

# Innovative Agriculture in Saline and Marginal Environments

ICBA Capacity Building Offerings



Developing and sharing credible, high-quality scientific knowledge is central to ICBA's work as it pursues its mission to work in partnership with various stakeholders to deliver agriculture and water scarcity solutions in marginal environments.

WELCOME TO

# ICBA'S CAPACITY BUILDING OFFERINGS

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## Introduction

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

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

Improving the generation and dissemination of knowledge is an important strategic objective and we are focusing on developing ICBA as a knowledge hub on sustainable management and use of marginal resources for agricultural production in marginal and saline environments. With the help of its partners, ICBA innovates, builds human capital, and encourages the learning that is fundamental to change.

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

## Our Mission

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

## Our Vision

To be the global Center of Excellence for innovative agriculture in saline and marginal environments



*The role of women in innovative agricultural research programs is gaining recognition in the Middle East and North Africa. An increasing number of regional leaders are calling for creating a cadre of competent women scientists who can later develop and assume leading roles, thus improving the dynamism and credibility of agricultural research.*

*To address this need, ICBA is planning to launch a fellowship program for Arab women scientists, promoting both leadership and technical skills within the region. Young Arab women scientists will be selected and offered the necessary capacity building support they need until they become proficient in generating innovation that rural stakeholders need in marginal environments.*

## Capacity building overview

Capacity building is central to ICBA's activities and spans geographical domains, research areas and methods. We believe that improving our skills as well as those of our partners and stakeholders is key to addressing the challenges affecting agriculture in marginal and saline environments.

### Our capacity building initiatives include:

- Post-doctoral, doctoral and masters research
- Training courses
- Farmers' field schools
- Internships
- Knowledge hub
- Soil museum

ICBA's capacity building opportunities are open to an array of audiences that can benefit from the expertise of the Center's international team of experts in soil, crop, water, policy and socio-economic research, as well as the various modern research and training facilities.

Our 100-hectare Center includes an experimental farm; central analytical, molecular biology, and plant genetic resources laboratories equipped with state-of-the-art equipment; nurseries and greenhouses equipped with modern irrigation systems; and a genebank that holds more than 12,000 accessions belonging to about 220 species of salt-tolerant plants from around 130 countries around the world. ICBA's soil museum is divided into various sections, each serving a specific function. It showcases landscapes and soil diversity; soils and environment; soils and climate change; and soils and desertification. The museum is used as a comprehensive facility for training purposes.

**We have interactive offerings with time allocated for discussion and hands-on-training in laboratories and fields.**

## Post-doctoral, doctoral and masters research

In 2013, ICBA started a post-doctoral program that ranges from one to two years in the fields of water and land management; crop diversification and genetics, and climate change modeling and adaptation. Post-graduate studies and research opportunities in the same areas of research are also available.

By working with ICBA scientists, post-doctoral and post-graduate fellows will have an opportunity to conduct field and laboratory research that is a pre-requisite for publishing papers in peer reviewed journals and completing their theses.

We help our post-doctoral fellows and masters students to:

- Design experiments
- Monitor field and laboratory research
- Analyze data

*“My research at ICBA broadened my scientific horizons on agriculture practiced in marginal environments. I have experienced the implementation of experiments with practical value for the farmers”*

*Dr. Dionyssia Angelika Lyra  
Post-Doc Fellow, Greece*



*ICBA also develops customized training modules for various projects that need support and specialized training in the thematic areas supported by ICBA. These offerings can be in English, Arabic, or the local language of the country hosting the project. In the past, ICBA has delivered training in French and Russian.*

## Training courses

Our workshops and training courses are open to a diverse range of audiences from different countries and backgrounds. Since its establishment in 1999, ICBA's training programs have built the capacity of more than 1,650 participants from 70 different countries. Depending on the needs and requirements of our partners and trainees, we deliver our training at ICBA headquarters or elsewhere within the UAE or abroad in collaboration with local partners. So far, we have supported carrying out training programs in 15 different countries.

ICBA offers standard and tailored training courses under the following thematic areas:

- Managing water and irrigation systems
- Land degradation and soil management in marginal environments
- Biosaline agriculture technologies
- Plant biodiversity
- Plant biotechnology
- Environmental impact assessments
- GIS technologies and modeling
- Policy and socio-economic analysis
- Strategies to adapt to climate change in marginal environments

Each thematic area includes different training modules that can be adapted from highly specialized offerings to experts, practitioners, and decision makers to modules targeted towards end users such as technicians, extension agents, farmers and rural families (men and women) involved in agricultural activities.

## Theme 1: Managing water and irrigation systems

Increasing water demand and decreasing water quality has put enormous pressure on agriculture to reduce its share of water consumption through the adoption of improved water management practices. In the water scarce environments, the challenge is to increase productivity of agricultural water use without compromising on crop yields and developing soil salinization. Therefore better management of land and water resources is a key to sustainable agricultural production and to ensure future food security for the rising population.

Two modules are available under this thematic area, each include a mix of lectures, hands-on training, field visits and practical assignments.

### Module 1: Water and soil management for salinity control – 3 days

The participants will learn about new ways of managing water in agriculture to control soil salinity and improve agricultural production. The module will also explain soil-water-plant relationships and their role in soil salinization. By the end of the course, they will be able to:

- Understand different irrigation management techniques
- Learn how salt-affected soils develop
- Recognize properties of saline, sodic and saline-sodic soils
- Describe appropriate management plans for prevention and reclamation of salt-affected soils

### Module 2: Estimation of crop water requirements – 3 days

Despite water shortages in the region, application of excessive irrigation amounts is very common. The attendees of this module will be given comprehensive training on the estimation of crop water requirements and the irrigation methods to improve water conservation. By the end of this training, participants will be able to:

- Learn different techniques to estimate crop water requirements
- Understand different irrigation techniques for water conservation
- Understand the benefits and weaknesses of different irrigation methods
- Learn irrigation demand management

### Who should attend?

Agronomists, irrigation engineers, extension workers, irrigation students of M.Sc. courses from research institutes, universities, NGOs, companies and others involved in the management of land and water resources. This course is particularly important for university students who are trying to write their M.Sc. theses in the field of irrigation/water management.

## Theme 2: Land degradation and soil management in marginal environments

Land degradation is a global problem related to agriculture use and affects large areas and many people in dryland regions. The major causes include land clearance, deforestation, depletion of soil nutrients through poor farming practices, overgrazing, inappropriate irrigation, soil contamination, and dumping of non-biodegradable materials. Soil salinization is a main cause of land degradation and understanding the principles and methods of soil salinity assessment, mapping and management is important for planning agricultural development in marginal lands.

### Module 3: Soil salinity management – 3 days

This module will address the salinity development processes, establish the cause-effect relationship, and develop appropriate methods of constraint/stress alleviation, soil restoration and quality enhancement through an integrated soil reclamation approach. Participants will learn about soil salinity assessment and management essential for optimum crop production in saline environments and by the end of the training course will be able to:

- Understand soil salinity at farm and landscape levels
- Develop soil salinity and sodicity assessment program
- Learn about different methods of soil salinity diagnostics and monitoring
- Analyze soil salinity and sodicity in the laboratory
- Understand soil salinity and sodicity reclamation program
- Publish soil salinity maps

### Module 4: Combating land degradation in marginal areas – 3 days (Advanced module)

The module will provide knowledge to understand the dynamics of the biophysical processes and causes leading to land degradation as well as to design rapid methods to assess certain land degradation problems at the farm and national levels. Moreover, it will help to:

- Understand biophysical processes and causes leading to land degradation
- Explore ecosystem and soil goods and services
- Understand the process that lead to salinity of irrigated land
- Perform field assessment of secondary salinity
- Analyze soil parameters in laboratory
- Practice the interpretation of results

### Who should attend?

Students of natural and environmental sciences, researchers, extension workers, professionals, irrigation engineers, and agricultural technicians.

*“It was very informative; I learned new things specifically about salinity which is a new problem in my country”*

*Charlotte Ooro, Kenya*



### Theme 3: Biosaline agriculture technologies

Traditional agriculture is not any more productive and feasible in marginal areas. It is very important to find new technologies to best use the marginal areas. However, it is very critical to understand biosaline agriculture technologies practices to avoid reverse impact on land and water resources.

#### Module 5: Biosaline agriculture in marginal environments – 5 days

In this basic module, participants will learn the principles of soil, water and cropping systems, and understand the concepts of biosaline agriculture. This module is a prerequisite to modules 1, 2, 3, 14 or 15. At the end of the training participants will be able to:

- Manage salinity and crop production in marginal areas
- Use alternative crops for salt-affected areas
- Assess and manage irrigation-induced soil salinity
- Determine plant nutrition and fertilizers management for improving plant performance
- Manage marginal water resources
- Select best irrigation management practices for saline and arid environments

#### Who should attend?

Researchers, extension workers, professionals, irrigation engineers, and those interested in salinity issues at the farm and landscape levels.

### Theme 4: Plant biodiversity

Plant genetic resources are an important component of agricultural biodiversity. They are the sources of rare genetic traits needed to cope with biotic stresses (insects and diseases) and environmental stresses (salinity, water scarcity, heat) that are becoming serious constraints to agricultural production. Efficient conservation and sustainable use of these resources are key to ensuring food and nutrition security, now and in the future.

Two modules are available under this thematic area, each includes a mix of lectures, field visits and practical hands-on sessions:

#### Module 6: Good practices for *ex situ* conservation – 3 days

By attending this module participants will learn how to employ the most appropriate technologies and procedures for the collection, conservation and documentation of crop diversity. By the end of the course, they will be able to:

- Understand the different techniques for collecting samples
- Perform the labeling and processing required for storage
- Monitor for viability and genetic integrity
- Appreciate the strategies for multiplication of samples for conservation and distribution; and documentation

#### Module 7: Sustainable utilization of genetic diversity – 3 days

By attending this module participants will learn how to make use of genetic resources in all relevant production systems to achieve sustainable development and poverty eradication. They will also learn about using genetic diversity for adaptation to the effects of climate change. By the end of the course, they will be able to:

- Study genetic diversity using morphological and molecular characterization
- Evaluate for tolerance to abiotic stresses (e.g. salinity)
- Understand the techniques to improve productivity making use of available genetic diversity
- Learn about documentation and information management

#### Who should attend?

Genetic resources professionals – including researchers, educationists and germplasm curators – employed by ministries, research institutes, universities, companies, and NGOs.



## Theme 5: Plant biotechnology

Plant biotechnology research on molecular genetic basis of salinity tolerance in different crops tends to be a critical component in agricultural research. This module will enable participants to identify, isolate and analyze various levels of gene regulation and to generate new salt-tolerant varieties either through molecular breeding (marker assisted selection) or genetic engineering technologies.

### Module 8: Principles of plant biotechnology – 4 days

This module will introduce participants to the principles of genetic engineering by using agrobacterium-mediated transformation and molecular markers used for diversity screening and breeding for salinity tolerance. At the end of the course, participants will be able to:

- Understand how plant biotechnology can tackle the problem of salinity in agriculture
- Assess genetic engineering using Agrobacterium-mediated transformation
- Do GMO detection and biosafety issues
- Apply molecular markers for diversity screening and breeding for salinity tolerance
- Perform experiments on Agrobacterium mediated transformation.
- Do DNA and RNA isolation, cDNA synthesis and RT-PCR analysis, cloning steps, and others

### Who should attend?

Junior researchers, post-graduate students and technicians.

*“Biotechnology from gene discovery to plants for the future”*

*Dr. Khaled Masmoudi, Tunisia*



## Theme 6: Environmental impact assessments

The theme will introduce the aims, principles and methods of the Environmental Impact Assessment (EIA). This could provide basic skills to conduct a pre- and post project EIA to identify possible environmental implications as a result of project activities. This will help modify the plans and the designs to avoid or at least minimize the adverse affects and increase potential benefits. The EIA thus ensures environmental scrutiny throughout the project and post project activities.

### Module 9: Environmental impact assessment in marginal areas – 3 days

Participants in this course will learn about the principles, procedures and benefits of environmental impact assessment needed for the sustainable implementation of projects' activities. At the end of the training course, participants will be able to:

- Understand the rational of EIA
- Learn different methods of EIA
- Conduct pre- and post project EIA
- Compile the EIA results
- Prepare EIA report

### Who should attend?

Researchers, environmentalists, natural resources scientists, policy makers and those interested in environmental issues are potential stakeholders of this module.



***Bridging the information gap for agricultural development in marginal environments***



## Theme 7: GIS technologies and modeling

Remote sensing is the acquisition of information about Earth from space. It is used to collect data and monitor the environment where it replaces the costly and slow data collection on the ground, in dangerous and inaccessible areas through analyzing the reflected and emitted radiation. The module aims at introducing the theories underlying this science and train attendees on using the different applications and satellite datasets in environmental and natural resources analysis to have a complete database over time on different fields such as agriculture, hydrology, forestry, cartography, geology, soil, and meteorology.

### Module 10: Introduction to remote sensing – 2 days

This module introduces participants to the basics of remote sensing, characteristics of remote sensors, and remote sensing applications in academic disciplines and professional industries. Emphasis is placed on image acquisition and data collection in the electromagnetic spectrum and data sets. Upon completion, participants will be able to:

- Understand remote sensing and explain its applications and history
- Understand sensors and image acquisition methods
- Realize remote sensing purposes, advantages, and limitations
- Visualize the characteristics of remote sensing imagery
- Differentiate between the numerous satellite datasets available

### Module 11: Satellite image classification and mapping – 3 days

This module aims at defining image classification using the quantitative spectral information contained in an image, which is related to the composition of the target surface. Image analysis will be performed on multispectral imagery. It requires an understanding of the way materials and objects of interest on the earth's surface absorb, reflect, and emit radiation in the visible, near infrared, and thermal portions of the electromagnetic spectrum. Upon completion, participants will be able to:

- Understand the difference between spectral and spatial resolution
- Differentiate between the different approaches of classification
- Apply supervised and unsupervised classification
- Understand field data requirements
- Assess image classification accuracy
- Apply mapping tools (GIS tools) to produce a final output map

### Who should attend?

Young engineers with natural science background who are interested in imagery analysis and remote sensing applications.



## Theme 8: Policy and socio-economic analysis

This theme recognizes the breadth and complexity of water and food security policy and provides four specific areas of focus. First, introduce basic concepts about policy and discuss the major ideas framing policy making and practice at local, national and international levels. This sets the scene for consideration of approaches and practical experiences of water and food security policy processes and outcomes. The public policy development process is then explored through with special reference to case study examples of domestic and agricultural water services in the Middle East. Water policy in a larger context is considered in terms of balancing food, energy and domestic water requirements as well as conserving the environment and promoting societal progress.

### Module 12: Water and food security policy concepts – 3 days

This module will consider the nature of water and food policy and the instruments involved in moving ideas into practice. Cases from urban and rural settings will be given to highlight policy in action. At the end of the course, participants will learn how to:

- Explore the ideas that have developed to explain policy development process ranging from problem identification and agenda setting to ideas development and evaluation
- Assess water utility with examples from the Middle East and North Africa region
- Consider the dynamics of policy making and change
- Examine the economics of policy ideas

### Module 13: Socio-economic impact and assessments – 3 days

Agricultural development, especially in rural areas, is measured through direct and indirect impact on the livelihood of rural families. This module will enable participants to:

- Perform socio-economic studies and impact assessments
- Understand research and data collection methods
- Develop data collection instruments
- Perform survey planning, implementation and monitoring
- Process data, analysis and reporting

### Who should attend?

Decision-makers and socio-economic experts.

## Theme 9: Strategies to adapt to climate change in marginal environments

Adaptation to climate change becomes very critical to mitigate the unfavorable drops in water resources and hence, agricultural productivity. Countries in marginal environments have to develop proper strategies to adapt to climate change. Modules under this theme will present technical innovations related to functional diversification, crop modeling, and crop management optimization under salinity and water limited conditions.

### Module 14: Field management in marginal environments – 3 days

Participants will learn methods and tools for developing on-farm cropping systems and optimization options under marginal conditions. They will also learn about the integrated management of land and water resources in marginal environments for optimum crop production. At the end of this module participants will be able to:

- Understand the integrated approaches to crop/livestock production under marginal conditions
- Manage non-conventional forage crops: resources, production and propagation
- Differentiate between major crop and forage production systems
- Select best irrigation management for water productivity of field crops

### Module 15: Climate change adaptation strategies – 5 days

Participants in this course will learn about principles of climate change adaptation strategies through the utilization of alternative crops and marginal resources. By the end of this course, participants will learn how to:

- Understand climate change and potential for biosaline agriculture
- Manage plant production systems under highly saline conditions
- Link climate change and plant biodiversity
- Develop integrated reclamation strategies of marginal lands for adaptation to climate change
- Develop adaptation strategies to mitigate impacts of climate change on water resources

### Who should attend?

Participants from various background: engineering, research, technicians and extension staff of national agricultural research systems, outreach, private sector (operating technicians) and planners (mid-level policymakers).

*“Many elements that were discussed during this training would be great solutions in tackling the water shortages and the decreasing quality of the available water resources”*

*Mohammed Ahmed Ismail Alyamani, UAE*



**“With farmers’ field school, I learned how to manage my land”**

*Jamal Al Khouli, Egypt*

## Farmers’ field schools

Farmers’ field schools are very effective in reaching out to extension agents, farmers and rural families. Even illiterate farmers can benefit from these schools that focus on an active participatory approach. Through these field schools, farmers and extension staff become active partners as they are involved throughout the life of ongoing trials from the identification of productive cultivars, to application of appropriate crop management practices, and the evaluation of production constraints. Along this process all involved are engaged in a direct and detailed knowledge exchange accompanied by targeted skills building activities.

ICBA has successfully initiated such schools in a number of countries and through them developed local capacity in various agricultural production techniques ranging from on-farm forage processing, full utilization and value addition to the farm products, best practices in seed production and crop management.

### Available training modules (1-2 days each)

- Introduction to biosaline agriculture
- Food and feed crops production and management
- Integrated crop/livestock production systems
- Feed blocks processing and utilization
- Livestock managements
- Dairy production at farm level
- Post-harvest technologies
- Best management practices for reusing of treated wastewater

**“Farmers’ field school can be a real vehicle of change that enhances food and nutritional security across marginal environments.”**

## Internships

Internships enable students and new graduates to acquire hands-on skills and job knowledge that will equip them with a better understanding of their field of study and prepare them for the job market. At ICBA, interns get to implement the theoretical and methodological tools acquired during the course of their study. Internship opportunities can be found in the Research & Innovation Division, Partnerships and Knowledge Management Division, as well as in the Corporate Services Division.

ICBA internship opportunities are arranged through formal channels with universities and are available throughout the year. They range in duration from 1 to 2 weeks (short-term) and 1 to 6 months (long-term).



## Knowledge hub

In the digital world of today, online knowledge hubs are ensuring that as many people as possible have open access to research findings and practical advice. Knowledge hubs are effective in fostering communities of practice as they bring together and link people with similar knowledge and needs, and provide them with a vehicle that facilitates knowledge and technology exchange across networks of researchers, government and communities. Within these virtual knowledge hubs, shared knowledge is stored and disseminated.

As part of ICBA's current strategy, the Center is working on launching much needed knowledge hubs that serve the needs of marginal environments and smallholders farmers living off these uncompromising lands. Our vision is that by 2020, we will have established the following knowledge hubs:

- **Biosaline Agriculture** - a one-stop shop for information and open discussions on the various halophytes, and salt-tolerant varieties of popular crops
- **MAWRED** - a data and training hub that provides insight on water, crop production, climate change and droughts in the Middle East and North Africa (MENA) region
- **Wastewater Reuse** - a regional platform that facilitates sharing of results, information, lessons learned, and best practices on wastewater reuse in the MENA region

Our Knowledge Hubs will utilize the latest digital technologies to enable virtual meetings, workshops, conferences, webinars, e-forums, and the establishment of a knowledge repository that will contain open learning materials and information.

*ICBA will strive to become a knowledge hub for problems and solutions relating to saline environments.*

*Strategy 2013-2023*





## Soil museum

With the rising global threat of food security, the importance of soil in agriculture and how soil responds to changing environments is crucial, especially in marginal environments such as the United Arab Emirates (UAE) where sandy soils cover close to 75% of the country's terrain.

Located at ICBA headquarters in Dubai Academic City, the museum is divided into various sections that showcase landscapes and soil diversity; soils and environment; soils and climate change; and soils and desertification. The museum includes a school outreach program designed to build knowledge and understanding among future generations on the principles of soil and its role in producing the food needed to feed the planet.

Initially the museum displays will focus on the UAE, but the vision is expand it to display the soils of all Gulf Cooperation Council (GCC) countries and later the remaining Arab countries.

**ICBA's soil museum aims to create awareness about what happens underground, how soil is changing over time, and what impacts there are on future food production.**

## Upcoming

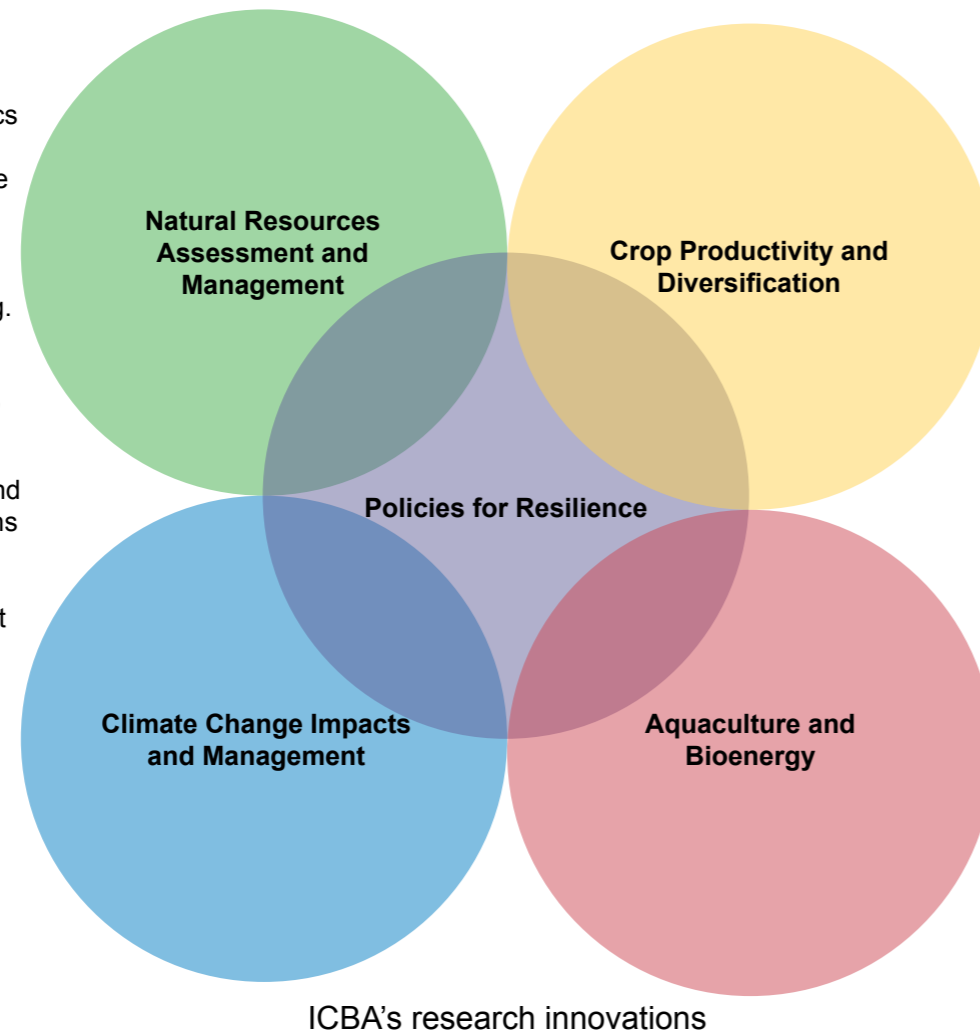
In our continuous strive to become the global center of excellence for innovative agricultural solutions in saline and marginal environments for attaining food and water security, we are continuously seeking new approaches and tools to develop and better serve our stakeholders.

Improving the generation and dissemination of knowledge related to our core themes is a strategic objective of ICBA as we believe it will result in increased food and nutritional security, improved water security, and more resilient environment and income in the marginal environments we target.

ICBA is currently working on designing and setting up two major capacity building initiatives that we believe are much needed by the stakeholders in marginal and saline environments, particularly in the Middle East and North Africa Region.

**E-learning:** ICBA is looking to develop a whole set of online modules that cover critical topics under the various thematic themes we work on. This will be developed based on identified stakeholders needs, targeting those that cannot bear the cost of structured classroom training. Our vision is to have these courses available in several languages so it is accessible to a wider range of audiences.

**Certification programs:** ICBA and a few similar sister organizations are exploring the opportunity of devising comprehensive certification programs that meet the needs and requirements of professionals and decision-makers working on food, nutrition and water security issues.



*In the coming years ICBA will focus on increased dialogue with partners and stakeholders to identify capacity-building needs, mutual interests, and opportunities for collaboration. It will also strive to encourage national ownership in research for development capacity-building interventions.*



## ABOUT ICBA

International Center for Biosaline Agriculture - ICBA is an international, non-profit organization that aims to strengthen agricultural productivity in marginal and saline environments through identifying, testing and facilitating access to sustainable solutions for food, nutrition and income security.

**For more information on ICBA capacity building programs and activities, please contact us at:**

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