

How to Manage MENA Drylands in a Warning Climate:

Think Global, Act Local

Global Drylands





Figure 1. Geographical distribution of dryland types based on the aridity index (AI). Source: within Mirzabaev, A. *et al.* 2019. Desertification. https://doi.org/10.1017/9781009157988.005

Why Do Dry Areas Matter? **VICARDA**



Science for resilient livelihoods in dry areas



The Drylands



Rainfed Farming

Water efficient & drought-resistant innovations reducing dependency on uncertain rainfall.

Desert Farming

More-per-drop' crops/livestock approaches in a no-rain environment

We LIN

Agrosilvopastoral farming

Rainwater harvesting, integrating crops, agroforestry, and livestock

Irrigated Farming

All-season diversified cropping with land management, green energy, and water management

Dry areas expanding





ICARDA Decentralization







Salt-affected areas in the World

- Globally, over 833 million ha area is affected by soil salinity and sodicity, which is 8.7% of the total land area.
- This value may grow significantly in the coming years, exacerbated by climate change and unsustainable agricultural production practices.
- The map currently covers 73% of the global land area.



Faster, widespread, intensifying



ACCELERATED WARMING

Climate simulations predict that global warming will rise exponentially if emissions go unchecked





onature

thought

nature

ENVIRONMENT

Climate change is hitting the planet

faster than scientists originally



A Major Report Warns Climate Change Is Accelerating And Humans Must Cut **Emissions** Now

August 9, 2021 · 4:00 AM ET

The New Hork Times

Climate Change Is Accelerating, Bringing World 'Dangerously Close' to Irreversible Change

Challenges in the Drylands

Conflicts and Fragility

High unemployment, unrest and migration

High Population

Demographic change, gender inequality

Urbanization and heat islands

Water Scarcity

High water scarcity and low efficiency Malnutrition

Food and nutrition insecurity

Land Degradation

Land degradation and desertification

Loss of Biodiversity

Loss of agrobiodiversity

Climate change

Double impact of climate change; increasing temperature and reducing precipitation

The perfect storm

AGRI-INNOVATION FOR RESILIENCE





- A powerful offer of the combined expertise, capacity and global science resources of Drylands CGIAR Research Centers
- Collaborating for a systematic and collective strategic deployment of pioneering agri-science across global drylands
- Prioritizing the interests and needs of our partners
 www.cgiar.org

IWM

POTATO CENTER

International Water Management Institute



ILRI

Transforming African Agriculture

INTERNATIONAL LIVESTOCK RESEARCH



The Global Dryland Strategy





- Create Climate-Optimized Farming and Diversified Agrifood Systems
- Conserve and utilize Biodiversity for Community and Ecosystem Resilience
- Manage Soil, Land, and Water Systems for Sustainable Production
- Ensure Access to Sustainable, Diverse, and Healthy Diets to Alleviate Hunger and Malnutrition.
- Translate Evidence-based Approaches into Policy for Development

1. Create Climate-Optimized Farming and Diversified Agrifood Systems

Dryland communities are on the frontline of climate change.

Our focus:

- Design climate-smart dryland farming systems for productivity and resilience.
- Diversify crops and livestock to bolster farm-level resilience.
- Prioritize breeding of crucial dryland crops and forages.
- Support optimal climate adaptation in livestock and aquaculture.
- Develop climate-resilient livestock feed technologies.

2. Conserve and Use Biodiversity for Community and Ecosystem Resilience





Dryland biodiversity for ecosystem health, resilience in agrifood systems, and combatting desertification.

Focus areas:

- Promote diverse and resilient forage and crop varieties tailored to local needs.
- Incentivize biodiversity conservation via value chain investments and supportive policies.
- Encourage agroforestry practices for soil stabilization, water regulation, and other benefits.

3. Manage Soil, Land and Water Systems for Sustainable Production





Managing natural capital sustainably for dryland agrifood systems' resilience

Focus areas:

- Promote conservation agriculture (CA) with diversified crops, drought-tolerant varieties, and water-efficient techniques, tailored to local conditions.
- Enhance sustainable water management for increased productivity, especially during scarcity.
- Improve soil health through conservation and regenerative practices, including land restoration.

4. Ensure Access to Sustainable, Diverse and Healthy Diets to Alleviate Hunger and Malnutrition



Access to nutritious food in drylands is crucial for children's development, particularly during the critical first 1,000 days of life. Focus areas:

- Promote diverse, nutrient-dense crops and animal-sourced foods.
- Encourage dietary shifts through education, market interventions, and policy incentives, with a focus on pregnant and lactating women and infants.
- Support agribusiness entrepreneurship in the private sector to develop healthy food products for both rural and urban consumers.
- Partner with humanitarian agencies to promote nutrient-rich foods and genetic innovations for resilience against climate change and other risks.

5. Translate Evidence-based Approaches into Policy for Development





Drive transformation in drylands, translating research into policy is key at all levels.

Focus areas:

- Co-design inclusive policies and innovations with partners for sustainable development, including land tenure and resource governance.
- Conduct local policy dialogues to mitigate resource conflicts.
- Generate evidence for informed decision-making, enhancing technology adoption.
- Establish equitable agrifood systems for all stakeholders, prioritizing marginalized groups.

CLIMATE-SMART CROPS





ICARDA plays a critical role in the conservation, development, improvement, and dissemination of climate-resilient, market-driven crop varieties that provide a crucial defence against extreme temperatures, water scarcity, the emergence of new pests and diseases, and nutritional insecurity.

Over the past four decades, ICARDA's improved cereal and legume varieties have been tested and released by national programs in partnership with ICARDA and adopted by farmers worldwide, generating net benefits of approximately US\$850 million each year.



Improving crops adapted to Target environment - Dry area ICARDA



Potential

312

02

CGIAR - ICARDA GENEBANKS



ICARDA's genebank system works alongside global networks to collect, conserve, and develop vital genetic resources to protect agrobiodiversity in dry regions.

ICARDA's dry region genebank system was established in 1985 in Syria. It now rests in two genebanks in Morocco and Lebanon and contains around 150,000 samples of major winter cereals, food legumes, forage, and rangeland species drawn from four major Vavilovian centers of plant diversity.

The collection is safety duplicated in genebanks around the world incldue the Svalbard Vault in Norway.

ICARDA's Genebank Collection





January 2012: ICARDA's Collection in Aleppo ~142,000 accs.

Safe duplication of the Collection at the SGSV





September 2015: Retrieval of the Collection

29th September 2016: Inauguration of ICARDA's Genebank facilities at Lebanon





September 2016: first samples deposited in ICARDA's Genebank facilities at Morocco



18th May 2022: Inauguration of new ICARDA's Genebank facilities at Morocco

Modernization of breeding



Use of speed breeding, genomic selection, data tools, and physiology

- It is widening the gap between CGIAR and NARES
- Need to train for success





Sustainable intensification (CWANA)

Established: G x E x M Experimentation in all countries



Crop Diversification: resilience and diversify the farm income

Supported soybean- mission of Egypt government



Explored crop diversification option: Morocco Egypt: Crops: Sorghum, millet, mungbean, maize, soybean, quinoa, forages



Climate smart mechanization & its value chain

1.Raised bed planters: >100,000 ha under mechanized raised beds in Egypt & expanding other countries, Sudan, Syria

2. Low-cost No-till seeder: supporting for 1 M hectare CA in Morocco



"The machine is amazing! It's so easy to use and works really well. As a farmer, it's a gamechanger for me. Not only does it make my work more efficient, but it also helps me save on seeds and fertilizers." - Tharwat Mohamed AbelAziz, Farmer

Supplemental irrigation over 1 M ha Morocco can reduce wheat imports by 35% in drought year

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European Journal of Agronor

Grinhan Prand Devkota, Mina Devkota , Rachirl Mountailek, Vinay Naugia

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European Journal of Agronour

tana Deviana *¹, Krishna Prand Deviana ', Mohammed Karrou ', Huny Nangia ''

Integrated food, land, water and energy systems for climate resilient landscapes



Water Reuse Cost Benefit Analysis Methodology / MA



Water Accounting + Dashboard MA – Sous Masa Watershed



LEBANON Terbol Research





JORDAN

MOU with MoA in Jordan signed on October 27th 1977. In 1989, ICARDA initiated the West Asia Regional Program Office in Amman to coordinate bilateral and regional activities. Major research activities:

- Conservation of genetic resources and crop improvement
- Small ruminants' production and introduction of spineless cactus as a feed and food crop.
- Natural resource management: rangelands rehabilitation, grazing management, irrigation, water management and harvesting, dairy value chains and pollinators diversity
- Social and economic policy, capacity development, big data, and ICT tools.



Spineless cactus Field Gene Bank



Recently Completed Projects (Donor)

- Food Security Project (AFESD)
- Pollinator Diversity Project (BMU)
- ET Project (SIDA/FAO)
- WFP Feasibility Study

ON-Going & NEW Projects (Donor)

- Watershed Rehab in Badia (USFS/USDA)
- SOILS4MED Project (PRIMA)
- Water Scarcity Project (FAO/NL)

Scaling digital innovations for Climate Resilient Agricultural Chains

Chains



Egypt



Raised bed irrigation

 Long-standing Partnership (began in 1979 through the Nile Valley Project, in conjunction with Sudan to deliver solutions for enhancing livelihoods and food security)

• Strategic Hub in Regional Program (Egypt plays a pivotal role in ICARDA's decentralization strategy and serves as a thematic research location for sustainable intensification in irrigated systems).

Financial Collaboration (Egypt is a contributing member of CGIAR due to its collaboration with ICARDA)

The Challenge

vs irrigation

Water scarcity in Egypt has crossed the threshold value of 1,000 m³/capita/year. Considering the population predictions for 2025, Egypt will be down to absolute scarcity level of 500 m³/capita/yr. This will further exaggerate the problems associated with water allocation for agriculture. The challenge in Egypt is how to produce more food with less water resources.

Flat bed irrigation



INDIA - FOOD LEGUMES RESEARCH PLATFORM

Major Objectives

- Represent ICARDA in South Asia and China to promote research for development activities
- Accelerating the development of climateresilient germplasm of legumes and cereals
- Application of precision agriculture and climate-smart approaches for site-specific advisories
- Promoting spineless cactus as 5F crop for improving livelihood of small-scale farmers
- Delivering genetic gain in farmers' fields through demonstration and informal seed systems in rice-fallows
- Capacity development to strengthen research and human capacities



ICARDA IN ARABIAN PENINSULA (APRP)

ICARDA-APRP Office was established in 1997. It is managed by a

regional coordinator with a specialized team

- (i) on-farm water use and irrigation management;
- (ii) rangeland, irrigated forages, and livestock; and
- (iii) protected agriculture

Program Partners

Bahrain: United Arab Emirates: Kuwait:	Ministry of Municipal Affairs and Agriculture Ministry of Climate Change and Environment Public Authority for Agriculture Affairs and Fish Resources
Oman:	Ministry of Agriculture, Fisheries & Water Resources
Qatar:	Ministry of Municipal Affairs and Agriculture
Saudi Arabia:	Ministry of Environment, Water, and Agriculture
Yemen:	Ministry of Agriculture and Irrigation
Current donors:	The Arab Fund for Economic and Social development (AFESD), The Kuwait Fund for Arab Economic Development (KFAED), & the
ww.icarda.org	Gulf Cooperation Council



Oman

Important research and technologies developed, implemented & transferred by the ICARDA-GCC DP project

- Successfully promoted the subsurface irrigation technology showed high potential in water saving and productivity. Successfully tested low-pressure drip irrigation & ultra-low pressure, solar-powered drippers
- Introduced the Eddy Covariance tech for calculating real water requirements & rationing date palm irrigation in KSA, Oman and UAE
- Optimized date Palm Liquid pollination technology and use of drones for pollination of date palms
- o Integrated Pest Management against major date palm pests particularly the Red Palm Weevil
- o Introduced artificial intelligence for monitoring & managing date palm pests (GeoAgro Mpro App)
- o Developed the polycarbonate date drying chambers; widely adopted by date farmers in the GCC
- Developed multi-purpose polycarbonate chambers for drying dates and raising vegetable seedlings
- $\circ~$ Developed the solar operated mobile date dryer
- Studied the diversity of 190 date palm cultivars collected from the GCC countries using 19 SSR primers
- Atlas of the popular date palm varieties in the GCC based on a genetic fingerprint and morphological studies
- Developed and launched an application for calculating the economic feasibility of date palm cultivation projects in the GCC region

In 2021, ICARDA won the prestigious Khalifa International Award for Date Palm and Agricultural Innovation, in the category 'Pioneering Development and Productive Projects.'

Thermal Imaging-based Irrigation





• This approach is based on leaves/air temperature difference (ΔT).

 In Egypt, thermal imaging proved reliability for detecting water stress, instant measurement of leaf relative/soil water content, and precision irrigation in new reclaimed lands.

PATHWAY FOR SCALING APPROPRIATE MECHANIZATION (AM) FOR CWANA







OCD



TUNISIA – ICARDA'S APPROACH FOR CROP-LIVESTOCK INTEGRATION AT FARM AND LANDSCAPE LEVELS IN TUNISIA





Integration

SUDAN HEAT PLATFORM





Seed system support: Sudan

Technologies for African Agricultural Transformation (TAAT)

- 60,000 tons of new heat tolerant bread wheat cultivars seeds produced
- Yield has increased from 2.1 t/ha in 2014 to 3.5 in 2020



Sudan - certified seed production



Sudan – wheat country data







IZMIR RUST CENTER - TURKEY



SYRIA



Objectives of the site:

- Former HQ of ICARDA for 35 years
- Tel Hadya farm is the largest ICARDA operated farm
- Activities in the country financed mainly by Syrian contribution due to sanction by US and EU.
- Rehabilitation of the farm and budlings under way with limited resources by Syrian Government, and it is managed now to reestablish the crop rotation and some seed multiplications.



INTEGRATED DESERT FARMING INNOVATION PROGRAM

A cross center program to address a cross sector issues in transformative and resilient agriculture circularity-based food system



"The Integrated Desert Farming Innovation Platform will improve the use of natural resources such as wind and solar power for a food and nutrition secure region. This event is crucial to discuss and expand on these aspects."

H.E. Mariam bint Mohammed Saeed Hareb Almheiri, Minister of Climate Change and Environment, UAE.



Economic losses







ENHANCING DATE PALM IRRIGATION EFFICIENCY

Synchronized evapotranspiration and water discharge through solar energy-powered ultra-low-pressure drippers in date palm plantation compared to conventional irrigation.



Solar Energy Powered Net-House with Root Zone Cooling Hydroponic System



Benefits

- Extending production until mid-June without quantitative and qualitative yield penalties
- Water productivity reached 37kg/m³ compared to 8 kg/m³ in a cooled greenhouse.
- 14% increase in net return and a 28% reduction in the cost of production
- Saving 6650-kWh electricity, equivalent to 4.7 metric tons of CO₂ sequestration.



64% GHG emission reduction with our Solarpowered Ultra-low Energy Drip Irrigation





Ultra-Low Energy drippers have an activation pressure of 0.15 bar, which require 85% less pressure, 50% less overall system pumping power than existing products and lowers the GHG emissions by 64% compared to diesel pumps and capital cost of a solar-powered drip irrigation system by 42%.



NEXT GENERATION: INTEGRATED DESERT FARMING SYSTEMS





- Agrivoltaics
- Solar desalination using electrodialysis technology
- Solar drip irrigation using ULE drip technology
- Solar hydroponics and root zone cooling

AI PLATFORM FOR DIGITAL EXTENSION SERVICES





ICARDA's flagship GeoAgro Platform can: Forecast weather Do yield gap analysis Forecast probability of disease outbreaks Improve modeling and climate change patterns





Grain yield of wheat under different management system

- Rainfed potential: long-term situation (1985-2022);
- Average yield under conservation agriculture & conventional tillage systems 7 years average (2015-2022)
- National average yield (1985 2022) FAOSTAT





