



# Enhancing Food Security

I N A R A B C O U N T R I E S

—  
A research for development initiative working across ten countries to raise wheat production and reduce the Arab World's growing dependence on costly wheat imports.



# Enhancing Food Security

I N A R A B C O U N T R I E S

---

A research for development initiative working across ten countries to raise wheat production and reduce the Arab World's growing depending on costly wheat imports.

---

PARTNER COUNTRIES

ALGERIA · EGYPT · IRAQ · JORDAN · MOROCCO · PALESTINE  
SUDAN · SYRIA · TUNISIA · YEMEN



# Raising Productivity While Reducing Import Dependence



PARTICIPATING FARMERS HAVE BENEFITED FROM NEW TECHNOLOGIES AND INCREASING WHEAT YIELDS.

***The Arab World needs a rapid solution to its growing dependence on costly wheat imports which expose ordinary people to the fluctuations of global commodity markets and enhance their vulnerability to sudden price hikes.***

The 'Enhancing Food Security in Arab Countries' aims to raise wheat production across ten Arab countries - helping farmers in both irrigated and rainfed production systems to confront multiple production constraints such as natural resource degradation, chronic water scarcity, and variable rainfall.

The initiative adopts an integrated and participatory approach:

- **Disseminating proven techniques and technologies**, using effective extension models – including improved high-yielding and resilient wheat varieties, more efficient irrigation systems, and sustainable agronomic practices.
- **Adaptive research under farmer conditions** to fine-tune new production technologies.
- **Capacity strengthening** for stakeholders – including farmers, researchers, and extension officers.
- **Assessing the impact of disseminated technologies** – improving the delivery and performance of practices and technologies.

Results provide a framework for participating countries and their efforts to raise wheat production and reduce import dependence. Selected results include:

- Average wheat yield increases of 27% and maximum yield increases of 70% were achieved at demonstration sites during the initiative's first phase (2011-2014).
- Average wheat yield increases of 25% and maximum yield increases of 61% were achieved at demonstration sites during the initiative's second phase (2015-2017).
- Wheat yield increases have translated into important economic gains for farmers: analyses conducted during the first phase estimated that an initial investment of 5.3 million USD generated estimated in-pocket gains of 54 million USD for farmers in Egypt, Tunisia and Jordan.
- One technology promoted by the initiative which has subsequently been incorporated into a national wheat campaign in Egypt – mechanized raised-bed – offers significant potential. An assessment examined the sensitivity of research results to several model assumptions – including the elasticity of supply and yield and cost changes – and concluded that benefits would vary between 2 and 6.4 Billion USD over a 15-year period.

#### HIGHLIGHT

*An initial investment of 5.3 million USD generated in-pocket gains of 54 million USD in Egypt, Tunisia and Jordan.*





DISSEMINATION METHODOLOGIES PROMOTE PROVEN PRODUCTION TECHNOLOGIES TO FARMERS

# Enhancing Access to Proven Technologies

*To encourage adoption, the initiative uses innovative and participatory technology transfer strategies adapted to prevailing conditions in participating countries.*

**Mass Dissemination Approach**, applied in Egypt, implementing within a given site the highest possible number of demonstration plots - covering a wide variation of soil types and water management systems. Individual plots are supervised by village-based and government extension agents, and every 8-10 fields are also closely supervised by research teams providing expertise on wheat improvement, pathology, soil science and plant nutrition expertise.

**Leading and Satellite (Clustered) Farmers Approach**, applied in Morocco and Tunisia, selecting progressive farmers to adopt and demonstrate improved wheat production packages on research platforms, and clustering 8-10 satellites farmers around each platform who receive training and advice.

**Multi-tool Dissemination Approach**, applied in Algeria, Jordan, Palestine, Sudan, Syria, Yemen and Iraq, using a limited number of demonstration plots distributed randomly across a given area/site where field days, farmer field schools and workshops are used to demonstrate and popularize advanced practices and technologies.



# Fast-track Seed Distribution

*Participatory seed systems — encouraging farmers to produce their own seed — have enhanced access to resilient varieties. With the right technical and scientific advice they have been able to produce quality seeds adapted to local conditions in record time.*

- Some 679 tons of seed were produced by Jordanian farmers in 2015-2017. Of this, 54% was used by farmers themselves and 33% was sold to the government.
- Four seed production groups were established in Palestine, producing more than 290 tons of certified seed.
- An informal seed network established in Tunisia produced 475 tons of improved wheat seed and 93 tons of improved faba bean seed in 2015-2017. Farmers also benefited from two seed cleaning and treatment units.
- In Sudan, two outstanding farmers successfully initiated a seed production business, becoming a major seed distributor to neighboring areas.
- In Palestine, four “Seed Production Groups” (SPGs) were established and were supplied with 19.5 tons of registered seed of improved durum wheat varieties. During the 2014-2017 period these SPGs produced more than 290 tons of certified seeds.

FAST-TRACK SEED DISTRIBUTION SYSTEMS  
ENHANCE ACCESS TO IMPROVED VARIETIES

HIGHLIGHT

*Some 679 tons of seed were produced by farmers in Jordan from 2015 to 2017*



# Conserving Scarce Water Resources



RAISED-BED PLANTING OFFERS A MORE EFFICIENT ALTERNATIVE TO CONVENTIONAL IRRIGATION SYSTEMS

***More efficient irrigation management is stabilizing wheat production while conserving scarce water resources. Examples include: raised-bed planting, deficit irrigation, drip irrigation, and improved irrigation scheduling.***



## HIGHLIGHT

*In Egypt, during 2013/14 season the project model was used by the national wheat campaign across 1900 demonstration sites in 22 governorates to boost wheat production.*

### Raised-bed planting

This practice involves planting crops on ridges and applying irrigation water to the bottom of furrows where it is most needed. During the initiative's first phase, the practice revolutionized the production of wheat in Egypt's Al-Sharkia governorate where farmers benefited from:

- An average saving of 25% in applied irrigation water.
- An average grain yield increase of 30%.
- An average increase in water use efficiency of 73%.
- Significant reductions in labor and fuel costs.

The technology was subsequently introduced to farmer fields in Al Dakahlia governorate where it achieved a 24% saving in irrigation water, a 23% increase in wheat grain yield, and a 62% increase in water-use efficiency. The result: the raised-bed planted wheat area increased from 2276 ha in 2014/15 to 9274 ha in 2016/2017.

As part of a national drive to increase wheat production, Egypt-ICARDA's raised-bed technology package was also distributed across 1900 demonstration sites in 22 governorates. By 2017 the area devoted to raised-bed sown wheat was estimated to be 125,000 ha – some 10% of Egypt's total wheat area. A recent evaluation predicts that over a 15-year period net benefits could reach 6.4 Billion USD, shared among one million wheat producers.







DRIP IRRIGATION IS ENHANCING  
FARMERS' WATER USE EFFICIENCY

HIGHLIGHT

*In Tunisia, Morocco,  
Sudan and Yemen, drip  
irrigation WUE rates  
surpassed those of  
conventional irrigation  
systems*

### Deficit irrigation

In Morocco, farmers using deficit irrigation experienced a 30% saving in irrigation water while limiting any negative impacts on wheat yields – achieving 7.51 tons per hectare (t/ha) compared to 7.68 t/ha for full supplemental irrigation (average over phase I and II).

There has been a clear trend towards rising yields in recent years: at the Doukkala project site in Morocco, the percentage of clustered farmers producing more than 7 t/ha increased from 0% in 2014/15 to 20% in 2016/17; while those producing less than 5 t/ha decreased from 42% to 14% over the same period. It was a similar story at the Tadla project site where clustered farmers producing more than 7 t/ha increased from 2% to 22%, while those producing less than 5 t/ha decreased from 31% to 8%.

### Drip irrigation

Drip irrigation has helped farmers enhance their water use efficiency (WUE). In Tunisia, drip irrigation out-yielded conventional sprinkler systems – generating an impressive 6.57 t/ha in 2013/14. During the initiative's second phase, participating farmers achieved 17% water savings, 29% yield increases, and a 42% increase in water use efficiency in comparison to sprinkler systems.

The positive results have seen drip irrigation systems extend across Tunisia's wheat-producing regions. At the Kairouan project site, for instance, drip irrigation is now applied across

more than 1550 hectares (ha) – up from just 825 ha in 2013/14.

In Morocco, Sudan and Yemen drip irrigation WUE rates surpassed those of other irrigation systems. In Morocco drip irrigation achieved a WUE of 1.3 kg/m<sup>3</sup> whereas basin and raised-bed systems achieved only 1.05 Kg/m<sup>3</sup> and 0.93 Kgm<sup>3</sup>, respectively. A similar pattern emerged during Phase II: research trials recorded a 1.44 kg/m<sup>3</sup> WUE for drip irrigation, 1.26 kg/m<sup>3</sup> for basin irrigation and 1.29 kg/m<sup>3</sup> for raised-bed systems.

In Sudan the average WUE for drip irrigation tested during Phase I was 0.62 Kg/m<sup>3</sup>, compared to 0.41 and 0.27 kg/m<sup>3</sup> for sprinkler and surface irrigation systems, and in Yemen WUE rates were almost double those of surface irrigation, generating wheat yields that were 18% higher.

### Irrigation scheduling

Short Messaging Service (SMS) technology has been adopted to help improve irrigation scheduling and save water - informing farmers when they should apply irrigation water for optimal gains and savings. Combining irrigation scheduling with water balance methods and SMS tools was particularly successful in Tunisia. Farmers adopting this package experienced yields that were 27% higher than those of farmers who did not adopt the technology - 6.28 t/ha versus 4.94 t/ha (an average over Phase II).

■



# Maximizing Gains From Rainfed Production



CONSERVATION AGRICULTURE HAS IMPROVED SOIL FERTILITY AND REDUCED COSTS

*Overcoming the production constraints presented by marginal dryland areas requires a practical and cost-effective approach that combines proven agronomic practices – including conservation agriculture, planting rates, fertilization, weed control, composting, and crop rotation.*

### Conservation agriculture

Conservation agriculture – the practice of minimizing soil disturbance, maintaining soil cover and rotating crops – is a proven technique that improves soil fertility and eliminates the efforts and costs associated with plowing.

During the initiative’s first phase conservation agriculture was applied in Jordan, Morocco and Syria where average yield increases were 16%, 19% and over 50%, respectively. Impressive results were repeated during the second phase: average yield increases were 9% in Jordan, 23% in Palestine, 50% in Morocco, and 15% in Syria.

### Optimal planting

Yields responded positively to reductions in the rate of planting: a reduced rate of 30-40% was applied in Syria, 25-50% in Morocco, and 20-25% in Yemen. Experimenting with the planting date also proved to be beneficial. In Jordan, for instance, shifting the date of planting from mid-November to mid-December raised yields from 2.14 to 2.22 t/ha on average.

### Weed control

Adopting herbicides has helped alleviate the negative effect of weeds – which can substantially reduce yields. In Jordan, the introduction of herbicides raised wheat yields by 44% in 2015-2017, and in Tunisia their application helped control the highly noxious ray grass, generating a 58% increase in wheat yields.

### Fertilization

The application of non-chemical fertilizers brought further success. In Palestine, due to the non-availability of chemical fertilizers

and a general shift towards organic farming and sustainability, compost fertilizers were introduced. A combination of potato by-products, cow manure, hay, tree branches and green plants, the compost helped farmers achieve 8% more grain yield, 11% more straw yield and reduced the costs of production.

Adopting an integrated approach to fertilization in Tunisia based on soil analysis and targeted yield levels also increased wheat yields by some 33% over conventional practices.

### H I G H L I G H T

*Organic compost helped Palestinian farmers achieve 8% more grain yield and 11% more straw yield*

### Crop rotation

Food legumes such as faba bean have been promoted as a part of improved production packages promoted under wheat-based systems. In Morocco, on average, the productivity of faba bean increased seven-fold from 0.25 t/ha to 1.88 t/ha (average of 2010/11 and 2012/13). In Tunisia, the introduction of improved production package for faba bean gave a 40% yield increase - results were 2.12 t/ha for the improved package and only 1.51 t/ha for conventional farmer practices and varieties.



# Achieving Long-Term Impact



THE YOUNG AGRICULTURAL SCIENTIST PROGRAM STRENGTHENS THE CAPACITY OF EARLY CAREER SCIENTISTS

*Training and knowledge-sharing opportunities equip farmers, researchers and extension officers with the expertise they need to enhance wheat-based agricultural systems. Almost 85,000 people have benefited since the project was initiated. At the national level capacity development efforts have included trainings, field days, farmer field schools, and workshops; at the regional level several knowledge-sharing events were organized to promote interaction among countries.*



## HIGHLIGHT

*Since 2011, almost  
85,000 people  
have benefited from  
capacity strengthening  
opportunities*

**Initiatives have included:**

- Regional travelling workshops organized in Egypt and Tunisia attended by farmers, extension agents and national coordinators enhanced interactions and information-sharing among participants in different countries.
- Cross-country visits of scientists and extension agents have provided valuable new learning on the application of agronomic techniques, improved varieties, and dissemination strategies.
- Regional workshops have targeted improved value chain analysis, enhanced innovation platforms, socio-economics and strategies to reduce food wastage.
- International seed exchanges have enhanced the development of improved higher-yielding and resilient crop varieties.

**Investing in the future**

Strengthening the capacity of young scientists helps achieve long-lasting impact. A 'Young Agricultural Scientist Program (YASP)' has provided training for some 54 young scientists, enhancing their knowledge and expertise across various areas related to wheat production systems - including the breeding of field crops, biotechnology, plant protection and water and soil management. An advanced degree training program has also enrolled four scientists in MSc degrees and two in PhD programs.



## PARTNERS

Institut National de la Recherche  
Agronomique

ALGERIA

Agriculture Research Center (ARC)

EGYPT

Institut National de la Recherche  
Agronomique (INRA)

MOROCCO

Office for Agricultural Research (OAR)

IRAQ

National Center for Agricultural Research  
and Extension (NCARE)

JORDAN

National Agricultural Research Center  
(NARC)

PALESTINE

Agricultural Research Corporatin (ARC)

SUDAN

General Commission for Scientific  
Agricultural Research (GCSAR)

SYRIA

Institut National des Grandes Cultures  
(INGC); Institution pour la Recherche et  
l'Enseignement Superieur Agricoles (IRESA)

TUNISIA

Agricultural Research and Extension  
Authority (AREA)

YEMEN

## DONORS

Arab Fund for Economic and  
Social Development

Kuwait Fund for Arab Economic  
Development

OPEC Fund for International  
Development

Bill and Melinda Gates  
Foundation

Islamic Development Bank

