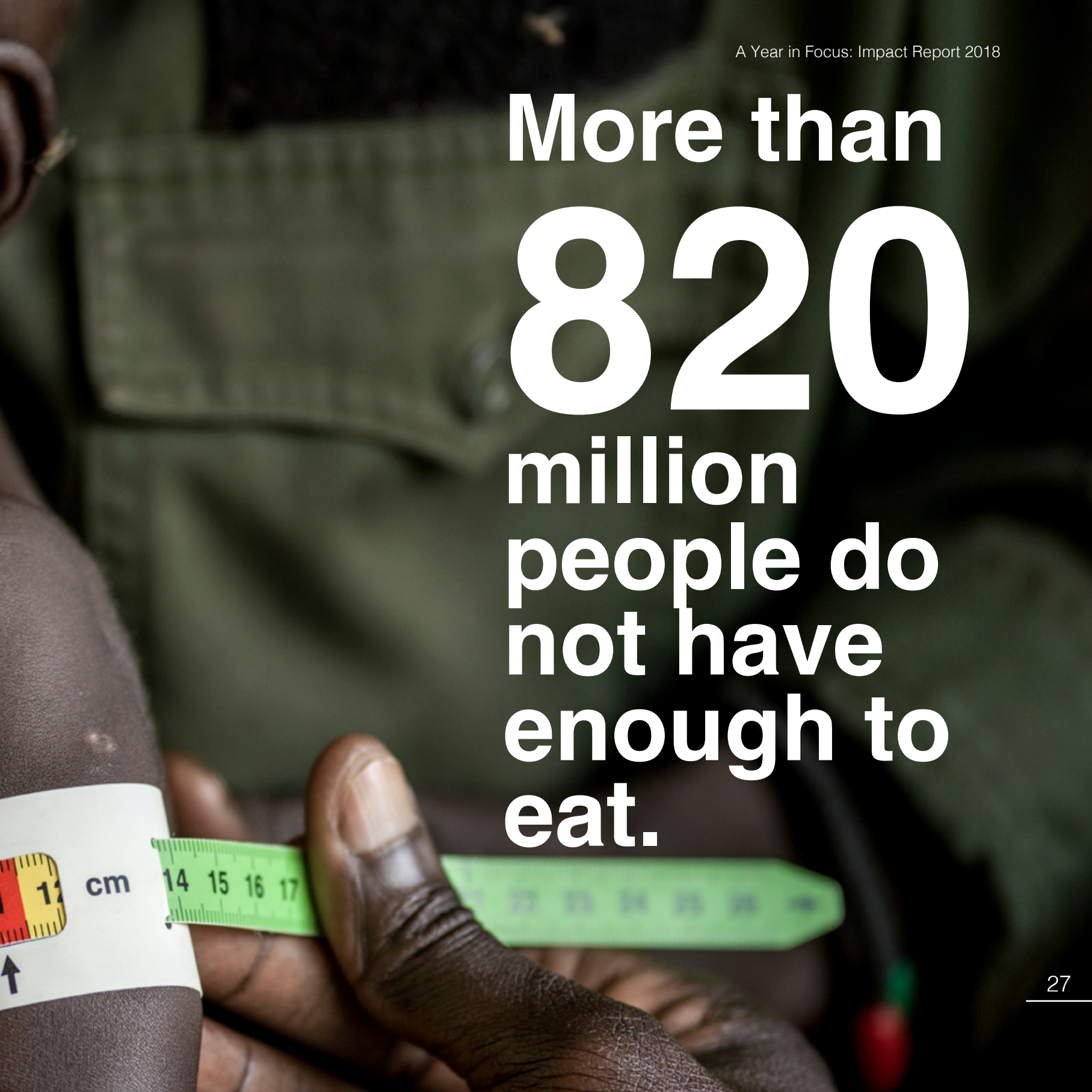
In 2018 a farmer in southern Tajikistan harvested around 600 kilograms of quinoa seed for the first time.

"This amount is enough to cover 100 hectares of land next year," Dr. Mavlon Pulodov says.

Some early-maturing genotypes yield 1.2 tonnes of seed per hectare under local conditions.

To support local seed production, ICBA is collaborating with Caritas Switzerland, an international aid agency, which purchases seed from smallholder farmers and distributes it among other smallholders in the country's south.

Dr. Mavlon Pulodov, a retired director of the National Center for Genetic Resources of the Tajik Academy of Agricultural Sciences, champions quinoa cultivation in Tajikistan.



More than 820 million people do not have enough to eat.

2 ZERO HUNGER

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Global hunger is on the rise again after a decade of steady decline. Around 821 million people are undernourished worldwide and some 2 billion lack key micronutrients such as iron and vitamin A.

The prevalence of undernourishment is most alarming in sub-Saharan Africa, East Africa and South Asia. These regions are also where smallholder farmers produce up to 80 percent of food.

Climate change-induced drought and salinization threaten smallholder farming in these and other regions where agriculture employs roughly 40 percent of the labor force. As staple crops produce little or fail, rural communities are faced with undernourishment and hunger.

Mainstreaming quinoa for food security and nutrition

Rural communities in water-scarce and salt-affected regions often stick to tradition when it comes to farming. This is mainly down to lack of knowledge about better alternatives and resources to do things differently. They continue to rely on crops that are less and less suited to the future.

To help them adapt, ICBA champions the cultivation of alternative nutritious drought- and salt-tolerant crops like quinoa in harsh environments.

Tackling food insecurity and poverty in Morocco through quinoa production

In 2018 ICBA initiated a new project in Morocco to popularize quinoa among smallholder farming communities.

As water gets scarcer and salinization undermines crop production in many parts of the country, small-scale farmers have to go for more resilient and nutritious plants. And quinoa fits the bill. It is tolerant of abiotic stresses and is highly nutritious, containing all nine essential amino acids and being richer in minerals like Ca, Fe, K, Mg, Cu and Mn than many cereals.

This is the rationale behind the project that aims to reach 1,075 farming households, or around 5,000 people in total.

Funded by Canada's International Development Research Centre, the project targets Rehamna Province where a large number of farmers live under the poverty threshold and a quinoa value chain already exists but is constrained due to various factors. Under the project, ICBA is supporting a women's cooperative which produces, markets and sells a range of quinoa-based products such as couscous - a national dish. Implemented in collaboration with the Mohamed VI Polytechnic University and several other national partners, the project will run until 2020.

Some 30 percent of the irrigated land in Morocco suffers from varying degrees of salinity. As a result, average yield losses are reckoned to be as high as 50 percent, with some estimates putting economic losses above 0.2bn USD per year.

More and more Emirati farmers start growing the crop.

Emirati farmers take to quinoa one step at a time

The number of farmers cultivating quinoa in the United Arab Emirates is steadily increasing thanks to a program led by ICBA in collaboration with national partner organizations.

ICBA is working with farmers to introduce genotypes that have performed well under local conditions during trials.

Since 2016, ICBA has distributed quinoa seeds to 12 pioneer farmers in the emirates of Abu Dhabi, Ajman, Sharjah and Fujairah.

In Sharjah, several farmers started planting quinoa in 2018 with support from ICBA and the Municipalities and Agriculture Affairs Department of the Government of Sharjah. It is expected that quinoa can yield up to 2.2 tonnes of grain per hectare despite high levels of soil and water salinity.

Dr. Juan Pablo Rodríguez Calle, a post-doctoral fellow at ICBA, says: "We are glad to see the initial results of quinoa farming in the United Arab Emirates. As the country imports most of the food to meet the domestic demand, increasing local production of different crops, including quinoa, will eventually enhance the country's food self-sufficiency and will help to boost farmers' incomes."

Researching salt tolerance in plants

As salinization poses great risks to farming, it is important to understand which plants cope better with salinity and other stresses and which traits make them better suited to saline soil and water conditions. Research will help breed new varieties of traditional and alternative crops for harsh environments.

In collaboration with various partners, ICBA conducts studies on salt, drought and heat tolerance of a wide range of plants.

Published in *Frontiers in Plant Science,* the study presents the genome assembly and annotation of Solanum pimpinellifolium, a wild relative of cultivated tomato.

Study brings scientists one step closer to salt-tolerant tomato

In 2018 a team of scientists from ICBA and the King Abdullah University of Science and Technology, Saudi Arabia, published the results of a study that sheds new light on the salinity tolerance of tomato.

Phenotypic data from an extensive experiment involving 214 wild and 13 cultivated tomato accessions demonstrates a higher level of salinity tolerance for fruit- and yield-related traits in *Solanum pimpinellifolium* compared with cultivated tomato.

"The utilization of saline water and salt-affected land requires appropriate plant species and varieties with economic or environmental value. Identifying both traditional and non-traditional plants that can withstand saline conditions is one of the primary steps in utilizing saline water resources and environments," says Dr. Mohammad Shahid, a geneticist at ICBA.

The study shows that the wild tomato relative offers a wealth of breeding potential for desirable traits such as tolerance to biotic (pests and diseases) and abiotic (drought and salinity) stresses.

This insight is expected to enable geneticists and breeders to further explore genes that underlie agronomic traits as well as stress-tolerance mechanisms in wild tomato, and to use this knowledge to improve tolerance to biotic and abiotic stresses in cultivated tomato.

Salt-tolerant crops show promise for agriculture in Middle East, North Africa

In 2018 scientists from ICBA published two studies on the potential of salt-tolerant crops such as safflower and quinoa for agriculture in the face of worsening soil and water salinity in the Middle East and North Africa.

The scientists carried out a series of experiments in the United Arab Emirates, which has conditions typical of the region, to investigate genotypic variations of safflower (*Carthamus tinctorius* L.) and quinoa (*Chenopodium quinoa* Willd.). Safflower is an oilseed crop with multiple commercial uses and quinoa is a hardy plant with high drought and salinity tolerance.

They examined six genotypes of each plant species and found that while soil salinity reduced yields of some genotypes, more resilient ones were still able to produce good yields.

Both plants proved to be resistant to drought and salinity. The studies, however, stress that it is important to continue developing genotypes that have higher intrinsic water use efficiency and yield.

The results provide important insights into the future of agriculture in the United Arab Emirates in particular and the Middle East and North Africa as a whole.

Safflower does well in arid and saline environments due to its deep root system.

Women make up nearly 50 percent of the agricultural labor force in East and Southeast Asia and sub-Saharan Africa.

5 GENDER EQUALITY

Achieve gender equality and empower all women and girls

Women comprise an average of 43 percent of the agricultural labor force in developing countries. If all women farmers had the same level of access to productive resources as men do, they could increase yields on their farms by 20-30 percent, lifting 100-150 million people out of hunger.

From the labor of agriculture to the science of agriculture, women's potential remains largely untapped.

Dr. Amani Bchir, a research associate at the Olive Tree Institute of the University of Sfax in Tunisia, is one of the four winners of a joint research grant program by ICBA and CRDF Global.

Empowering Arab women scientists

A joint research grant program by ICBA and CRDF Global, launched in October 2016, is helping four Arab women scientists to conduct advanced research in collaboration with leading US scientists.

This program is part of efforts by ICBA and its partners to empower women scientists in the Middle East and North Africa and contribute to narrowing the gender gap in agricultural research and development in the region.

Under the program, four teams of Arab women scientists and scientists from US universities were awarded a grant of 100,000 USD each for a period of three years. Three of the Arab women scientists are from Tunisia and one from Morocco.

Dr. Amani Bchir, one of the winners of the grant, says: "It was a good opportunity for me as a woman researcher from North Africa to receive this grant. The grant helped me to achieve part of my research activities, which include studying olive trees, especially in terms of water management and irrigation. The objective of my project is to use satellite imagery and remote sensing to control water use and estimate water needs for olive trees and look at the effect of different water quality on olive yield and quality."

The program made it possible to build long-term research collaboration between the Arab women scientists and their counterparts and mentors from the US universities.


Up to
3.5
billion
people might
experience
water
scarcity by
2025.

6 CLEAN WATER AND SANITATION

Ensure availability and sustainable management of water and sanitation for all

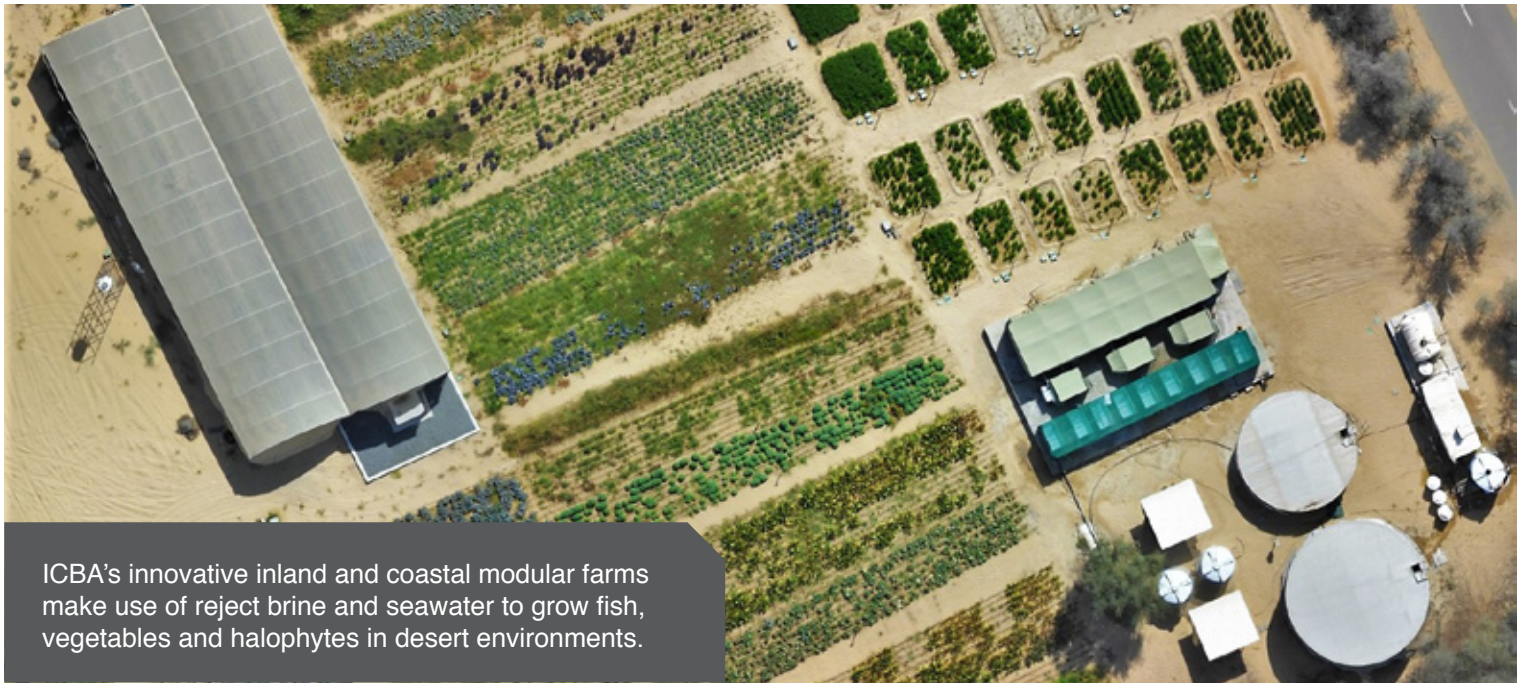
As many as 2 billion people currently live in water-scarce regions. Around half a billion endure water shortage year-round. As climate change is shifting precipitation patterns and speeding glacial melt, water supplies are set to decline and floods and drought to intensify. Against this backdrop, it is alarming that freshwater resources and coastal aquatic ecosystems are being degraded by pollution, particularly brine discharge.

Turning waste into a resource

Water shortage means many countries, especially those in the Middle East and North Africa, have to resort to desalination to meet their freshwater needs. This causes a big salty problem: reject brine. Globally, desalination plants discharge some 142m cubic meters of hypersaline reject brine every day. This is a serious environmental threat.

Another problem in the region is treated wastewater. Plenty of it is discarded into the environment without a second thought. It is a huge waste given the amount of resources that go into wastewater treatment.

ICBA, however, views both reject brine and treated wastewater as resources for food production and develops technologies that make better use of them.



ICBA's innovative inland and coastal modular farms make use of reject brine and seawater to grow fish, vegetables and halophytes in desert environments.

Farming fish with reject brine

Since 2013 ICBA has operated innovative inland and coastal modular farms in the United Arab Emirates to study the use of reject brine and seawater for farming. The inland farm uses desalinated water for vegetables, reject brine for tilapia and seabream, and then fish effluent for halophytes. The coastal farm uses seawater directly to grow fish and the resultant effluent to irrigate halophytes such as Salicornia.

Dr. Dionysia Angeliki Lyra, a halophyte agronomist at ICBA, says: "One of the main goals of our research experiment is to develop a cost-effective production model that transforms reject brine and seawater into profitable sources for local farmers."

Following some modifications in 2018, scientists managed to get one of the highest biomass densities for tilapia - 30 kilograms per cubic meter - using reject brine on the inland farm. And the coastal farm, managed jointly with the Marine Environment Research Department, recorded an increase from 0.62 kilograms per cubic meter to 5 kilograms per cubic meter for tilapia.

The modifications also helped to speed up weight gain, making it possible to raise fish twice a year. They also reduced the fish feed requirement from 2 kilograms of feed per 1 kilogram of fish to 1.1 kilogram of feed per 1 kilogram of fish.

"In addition to reducing the fish feed cost and increasing fish biomass, we were also successful in decreasing the labor expenses. All we need is just one trained worker for a maximum of 2 hours per day to operate and maintain the system," says Mr. Efstathios Lampakis, an aquaculturist from Greece, who provided technical expertise.

This work is supported by a grant from the Expo 2020 Dubai's Expo Live Innovation Impact Grant Program.

In a first, ICBA starts growing halophytic vegetables in United Arab Emirates

In 2018 scientists at ICBA began a pilot project to grow halophytic, or salt-loving, vegetables in the United Arab Emirates using reject brine from desalination units treated with fish effluents.

It was the first time that halophytic vegetables had been grown in the country, both in the open field and a simple net-house structure, without using fresh water.

The idea is to save fresh water and introduce these vegetables into the local diet.

Dr. Dionysia Angeliki Lyra, a halophyte agronomist at ICBA, says: "We are very happy to grow halophytic vegetables in the United Arab Emirates conditions and the initial results are very promising. In addition to saving fresh water and utilizing reject brine for vegetable production in the country, our focus on halophytic vegetables is based on the scientific studies which demonstrate that these vegetables are very rich in antioxidants, fatty acids, vitamins and other vital elements essential for the human health. Some of them have pharmaceutical and medicinal properties. For example, purslane is the richest plant source of alpha-Linolenic acid — one of the two essential fatty acids necessary for health that cannot be produced within the human body, and therefore must be acquired through a diet."

As part of the project, ICBA is also working with Chef Doxis Bekris, a renowned chef in the United Arab Emirates, to develop recipes with halophytic vegetables.

The project is funded by the Expo 2020 Dubai's Expo Live Innovation Impact Grant Programme.

The halophytic vegetables include *Salsola soda* (agretti); *Crithmum maritimum* (rock samphire); *Beta maritima* (sea beet); *Aster tripolium* (sea aster); *Salicornia bigelovii* (samphire); and *Portulaca oleracea* (common purslane).

ICBA achieves progress in breaking Salicornia yield ceiling

In 2018 a team of scientists at ICBA made a major breakthrough in increasing yield potential of Salicornia, a multi-purpose halophyte, or a salt-loving plant.

Working closely with national partners, the scientists recorded a bumper seed yield of 3 tonnes per hectare using seawater passing through an aquaculture system. That was the first time Salicornia had produced such high yield under the conditions of the United Arab Emirates.

Dr. Dionysia Angeliki Lyra, a halophyte agronomist at ICBA, says: "We are extremely happy to see that years of our research efforts are bearing fruit as the crop has achieved a great feat. One of the main purposes of our research was to identify an alternative crop for multiple uses that is well adapted to marginal saline environments. In particular, we wanted to assess the potential of growing Salicornia under extreme soil and water conditions and select the best-performing lines in terms of seed and biomass production for future breeding and commercial production."

The long-term objective of this research is to increase Salicornia production in the country and expand it in coastal areas of the Arabian Peninsula. The crop has a great commercial value thanks to its potential for biofuel and forage production.

Salicornia can be used as a food, forage and biofuel crop.

Mr. Mohammad Al Fayaz knows first-hand what water scarcity is. His village of Umm Rumaneh is the only village in Al Jizah District, Jordan, where no underground water has been found.

Jordanian farmers learn how to grow forage crops with treated wastewater

Faced with water scarcity, many farmers in Al Jizah District, Jordan, are turning to treated wastewater. So ICBA started training a group of farmers in the district in 2016 how to use it safely for forage production.

Mr. Mohammad Al Fayaz, a native of Al Jizah District, is one of them.

He says: "At the beginning of 2016, with the implementation of the water treatment station project near Al Jizah District, we learned how to safely use treated wastewater at a workshop carried out by ICBA in cooperation with the National Center for Agricultural Research. Scientists from ICBA said that it is possible to grow salt-tolerant crops and forage crops and highlighted environmental management systems that can work with treated wastewater. We succeeded in obtaining approvals from the owners of the land which the water passes through, right from the station to our own land, and started to collect it in a 0.5-hectare pool. As a result, we began cultivating 10 hectares of land rather than 3 hectares."

This became possible thanks to ICBA's efforts to raise awareness about the safety of treated wastewater for irrigating forage crops.

Today the area of land cultivated throughout the year in the village has increased and people have changed their opinions about treated wastewater.

This work, part of the Beit Al Khair Society projects on growing fodder, has improved the area's infrastructure and led to building more roads and installing electricity poles.

The results have also encouraged farmers in other areas near the wastewater treatment station to use it to grow forage crops.

2018

was the fourth hottest year ever recorded. Climate change is real.

13 CLIMATE ACTION

Take urgent action to combat climate change and its impacts

Global climate data shows that the past five years - from 2014 to 2018 - were the warmest years since records began in 1850. As the globe is warming, the prospect of food insecurity looms large in many countries.

Farmers the world over are already bearing the brunt of climatic extremes. The hotter and drier the weather becomes, the higher the chances are of crop yield reduction or failure and livestock loss. Extreme events such as droughts, heat waves and floods are becoming more frequent and intense in many Middle Eastern and African countries, causing immense economic damage.

Promoting climate change preparedness in vulnerable regions

Climate change is already impacting on food production in many parts of the world. And future forecasts are not encouraging.

Global mean yields of rice, maize and wheat are projected to drop by 3-10 percent per degree of warming in the long run.

Large parts of Africa, the Middle East and South and Southeast Asia are expected to experience declines in agricultural production due to climate change. South Asia and sub-Saharan Africa, particularly West Africa, are considered as the most vulnerable regions. In these regions, national economies depend on agriculture for a large share of GDP and employment.

More worryingly, smallholder farmers who dominate the agricultural sectors in these regions have little access to innovative technologies and inputs, and thus have little to no capacity to adapt to a changing climate.

To help mitigate these risks, ICBA develops and shares climate-smart solutions with key stakeholders. ICBA works at two levels. One is helping countries better manage and plan for current and future risks at the national level. The other is equipping smallholder farmers, researchers and policymakers with necessary knowledge and technology.

Climate change is making droughts more frequent and extreme in Morocco.

Study sheds new light on drought threat in Morocco

In 2018 a team of climate scientists from ICBA contributed to a World Bank study which provides new insight into the scale of drought impact on Morocco's water systems and food production.

The study analyzed climate variability, drought, and drought management in Morocco's agricultural sector.

Dr. Rachael McDonnell, a climate change scientist at ICBA, says: "Droughts have impacted Morocco in the past and will continue to do so. The recent event of 2015–2016 had a pronounced impact on water systems and food production, leading to a real impact on the national economy."

The study notes that although drought maps are regularly generated, they are not used extensively by national and local government agencies and businesses to minimize the impact on people, the economy and the environment.

It also warns that the country is projected to be more exposed to drought and other extreme weather events over the next 20 years unless serious preventive measures are taken.

The study concludes that the authorities should take a proactive approach to drought preparedness across the country, develop and implement investment plans and adopt drought-resilient technologies and crops.

Research reports highlight drought risks in Lebanon and Tunisia

Two research reports, co-authored by a team of climate scientists from ICBA and published by the World Bank in 2018, underscore the growing risks of drought in Lebanon and Tunisia.

The reports offer a better understanding of the likely impacts of climate change on rural communities.

The authors warn that greater climatic variability in the short term will make it difficult for farmers, policymakers, and other stakeholders to plan ahead for lean years or catastrophic weather events.

Drought in both countries is a serious concern and is likely to impact on food security and livelihoods in rural areas.

The reports note that economically important crops such as fruits, olives, and cereals, especially wheat, are negatively affected by variable rainfall and increased temperatures. In Tunisia, the dairy sector is also hit hard as heat stress and water shortage limit the production and quality of dairy products.

However, the response to drought conditions in both countries is emergency-based, leaving little room for long-term drought planning and management.

The authors point to an urgent need for better drought planning and management at all levels.

The governments should do more to offer financial and technical solutions, including agricultural insurance, to farmers as a bulwark against crop loss in times of drought. It is also important to adopt non-traditional crops better suited to arid conditions, including blackberries and quinoa in Lebanon and barley and salt-tolerant tomatoes in Tunisia.

Drought is a growing problem in Lebanon and Tunisia.


Globally, there are roughly
400,000
plant species. Today this biodiversity is in danger.

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Biodiversity is under serious threat as a result of human activities. Climate change, habitat conversion and over-exploitation of natural resources are just some of the main factors. So alarming is the current rate of biodiversity loss that some scientists suggest a sixth mass extinction in Earth's history is under way.

Agrobiodiversity, a vital sub-set of biodiversity, is also in decline. The diversity of crops present in farmers' fields has fallen and threats to crop diversity are increasing. In view of climate change, this diversity is crucial for global food security and nutrition.

It is critically important to preserve biodiversity in general and agrobiodiversity in particular for a sustainable and food-secure future. ICBA works on neglected and underutilized crops to tackle the challenges of climate change.

Safeguarding plant genetic resources for future

In the context of food and agriculture, plant genetic resources are the raw material that farmers and plant breeders use to improve the quality and productivity of crops. Their diversity underpins the ability of agriculture to cope with risks as they provide traits that can help adapt crops to changing climatic conditions and outbreaks of disease. These resources are crucial for sustainable agricultural intensification and the livelihoods, food security and nutrition of millions who depend on agriculture.

Today plant genetic diversity is threatened by genetic erosion as local varieties are replaced by modern varieties and commercial varieties are introduced into traditional farming systems. The emergence of new pests, weeds and diseases, environmental degradation, urbanization and land clearing through deforestation and bush fires exacerbate the problem.

To tackle the problem, ICBA collects and preserves genetic diversity of resilient plant species from around the world for food and agriculture, and the environment.

Scientists save rare plant from likely extinction in United Arab Emirates

As part of the conservation of plant genetic resources in the United Arab Emirates, ICBA conducts regular expeditions to different locations to collect some of the economically important indigenous species which may be under threat due to overgrazing and expansion of human settlements.

This work has helped to preserve Halfa grass, scientifically known as *Desmostachya bipinnata*, from possible extinction. The plant is a rhizomatous perennial grass and is important for stabilizing soils. It can also be used as fodder.

In a study published in *Tribulus*, a journal of the Emirates Natural History Group, a team of scientists led by Dr. Mohammed Shahid, a geneticist at ICBA, reported 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.

However, 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 well. Thanks to their efforts, the plant is now well-preserved at ICBA and can be used for reintroduction to the wild.

Scientists from ICBA have saved Halfa grass, a rare plant species in the United Arab Emirates, from possible extinction.

Senna alexandrina is believed to be a threatened, indigenous plant species in the United Arab Emirates.

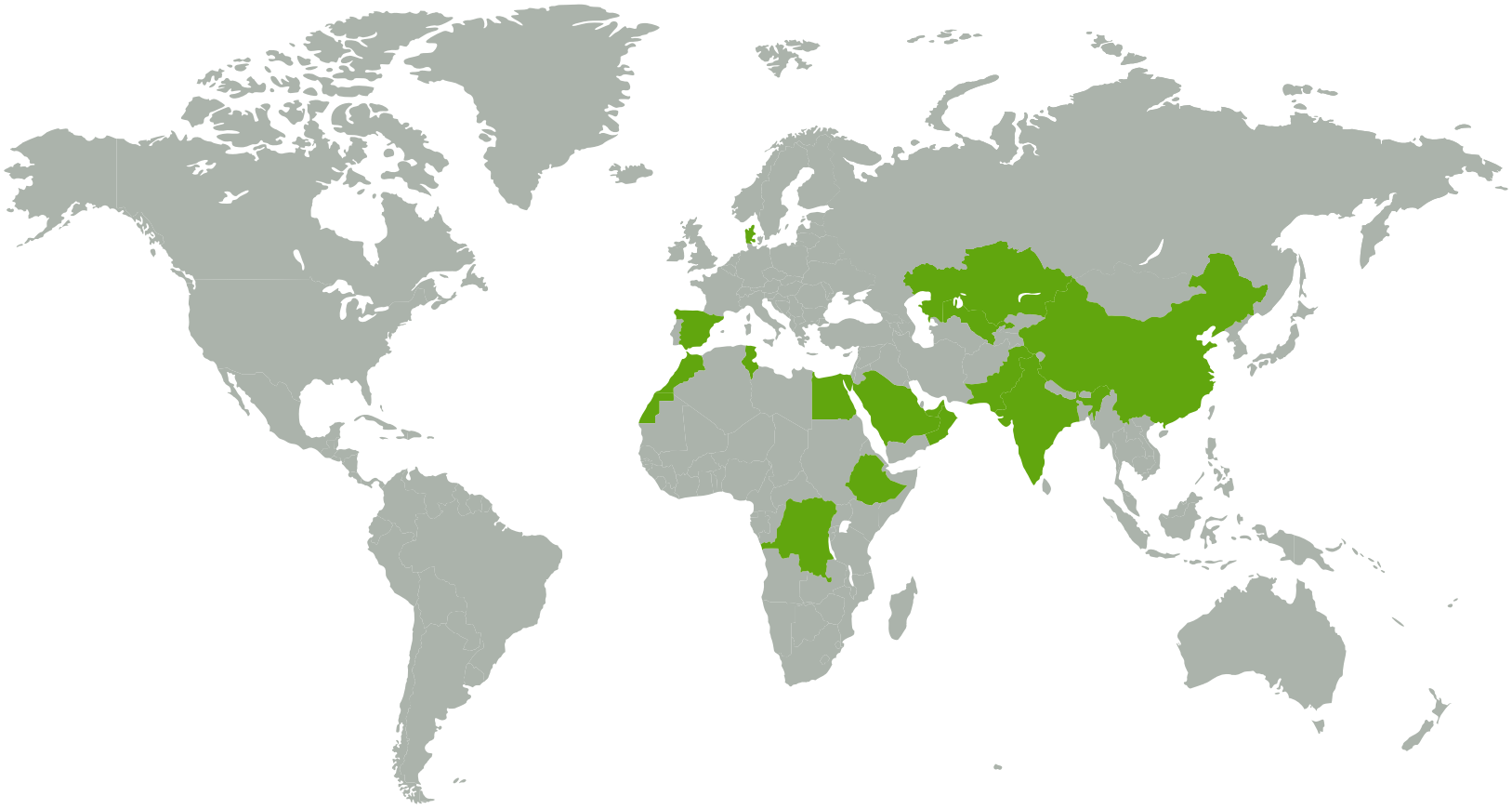
ICBA gives Dubai Municipality seeds of threatened, indigenous plant species

ICBA's genebank is a unique repository of specific plant genetic resources. It stores over 14,000 accessions of about 250 salt-, heat- and drought-tolerant plant species from more than 150 countries. Seeds of 70 wild plant species from the United Arab Emirates are also preserved.

This germplasm serves as an important source for research and propagation.

In 2018 ICBA provided Dubai Municipality with more than 800 seeds of five threatened, indigenous wild plant species from its genebank. According to scientists, the species - *Ochradenus aucheri, Salvia macilenta, Indigofera oblongifolia, Senna alexandrina* and *Senna italica* - are considered threatened in the country due to different factors, including climate change and urbanization.

The seed transfer forms part of ICBA's program on collecting, preserving and sharing plant genetic material with different institutions around the world.



Sharing plant genetic resources

Under its mandate for marginal environments, ICBA collects, preserves and shares germplasm of plant species with proven or potential salinity, heat and drought tolerance.

ICBA provides seed samples to different institutions around the world for research, breeding and introduction.

In 2018 the center supplied seed samples of 22 crops to partner organizations in 16 countries.

Partnerships are key to achieving the Sustainable Development Goals.

17 PARTNERSHIPS FOR THE GOALS

Strengthen the means of implementation and revitalize the global partnership for sustainable development

Today the world faces a plethora of threats. From climate change to natural resource depletion, never in human history has the scale and complexity of the challenges been so immense. This means all countries must come and work together to address them. National, regional and international organizations also must join forces and support governments. Collaboration and partnerships are crucial for progress and success.

Tackling global challenges through partnerships

Partnerships are one of the pillars on which ICBA's work is built. They produce success and impact on the ground. Throughout 2018, ICBA continued to strengthen existing relationships and form new ones with donor, research and development organizations around the world.

The HSBC-funded Food for the Future project supported seven poor villages and improved the livelihoods of some 460 families in Egypt.

Winning partnership: ICBA shares prestigious award for food security project

In 2018 ICBA and the Research Institute for a Sustainable Environment, of the American University in Cairo, Egypt, won a second-place 2018 International Business Excellence Award in the sustainability category.

Both organizations were recognized for their impact under the Food for the Future project sponsored by HSBC.

Dr. Ismahane Elouafi, Director General of ICBA, says: "Recognitions like this award encourage us to further excel in our mission to serve farming communities and seek more collaboration with the private sector and academia."

The project was implemented in Egypt and the United Arab Emirates and included components on sustainable farming, solar chicken incubators, rooftop garden, economic empowerment for women in rural areas and land rehabilitation.

The project enhanced the livelihoods of around 460 families in seven poor villages in Egypt by providing a sustainable source of income.

Today all project locations serve as learning hubs for the rural communities.

ICBA and BGI team up to establish genomics center in United Arab Emirates

2018 marked the beginning of a strategic partnership between ICBA and BGI, the world's largest genomics institution.

With the support of the Food Security Office of the United Arab Emirates, both organizations will establish the Desert Life Sciences Center in the country to advance different fields of science, particularly genomic research on salt-tolerant plants like Salicornia and quinoa.

Her Excellency Mariam bint Mohammed Almheiri, Minister of State for Food Security of the United Arab Emirates, says: "Through this collaboration, we look forward to exploring the many possible applications of genetic science to future food security. While still an emerging field for the time being, genomic studies stand to have a significant positive impact on these vital and strategic sectors."

ICBA and BGI signed the agreement on the sidelines of a genomics symposium titled "Applications of advanced sciences for food security & health" at the Khalifa University of Science and Technology in Abu Dhabi in early March 2018.

ICBA and BGI, the world's largest genomics institution, signed the agreement in Abu Dhabi in the presence of Her Excellency Mariam bint Mohammed Almheiri, Minister of State for Food Security of the United Arab Emirates, and Dr. Wang Jian, President of BGI.

ICBA, South Korean agriculture agency join forces for biosaline R&D

In 2018 ICBA inked an agreement with South Korea's Rural Development Administration to work on advanced knowledge and technology exchange for biosaline research and development in South Korea and the United Arab Emirates.

The partnership will pave the way for closer cooperation between the two organizations which share broad objectives of supporting rural farming communities through agricultural R&D and extension.

ICBA and the Rural Development Administration will collaborate on improving food security in the two countries by adopting innovative technologies such as advanced sensor technologies, net-houses and vertical farming, as well as finding genes responsible for salt tolerance in plants with a particular focus on drought and salinity resilience of rice.

As a center of research excellence, ICBA will also host students and scientists from South Korea to conduct research in salinity and other fields.

Dr. Ra Seung-yong, Administrator of the Rural Development Administration, says: "We expect that our collaboration in agricultural technology using sensor in Korea, smart greenhouse, and automation technology for plant irrigation and fertigation will greatly contribute to the agricultural development in the United Arab Emirates."

The partnership will pave the way for closer cooperation between the organizations, which share broad objectives of supporting rural farming communities through agricultural R&D and extension.

The collaborative agreement between ICBA and IFAD builds on more than ten years of strategic collaboration.

ICBA partners with IFAD to improve food security in developing countries

2018 saw the establishment of a strategic partnership between ICBA and IFAD, a specialized agency of the United Nations. ICBA and IFAD signed a cooperative agreement in the presence of Her Excellency Mariam bint Mohammed Almheiri, Minister of State for Food Security of the United Arab Emirates, at ICBA's headquarters in Dubai.

Under the agreement, ICBA and IFAD will work towards agricultural development and food security in developing countries, contributing to the achievement of the Sustainable Development Goals.

In particular ICBA will provide technical expertise to IFAD and organize joint knowledge-sharing and capacity-building events.

The collaboration will concern such areas as climate-resilient crops, land and water management for salinity and sodicity, and climate change mitigation and adaptation in marginal environments.

ICBA and IFAD will also work on the use of non-conventional water like saline and brackish water, treated wastewater, and sea water for different agricultural and agro-forestry purposes, and seed production and small-scale irrigation systems.

Ms. Charlotte Salford, IFAD Associate Vice-President, External Relations and Governance Department, says: "The goal of the MoU we signed today is to strengthen relations between IFAD and ICBA in order to improve our work in sub-Saharan Africa and enhance the effectiveness of our investments. Over ten years of fruitful cooperation, we have provided grants to ICBA in order to assist vulnerable small producers to improve their productivity and livelihoods, and we value ICBA's long experience in tailoring technological innovations for advancing agricultural production."

Knowledge sharing

ICBA creates and shares knowledge that empowers smallholder farmers.

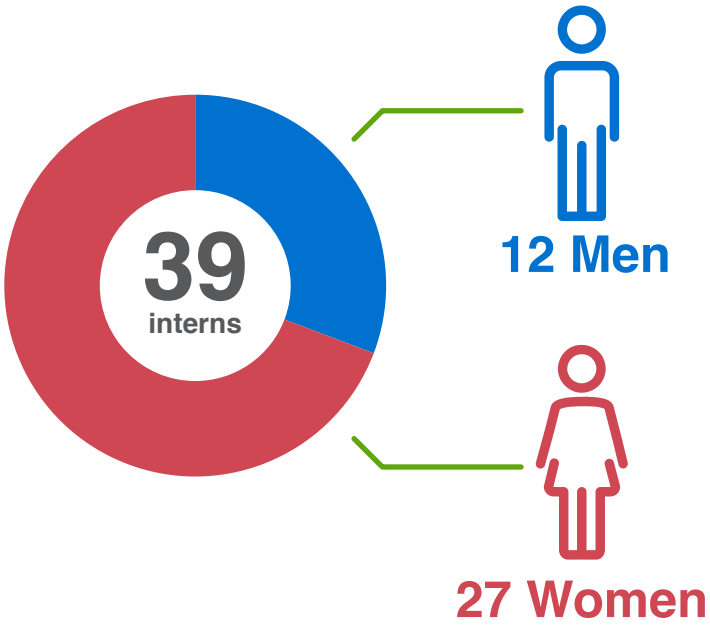
One of the main outputs of ICBA's work is knowledge. We are committed to creating and sharing this knowledge with all of our stakeholders from smallholder farmers to policymakers. We disseminate science-based knowledge by means of capacity development, knowledge hubs and communications.

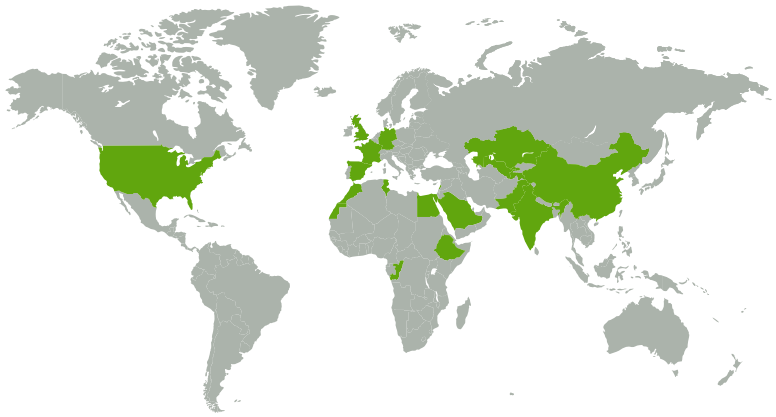
Building capacities

Capacity development is an integral part of ICBA's work. In 2018 our scientists focused considerable efforts and resources on identifying different stakeholders' capacity-building needs and catering to them.

They 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.

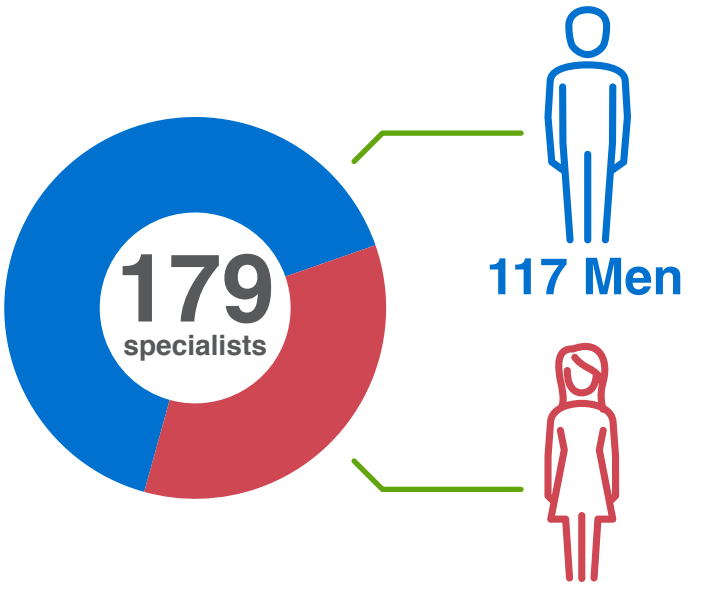
Internships

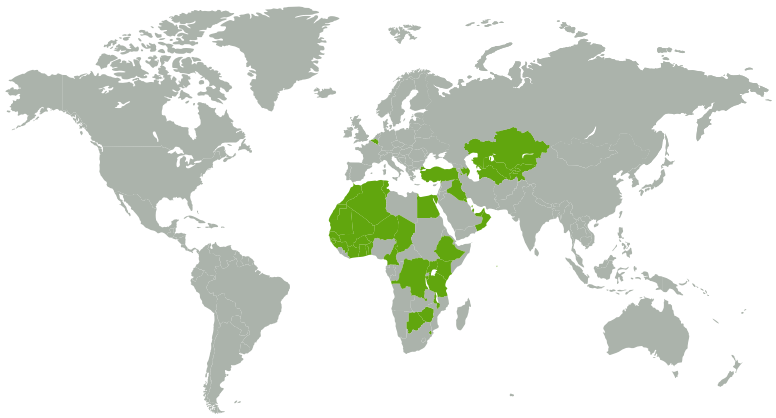




University students from seven countries

Technical training courses





Nine technical training courses in six countries for participants from 43 countries

Powering decision-making through drone technology

Agriculture is one of the most resource-intensive sectors. It requires a lot of water and other resources that are getting ever scarcer in many parts of the world. To make it sustainable and efficient, it is important to cut down on inputs while maximizing outputs. In other words, it is necessary to make farming more accurate and controlled. This is the idea of precision agriculture, an approach based on the use of an array of technologies such as GNSS-based systems, sensors, robots and drones. As drones are becoming ubiquitous in different industries, their uses in agriculture are expanding as well. They are being used to check crop health, track livestock and survey farmland. They also help collect more accurate crop-related and other data than satellites can.

To integrate drone technology into its research-for-development programs, ICBA

Drones have great potential for improving agriculture in marginal environments.

established a partnership in 2018 with the Falcon Eye Drones, a specialized private company based in Dubai, the United Arab Emirates. This partnership helped to expand the center's research and development capabilities and created new synergy.

Dr. Ismahane Elouafi, Director General of ICBA, says: "Our scientists began researching drone applications for various agriculture-related purposes, including water productivity; water management; crop monitoring; and salinity management. For date palm research, we are now testing the application of drones in optimizing date palm pollination techniques and red palm weevil detection. This approach involves artificial intelligence systems based on drone models and various sensor technologies."

As one of the first steps, ICBA, the Falcon Eye Drones and Zayed University also organized in Dubai Drones Synergies 2018, a global conference focused on building the capacity of different stakeholders in drone technology. The two-day conference showcased the latest drone technologies and their uses in various fields such as precision agriculture and environmental and natural resource management.

Through 20 capacity-building workshops and field trials, more than 150 participants from governmental and non-governmental organizations, universities and private companies learnt about drone and artificial intelligence-based solutions that facilitate decision-making in farming and other sectors. They also enhanced their skills in operating hyperspectral drones to collect data from the field.

Dr. Ali Elbattay, a senior scientist in remote sensing and drone technology at ICBA, says: "The first edition of Drones Synergies gave our stakeholders from across the Gulf Cooperation Council region an opportunity to have a unique insight into the potential of unmanned aerial vehicles. It featured a project-based learning approach so that participants can gain practical knowledge and skills through capacity-building workshops and field trials."

Communicating science-based knowledge

During the past year, ICBA stepped up efforts to communicate its science-based knowledge and research and development work to different audiences through the news media, its website and social media channels.

274
media mentions

119,591
website sessions

111,050
YouTube views

Knowledge products

Research publications

Science-based publications form the core of ICBA's knowledge output. They are part of the center's contribution to the advancement of agricultural science. In 2018 our scientists produced a total of 22 research publications and contributed to four patents.

Aralova, D., Karieva, J., Khujanazarov, T. & **Toderich K.** (2018) Drought Variability and Land Degradation in Central Asia: Assessment Using Remote Sensing Data and Drought Indices. In: Egamberdieva, D. & Öztürk, M. (eds.) Vegetation of Central Asia and Environs. Springer, Cham. pp. 15-47.

Aralova, D., Gafurov, D. & **Toderich, K.** (2018) NDVI-Based Monitoring Long-Term Vegetation Change Dynamics in the Drylands of Central Asia. In: Egamberdieva, D. & Öztürk, M. (eds.) Vegetation of Central Asia and Environs. Springer, Cham. pp. 49-71. https://link.springer.com/chapter/10.1007/978-3-319 -99728-5_3

Boboev, H., Djanibekov, U., Bekchanov, M., Lamers P.A., J. & **Toderich, K.** (2018) Feasibility of conservation agriculture in the Amu Darya River lowlands, Central Asia. International Journal of Agricultural Sustainability. Taylor & Francis Group, pp. 280-297. https://doi.org/10.1080/14735903.2018.1560123

Brouziyne, Y., Abouabdillah, A., **Hirich, A.**, Bouabid, R., **Zaaboul, R.** & Benaabidate, L. (2018) Modeling sustainable adaptation strategies toward a climate-smart agriculture in a Mediterranean watershed under projected climate change scenarios. Agricultural Systems, 162, pp. 154-163. https://doi.org/10.1016/j.agsy.2018.01.024

Douthwaite, B., Ahmad, F., Shah, G. M., Schreinemachers, P., Kassie, M., Williams, F., **Ciolina, D.**, Ishrat, J., Nagarajan, L., Feldman, A., Ahmad, T., Kadel, L. & Devkota, P. (2018) Strengthening AIRCA Monitoring and Evaluation Systems. ICIMOD Working Paper.

Hazzouri, K. M., Khraiwesh, B., Amiri, K. M. A., Pauli, D., Blake, T., **Shahid, M.**, Mullath, S. K., Nelson, D., Mansour, A. L., Salehi-Ashtiani, K., Purugganan, M. & Masmoudi, K. (2018) Mapping of HKT1;5 gene in barley using GWAS approach and its implication in salt tolerance mechanism. Frontiers in Plant Science, 9, 156. doi:10.3389/fpls.2018.00156

Khodjaniyazov, Kh. U., Mamadrakhimov, A. A. & **Toderich, K.** (2018) Characteristic fragmentations of 2,3-polymethylenepyrido[2,3-d]pyrimidin-4-ones and their derivatives on liquid chromatography/mass spectrometry. Uzbek Biological Journal, 4, pp. 3-6. (In Russian)

Kunypiyayeva, G., **Zhapayev, R.**, Karabayev, M., Suleimenova, M. & Omarova, A. (2018) Photosynthetic activity and productivity of winter wheat under conservation agriculture technology. World Science, 3 (31), pp. 10-12.

Leidi, E. O., Altamirano, A. M., Mercado, G., **Rodriguez, J. P.**, Ramos, A., Alandia, G., Sorensen, M. & Jacobsen S.-E. (2018) Andean roots and tubers crops as sources of functional foods. Journal of Functional Foods, 51, pp. 86-93. https://doi.org/10.1016/j.jff.2018.10.007

Mahmoudi, H., Al-Jabri, G. J. & **Tutundjian, S.** (2018) Women Empowerment in Agriculture. The Mouth: Critical Studies on Language, Culture and Society. (In press)

Nefissi, O. R., Jardak, R., Chikha, B. M., Yaala, B. W., Abid, G., **Mahmoudi, H.**, Hamdi, Z., Mejri, S. & Ghorbel, A. (2018) Physiological, antioxidative enzymes activities and related gene expression responses to salinity in contrasting barley genotypes. Journal of Agronomy and Crop Science. (In press)

Nokerbekova, N., Zavalin, A., Suleimenov, Ye. & **Zhapayev, R.** (2018) The nutrition influence of nitrogen fertilizers on the sugar content of sweet sorghum plants in the southeast of Kazakhstan. Russian Agricultural Sciences, 44 (1), pp. 25-30.

Nokerbekova, N., Suleimenov, Ye. & **Zhapayev, R.** (2018) Influence of fertilizing with nitrogen fertilizer on the content of amino acids in sweet sorghum grain. Agriculture and Food Sciences Research, 5 (2), pp. 64-67.

Patents

Qureshi, A. S., Abdallah, A. J. & Tombe, L. A. (2018) Farmers' perceptions, practices and proposals for improving agricultural productivity in South Sudan. African Journal of Agricultural Research, 13 (44), pp. 2542-2550. doi:10.5897/AJAR2018.13525

Qureshi, A. S., Ertebo, T. & Mehansiwala, M. (2018) Prospects of alternative cropping systems for salt-affected soils in Ethiopia. Journal of Soil Science and Environmental Management, 9 (7), pp. 98-107. doi:10.5897/JSSEM2018.0686

Qureshi, A. S. (2018) Challenges and Opportunities of Groundwater Management in Pakistan. In: Mukherjee A. (ed.) Groundwater of South Asia. Springer Hydrogeology. Springer: Singapore. https://doi.org/10.1007/978-981-10-3889-1_43

Qureshi, A. S. (2018) Managing Surface Water for Irrigation. In: Oweis, T. (ed.). Water Management for Sustainable Agriculture. Burleigh Dodds Science Publishing: Cambridge, UK.

Razali, R., Bougouffa, S., Morton, M. J. L., Lightfoot, D. J., Alam, I., Essack, M., Arold, S. T., Kamau, A., Schmöckel, S. M., Pailles, Y., **Shahid, M.**, Michell, C. T., Al-Babili, S., Ho, Y. S., Tester, M., Bajic, V. B. & Negrão, S. (2018) The genome sequence of the wild tomato Solanum pimpinellifolium provides insights into salinity tolerance. Frontiers in Plant Science, 9, 1402. https://doi.org/10.3389/fpls.2018.01402

Rodriguez, J. P., Ørting, B., Andreasen, C., Jacobsen, S.-E. & Sørensen,M. (2018) Trends and drivers of on-farm conservation of the root legume ahipa (Pachyrhizus ahipa) in Bolivia over the period 1994/96–2012. Genetic Resources and Crop Evolution, 65 (2), pp. 449-469. https://doi.org/10.1007/s10722-017-0544-y

Shahid, M. (2018) A newly-reported Salicornia europaea population under threat. Tribulus, 26, pp. 82-83.

Toderich, K., Shuyskaya, E., Rakhmankulova, Z., Bukarev, R., Khujanazarov, T., **Zhapaev, R.**, **Ismail, S.**, Gupta, K. S., Yamanaka, N. & Boboev, F. (2018) Threshold tolerance of new genotypes of Pennisetum glaucum (L.) R. Br. to salinity and drought. Agronomy, 8, pp. 230-238. doi:10.3390/agronomy8100230

Toderich, K., **Ismail, S.**, Khujanazarov, T. & Khasankhanova, G. (2018) Biosaline technologies and approaches on salinity management of different agro-landscapes in arid climate (with reference to Central Asia and the Caucasus). In: Vergas, R., Pankova, E. I., Baliyuk, S. A., Krasilnikov, P. V. & Khasankhanova, G. M. (eds.) Salinity Management Handbook. pp. 61-72.

Patent No. 576. (2018) Sorgo sakharnoe KazInd (sweet sorghum). Nur-Sultan, Kazakhstan: Ministry of Justice of Kazakhstan.

Patent No. 577. (2018) Sorgo zernovoe KazInd (sorghum). Nur-Sultan, Kazakhstan: Ministry of Justice of Kazakhstan

Kaparova, E., Shalpykov, K., **Toderich, K.** & Omarova Z. (2018) Kyrgyzpatent No. 2046. Nutritional value of quinoa seeds: "Bojo" drink (from fermented mixed seeds of barley and quinoa). Bishkek, Kyrgyzstan: Kyrgyzpatent.

Kaparova, E., Shalpykov, K., **Toderich, K.** & Omarova Z. (2018) Kyrgyzpatent No. 2088. Nutritional value of quinoa seeds: cookies from floor of quinoa seeds and wheat flour. Bishkek, Kyrgyzstan: Kyrgyzpatent.

Supporters and contributors

ICBA's progress on improving food security and nutrition and creating employment opportunities for vulnerable rural communities in different countries is possible thanks to unwavering support of the many donor and development agencies and partner organizations we work with.

In 2018 most of the funding came from ICBA's founders: the Government of the United Arab Emirates (through the Food Security Office and the Environment Agency – Abu Dhabi) and the Islamic Development Bank. This funding helps ICBA continue to deliver on its vision and mission.

Our research and development work was also funded by other supporters and contributors. We would like to thank all of them for their generous contributions.

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- Arabian Gulf University
- Arab Bank for Economic Development in Africa
- AustraBlend
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- King Abdullah University of Science and Technology
- Mercy Corps
- Ministry of Energy and Industry of the United Arab Emirates
- National Academy of Sciences of Uzbekistan
- OCP Foundation
- OPEC Fund for International Development
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- Swedish International Development Cooperation Agency
- United States Agency for International Development

Financials

Statement of financial position

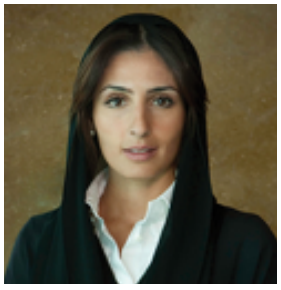
	As at 31 December		As at 1 January 2017
	2018	2017	
	USD'000	USD'000	USD'000
ASSETS			
Non-current asset			
Property and equipment	4,712	5,290	6,619
Current assets			
Inventories	28	13	-
Accounts receivables	1,922	922	656
Short-term deposits	14,710	10,896	5,448
Cash and cash equivalents	4,667	5,724	9,800
	21,327	17,555	15,904
Total assets	**26,039**	**22,845**	**22,523**
EQUITY AND LIABILITIES			
Equity			
Reserves – Designated	15,397	15,397	15,397
Reserves – Undesignated	2,678	2,039	1,556
	18,075	17,436	16,953
LIABILITIES			
Non-current liability			
Provision for employees' end of service benefits	383	239	172
Current liability			
Deferred income – restricted	1,639	1,345	2,057
Accounts payables	5,941	3,825	3,386
	7,580	5,170	5,443
Total liabilities	7,963	5,408	5,570
Total equity and liabilities	26,039	22,845	22,523

Statement of activities and other comprehensive income

	Year ended 31 December	
	2018	2017
	USD'000	USD'000
Grants income	10,549	10,827
Other income	20	6
Research and collaborator expenses	-7,773	-7,949
General and administration expenses	-2,401	-2,551
Operating surplus for the year	395	333
Finance expense	-15	-12
Finance income	259	162
Surplus for the year	639	483
Other comprehensive income	-	-
Total comprehensive income for the year	639	483

Board of directors

In June 2018 Her Excellency Mariam bint Mohammed Almheiri, Minister of State for Food Security of the United Arab Emirates, approved ICBA's new board of directors. The nine-strong board includes renowned leaders and experts from government and non-government organizations, donor agencies, as well as international research and development organizations from the Middle East, Africa, Asia, Europe and Australia. In this regard, Her Excellency Mariam bint Mohammed Almheiri thanked the previous board members for their valuable contribution and commitment to ICBA's vision and mission over the past several years.



H.E. Razan Khalifa Al Mubarak
Managing Director, Environment Agency - Abu Dhabi (Chair)

Dr. Abdelouahhab Zaid
Agricultural Advisor, Ministry of Presidential Affairs of the United Arab Emirates

Mr. Essa AbdulRahman Al Hashemi
Head, Food Security Office, Office of the Prime Minister of the United Arab Emirates

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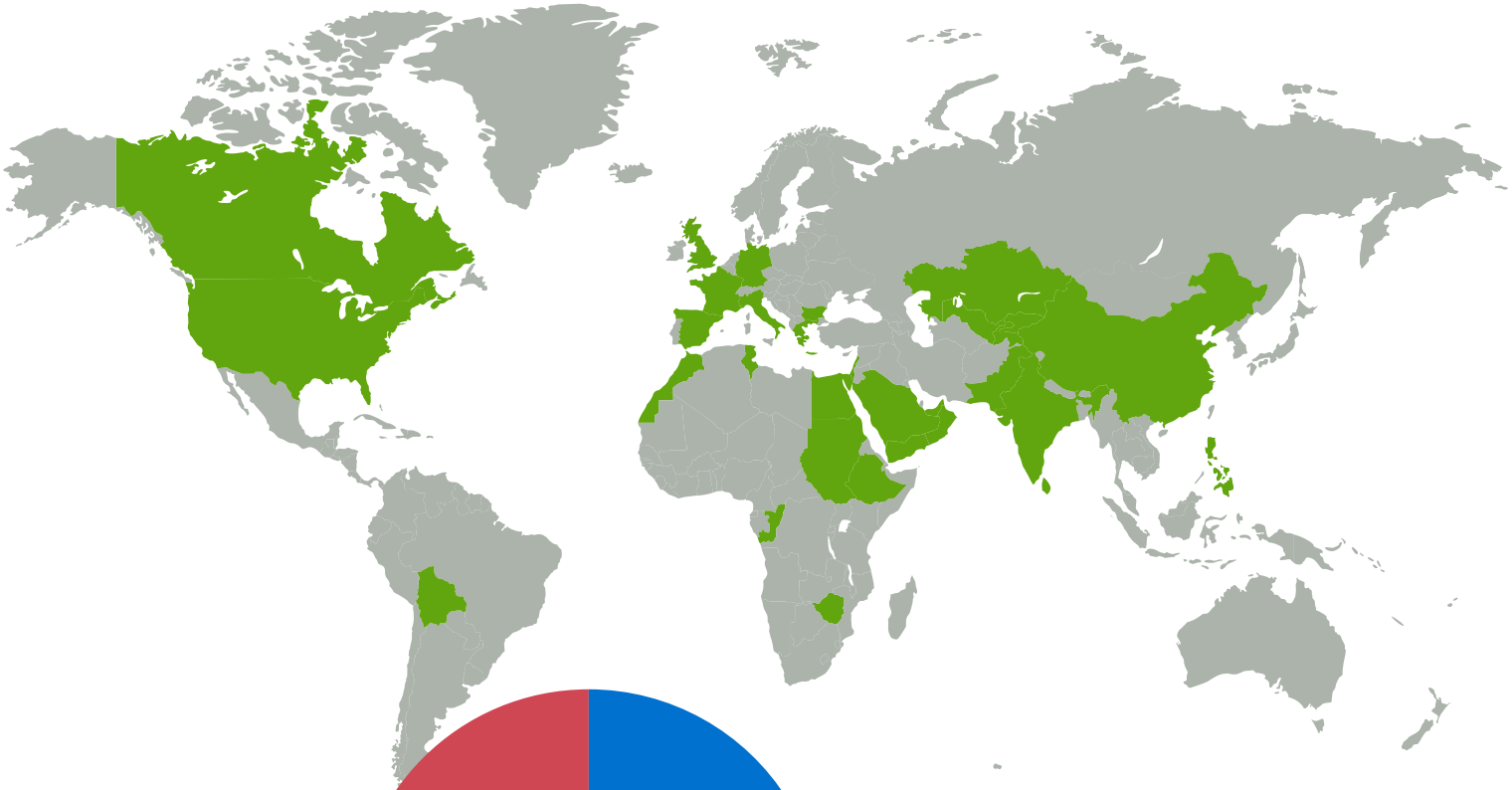
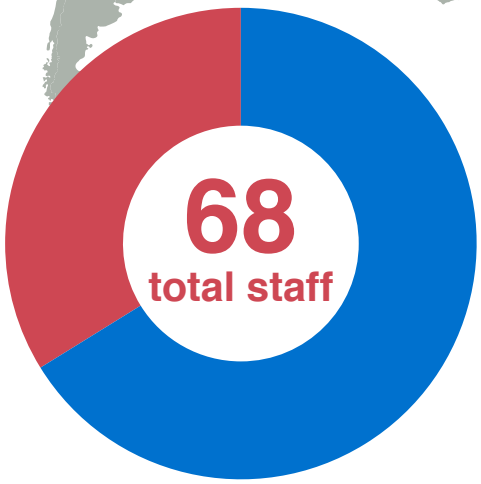
Dr. Ismahane Elouafi
Director General, ICBA (Ex officio member)

Staff





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25

countries around the world

23

women

45

men

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