



*Nile Delta farmers participating in wheat research reaped a bountiful harvest through ICARDA's Water Benchmark Project*

## Agriculture in Egypt

Only a tiny fraction of Egypt's total land area is suitable for agriculture, yet this small area is among the world's most productive agricultural regions. Egypt has a relatively high population growth rate, making both water use and food security key challenges. With a per capita annual availability of water that is one-fifth of the global average, water management is a critical issue.

## A long and fruitful partnership

Egypt-ICARDA ties are marked by an ever growing research partnership that has successfully delivered solutions to improve livelihoods and enhance food security over several decades. ICARDA's partnership with Egypt dates from 1979, when together with Sudan, it launched the Nile Valley Project. Today, Egypt forms the hub of ICARDA's Nile Valley and Red Sea Regional Program, which strategically aligns activities with Sudan, Eritrea, and Yemen. The country is also a key player in ICARDA's new decentralization strategy as a thematic research location for sustainable intensification in irrigated systems, and is a financially-contributing member of the CGIAR as a result of its collaboration with ICARDA.

## Water and land management for greater productivity and sustainability

### *Saving irrigation water for smallholder farmers: raised bed planting*

Raised-bed planting – a practice that involves planting crops on ridges and applying irrigation water to the bottom of furrows – offers an efficient and sustainable alternative to conventional irrigation techniques. ICARDA and Egyptian partners have tested, validated and refined techniques over several years and raised-bed is now being disseminated as part of the ICARDA-managed initiative ‘Enhancing Food Security in Arab Countries.’



*Mechanized raised bed technology, developed by the ICARDA-Egypt partnership is managing water and land productivity in the Nile Delta region and beyond*

In Al-Sharkia, for instance, where the practice was successfully implemented, the area devoted to raised-bed sown wheat increased from 950 hectares (ha) in 2009/2010 to over 40,400 ha in 2016/2017. The initiative’s dissemination model was subsequently incorporated into a nationwide campaign to raise wheat production across 22 governorates. By 2017 the area devoted to raised-bed sown wheat extended across some 125,000 ha – or 10% of the country’s total wheat area. There are now plans to extend it even further – reaching some 25% over the next five years.

Raised-bed activities been funded by a consortium of partners: the Arab Fund for Economic and Social Development (AFESD), the UN’s Food and Agriculture Organization (FAO), the International Fund for Agricultural Development (IFAD), the Kuwait Fund for Arab Economic Development (KFAED), the Government of Egypt, the Islamic Development Bank (IsDB), and the OPEC Fund for International Development (OFID).

### *Improving the livelihoods of women farmers*

*Documenting the experience of rural women builds understanding of the challenges they face – identifying the strategies needed to improve their livelihoods. ICARDA is exploring women’s remuneration, labor conditions, ownership rights, and control over assets and decision-making. The Women Empowerment in Agriculture Index, an international measure to directly capture women’s empowerment and inclusion levels, has been adapted to the Egyptian context. Findings reveal the need for corrective measures in the wage sector to tackle late payments, low wages and a growing gender wage gap; efforts to strengthen women’s role in local organizations; and promising prospects for joint land titles.*

### *Combating salinity and expanding Egypt's New Lands*

ICARDA is working with Egyptian institutes and authorities to improve the productivity of irrigation water through intensification on existing cultivated land. The partnership adopts an integrated approach: identifying institutional and technical barriers to improve water management, introducing low water-use farming methods, and building human and institutional capacity. The work, funded by the Governments of Australia and Egypt, improves understanding of the conditions that lead to salinity, and the links between water management practices and the movement and accumulation of salt. Modeling of the whole central delta is building a clearer picture of how much water can potentially be 'saved' for use in the New Lands.



*Farmers and decision makers come together to expand the use of new technologies*

## Improving crop systems and strengthening food security

### *Enhancing wheat productivity*

Since 2009 the ICARDA-ARC Wheat Improvement Program (WIP) has been working to improve germplasm, enhance crop management and strengthen national capacity. The program has developed resilient crop varieties that offer high yield potential, water-use efficiency, heat tolerance, and resistance to multiple diseases and pests – especially yellow rust and leaf rust. The varieties have brought stable production and higher incomes for farmers.

The program also extends benefits beyond Egypt – making the improved germplasm freely available, through international nurseries, to national wheat breeding programs in partner countries. A rust-resistant variety released in Egypt – Misr1 – was exported to Afghanistan to tackle the threat of stem rust. The Sids Research Station has become a destination for scientists from Central Asia, North Africa, and Sub-Saharan Africa, and wheat cultivars developed there are now reaching 12 African countries through an initiative funded by the African Development Bank, ‘Support to Agricultural Research for Development of Strategic Crops in Africa (SARD-SC).’

### *Biotechnology, ICARDA & AGERI collaboration*

Egypt’s Agricultural Genetic Engineering Research Institute (AGERI) generously donated new facilities to ICARDA scientists after their departure from Aleppo in 2013. A research partnership with AGERI that harnesses biotechnology has made significant contributions towards the development of resilient chickpea, faba bean and wheat varieties. Recent activities have included: the development of two mutant populations in chickpea and faba bean; full genome sequence of chickpea genotyping using next generation technology; and the development of new markers associated with biotic stresses in chickpea, faba bean and wheat – including drought, heat, cold, and salinity. The new facilities donated by AGERI have also provided training opportunities for student researchers – including trainees from Sudan, Morocco, Jordan, and Egypt. Some 18 MSc and PhD students have benefited.

### *Reviving faba bean production*

One of the most successful strategies in the Egypt-ICARDA partnership has been increasing the productivity of faba beans, a crop largely grown by subsistence farmers,

particularly in drought-prone areas. Farmers adopting the recommended faba bean packages of the Nile Valley Project saw their average incomes increase by 173%. In orobanche-infested areas of Middle and Upper Egypt, the adoption of a package of glyphosate treatment and partially resistant varieties – Giza 843 and Misr 3 – brought yield increases of 256 kg/ha; reduced production costs by some 350 USD/ha; and increased net incomes by 550 USD/ha. Recently, ARC and ICARDA have released two additional varieties: Giza 1557, resistant to chocolate spot and recommended for the Nile Delta, and Giza 1813, a short duration variety that is resistant to orobanche and recommended for distribution in Upper Egypt. ICARDA’s faba bean research has been funded by the European Commission, IFAD and the Government of Egypt.

### *Strengthening seed systems*

Replacing traditional varieties used by farmers is often a big challenge, and ICARDA works with Egyptian partners to accelerate seed distribution. In 1999, for instance, in response to an aggressive new strain of stem rust – Ug99 – an ARC-ICARDA initiative, with funding from USAID, combined fast-track rust-resistant wheat release, rapid seed multiplication, demonstrations and popularization efforts, accelerated early generation and certified seed production, and capacity strengthening. The resistant varieties generated yield advantages of 21-25% and net benefits of 39-46% over existing commercial varieties; capacity strengthening benefited 16,000 researchers, extension agents and farmers; and some 19,840 tons of certified rust-resistant and high-yielding seed was distributed – with the potential to cover 11% of Egypt’s wheat area.

The ICARDA initiative ‘Enhancing Food Security in Arab Countries’ built on this success and enhanced smallholder access to certified seed. The result: an increase of 117% in the use of certified seed from the 2010/2011 to 2012/2013 cropping season. Some participating farmers also sold their grain yield as seed to neighboring farmers, generating additional income of 900-1000 USD per ton. Currently, ARC and ICARDA are identifying resilient barley varieties and implementing a decentralized community-based seed production initiative in Marsa Matrouh and North Sinai. Two varieties – Giza 126 and Giza 2000 – have been selected and community seed production initiated in two locations.

## Resilient small ruminant production in a changing climate

With funding from the Government of Egypt and the CGIAR Research Program on Livestock, ICARDA's Small Ruminant Genetics and Genomics team, the Animal Production Research Institute (APRI) and Iowa State University undertook a genetic analysis of sheep and goats indigenous to the drylands to determine how their genetic 'fingerprints' best suit them to be resilient in the face of climate change. The initiative found high genetic diversity but low genetic differentiation between the populations, with at least two genetic backgrounds characterizing the genetic makeup of the two species in Egypt.

Adaptation to hot arid climates was the result of genes that affected muscle function, metabolism, the development and function of the nervous and endocrine systems, thermo-tolerance, body size and development, and autoimmune and inflammatory response and regulation. The study is a promising step towards mining the genetic potential of adaptable indigenous livestock to provide the foundation to breed appropriate small ruminant genetic resources to mitigate against food insecurity and instability in increasingly volatile climate events.

## Developing Egypt's young scientists and national capacity for a stronger agriculture future

Since 1978, over 2000 Egyptian researchers have benefited from ICARDA's comprehensive capacity development program. Capacity strengthening of farmers, extension staff, local scientists, and community workers is also integrated across all research activities and has helped ensure the continued uptake of knowledge and new technologies. Skilled courses have included crop improvement, advanced biotechnology tools, water management, seed production, and the use of GIS application.

## Moving from research to development

The outcomes of the Egypt-ICARDA partnership are being successfully scaled-out for bigger impact through development partners: the improved irrigation system developed under the Irrigated Benchmark Project has been adopted by the East Delta Rural Development Project (financed by IFAD and the World Bank) and the Crop Intensification Project of Middle Egypt (financed by IFAD). In addition, the national extension system is transferring the package to six governorates in Egypt – amounting to substantially higher gains in water savings and improved farmer incomes. The Egypt-ICARDA partnership is also scaling-out new innovations and technologies to other countries for greater benefits across the region.



ICARDA's research programs in Egypt provide training to MSc and PhD students

ICARDA works closely with several key partners in Egypt, including: Agricultural Research Center (ARC), Ministry of Agriculture and Land Reclamation; National Water Research Center (NWRC), Ministry of Water Resources and Irrigation; Ministry of Scientific Research and Technology; Numerous educational and research institutions and colleges of agriculture of several universities; Water users associations; Farmers groups and farmer associations; Government level rural development institutions; Development projects funded by international donors; Private sector.

### Completed and on-going initiatives:

- *Middle East Water and Livelihoods Initiative – Improving livelihoods through sustainable water and land management. Funded by USAID. On-going and finishing in 2017.*
- *Wheat-Legume Cropping System for Smallholder Farmers in West Asia and North Africa – Improving food security in the changing climates of dryland regions. Funded by EU-IFAD. On-going.*
- *Enhancing Food Security in Arab Countries – Increasing the productivity of dryland production systems. Funded by AFESD, KFAED, and IsDB. On-going.*
- *Management of Water and Salinity in the Nile Delta – Improving water management in the Nile Delta. Funded by ACIAR. Completed.*
- *ARC-ICARDA Collaborative Program on Irrigated Wheat-Based System and Small Ruminant-Based System. Funded by Egypt through CGIAR, and ICARDA. On-going.*
- *Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry Areas. Funded by IFAD. On-going.*
- *CLIMED and Dairy: Understanding the traditional milk supply chain functioning in Cairo. Funded by CIRAD. On-going.*
- *Cross-cutting M&E Functions and Knowledge Management for INRM within MENARID. Funded by IFAD. Completed.*
- *Accelerated seed multiplication to counter the threat of stem rust in wheat. Funded by USAID. Completed.*