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# Improving smallholder wheat-legume production systems for enhanced climate change adaptation and food security

Since 2006, IFAD and the European Union have partnered to invest over EUR 230 million in agricultural research programmes carried out through the CGIAR system. This collaboration aims to support research and scientific innovation with the active involvement of smallholder farmers themselves. Thus, the European Union-IFAD financing has produced solutions that are demand-driven and context-specific, leveraging the agricultural research capacity of the CGIAR system to advance both food security and climate change adaptation.

## QUICK FACTS

**PROJECT** Enhanced Smallholder Wheat-Legume Cropping Systems to Improve Food Security under Changing Climate in the Drylands of West Asia and North Africa

**FOCUS COUNTRIES** West Asia and North Africa

**LEAD IMPLEMENTING INSTITUTION** International Center for Agricultural Research in the Dry Areas (ICARDA) – CGIAR partnership

**GOAL** Contribute to climate resilience, food security, nutrition and the livelihoods of rural communities through improvements in the productivity and production of wheat- and legume-based cropping systems

**BENEFICIARIES** Smallholder farmers, national researchers and extension staff operating in dry areas

**DATES** 2012-2015

**FINANCING** EUR 4.268 million

## Context, challenges and opportunities

West Asia and North Africa face a complex set of interrelated agricultural challenges. They encompass some of the most water-scarce regions in the world, where erratic rainfall, frequent droughts and high soil salinity greatly limit the potential of arable land. Climate change continues to exacerbate these patterns, further constraining the capacity of farming systems to nourish a fast-growing population – currently, cereal yields fall far below the global average of 2 tons per hectare. Because crop productivity is so low, much of West Asia and North Africa depends heavily on food imports, and undernourishment in the region is high: the Food and Agriculture Organization of the United Nations (FAO) estimates that the number of chronically undernourished people increased from 16.5 million people in 1990-1992 to 33 million in 2014-2016.

While wheat is the main staple food in the region, its production has been seriously affected by limited access to improved agricultural technologies, such as drought-tolerant varieties and efficient seed-delivery systems. For over 20 years, the promotion and uptake of higher potential varieties and quality seeds have been very slow. Inadequate fertilizer use and insufficient crop-protection inputs have further inhibited production capacity, while unfavourable markets and policy environments discourage farmers' integration into national economies. Similar problems have affected the food legumes sector as well.

Wheat and legumes are central to traditional diets in West Asian and North African countries, especially for the poorer households. Enhancing the performance of combined wheat and legumes farming systems among smallholders in drylands can increase household productivity, profitability, nutrition, climate resilience and food security. It can also improve soil fertility and reduce land degradation through rotational farming systems.

## Setting objectives

The Enhanced Smallholder Wheat-Legume Cropping Systems to Improve Food Security under Changing Climate in the Drylands of West Asia and North Africa project was formulated as a multi-country initiative involving national agricultural research system institutions. The project focused on two main objectives: (i) testing and promoting technologies to enhance crop rotation, which can enable smallholder farmers to improve production of wheat and legumes; and (ii) developing and showcasing new varieties of

seeds and crops that are more resistant to biotic and abiotic stresses. After an initial research phase, the project's focus shifted to disseminating technologies and building farmers' capacity.

## Solutions and results

The project directly benefited nearly 150,000 farmers in eight countries: Algeria, Egypt, Jordan, Lebanon, Morocco, Sudan, Tunisia and Turkey. Tailored technology packages (such as the orobanche control on faba beans in Egypt and Hessian fly control on wheat in Morocco) were developed and promoted to suit the peculiarities of the different agroecological zones. The project adopted a combined approach, introducing both improved varieties and new technologies to produce significant outcomes:

- 136 improved varieties of wheat and legume crops were introduced across all countries, generating visible increases in yields
- 740 trials and nursery sets for different wheat and legumes were set up, in collaboration with the national agricultural research system, to test, select and promote the best performing varieties
- 910 tons of quality seeds were produced, of which 590 tons were wheat and 320 tons were food legumes
- five pilot mobile seed processing units were installed
- overall yields increased by 34-77 per cent as smallholders adopted integrated pest management and supplemental irrigation techniques
- the promotion of conservation agriculture practices, such as zero or minimum tillage, contributed to improving soil fertility and water conservation and increased wheat yields up to 128 per cent and legume yields by 133 per cent.

Over three years, farmers' productivity was boosted thanks to the activities promoted by the project. In Tunisia, for example, the productivity of durum increased by 43-51 per cent after farmers adopted the two varieties supported by the project. In Morocco, farmers' yields increased by 37 per cent (389.5 kilograms per hectare) by rotating wheat cropping with legumes. Meanwhile, in Egypt, the demonstration and dissemination of the "raised bed" technology led to an average grain-yield increase of 22.7 per cent (0.88 tons per hectare) and water savings of 20-25 per cent, compared to flat planting of faba beans. This technology is now being promoted in other countries throughout West Asia and North Africa.





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## From research results to impact

By addressing some of the structural constraints of the wheat and legume sectors in participating countries, the project was able to increase food security, nutrition, farmers' incomes and smallholder empowerment.

In Morocco, for example, the adoption of improved wheat varieties generated a 48 per cent increase in net income for participating farmers. Similarly, the adoption of improved faba bean varieties generated an average increase of 11.6 per cent in farmers' net incomes. In addition, the adoption of faba bean/wheat rotation, combined with the use of improved seed varieties, led to an increase in net returns of US\$875 per hectare (a 136 per cent increase) over wheat monocropping.

One of the project's major achievements was the development of orobanche-resistant faba beans in Egypt, Sudan and Tunisia. In the Egyptian governorates where improved faba bean technologies were disseminated, average yields were 22.5 per cent higher, reaching peaks of a 38 per cent increase. By reducing the use of herbicides, faba bean production costs decreased; this generated an increase in net revenue of US\$550 per hectare. This means that farmers benefited from higher incomes and a more secure financial basis as a result of a more stable and more profitable production.

The approach promoted by ICARDA in Egypt also had effects at the national level. Successful results encouraged the Academy of Scientific Research and Technology in Egypt to fund and initiate the National Campaign on Faba Bean Rehabilitation. The national productivity increased by 3.5 tons per hectare, a 12 per cent yield increase since 2010. These positive production trends contributed to reducing Egypt's dependency on international imports. Rough estimates

have suggested that through enhanced self-sufficiency, Egypt was able to save around US\$15 million. This seemed to be partly attributable to increased domestic faba bean production, which rose from 139,000 tons in 2011/2012 to 185,000 tons in 2016/2017. This is an important step in the direction of ensuring food and nutritional security amid growing concerns of climate change.

## Innovations

**In the community of El Hilal, Morocco, ICARDA's Seed Section trained local farmers in the production of quality food legume seeds. A village-based seed enterprise was established to boost the production of chickpea, faba bean and lentil seeds. The enterprise, which was managed by 17 farmers as a cooperative, eventually produced 20 tons of quality seed that could cover over 200 hectares and is now serving other communities throughout the wider Marchouch-Romani region.**

The project introduced innovations in many ways. In addition to generating new techniques and activities (new varieties, pest and disease management options, etc.), the project also introduced existing technologies and validated approaches in countries that were not familiar with them, such as supplementary irrigation, conservation agriculture, and raised bed techniques.

A major innovation implemented by the project was the technology dissemination platform (TDP). This approach allows for on-farm interactive dissemination of technologies. Community leaders were trained to mobilize and expose neighbouring farmers to the use of the promoted technologies. Thanks to the 1,558 TDPs



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implemented during the project, over 18,500 people could access new knowledge, enabling progressive adoption and enhancing small-scale farmers' productivity.

Other innovative approaches promoted by the project included the popularization of small-scale seed enterprises and the introduction of mobile seed-processing units to support the informal seed sector, where seeds are produced by farmers themselves rather than purchased from government organizations or private companies. Another innovative practice was the participatory selection of new varieties and the development of integrated pest management options, whereby farmers were invited to visit trials during on-farm testing and were granted decision power on varieties and practices to be selected.

## Future directions

The project provides an opportunity to use the region as a platform to scale up and disseminate findings in other parts of the world. In light of the results, the national agricultural research and extension institutions of the countries involved have continued the activities initiated beyond the project's time frame. Since the project's completion in 2015, the national systems have continued to work with smallholders to increase the uptake of the wheat and legume farming technologies promoted by the project. To support these efforts, IFAD provided additional resources to the participating countries for the 2015/2016 cropping season. Some elements have ensured the long-term impact and scaling up of the project's successes, such as the establishment of small-scale seed businesses by farming villages, groups or individuals that has facilitated the continued supply of quality seed. In addition, to enhance the long-term sustainability of the project's achievements, the initiative has focused on building and strengthening the capacities of national research institutions so they can continue leading the learning processes initiated by the project.

The initiative has provided training and advisory services for both women and men farmers through widespread capacity-development opportunities. Pilot studies have shown that there is scope to achieve higher gender impact in rural areas through the activities initiated by the project. Moving forward, participating countries may achieve further progress in this area, particularly in terms of income-generating opportunities and strengthening women's decision-making roles in agriculture and household well-being.

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