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ICBA
AGRICULTURE FOR TOMORROW

A Year in Focus: Impact Report | 2022

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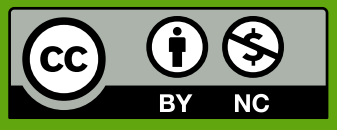

A Year in Focus: Impact Report

2022

Contents

H.E. Dr. Amna bint Abdullah Al Dahak Al Shamsi
Minister of Climate Change and Environment of the UAE

H.E. Dr. Muhammad Sulaiman Al Jasser

President of the Islamic Development Bank and Group Chairman

Acknowledgement of Core Donors

We sincerely acknowledge the Ministry of Climate Change and Environment (MOCCAE), the Islamic Development Bank (IsDB), and the Environment Agency – Abu Dhabi (EAD) for their vital and continued support. Their contributions have been integral to advancing ICBA's mission of addressing the critical challenges of climate change, water scarcity, and soil salinity in arid and saline regions. Their partnership strengthens our ability to implement impactful solutions, enhance food security, and build resilience for vulnerable communities worldwide. We deeply value their trust and collaboration, which are pivotal in achieving ICBA's vision of sustainable and climate-resilient agriculture.

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

Mr. Mohammad Jamal Alsaati
Special Advisor, Office of the President of the Islamic Development Bank and Group Chairman

Ms. Aysha Al Suwaidi
Project Manager, Ministry of Climate Change and Environment of the UAE

Mr. Saeed Amidi
Founder and CEO, Plug and Play

Prof. Khaled Amiri
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President, International Fund for Agricultural Development

Dr. Celso Moretti
President, Embrapa

Dr. Emilia Nordlund
Team Leader, VTT Technical Research Centre of Finland Ltd

Dr. Ren Wang
Director General, China National GeneBank

Dato' Dr. Mohamad Zabawi bin Abdul Ghani
Director General, Malaysian Agricultural Research and Development Institute

Dr. Tarifa Alzaabi
Director General, ICBA (Ex officio member)

Acknowledgement of the Board of Directors

We extend our deepest gratitude to the Board of Directors for their unwavering guidance, strategic vision, and commitment to ICBA's mission. Their leadership has been instrumental in advancing our work to address critical agricultural and environmental challenges in arid and saline environments. The Board's dedication to ICBA's vision of sustainable livelihoods and food security is a cornerstone of our progress and success, and we are profoundly thankful for their continued support and insightful governance.

Dr. Tarifa Alzaabi
Director General

Foreword from the Director General

The year 2022 was one of profound progress for the International Center for Biosaline Agriculture (ICBA). Building on decades of dedication to advancing sustainable agricultural solutions, we expanded our research, innovation, and capacity-building efforts to meet the challenges posed by climate change, water scarcity, and soil salinity. ICBA's work this year exemplified resilience, adaptability, and an unwavering commitment to empowering communities in arid and saline environments.

ICBA continued to lead the way in developing innovative agricultural technologies and practices. Notable achievements included advancing climate-resilient crops such as millets and quinoa, pioneering controlled-environment agriculture systems tailored for arid conditions, and refining integrated management solutions for date palms—crops of vital cultural and economic importance. These breakthroughs are helping to strengthen food security and diversify

agrifood systems in some of the world's most challenging regions.

This year also underscored ICBA's role as a hub for scientific advancement. From conducting ground-breaking research in vertical farming and genomics to launching a new framework for climate risk assessment, ICBA has demonstrated how science and technology can address complex agricultural and environmental challenges. These efforts reflect our commitment to providing actionable solutions for a rapidly changing world.

Capacity development remained a cornerstone of our work in 2022. Through targeted training programs, e-learning platforms, and extensive knowledge-sharing initiatives, ICBA reached thousands of stakeholders, equipping farmers, researchers, and policymakers with the skills and tools they need to innovate and thrive. By fostering collaboration and building local expertise, we are ensuring sustainable impacts at both the community and global levels.

I would like to extend my heartfelt gratitude to our Board of Directors for their steadfast guidance and unwavering support. Their strategic insights and leadership have been pivotal in shaping ICBA's journey and driving its mission forward. I also thank our partners, whose collaboration and trust enable us to achieve impactful and sustainable outcomes worldwide.

As we look to the future, ICBA remains committed to its mission to transform agricultural systems in arid and saline regions. Guided by innovation, collaboration, and a vision for a more food-secure world, we are committed to creating sustainable, climate-resilient solutions that uplift the lives of those who need them most.


ICBA

ICBA at a glance

VISION
Sustainable livelihoods and food security in marginal environments

MISSION
To work in partnership to deliver agricultural and water scarcity solutions in marginal environments

STRATEGIC OBJECTIVES

- Promote sustainable management of natural resources
- Enhance agricultural value chains
- Provide climate change solutions
- Advance sustainable food, feed & biofuel agri-technologies

ICBA is an international not-for-profit applied agricultural research center with a unique focus on marginal environments 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, among other factors.

Since its formation in 1999, the center has implemented projects in some 40 countries in Central Asia, the Middle East, North Africa, South Asia, the South Caucasus, and sub-Saharan Africa.

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

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

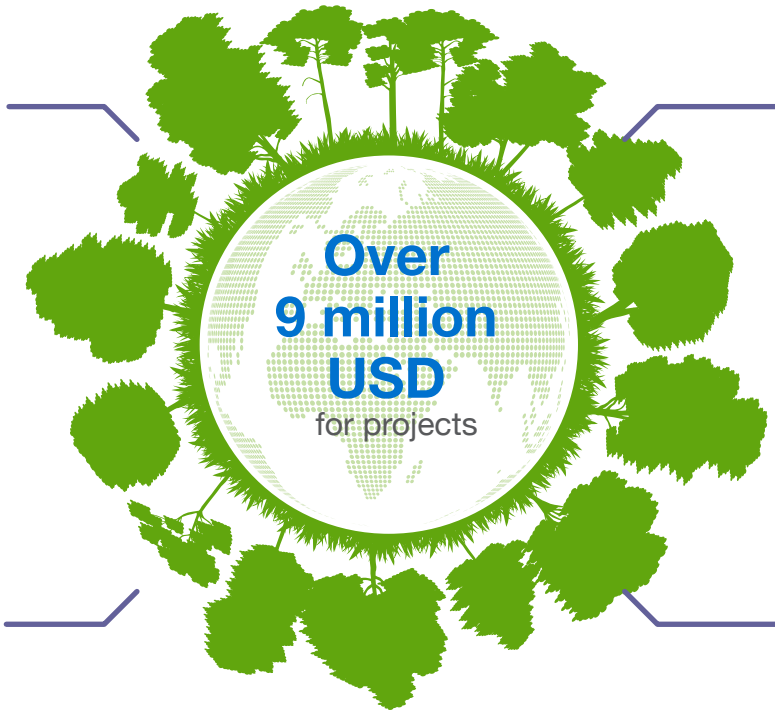
AIRCA
Association of International Research and Development Centers for Agriculture

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

ICBA contributes to the achievement of seven Sustainable Development Goals:

2022 in numbers

59
projects



32
new collaborative agreements

410
mentions in leading news outlets

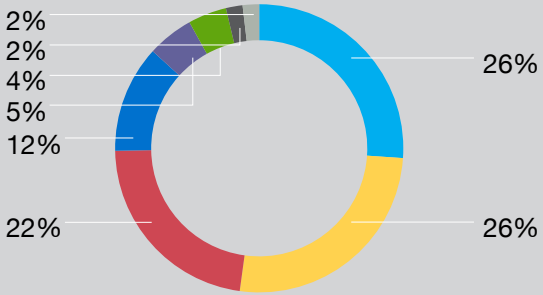
565
participants at 18 special technical training courses, including 299 women, from 21 countries

68
research publications

60 beneficiary countries*

* This also includes beneficiaries of capacity development programs.

Funding Sources



- Environment Agency - Abu Dhabi
- Ministry of Climate Change and Environment
- Islamic Development Bank
- Other External Donors
- International Fund for Agricultural Development
- Sergey Bin Family Foundation
- Food and Agriculture Organization of the United Nations (FAO)
- Emirates Nature - WWF

Highlights of 2022

UAE President visits ICBA

UAE President His Highness Sheikh Mohamed bin Zayed Al Nahyan planted a Ghaf tree at the beginning of the visit.

In 2022 UAE President His Highness Sheikh Mohamed bin Zayed Al Nahyan visited ICBA to review the center's initiatives to boost agricultural productivity and sustainability locally and globally.

His Highness was welcomed by H.E. Mariam bint Mohammed Almheiri, Minister of Climate Change and Environment of the UAE; H.E. Razan Khalifa Al Mubarak, Managing Director of the Environment Agency - Abu Dhabi, President of the International Union for Conservation of Nature and Chair of ICBA's Board of Directors; and Dr. Tarifa Alzaabi, Director General of ICBA.

His Highness toured ICBA's research facilities and experimental fields, including the Desert Life Science Laboratory, the genebank, and the Emirates Soil Museum.

His Highness praised the efforts of the center's staff and the important role ICBA plays in one of the most important areas related to development in the UAE and the world - agriculture and water.

His Highness also stressed that ICBA embodies the UAE's leading role in efforts to achieve sustainable development at the regional and global levels by investing in knowledge, innovation, and scientific research. He said ICBA's work confirmed the UAE's belief that science was the main way to tackle challenges facing humanity in various areas, especially agriculture and water.

At the end of his tour, His Highness expressed his best wishes to the center's staff and management, and urged them to continue supplementing national agriculture, food security, and water plans with more important ideas and innovations.

During his visit, His Highness was accompanied by H.H. Sheikh Nahyan bin Zayed Al Nahyan, Chairman of the Board of Trustees of the Zayed Charitable and Humanitarian Foundation; H.H. Lt. General Sheikh Saif bin Zayed Al Nahyan, Deputy Prime Minister and Minister of the Interior; H.H. Sheikh Mansour bin Zayed Al Nahyan, Deputy Prime Minister and Minister of Presidential Affairs; and H.H. Sheikh Hamdan bin Mohamed bin Zayed Al Nahyan.

ICBA welcomes new director general

Dr. Tarifa Alzaabi has over 25 years of experience in executive leadership and management, strategy development, innovation support, research, and national and international capacity development.

In 2022 Dr. Tarifa Alzaabi was appointed as ICBA's new Director General in line with the provisions of the center's articles of association.

She became the first Emirati social scientist to take on the position of Director General since ICBA's foundation in 1999. Dr. Tarifa Alzaabi had joined the center in August 2019 as Deputy Director General.

A graduate of the UAE Government Leaders Program (Executive Leadership), she had delivered executive training and development programs for government officials in various countries as part of the UAE Government's initiatives to transfer knowledge and develop executive government capacities.

She holds a Ph.D. in Education from the British University in Dubai, an Executive MBA from the University of Sharjah, and executive education in Climate Change Economics and Governance from the London School of Economics and Political Science.

ICBA wins prestigious international date palm award

H.E. Sheikh Nahayan Mabarak Al Nahayan, Minister of Tolerance and Coexistence of the UAE, presented the award to Dr. Tarifa Alzaabi, Director General of ICBA, at the 14th session of the Khalifa International Award for Date Palm and Agricultural Innovation.

In 2022 ICBA won a special award from the Khalifa International Award for Date Palm and Agricultural Innovation for a multi-stakeholder project in the UAE.

ICBA was selected in the category "Pioneering Development and Productive Projects" for the collaborative project co-financed through the Expo 2020 Dubai's Expo Live Innovation Impact Grant Programme.

The center worked with several government and private entities in the UAE to develop value chains for halophyte-based food products. In particular, ICBA trained a group of farmers in the emirate of Abu Dhabi in growing Salicornia, a halophytic or salt-loving plant, and fish using reject brine from desalination units. The project adopted an Integrated Agri-Aquaculture Systems approach for this purpose.

Dr. Dionysia Angeliki Lyra, a halophyte agronomist at ICBA, says: "We focused a lot on knowledge and technology transfer under this project. It was important for us to build public awareness and increase consumers' knowledge about the nutritional benefits of Salicornia-based food products."

Titled "From desert farm to fork: value chain development for innovative halophyte-based food products", the project was implemented by ICBA jointly with farmers in Abu Dhabi; the Abu Dhabi Agriculture and Food Safety Authority; the Environment Agency – Abu Dhabi; the Khalifa Fund for Enterprise Development; and the Global Food Industries LLC.

The project aimed to develop value chains for Salicornia-based food products involving different actors based in the UAE.

An estimated 8.5% of the global population lived in extreme poverty in 2022.

End poverty in all its forms everywhere

About 682 million people suffered from extreme poverty, with sub-Saharan Africa accounting for the majority of the world's destitute*.

While the figure dropped a little as the global economy picked up after the pandemic, poverty rates returned to the levels in 2019.

The latest data shows that extreme poverty is more pronounced in such regions as sub-Saharan Africa, which is home to 66 percent of all people who subsist on less than 2 USD a day.

Most of the extremely poor in rural areas rely on smallholder or subsistence farming. And it is reckoned that there are more than 608 million smallholder farming households worldwide**.

Lacking adequate skills and resources to farm sustainably and profitably, 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.

* Christensen, Z. (2023, February 28). Economic poverty trends: global, regional and national. Development Initiatives. https://devinit.org/resources/poverty-trends-global-regional-and-national/#note-LdT0zfnCI
** Food and Agriculture Organization of the United Nations. (2021). Small family farmers produce a third of the world's food. https://www.fao.org/news/story/en/item/1395127/icode/

Millets are nutrient-dense and versatile crops adapted to unfavorable environmental conditions.they often lack knowhow, technology, and finance.

Millets show promise for dietary diversification in saline, dry conditions

Climate change poses major risks to global food security and nutrition. Drought and other weather extremes and environmental factors exacerbated by climate change are forecast to impact agriculture and reduce yields of staple crops such as wheat, rice, and maize. But agrobiodiversity holds great potential for mitigating such threats to agriculture in different parts of the world as there are many forgotten and neglected crops which are more tolerant of biotic and abiotic stresses and have better nutritional profiles.

So, it is important to diversify agrifood systems and diets by growing and consuming more resilient and nutritious crops like millets. In fact, not only are millets good for the consumer, but also the farmer and the environment. They are not just nutritious foods. They are climate-smart too as their cultivation and consumption helps to reduce agriculture's footprint on the environment.

This was the idea behind a project to assess a variety of millets under different water salinity and irrigation conditions. Since 2021, researchers at ICBA had studied pearl millet, finger millet, foxtail millet, fonio, proso millet, barnyard millet, buckwheat, moth bean, and spices (cumin and ajwain). Thanks to their nutritional and other qualities, these crops are considered ideal candidates for dietary diversification and adaptability in salt-affected and arid environments such as the UAE.

Based on preliminary results, finger millet, foxtail millet, pearl millet, and proso millet were identified as promising and adapted to drought and varying levels of saline water in desert conditions. According to the researchers, all four crops could contribute to a healthy diet as they are excellent sources of protein, fiber, vitamins, and minerals. What is more, most of the millets in their natural form are generally gluten-free, making them the best choice for health.

Dr. Nhamo Nhamo, a senior agronomist at ICBA, says: "As we look for ways to make agrifood systems more sustainable and climate-resilient, crops like millets should receive more attention. Not only can they become a healthy addition to local diets, but also serve as a powerful tool for climate change adaptation and mitigation."

The study aimed to provide additional data on the consistency of the performance and stability of the millet cultivars on a large scale. The findings will help to promote the best-performing cultivars from each of the four crops for release and commercialization.

Developing integrated date palm management solutions

Date palm cultivation has great cultural, economic, and social significance in the Middle East and North Africa. But water scarcity, soil and water salinity, and low soil fertility, among other factors, make it challenging to grow date palm trees.

On top of abiotic stresses, date production is constrained by pests and diseases, and specifically red palm weevil (Rhynchophorus ferrugineus). According to the Food and Agriculture Organization of the United Nations, the annual losses in global date production can be as much as 30 percent because of pests and diseases*.

As around 90 percent of the world's date palm trees are grown in the region** and many farmers depend on date production for their livelihoods, it is important to develop effective solutions for dealing with biotic and abiotic stresses. On the one hand, it is necessary to identify date palm varieties that are more tolerant of biotic and abiotic stresses. On the other hand, integrated approaches are required to save water and other inputs, fight pests and diseases, and ensure higher yields in unfavorable environmental conditions.

This rationale has guided date palm research at ICBA for over two decades. Since 2002, the center has conducted different experiments in the UAE to determine the long-term effect of saline water irrigation on date palm growth, productivity, fruit quality, and the impact of salinity on the soil. The experiments are conducted on 18 date palm varieties from Saudi Arabia and the UAE.

Dr. Zied Hammami, an agronomist at ICBA, says: "As date production in the region faces a host of challenges, we need to adopt a holistic approach to date palm management. And our research program is aimed at meeting the need for such solutions and supporting efforts by other organizations to improve the livelihoods of date producers in the region and beyond."

As part of this research program, scientists have continued experiments to determine actual water requirements of date palm trees in the UAE, test various water-saving technologies, including hydrogels and sub-surface irrigation systems, and evaluate the effectiveness of different techniques for controlling red palm weevil.

This work is part of ICBA's efforts to ensure the resilience and sustainability of agrifood systems in the Middle East and North Africa, and other regions.

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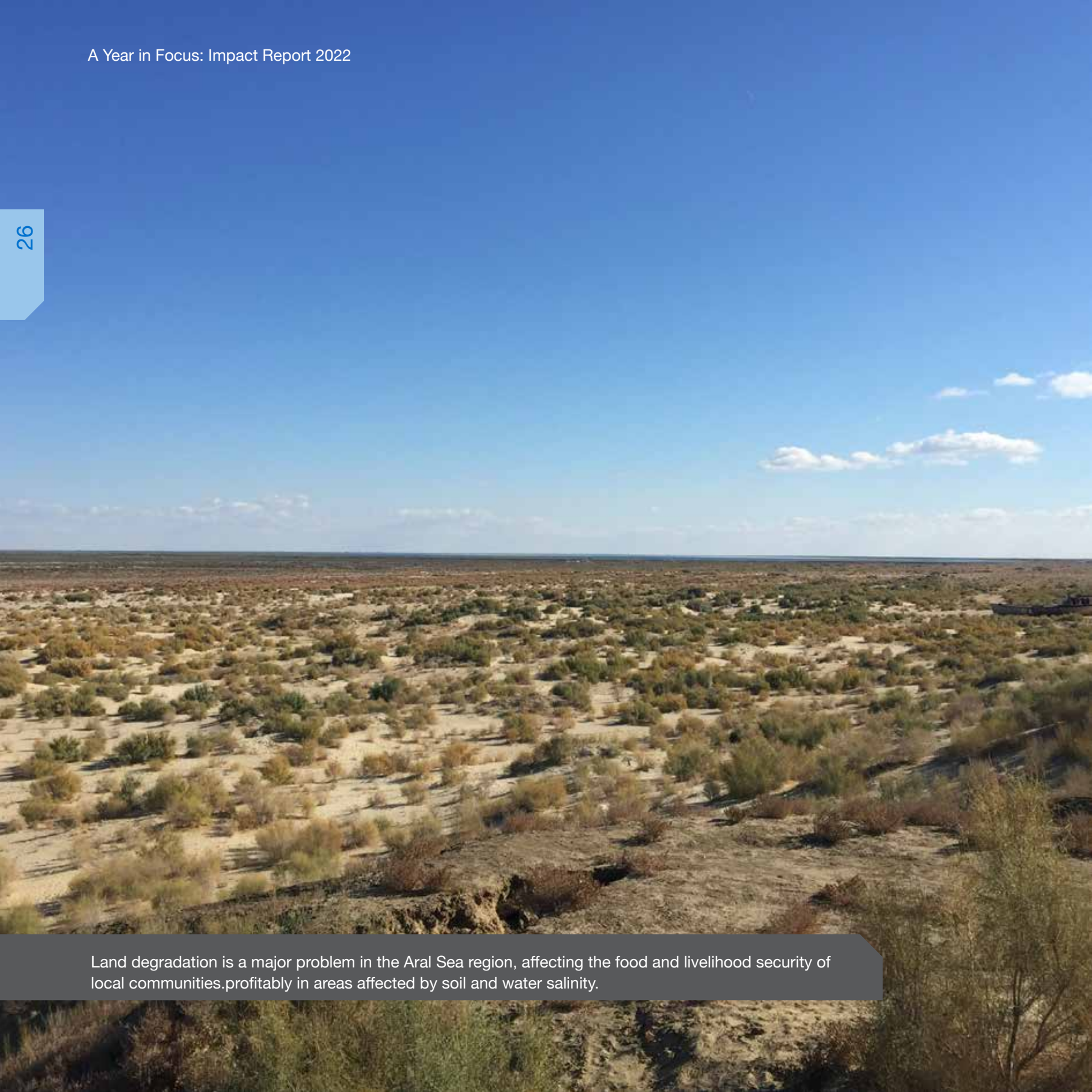
* UN. (2004, July). Global Date Palm Production at Risk Due to Pests, Diseases, Says UN Food and Agriculture Organization. https://press.un.org/en/2004/sag276.doc.htm
** Johnson, D. V. (2010). Worldwide Dispersal of the Date Palm from its Homeland. Acta Horticulturae, 882, pp. 369-375. https://doi.org/10.17660/ActaHortic.2010.882.42

Date production in the Middle East and North Africa is undermined by a range of abiotic and biotic threats.conditions than their counterparts used by local farmers.



Land degradation is a major problem in the Aral Sea region, affecting the food and livelihood security of local communities.profitably in areas affected by soil and water salinity.

Climate-proofing agrifood systems in degraded areas of Aral Sea basin

The rural population in the Aral Sea region struggles to make a living from farming. Land degradation and other factors make it difficult to raise crops and livestock sustainably. This, in turn, impacts the lives and livelihoods of farming communities.

But it is important to provide local farmers with skills and technologies to help them adapt to agricultural challenges and improve their resilience to climate change and other threats. Above all, they need science-based solutions for increasing agricultural productivity and sustainability.

This is the goal of a new multi-year project titled "Development of Sustainable Agricultural Production Systems in Degraded Areas of Karakalpakstan". Launched in 2022 with financial support from the Abu Dhabi Fund for Development, it is implemented by ICBA in partnership with the Ministry of Innovative Development of Uzbekistan and the Ministry of Agriculture of Uzbekistan.

Dr. Tarifa Alzaabi, Director General of ICBA, says: "This project brings together our long-time partners – the Ministry of Innovative Development of Uzbekistan and the Ministry of Agriculture of Uzbekistan — with the aim of supporting resource-poor rural communities and restoring degraded ecosystems in the Aral Sea region. There is great potential for transforming these degraded areas into places where science and innovation offer hope for a better and more sustainable future."

Running until 2026, the project is designed to enhance farming communities' resilience to climate change and develop their adaptive capacity to land degradation and other unfavorable factors.

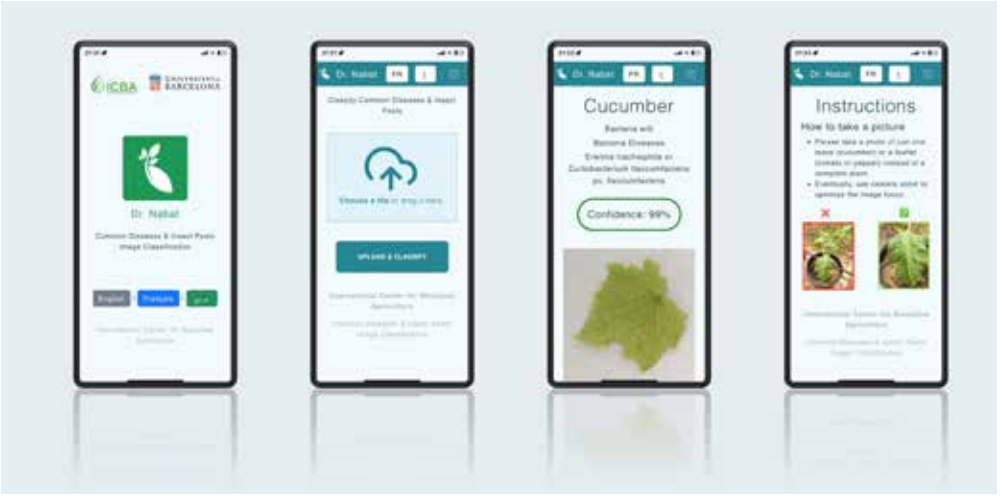
This will be achieved through, among other things, the introduction of stress-tolerant crops, best practices in crop, soil and water management, and integrated farming systems.

As part of the project, ICBA will establish a seed production unit to cater to farmers' need for quality seeds as lack of access to diverse climate-resilient crops and their improved seeds is regarded as one of the main constraints on agriculture.

The project is expected to directly benefit up to 15,000 farmers and agropastoralists and their households (up to 75,000 people), develop the capacity of up to 150 extension workers, as well as establish or strengthen up to 15 farmers' cooperatives.

Moreover, the project will engage national and international organizations to support agricultural development policies, as defined in Uzbekistan's Agri-Food Development Strategy 2019-2030, contribute to the country's efforts to improve food security and nutrition among vulnerable rural communities and several Sustainable Development Goals, including SDGs 1, 2, 5, 13 and 17.

Harnessing AI for crop disorder detection



According to some estimates, the annual loss in crop production due to pests and diseases ranges between 20 and 40 percent globally. Each year plant diseases cost the world's economy around 220 billion USD, and invasive insects around 70 billion USD*.

So, it is necessary to develop innovative solutions like mobile applications to empower farmers and extension specialists to make prompt diagnoses. This will help to take effective and timely action, and thus increase food security and income.

This rationale is behind a project conducted by ICBA together with the University of Barcelona, Spain. Called "Developing a user-friendly application for smallholder farmers for detection of plant disorders", the project developed an AI-powered mobile application called Dr. Nabat to help identify and deal with diseases and disorders in different crops.

Created with the support of local partners in Egypt, Tunisia, and the UAE, the application is designed to aid smallholder farmers and extension specialists in spotting crop diseases and disorders at early stages, and thus minimizing yield losses and improving incomes. It can identify 18 different common disorders affecting tomato, capsicum, and cucumber. These cash crops are considered important for smallholder farmers who practice protected agriculture.

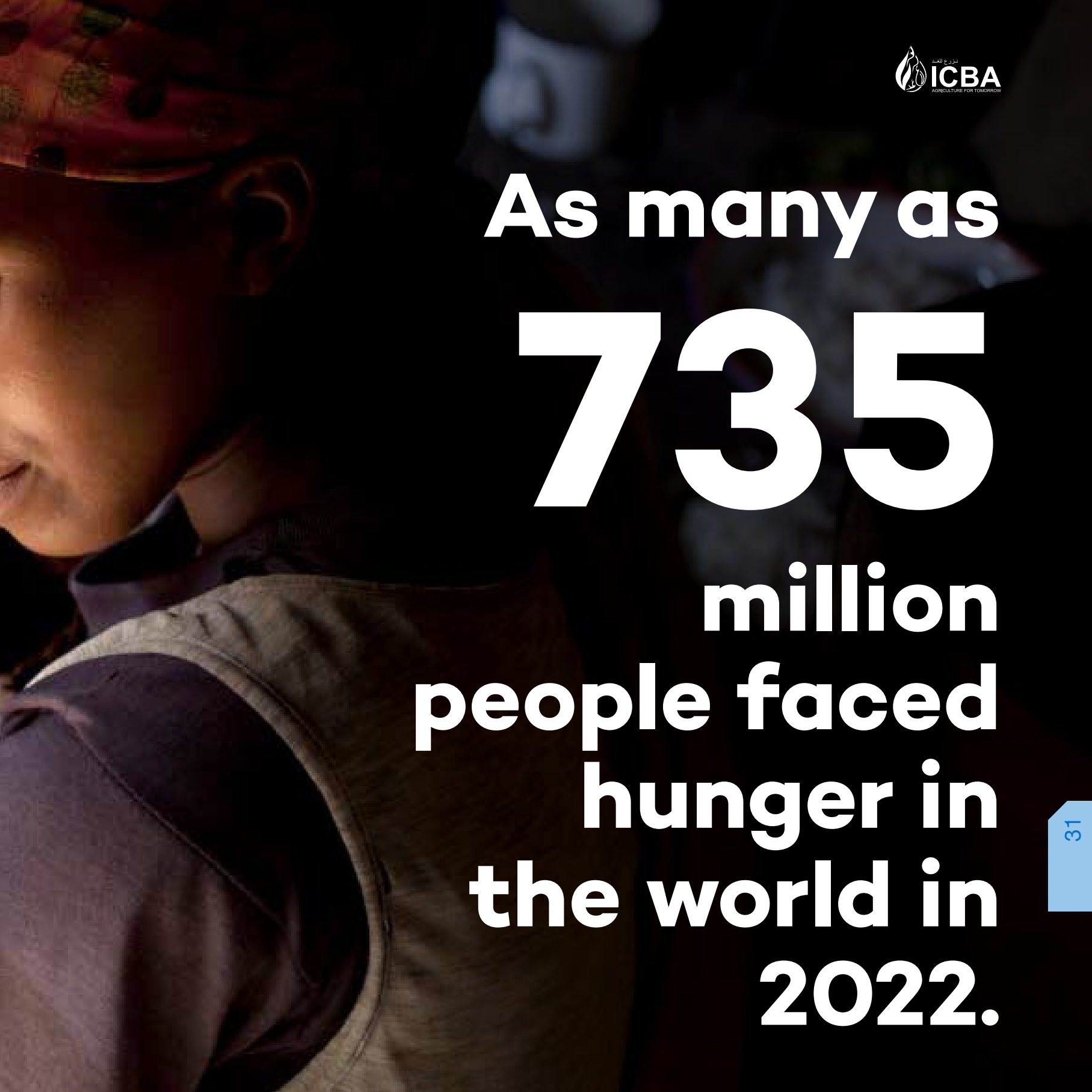
As part of the project, ICBA collected raw data from the three countries for training the AI model which was developed by the University of Barcelona. The application was field-tested, and 414 smallholder farmers and extension specialists were trained and provided their feedback on the beta version from 2020 to 2022.

Dr. Henda Mahmoudi, a plant physiologist and lead of the project at ICBA, says: "Crop disorders and pests pose a major challenge to smallholder farmers in the Middle East and North Africa. Intelligent systems such as this application can play a crucial role in facilitating prompt diagnoses and effective and timely action."

Currently, the application is customized for Egypt, Tunisia, and the UAE. But there are plans to upgrade and roll out the application in other countries in the future.

* FAO. (2019, April 3). New standards to curb the global spread of plant pests and diseases. https://www.fao.org/news/story/en/item/1187738/icode/

Unveiled by H.E. Mariam bint Mohammed Almheiri, Minister of Climate Change and Environment of the UAE, during a ceremony at ICBA, the AI-powered mobile application for detecting crop diseases and disorders had been trialed among farmers and extension specialists in Egypt, Tunisia, and the UAE.


ICBA
AGRICULTURE FOR TOMORROW
As many as
735
million
people faced
hunger in
the world in
2022.

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

About 9.2 percent of the global population was affected by hunger in 2022, up from 7.9 percent in 2019*.

Some 122 million people joined the ranks of the world's hungry after the Covid-19 outbreak. Globally, almost one in three people suffered from moderate or severe food insecurity in 2022 due to the impacts of the pandemic, conflict, and climate change.

A much larger proportion of the population in Africa was undernourished compared to other regions of the world – nearly 20 percent as against 8.5 percent in Asia or 6.5 percent in Latin America**. South Asia, East Africa, and sub-Saharan Africa had the highest levels of undernourishment.

Climate change-induced drought, salinization, and other factors threaten food security in these and other regions where small-scale agriculture supplies most of the food. As staple crops produce little or fail, rural communities are faced with undernourishment and hunger.

* United Nations Statistics Division. (n.d.). Zero hunger. https://unstats.un.org/sdgs/report/2023/Goal-02/
** FAO, IFAD, UNICEF, WFP and WHO. 2023. In Brief to The State of Food Security and Nutrition in the World 2023. Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum. Rome, FAO. https://doi.org/10.4060/cc6550en

MINISTRY OF AGRICULTURE OF THE REPUBLIC OF TAJIKISTAN

STATE OFFICE "STATE COMMISSION FOR VARIETY TESTING AND VARIETY PROTECTION"

CERTIFICATE OF BREEDER'S RIGHT

According to the decision of the Commission of Plant Varieties Release of the Ministry of Agriculture of the Republic of Tajikistan №1 from 18-th of June 2021 released.

Starting from 2021 officially included in the State Register of protected plants varieties allowed to use in the territory the Republic of Tajikistan.

№ 0000028

“Vahdat”, as the new variety is known, will be an ideal addition to the diets of rural farming communities in Tajikistan.

Quinoa genotype from ICBA gets go-ahead for cultivation in Tajikistan

Agriculture is a key engine of growth in Tajikistan. The sector accounts for almost 20 percent of GDP and 61 percent of employment*.

But it is hampered by different factors, including drought and salinization, leaving many smallholder farmers across the country in a tight spot. It is estimated that some 98 percent of agricultural land in the country suffers from some level of soil degradation**, as well as other constraints.

What is more, the country is also faced with nutrition insecurity. Low dietary diversity, particularly of good quality protein and micronutrient-rich food, affects rural communities, especially children, and contributes to high rates of stunting in poor households.

Against this backdrop, it is necessary to adopt more resilient and nutritious crops like quinoa. Quinoa can adapt to a range of agroecosystems and is rich in protein, fatty acids, and micronutrients.

Under a project titled "Cross-regional Partnerships for Improving Food and Nutritional Security in Marginal Environments of Central Asia", researchers from ICBA worked with national partners to promote quinoa as a potential alternative for saline and dry areas in the region.

In Tajikistan, this work focused on integrating quinoa into local cropping systems. Jointly with the Center of Genetic Resources of the Tajik Academy of Agricultural Sciences, they conducted screening trials of five quinoa genotypes from ICBA at various locations across the country. This research resulted in the identification of a genotype called ICBA-Q5 as the most promising in terms of salinity and drought tolerance, as well as grain production and quality. It is early-maturing, high-yielding, and nutrient-rich.

Dr. Kristina Toderich, a senior fellow at ICBA, says: "As the soils in the world's drylands in countries like Tajikistan become more saline and as climate changes, we need to cultivate crops which can tolerate salt, heat, and drought. While quinoa has attracted global attention because of its resistance to a range of abiotic stresses and its high nutritional value, there has been hitherto limited knowledge about its potential in Tajikistan."

Named "Vahdat" (unity in Tajik) by local scientists, the variety was presented to the State Commission for Variety Testing and Variety Protection for further evaluation. A group of local farmers were also engaged in the evaluation following evolutionary participatory breeding methods. Following multi-year trials, the State Commission for Variety Testing and Variety Protection approved and released "Vahdat" for national distribution as it was proven to be salt- and heat-tolerant in various agroecological zones of the country.

Certainly, it will take some time before "Vahdat" will be grown widely across the country. But as more farmers learn about quinoa and start growing it, they will worry less about drought and salinization. More importantly, they will be able to produce enough to eat and sell.

* IFAD. (n.d.). Tajikistan. https://www.ifad.org/en/web/operations/w/country/tajikistan

** UNDP-UNEP Poverty Environment Initiative. (2012). The Economics of Land Degradation for the Agriculture Sector in Tajikistan – A Scoping Study. https://wedocs.unep.org/bitstream/handle/20.500.11822/33636/TELDAST.pdf?sequence=1&isAllowed=y

Promoting food security awareness in UAE

In 2022 ICBA continued to raise awareness about sustainable agriculture and contribute to broader efforts on food security in the UAE under its community initiative called 3N.

As part of the initiative, the center worked with local partners and authorities to reach a diverse group of beneficiaries through different activities.

In observance of Zayed Humanitarian Day, ICBA organized a special event for a group of women students from the Kulna Club of Zayed University's Dubai campus. The event aimed to raise awareness among youth about sustainable agricultural practices and cultivate a sense of generosity and service.

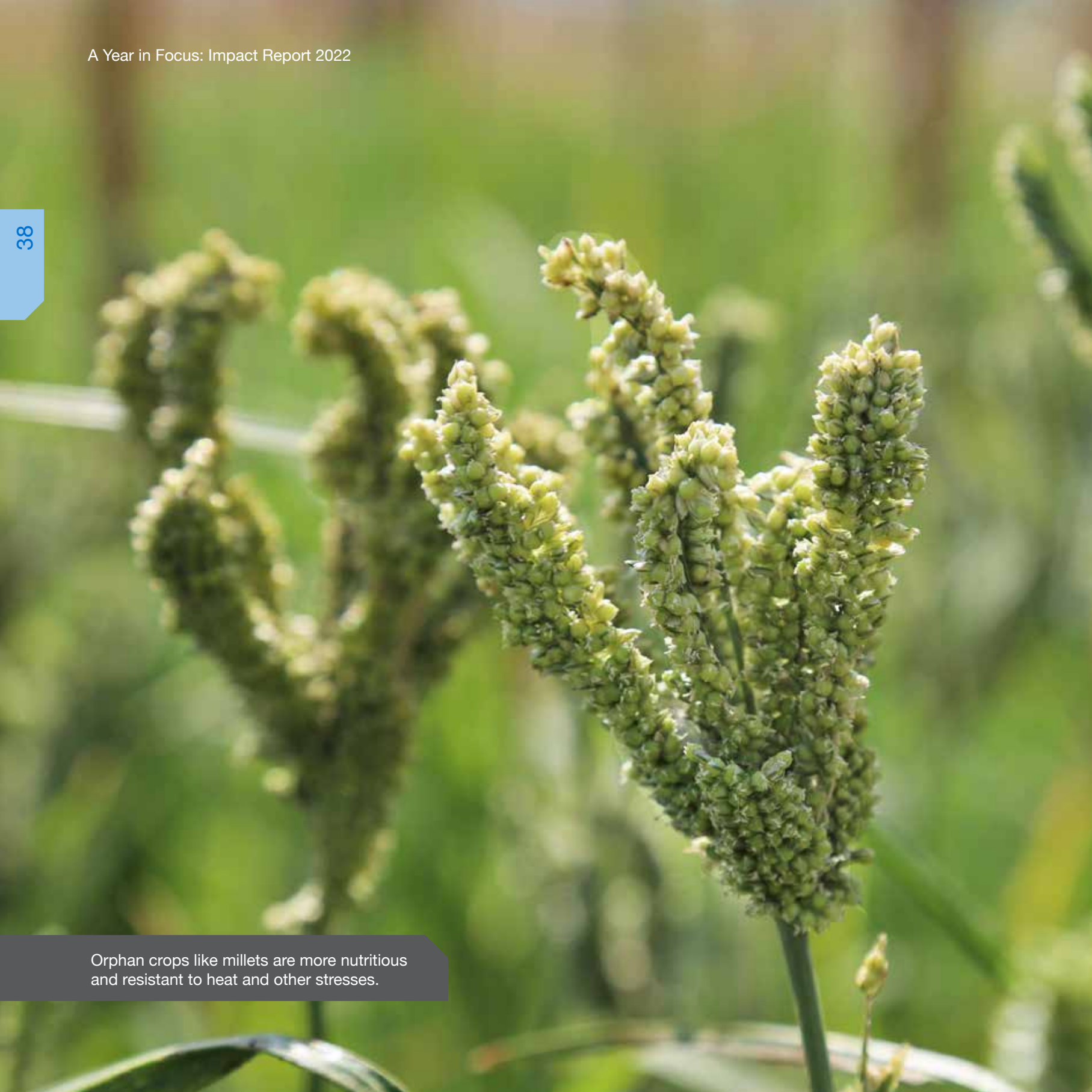
During the event, the students got the opportunity to interact with ICBA's scientists and specialists and learn about the center's research-for-development programs that contribute to food security efforts in different countries, including the UAE.

The students also toured the Emirates Soil Museum and visited the center's research facilities, including greenhouses. Moreover, they collected about 200 kg of tomatoes, which were donated to the Emirates Red Crescent at the end of the event.

Dr. Suhail AlGhfeli, Co-Chair at Zayed University's College of Natural and Health Sciences, says: "The cooperation between Zayed University and ICBA is a fruitful one, which can be illustrated through university social responsibility towards our community, and the role of ICBA in community events such as Zayed Humanitarian Day is a remarkable example of strengthening the bonds with the UAE's society. The event was launched with the participation of the Emirates Red Crescent, which helps people locally and internationally."

3N was launched in 2020 in line with the vision of the late founding father of the UAE, Sheikh Zayed bin Sultan Al Nahyan, to work together with local stakeholders to contribute to food security, raise awareness among communities about sustainable agriculture, and promote healthy eating habits.

Dubbed 3N, ICBA's community initiative represents three key actions: grow, harvest, and share.



Orphan crops like millets are more nutritious and resistant to heat and other stresses.

Spotlighting potential of orphan crops for food security and nutrition

While farming remains the main source of food and livelihood for rural communities in marginal areas, it is challenging due to a host of constraints such as salinity, water scarcity, and drought. As staple crops like rice, wheat, and maize fare badly under these conditions, smallholder farmers need alternatives.

In contrast, orphan crops, a diverse group of neglected and underutilized crops, hold considerable promise for food security and nutrition in marginal areas. But these indigenous crops are usually grown by subsistence farmers. They also provide income for local farmers and serve as staples in local diets.

Despite their significance locally, they tend to receive relatively limited attention in agricultural research and development initiatives globally.

For this reason, a study* by a team of scientists from ICBA evaluated the potential of orphan crops for improving food security and nutrition in marginal areas characterized by poor soils, inadequate quantity and quality of water, and unfavorable climatic conditions.

Published in Frontiers in Plant Science, the study reviewed 14 orphan crops based on their resilience to salinity, drought, and heat; high nutritional profile; amenability to varying cropping systems; and local availability for economic growth and social development.

In particular, the study looked at finger millet, proso millet, barnyard millet, buckwheat, fonio, little millet, African yam bean, African winged bean, moth bean, Bambara nut, jatropha, jojoba, camelina, and teff.

The study noted that orphan crops have great potential in marginal areas and the introduction, evaluation, and adaptation of outstanding varieties of such crops for dietary diversification will contribute not only to sustained food production but improved nutrition as well.

According to Dr. Abidemi Talabi, a post-doctoral fellow at ICBA and one of the lead authors of the study: "Orphan crops are more relevant than ever before as we face a plethora of challenges in agriculture due to climate change. With increasing pressure on limited natural resources and population growth, we need to incorporate more climate-resilient and nutritious crops into our agrifood systems."

There is still a long way to go before these crops are grown in farmers' fields and added to local diets on a large scale. But frequent climate extremes, continued land degradation, and increased awareness of healthy lifestyle and diet are bringing these crops back to the limelight. Thanks to global awareness efforts, some of the erstwhile neglected and underutilized crops like quinoa have gained popularity beyond their place of origin.

According to the authors, the objective is not for orphan crops to dominate the diet or compete with the major food crops but to complement production to meet the food requirements of the fast-growing population.

The study concludes by presenting a potential roadmap for future research engagement and a policy framework with recommendations to facilitate and enhance the adoption and sustainable production of orphan crops under marginal conditions.

* Talabi, A. O., Vikram, P., Thushar, S., Rahman, H., Ahmadzai, H., Nhamo, N., Shahid, M. & Singh, R. K. (2022). Orphan Crops: A Best Fit for Dietary Enrichment and Diversification in Highly Deteriorated Marginal Environments. Frontiers in Plant Science, 13 (2022): 839704. https://doi.org/10.3389/fpls.2022.839704

Study gauges long-term salinity effect on date palm fruit yield

A study* by a team of scientists from ICBA, the United Arab Emirates University, and the University of Vigo, Spain, offers a fresh insight into the long-term impact of salinity on fruit yield of 18 date palm varieties from the Arabian Peninsula.

Published in Agricultural Water Management, the study is based on the results of an experiment carried out at ICBA's research station in Dubai from 2001 to 2016. Researchers evaluated the performance of 18 local and regional date palm varieties in an open-field area of 2.5 hectares.

In particular, they analyzed the effect of irrigation with water at three levels of salinity (5, 10 and 15 deciSiemens per meter) on the productivity of 10 date palm varieties from the UAE and eight from Saudi Arabia.

The experiment showed that the varieties responded differently to irrigation with saline water as yield stability was affected. Based on the varieties' salinity tolerance thresholds, the researchers identified four different groups.

The first group included varieties with a high yield and salinity tolerance such as Lulu and Barhi. The second group comprised Khisab, Sukkari, Jabri, and Shahla, which were identified as high-yielding but sensitive to salinity rise. The third group was characterized by medium to high yield potential at low salinity levels with moderate salinity tolerance and included Fardh, Um Al Hamam, Naghal, Abu-Maan, and Rhothan. The fourth group included Shagri, Khnizi, Nabtat Saif, Ajwa Al Madinah, Khalas, and Maktoumi, which demonstrated low yield potential with low salinity tolerance.

Dr. Zied Hammami, an agronomist at ICBA, says: "The study is a result of extensive research efforts over 15 years to understand the impact of salinity on date palm varieties from the region and their adaptation capacity. Its findings are important for developing better and more resilient date palm varieties using conventional and advanced biotechnological tools."

Many aspects of date palm nutrition, physiology, and genetics, among other things, have been thoroughly researched to date. However, research on the impact of salinity on date palm growth and productivity is limited to short-term studies or is focused mainly on the seedling stage, not the mature plants in the field.

According to the authors, in addition to determining the long-term effect of salinity, the study aimed to establish precise salinity thresholds for a diverse range of date palm genetic material.

The study will also have significant implications for water management, especially under desert and saline conditions, and mark an essential step towards deeper knowledge of the long-term impacts of salinity on date palm fruit yield.

Overall, the study will help to guide future research on genetic enhancement and development of integrated date palm management approaches in desert and saline conditions.

* Al-Dakheel, J. A, Iftikhar, H. M, Abdulrahman, A. & Abdullah, A. (2022). Long-term assessment of salinity impact on fruit yield in eighteen date palm varieties. Agricultural Water Management, 269 (2022): 107683. https://doi.org/10.1016/j.agwat.2022.107683

ICBA has been at the forefront of research and development in date palm since 2001.
Mohammed Almheiri, Minister of Climate Change and Environment of the UAE.

Women form the backbone of the rural economy in regions like sub-Saharan Africa and North Africa.

Achieve gender equality and empower all women and girls

Women make up an average of 43 percent of the agricultural labor force in developing countries. But only 10 to 20 percent of the farmland holders are women, and in some parts of the world, women still cannot legally own or control land*.

The majority of women farmers are either unpaid family workers or paid laborers. These women were hit hardest by the pandemic, with many being left indebted and hungry**.

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***.

Whether it is on the farm or in the lab, women's potential around the world remains largely untapped.

* Duckett, K.M. (n.d.). Empowering female farmers to feed the world. National Geographic. https://www.nationalgeographic.com/culture/article/partner-content-empowering-female-farmers
** ActionAid. (2020, October 16). World Food Day: Women farmers most at risk from Covid-19 food crisis. https://actionaid.org/news/2020/world-food-day-women-farmers-most-risk-covid-19-food-crisis
*** United Nations. (2011, March 7). Women could feed millions more people if given access to means of production – UN. https://news.un.org/en/story/2011/03/368252-women-could-feed-millions-more-people-if-given-access-means-production-un#:~:text=Women%20in%20rural%20areas%20have,United%20Nations%20report%20released%20today

Aspiring Arab women scientists graduate from regional fellowship program

Sixteen women scientists from seven countries graduated from the Arab Women Leaders in Agriculture (AWLA) fellowship program in 2022.

To celebrate their achievements, ICBA hosted a special ceremony for the second cohort of fellows at Expo 2020 Dubai on International Women's Day.

During a seven-month online program, the fellows from Algeria, Egypt, Jordan, Lebanon, Morocco, Tunisia, and the UAE undertook an intensive curriculum designed to equip them with research, leadership, and other skills for professional and personal development.

Funded by the Bill & Melinda Gates Foundation and the CGIAR Research Program on Wheat, the second edition of AWLA included a mix of virtual and e-learning courses tailored to improve the fellows' research, leadership, and project management skills, among others.

Mr. James Carty, Interim Deputy Director for the Middle East and East Asia at the Bill & Melinda Gates Foundation, says: "As the world begins to emerge from the pandemic, both governments and the private sector must support women's employment and women-led scientific innovation as essential levers to food security, sustainability, and stronger economic growth. AWLA delivers concrete solutions that help break down barriers for Arab women researchers and we're proud to have supported it and help empower women in positions of leadership in all fields, particularly critical sectors like agriculture and science."

Being the first of its kind in the Middle East and North Africa, AWLA is designed to enable women researchers from across the region to spearhead positive changes in agriculture, food production, and environmental sustainability while addressing the challenges they face in their careers.

AWLA serves as a platform for early- and mid-career women professionals across agricultural disciplines to exchange ideas and experiences and collaborate on various projects aimed at enhancing food, water, and nutrition security in the region.

Its long-term goal goes beyond capacity development and includes improved food security and nutrition, a better research and development landscape, and economic and social benefits of a narrowed gender gap in the region.

The Arab Women Leaders in Agriculture fellowship program is focused on narrowing the gender gap in agricultural science and leadership in the Middle East and North Africa.


ICBA
AGRICULTURE FOR TOMORROW
Over
2 billion
people live in
water-stressed
countries.

Ensure availability and sustainable management of water and sanitation for all.

Globally, 72 percent of all water withdrawals are used for agriculture*. Yet 3.2 billion people live in agricultural areas with high to very high water shortages or scarcity**.

As climate change is shifting weather patterns, water supplies are set to decline and droughts to intensify. This poses a serious threat to rural populations who depend on farming for their food security and livelihood.

Against this backdrop, it is worrying that freshwater resources and aquifers are being depleted and degraded at an increasing rate.

* UN Water. (2021, February 24). Summary Progress Update 2021: SDG 6 — water and sanitation for all. https://www.unwater.org/publications/summary-progress-update-2021-sdg-6-water-and-sanitation-all
** FAO. (2020). The State of Food and Agriculture 2020. Overcoming water challenges in agriculture. Rome. https://doi.org/10.4060/cb1447en

ICBA has extensive experience in research and innovation in controlled-environment agriculture technologies.

Low-cost greenhouse system shows promise for desert conditions

In the UAE, controlled-environment agriculture is an effective way to cut down on water use as it makes it possible to grow crops with up to 95 percent less water than traditional agricultural methods. It is also one of the main planks of the UAE's National Food Security Strategy 2051.

In support of the country's efforts on sustainable agriculture and food security, scientists at ICBA are developing new models of greenhouses that are more resource-efficient and better adapted to desert environments. They range from high-tech to mid-tech to low-tech systems.

As part of this work, researchers began testing a new low-cost controlled-environment agriculture system. The experiment involves the cultivation of Chal tomato, a South Korean tomato variety, in a customized low-cost greenhouse facility adapted to local conditions.

The facility uses environmentally friendly material instead of plastic or polycarbonate sheets and consumes far less electricity as compared to traditional greenhouses with fan and pad cooling systems. What is more, the plants are grown without any chemicals and irrigated with a mix of fresh and saline water, thus saving fresh water.

According to Dr. Hicham Fatnassi, a senior horticulture scientist at ICBA: "We are very happy with the preliminary results of this low-cost greenhouse facility at ICBA. What we have observed is that almost all the plants are performing well and producing good quality tomatoes."

Conducted in collaboration with a South Korean company, the experiment is part of ICBA's efforts to test, develop, and introduce resource-efficient crops and technologies that help produce more food, save more resources, and protect the environment.

Following the design and validation of the system, scientists aim to try more crops and develop policy recommendations for both open-field and controlled-environment agriculture systems in arid regions and enhance the capacity of farmers and laborers to manage these systems.

ICBA tests new vertical farming system

As agriculture is constrained in arid ecosystems by a range of factors, including shortage of fresh water and extreme heat, vertical farming can help to increase food production while helping save water and other inputs.

It has the potential to provide a year-round supply of quality produce using less water compared to traditional greenhouses.

But most of the available data for vertical farming systems has been collected mainly in European and other countries. So, it is necessary to estimate the quantity of resources used for growing various vegetables and fruits in vertical farming systems and analyze how these requirements are affected by external conditions in arid climates.

To address this gap in knowledge, scientists at ICBA are assessing a new vertical farming system better adapted for arid environments such as the UAE.

As part of a study at ICBA's research station in Dubai in collaboration with a South Korean company, they are looking to develop, test, and introduce a sustainable vertical farming system that can help to increase agricultural production in arid conditions while consuming much less water and energy compared to standard systems.

The study will help to generate important data on resources required for vertical farming systems in environments like the UAE.

According to Dr. Augusto Becerra Lopez-Lavalle, Chief Scientist at ICBA: "Vertical farming systems, including container-based ones, are particularly suited to offsetting the effects of climate change since they have controlled climate parameters, including temperature, humidity, light, and carbon dioxide concentration. Despite all the benefits, these systems also have a major drawback: they need a significant amount of energy for artificial lighting required for photosynthesis, air conditioning for cooling and dehumidification. For this reason, we are studying how to optimize use of resources such as light (intensity, quality, and duration) and nutrients and develop a model adapted to local climatic conditions and replicable in similar environments around the world."

The study will result in the development of technical guidelines focusing on crop production practices to optimize water use efficiency in arid climates.

In particular, the guidelines will explain the basics of good practices in vertical farming in arid climates. They will also cover such topics as climate control, cropping systems, practices that reduce water and energy use, and use of adapted cultivars, among other things.

The scientists plan to grow different high-value crops, including strawberries and medicinal herbs.

Vertical farming is considered as one of the approaches to producing food with limited resources.

2022

set new records for several key climate change indicators.

Take urgent action to combat climate change and its impacts

Global climate data shows that 2015 to 2022 were the eight warmest years on record*. While 2020 was the hottest year in recorded history worldwide despite an abrupt decline in carbon dioxide emissions during the pandemic**, record-breaking droughts, heatwaves, and rainfalls hit different parts of the world in 2022.

As the planet is heating up, 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, heatwaves, and floods are becoming more frequent and intense in many Middle Eastern and African countries, causing immense social and economic damage.

* World Meteorological Organization. (2023, April 21). WMO annual report highlights continuous advance of climate change. https://public.wmo.int/en/media/press-release/wmo-annual-report-highlights-continuous-advance-of-climate-change

** National Aeronautics and Space Administration. (2021, January 14). 2020 Tied for Warmest Year on Record, NASA Analysis Shows. https://www.nasa.gov/press-release/2020-tied-for-warmest-year-on-record-nasa-analysis-shows

The framework will improve decision-making in climate change adaptation and mitigation.

Scientists create new framework for climate risk assessment

While climate change poses a plethora of hazards worldwide, its impact is forecast to vary by region and be both beneficial and detrimental. Assessing the severity of risks stemming from climate change is therefore critical to decision-making.

Information about how a hazard has changed, or will change, will help stakeholders prioritize their adaptation, mitigation, and risk management strategies. For example, aid agencies may allocate limited disaster relief resources if they know that tropical cyclones are projected to become more intense even as the frequency of those storms may not change. And planners may consider that even heatwaves that are not record-breaking in their intensity can still be problematic for vulnerable populations when they persist over a long period.

To enhance this decision-making process, an international team of leading climate scientists, including from ICBA, has developed a new framework for climate risk assessment in different parts of the world.

In a paper published in Earth's Future, they provide a detailed overview of the framework and its uses. Building on initial research presented in Chapter 12 of the IPCC Sixth Assessment Report, the paper details 33 climatic impact-drivers under seven categories. The framework is designed to serve as the basis for future climate change studies and risk analyses.

Mr. Rashyd Zaaboul, a climate modeling scientist at ICBA and co-author of the paper, says: "Our framework focuses on just one type of impact-drivers — those that are directly related to the climate system. These climatic impact-drivers, or CIDs, are physical climate conditions that directly affect society or ecosystems."

CIDs may represent a long-term average condition (such as the average winter temperatures that affect indoor heating requirements), a common event (such as an early frost that kills off plants), or an extreme event (such as a coastal flood that destroys homes). A CID may be detrimental for one part of society while benefiting another, or not affecting yet another at all.

CIDs capture important characteristics of the average climate and both common and extreme events that shape society and nature.

The framework will help to ensure that a comprehensive set of climatic conditions informs adaptation planning and risk management and may also help prioritize improvements in modeling sectoral dynamics that depend on climatic conditions.


ICBA
AGRICULTURE FOR TOMORROW
Human activity has altered nearly
75%
of Earth's surface.

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

Today biodiversity is declining faster than at any other time in human history. It is under serious threat as a result of human activities. Alas, the world is falling short of meeting its targets to halt biodiversity loss. Around 1 million animal and plant species face the risk of extinction*.

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 decreased and threats to crop diversity are growing. 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.

* United Nations. (n.d.). Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss. https://www.un.org/sustainabledevelopment/biodiversity/

Supporting sustainable urban landscaping in UAE

As fresh water is a scarce resource not only in the UAE but across the Middle East and North Africa region, it is important to tap into the potential of alternative sources of irrigation, such as salt water and treated wastewater, for landscaping and other purposes. This will help to reduce pressure on freshwater resources and maximize their use for agriculture and other sectors.

Part of ICBA's mandate is to promote crops and technologies that make the best use of saline water for different needs. So, the center's scientists worked with specialists at the Abu Dhabi City Municipality to create a model of garden which utilizes saline water and halophytic, or salt-loving, and salt-tolerant plants for landscaping.

As part of this work, they completed the first phase of a project to establish a new sustainable garden for halophytic and salt-tolerant plants at Al Shahama, the emirate of Abu Dhabi.

H.E. Eng. Salem Sultan Almemari, Acting Director General of the Abu Dhabi City Municipality, says: "We are pleased to announce the success of the first phase of the botanical garden for halophytic plants in Al-Sader Area of Al Shahama. The results of this phase are promising and there is potential for adopting this approach and experience to increase the number of pioneering environmental projects."

Under this collaboration, ICBA provided technical assistance and recommendations on best practices in irrigation, drainage, and cropping. The center also shared a list of halophytic and salt-tolerant plants and supplied seed of some from its genebank for cultivation.

Currently, a number of halophytic and salt-tolerant plants, including Salicornia, Atriplex, tamarind, mangrove, are grown at the garden. The garden was built using recycled and upcycled materials. ICBA and the Abu Dhabi City Municipality had worked on the project since 2021.

It is hoped that the garden will serve as a blueprint for other landscaping projects in arid and coastal environments.

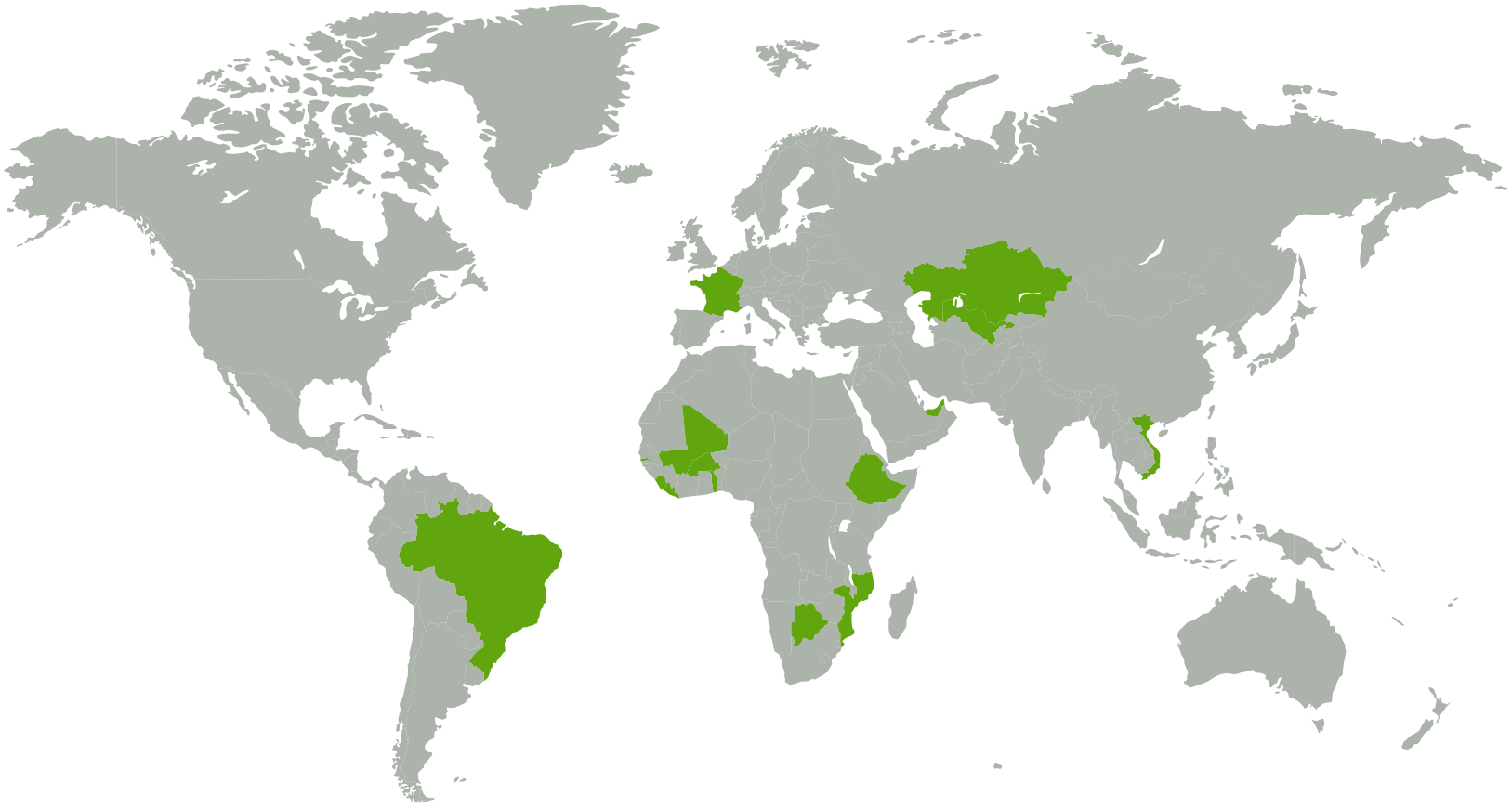
The garden is a result of a year-long collaboration between scientists from ICBA and specialists from the Abu Dhabi City Municipality.

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 2022 the center provided 312 seed samples belonging to 22 different crops to various stakeholders in 16 countries.



Partnerships of every kind must be at the heart of the Sustainable Development Goals.

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

Today's global problems call for global actions. All countries must come and work together to resolve the great challenges ranging from climate change to ecosystem degradation.

Goodwill and cooperation among nations is crucial for the fight against common threats. National, regional, and international organizations also must combine their efforts and support governments.

Collaboration at every level is key to achieving the Sustainable Development Goals.

Youth and women empowerment took center stage during many of ICBA's sessions at COP27.

Partnering for global climate action

As climate change continues to be at the top of the global agenda, it is important to mobilize efforts, raise ambitions, and create partnerships at all levels to accelerate climate action.

But this requires continuous exchange of knowledge, critical review of progress, effective collaboration, and increased investment in climate adaptation and mitigation. And the Conference of the Parties, or COP, serves as a crucial platform for facilitating this process. Every year nations convene to set ambitions and responsibilities and identify and assess climate measures.

As a global research-for-development center, ICBA also takes an active part in this process through various initiatives. In 2022 the center implemented a comprehensive plan of activities and engagements to contribute to COP27's program in Sharm el-Sheikh, Egypt.

ICBA organized and participated in 15 sessions, attended by around 600 delegates, to showcase its research and development work in different parts of the world.

Dr. Tarifa Alzaabi, Director General of ICBA, says: "As an international forum, COP27 was a great opportunity to present ICBA's research and development work to a diverse audience. We were proud to showcase our initiatives in various areas and form partnerships with different organizations. We look forward to building on this achievement in the run-up to COP28 in the UAE."

ICBA hosted and contributed to the sessions jointly with eight organizations, including the Food and Agriculture Organization of the United Nations, the International Atomic Energy Agency, and the Islamic Development Bank.

Joining forces to support soil conservation in UAE

In 2022 ICBA signed a memorandum of understanding with the Conscious Planet Movement to Save Soil (Conscious Planet) to collaborate in efforts to protect agricultural soil in the UAE.

The agreement was signed by Prof. Khaled Amiri, a member of ICBA's Board of Directors, and Sadhguru, a global visionary and founder of Conscious Planet, in the presence of H.E. Mariam bint Mohammed Almheiri, Minister of Climate Change and Environment of the UAE.

Under the agreement, ICBA and Conscious Planet will join forces to raise public awareness about the importance of soil conservation, empower stakeholders, provide training, and facilitate knowledge exchange. The organizations will also support each other's relevant initiatives.

Sadhguru says: "It is not the rain that brings greenery, it is the greenery that begets rain. Wherever there is sunlight, with a bit of effort, we can turn the land around into living and productive soils. The UAE, with its visionary and determined leadership, can and should make this possible. Looking forward to this exciting and far-reaching collaboration."

ICBA has extensively worked with various partners in sustainable natural resources management, soil management and rehabilitation locally and globally. In the UAE, the center completed the mapping and classification of the UAE's soils according to the World Reference Base in 2020 and conducted a major soil survey in 2006-2009 and follow-up studies to collect soil data, which is showcased at the Emirates Soil Museum.

Conscious Planet is a global campaign to inspire a conscious approach to saving the world's soil. Its aim is to activate the support of over 3.5 billion people and assist governments in formulating policies that will address soil health and make farming activity more soil-friendly to halt and reverse further soil degradation.

The agreement between ICBA and Conscious Planet envisages collaboration in different areas related to soil conservation.

ICBA creates and shares knowledge that empowers smallholder farmers.

Knowledge sharing

One of the main outputs of ICBA's work is knowledge. The center is committed to generating and sharing this knowledge with all stakeholders from smallholder farmers to policymakers. ICBA disseminates science-based knowledge by means of capacity development, knowledge hubs, and communications.


ICBA

Capacity development and knowledge transfer is an integral part of ICBA's work in the UAE.

Extending knowhow to farmers and agri-businesses in UAE

In 2022 ICBA hosted an open day for more than 20 agri-business owners, farmers, and extension specialists from across the UAE.

The event was organized in collaboration with the Ministry of Climate Change and Environment of the UAE and the Abu Dhabi Agriculture and Food Safety Authority on the initiative of H.E. Mariam bint Mohammed Almheiri, Minister of Climate Change and Environment of the UAE.

During the event, scientists presented a wide range of sustainable technologies and climate-resilient crops adapted to local conditions. The program also featured a tailor-made training workshop on water-energy-food nexus innovations and a tour of ICBA's research experiments and facilities.

Dr. Charbel Tarraf, Chief Operations and Development at ICBA, says: "ICBA is committed to supporting national efforts on sustainable agriculture and food security by sharing its experience and knowhow and developing the capacities of local stakeholders, and particularly farmers. Our scientists have accumulated a vast amount of knowledge and data based on extensive research studies in local conditions and are always keen to provide technical expertise and assistance and thus contribute to the adoption of solutions for sustainable agricultural development."

The participants learned about some of the latest technologies suited to the environmental conditions of the UAE. They also visited various experiments, including the longest-running study in the country to assess the long-term impact of different levels of irrigation water salinity on the growth and production of 18 date palm varieties from Saudi Arabia and the UAE.

They were also introduced to salt-tolerant forages adapted to the local environment; diverse and nutritious crops like millets that can grow under varying salinity and irrigation conditions; resource-efficient controlled-environment agriculture technologies; and the integrated agri-aquaculture systems that make it possible to grow fish, vegetables, and halophytic plants such as Salicornia in a circular and sustainable way.

Raising awareness about desert farming

As the curtain came down on the Expo 2020 Dubai, a World Expo hosted by Dubai, the UAE, from 1 October 2021 to 31 March 2022, The Desert Farm in the Expo 2020 Dubai's Sustainability District had recorded 226,379 visits.

ICBA contributed to the design, installation, and operation of The Desert Farm as part of its collaboration with the Expo 2020 Dubai.

Over the six-month period, the center hosted a wide range of visitors at the installation from different countries. They included ministers, ambassadors, representatives of various international organizations, families and students from universities, colleges, and schools.

Managed by a team of scientists and specialists from ICBA, the installation is a proof-of-concept circular agriculture model that showcased innovations for food, feed, energy, and water security in desert environments.

Dr. Dionysia Angeliki Lyra, a halophyte agronomist at ICBA, says: "The Desert Farm served as a one-of-its-kind platform to demonstrate ICBA's research and development work over the past two decades and its efforts to develop and introduce resource-efficient crops and technologies suited for areas that face the problems of water scarcity, salinity, heat and drought, among others."

In particular, the installation showed how to make better use of the resources available in deserts – the sun, the sand, and the sea (saline water and reject brine) - to grow fish and highly resilient crops for food and feed such as quinoa, Salicornia, and blue panicum.

Overall, the purpose was to promote use of alternative sources of water like reject brine from desalination in agriculture and highlight the importance of diversifying agrifood systems and diets by growing nutritious food crops that are better suited to local conditions.

The Desert Farm is a result of many years of research and development work under ICBA's program on integrated agri-aquaculture systems and incorporates a number of tailor-made solutions for desert environments.

Based on the principle of circular agriculture, The Desert Farm is a proof-of-concept model of an integrated agri-aquaculture system.

ICBA
E-learning
Platform

Water Resources and Irrigation Management Systems in Arid Regions

E-learning makes it possible to reach more people in more countries.

Harnessing e-learning to develop capacities globally

With widespread access to the Internet and digital technologies around the world, e-learning has become an effective form of education. Its convenience and user-friendliness make it an ideal choice for more and more learners.

As ICBA gives priority to knowledge transfer, the center works to expand the reach and range of its capacity development offerings aimed at equipping farmers, extension specialists, researchers, and young people, among others, with skills, resources, and tools to innovate and deal with various agricultural challenges.

This rationale also informed the center's decision to launch its own e-learning platform in 2022 to provide specialized courses in agriculture accredited by the Continuing Professional Development Certification Service, the UK.

The platform features both advanced courses for professionals and specialists and intermediate ones for students and beginners on various topics. It also gives access to courses designed in collaboration with the e-learning Academy of the Food and Agriculture Organization of the United Nations.

Developed with support from donors and partners, including the Environment Agency - Abu Dhabi, the courses are self-paced and include presentations, videos, quizzes, and reading materials. The courses offer comprehensive curricula covering the latest techniques and strategies in land management, biosaline agriculture, the impact of climate change on arid regions and irrigation management, among others.

Dr. Charbel Tarraf, Chief Operations and Development at ICBA, says: "We pay special attention to developing the capacities of different stakeholders around the world – from farmers to researchers — to support sustainable agricultural development. With the launch of this platform, we are aiming to provide access to ICBA's extensive knowledge and expertise to a larger number of people."

With four courses available in 2022, over 200 course completions had been registered by the end of the year. The learners from 38 countries, including Australia, Egypt, Kenya, Morocco, Nigeria, Pakistan, Tunisia, and the UAE, completed one or more courses, with women making up 23 percent.

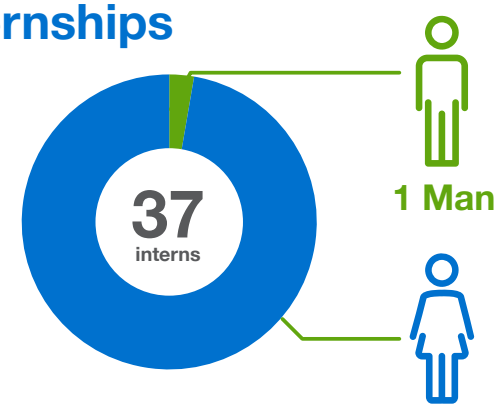
Building on this success, the center will continue developing new courses and diversifying topics to cater to the needs of all stakeholders.

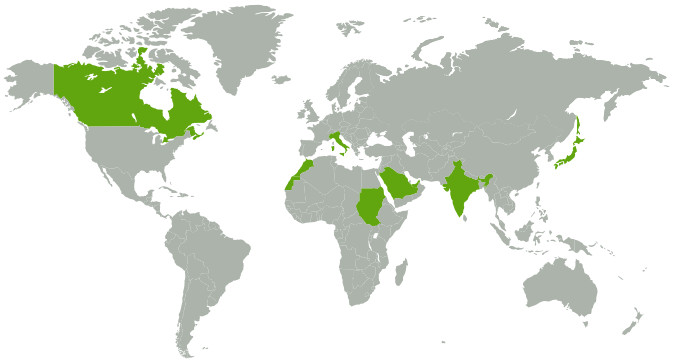
Developing capacities

Capacity development is an integral part of ICBA's work. In 2022 the center focused considerable efforts and resources on catering to the capacity development needs of different stakeholders.

ICBA continued to work on enhancing 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.

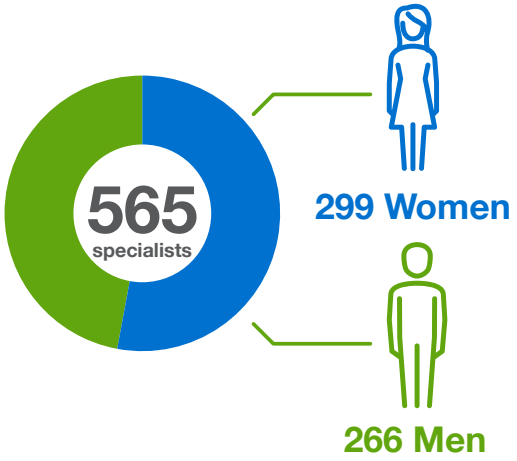
Internships

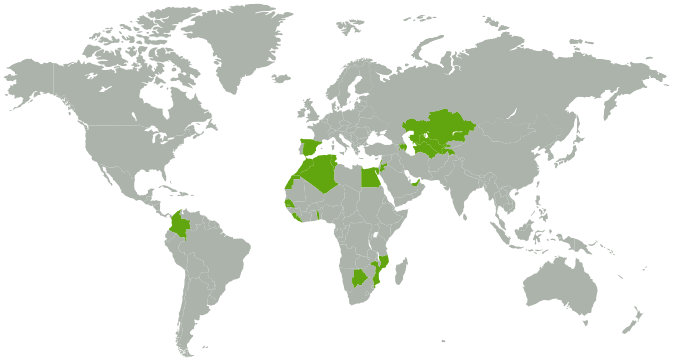




University students from eight countries

Technical training courses





18 special technical training courses, online and in-person, for participants from 21 countries

E-learning courses

ICBA's e-learning statistics for 2022

4
Courses

770
Users

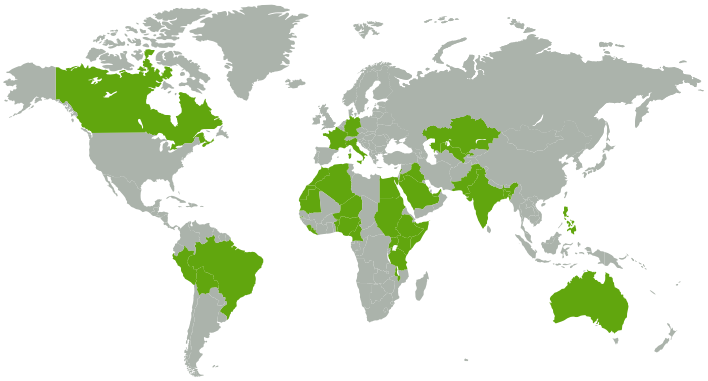
214
Completions*

165
Male

49
Female

* Managed to complete a course and received ICBA's e-certificate

Beneficiaries of ICBA's e-learning courses from 38 countries



Communicating science-based knowledge

ICBA continued to communicate its science-based knowledge and research and development work to different audiences through the news media, its website, and social media channels.

410
media mentions

158,998
website sessions

40,870
YouTube views

Knowledge products


ICBA
AGRICULTURE FOR TOMORROW
United Arab Emirates Keys to Soil Taxonomy
Science, Policy and Politics of Modern Agricultural System
WATER CONSERVATION STRATEGY
2010
THE UNITED ARAB EMIRATES
FAWZI M KARIM & ABDULLAH J DAKHEEL
Developments in Soil Classification, Land Use Planning and Policy Implications

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 2022 our scientists produced a total of 68 research publications.

Peer-reviewed journals

Published

1. Aboelsoud, H. M., AbdelRahman, M. A. E., **Kheir, A. M. S.**, Eid, M. S. M., **Ammar. K. A.**, Khalifa, T. H. & Scopa, A. (2022). Quantitative Estimation of Saline-Soil Amelioration Using Remote-Sensing Indices in Arid Land for Better Management. Land, 11 (1041). Doi: https://doi.org/10.3390/land11071041 (IF: 3.905)

2. Ahmed, M., Hayat, R., Ahmad. M., Ul Hassan, M., **Kheir, A. M. S.**, Ul Hassan, F., Ur Rehman, M. H., Shaheen, F. A., Ali Raza, M. & Ahmad, Sh. (2022). Impact of Climate Change on Dryland Agricultural Systems: A Review of Current Status, Potentials, and Further Work Need. International Journal of Plant Production. Doi: https://doi.org/10.1007/s42106-022-00197-1 (IF: 2.017)

3. Alia, S., Tyagia, A., Mushtaq, M., **Mahmoudi, H.** & Bae, H. (2022). Deciphering the Plant Microbiome to Improve Drought Tolerance: Mechanisms and Perspectives. Environmental and Experimental Botany, 22 (00155-1). (IF: 5.545)

4. Al Tamimi, M., Green, S., **Hammami, Z., Ammar, K. A,** Al Ketbi, M., Al-Shrouf, A.M., Dawoud, M., Kennedy, L. & Clothier, B. (2022). Evapotranspiration and crop coefficients using lysimeter measurements for food crops in the hyper-arid United Arab Emirates. Agricultural Water Management. 272 (2022: 107826). Doi: https://doi.org/10.1016/j.agwat.2022.107826 (IF: 4.516)

5. Alia, S., Tyagia, A., Mushtaq, M., **Mahmoudi, H**. & Bae, H. (2022). Harnessing plant microbiome for mitigating arsenic toxicity in sustainable agriculture. Environmental Pollution, 300 (2022: 118940). Doi: https://doi.org/10.1016/j.envpol.2022.118940 (IF: 9.988)

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7. **Ammar, K. A., Kheir, A. M. S.** & Makinas, I. (2022). Agricultural big data and methods and models for food security analysis – A mini-review. PeerJ, 10 (2022: e13674). Doi: 10.7717/peerj.13674 (IF: 3.061)

8. **Attia, A., Qureshi, S. A.**, Kane, A. M., **Alikhanov, B., Kheir, A. M. S.**, Ullah, H., Datta, A. & Samasse, K. (2022). Selection of potential sites for promoting small-scale irrigation across Mali using remote sensing and GIS. Sustainability, 14 (12040). Doi: doi.org/10.3390/su141912040 (IF: 3.885)

9. Ayadi, S., Jallouli, S., Chamekh, Z., Zouari, I., Landi, S., **Hammami, Z.**, Ben Azaiez, F. E., Baraket, M., Esposito, S. & Trifa, Y. (2022). Variation of Grain Yield, Grain Protein Content and Nitrogen Use Efficiency Components under Different Nitrogen Rates in Mediterranean Durum Wheat Genotypes. Agriculture, 12 (916). Doi: https://doi.org/10.3390/agriculture12070916 (IF: 5.37)

10. Ayadi, S., Jallouli, S., Chamekh, Z., Zouari, I., Landi, S., **Hammami, Z.**, Ben Azaiz, F. E., Baraket, M., Esposito, S. & Trifa, Y. (2022). Comparative effects of Nitrogen supply on Nitrogen-Use-Efficiency in Tunisian durum wheat under field conditions. Agriculture, 12 (2022). Doi: https://doi.org/10.3390/xxxxx (IF: 5.37)

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14. Bekraoui, A., Chakir, S., Fatnassi, H., Mouqallid, M. & Majdoubi, H. (2022). Climate Behaviour and Plant Heat Activity of a Citrus Tunnel Greenhouse: A Computational Fluid Dynamic Study. AgriEngineering, 4 (4), pp. 1095-1115. Doi: https://doi.org/10.3390/agriengineering4040068 (IF: 1.63)

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20. Ihoume, I., Tadili, R., Arbaoui, N., Bazgaou, A., Idrissi, A., Benchrifa, M. & **Fatnassi, H.** (2022). Performance study of a sustainable solar heating system based on a copper coil water to air heat exchanger for greenhouse heating. Solar Energy, 232 (2022), pp. 128-138. Doi: https://doi.org/10.1016/j.solener.2021.12.064 (IF: 5.742)

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27. **Lyra, D.-A.**, Raman, A., Hozayen, A., **Zaaboul, R.**, Abou-Zaid, F.-O., **El-Naggar, A.**, Mansoor, S., **Mahmoudi, H. & Ammar, K.** (2022). Evaluation of Salicornia bigelovii Germplasm for Food Use in Egypt and the United Arab Emirates Based on Agronomic Traits and Nutritional Composition. Plants, 11 (2653). Doi: https://doi.org/10.3390/plants11192653 (IF: 3.899)

28. Namozov, F., Islamov, S., Atabaev, M., Allanov, K., **Karimov, A., Khaitov, B.** & Park, K. W. (2022). Agronomic Performance of Soybean with Bradyrhizobium Inoculation in Double-Cropped Farming. Agriculture, 12 (6). (IF: 3.5)

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39. Tabatabaei, I., Alseekh, S., **Shahid, M.**, Leniak, E., Wagner, M., **Mahmoudi, H.**, **Thushar, S.**, Fernie, A. R., Murphy, K. M., Schmöckel, S., Tester, M., Mueller-Roeber, B., Skirycz, A. & Balazadeh, S. (2022). The diversity of quinoa morphological traits and seed metabolic composition. Scientific Data Nature, 323. Doi: https://doi.org/10.1038/s41597-022-01399-y. (IF: 6.444)

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Accepted

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48. Bazgaou, A., **Fatnassi, H.,** Bouharroud, R., Tiskatine, R., Wifaya, A., Demrati, H., Bammou, Aharoune, A. & Bouirden, L. (2022). CFD modeling of the microclimate in a greenhouse using a rock-bed thermal storage heating system. Horticulturae. (IF: 2.923) (In press)

49. **Fatnassi, H.,** Bournet, P. E., Boulard, T., Roy, Molina-Aiz, F. D. & **Zaaboul, R.** (2022). Use of Computational Fluid Dynamic tools to model the coupling of plant canopy activity and climate in greenhouses and closed plant growth systems: a review. Biosystems Engineering. (IF: 5.002) (In press)

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2. Bergaoui, K., Belhaj Fraj, M., Fragaszy, S-R., Ghanem, A., Al-Karablieh, E., Al-Bakri, J., Fakih, M., Fayyad, A., Comair, F., Arrach, R., Yessef, M., Arsenault, K., Peters-Lidard, C., Kumar, S., Hazra, A., **Zaaboul, R.,** Nie, W., Hayes, M., Svoboda, M. & McDonnell, R. (2022). Development of a Composite Drought Indicator for operational drought monitoring in the MENA region. Bulletin of the American Meteorological Society. (IF: 8.766) (In press)

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4. El-Sonbaty, A. E., **El-Naggar, A. H.,** Farouk, S. & El-Gamal, S. M. A. (2022). Enhancement of Rose-scented geranium plant growth, secondary metabolites, and essential oil components through the foliar applications of iron in alkaline soils. Frontiers in Plant Science. (IF: 5.753) (In press)

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9. **Fatnassi, H., Zaaboul, R., Elbattay, A.,** Molina-Aiz, F. D. & Valera, D. L. (2022). Protected agriculture systems in the UAE: challenges and opportunities. Acta Horticulturae. (IF: 0.257) (In press)

10. Houmani, H., Ellouzi, H., Abdelly, Ch., Debez, A. & **Mahmoudi, H.** (2022). The potential of seed nutri-priming to mitigate emerging global issues, emphasizing COVID-19 and climate change. Scientia Horticulturae. (IF: 3.463) (In press)

11. Molina-Aiz, F. D., Honore, M., **Fatnassi, H.,** Valera, D. L., López-Martínez, A. & Moreno-Teruel, M. A. (2022). Experimental and numerical assessment of carbon sequestration in horticultural crops inside Mediterranean naturally ventilated greenhouses. Acta Horticulturae. (IF: 0.257) (In press)

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Book chapters

Published

1. Ali, E., Abu El-Eyuoon, A. M., Yang, X., Yousaf, B., **El-Naggar, A. H.,** Yanjiang, C. & Chang, S. X. (2022). Biochar for remediation of alkaline soils contaminated with toxic elements. In: Daniel, C. W. & Tsang, Y. S. O. (eds). Biochar in Agriculture for Achieving Sustainable Development Goals. Academic Press. https://doi.org/10.1016/B978-0-323-85343-9.00029-X.

2. Ali, E., Abu El-Eyuoon, A.M., Yang, X., Yousaf, B., **El-Naggar, A. H.,** Yanjiang C. & Chang, S.X. (2022). Potential of Biochar to Immobilize Vanadium in Contaminated Soils. In: Rinklebe, J. (eds). Vanadium in Soils and Plants (1st ed.). CRC Press. https://doi.org/10.1201/9781003173274

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Supporters and contributors

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- Bill and Melinda Gates Foundation
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- Earth Link and Advanced Resources Development
- Emirates Nature - WWF
- Environment Agency - Abu Dhabi
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- Hydrorock International
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- National Oil and Gas Authority of Bahrain
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- Food and Agriculture Organization of the United Nations
- Institute of International Education
- University of Wollongong in Dubai

Financials

Statement of financial position

	As of 31 December	
	2022	2021
Assets	**USD'000**	**USD'000**
Non-current assets		
Property and equipment	2,939	3,684
Right-of-use assets	17	24
	2,956	3,708
Current assets		
Inventories	40	46
Accounts and other receivables	619	607
Deposits	19,068	17,706
Cash and bank balances	6,803	3,961
	26,530	22,320
Total Assets	**29,486**	**26,028**
Equity and Liabilities		
Equity		
Reserves – Designated	15,397	15,397
Reserves – Undesignated	5,382	4,840
Total Equity	**20,779**	**20,237**
Non-current liabilities		
Provision for employees' end of service benefits	768	656
Deferred income	2,160	673
Lease liabilities	-	4
	2,928	**1,333**
Current liabilities		
Accounts and other payables	2,829	2,847
Deferred income	2,931	1,589
Lease liabilities	19	22
	5,779	**4,458**
Total Liabilities	**8,707**	**5,791**
Total Equity and Liabilities	**29,486**	**26,028**

Statement of activities and other comprehensive income

	Year ended 31 December	
	2022	2021
	USD'000	USD'000
Grants income	9,584	9,730
Other income	57	22
Operating expenses		
Research and collaborator expenses	-7,147	7,255-
Administrative and general expenses	-2,188	-1,698
Operating surplus for the year	**306**	**799**
Finance income – net	236	164
Surplus for the year	**542**	**963**
Other comprehensive income	-	-
Total comprehensive income for the year	**542**	**963**

Board of directors

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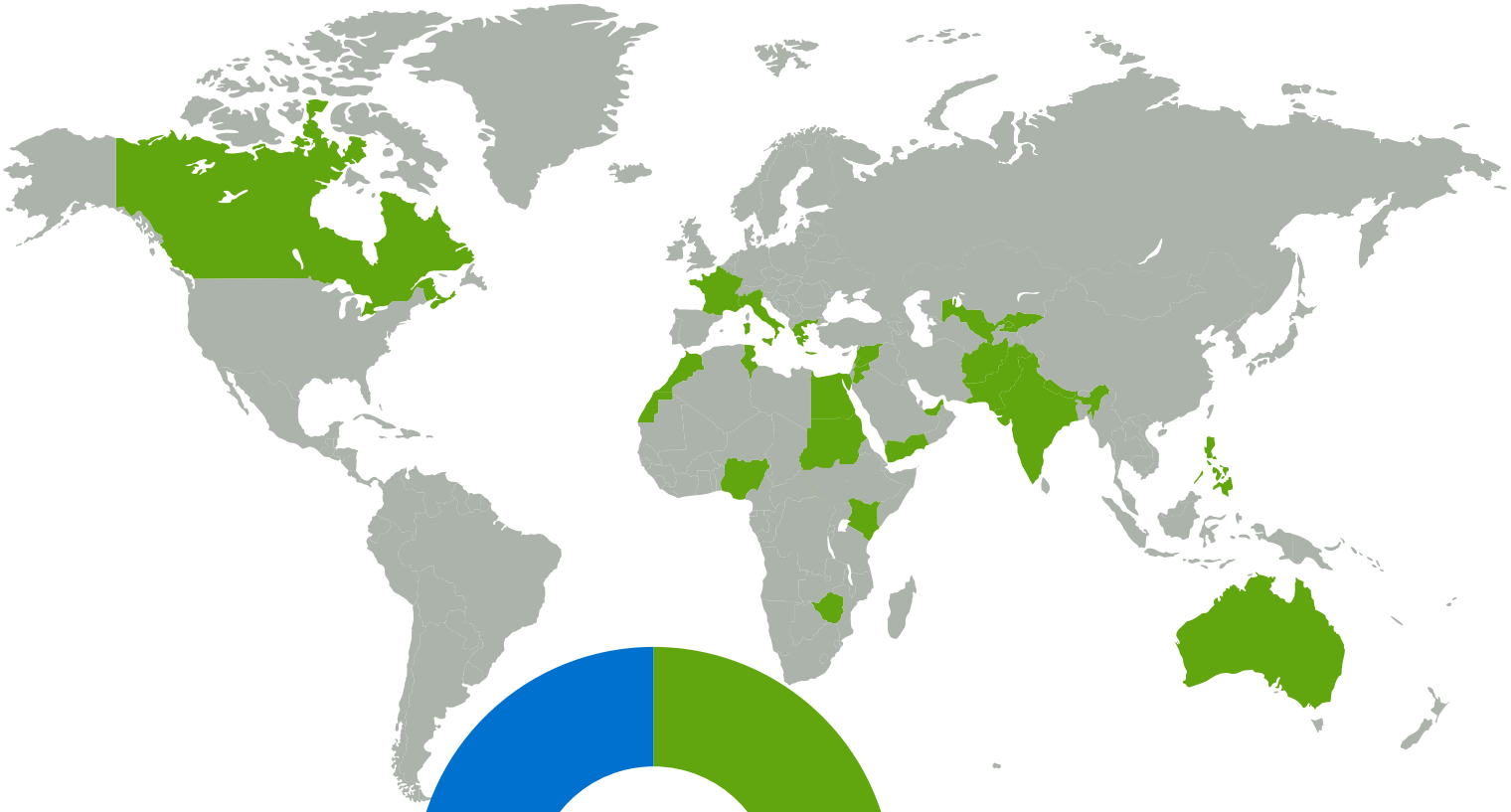

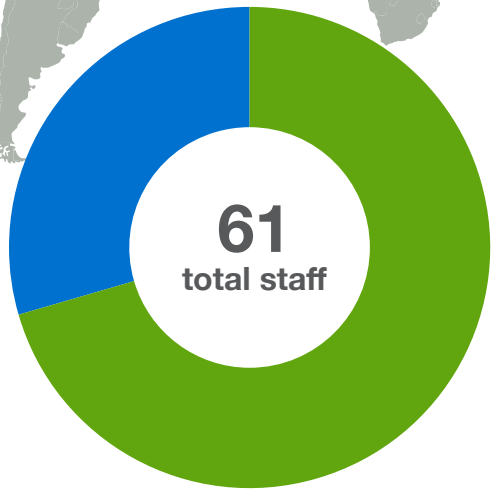

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25

countries

18

women

43

men

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ICBA
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INTERNATIONAL CENTER FOR BIOSALINE AGRICULTURE

Agriculture for tomorrow

ICBA Headquarters
Al Ruwayyah 2, Academic City
P.O. Box 14660, Dubai
United Arab Emirates
Email: icba@biosaline.org.ae
Phone: +971 4 304 63 00

ICBA Central Asia and South Caucasus
6 Osiyo Street, P.O. Box 4375
Tashkent, 100083
Uzbekistan
Email: a.karimov@biosaline.org.ae
Phone: +998 71 237 21 69

www.biosaline.org

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