

## Returns to Investment on Barley Improvement Research in Dry Areas

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Barley, one of the earliest crops in human history, is grown in over 100 countries. In the West, it is used mainly for animal feed or as malt for producing beverages. In developing countries it is a staple food for millions of people. Developing countries produce about 27 million tons a year, worth \$ 4 billion. Over 90% of this is grown in Central Asia, West Asia and North Africa – where ICARDA's work is centered. ICARDA has a global mandate for barley improvement research.

### Science for the smallholder

Barley can survive low rainfall, cold temperatures and poor soils better than most other crops. In many areas, it is the only food crop that can provide reliable harvests even in bad years. ICARDA's barley program seeks to build on this natural hardiness, to improve income and food and feed security of poor farmers in harsh environments.

The results have been impressive: high-yielding, disease-resistant varieties; new insights on the physiology of resistance; cultivars that provide both grain and fodder; and biotechnology methods to complement traditional plant breeding methods. ICARDA has also pioneered the use of farmer-participatory breeding, which is now used by many national programs.

ICARDA's genebank holds the world's largest collection of cultivated and wild barley – nearly 26,000 accessions – preserving biodiversity for the future, and ensuring raw material for future breeding programs.



*Farmers help to test, select and multiply new barley varieties. Result – faster and more efficient variety development, wider adoption.*

### Targeting the poor

Barley is grown for food and feed, mainly by poor subsistence farmers in drought-prone areas where poverty levels are high.

That means ICARDA's barley research directly addresses hunger and poverty. Our research benefits a range of people and organizations, but the largest beneficiaries are the rural poor in the Third World.

### New varieties take root

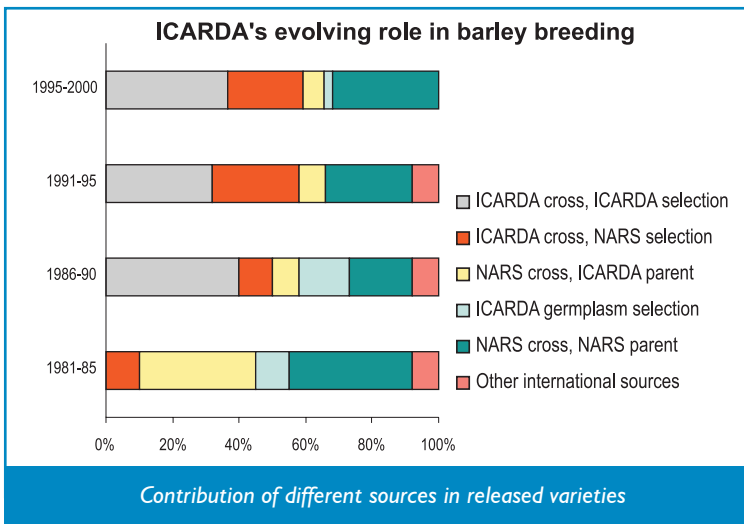
To date, 186 improved barley varieties, developed by ICARDA and its national partners, have been released in 42 countries. We examined data from nine of the world's top ten producers of food barley – Algeria, Ecuador, Egypt, Ethiopia, Iraq, Jordan, Morocco, Syria, and Tunisia (no figures were available for Kazakhstan). Varieties developed by ICARDA, or by national agricultural research systems (NARS) from ICARDA-supplied germplasm, occupy over 10% of the total barley area in these countries. Another 4-5% is sown to improved varieties developed by NARS, with ICARDA support. In some countries (Ecuador, Egypt, Jordan), ICARDA varieties occupy over half the national barley area.

The new varieties offer substantially higher yields than traditional varieties, with no additional investment and little or no change in management methods. In the nine countries studied, on-farm yields increased by 10-15% in three countries, around 25% in five countries, and 32% in one country.

## ICARDA's evolving role

ICARDA's barley breeding program plays a dual role. It produces 'finished products', i.e. varieties that can be tested by national programs and then released for cultivation. It also produces 'raw material', i.e. breeding lines, populations, and improved germplasm, that national breeders use to develop new varieties. The balance between these two roles varies by country – more raw material for strong NARS, more finished products for others. The balance also changes with time, as the NARS grow stronger (see chart).

The chart shows three trends. First, germplasm has given way to improved varieties. In the early 1980s, a large proportion of new varieties were direct selections from ICARDA germplasm; but this proportion declined as national programs became stronger. Second, the proportion of 'finished products' (grey bar) has fallen slightly. This is a reflection of increasing NARS strength, and ICARDA's deliberate efforts to devolve selection activities to NARS.



Third, a declining proportion of variety releases are from NARS crosses, even though the number of such crosses has increased in the last 10 years. ICARDA is receiving increasing requests for crosses, probably because we have access to a much larger pool of genetic material. Evidently, NARS breeding programs are now relying on selection, rather than crossing, to overcome skills/funding shortages. This strategy has worked so far; but it requires a continuous flow of improved germplasm from ICARDA – which in turn requires adequate and stable funding for research.

## Returns to research investment

ICARDA spends about \$700,000 per year on barley improvement research in these nine countries; their governments spend another \$6.9 million per year. International donors provide most of these funds. Are they getting value for their money?

We analyzed data, provided by each country, on research staffing, new varieties (adoption, performance etc), and the composition of national breeding pools (to measure use of ICARDA materials). We also looked at research expenditures, and used the economic surplus model to estimate costs, returns and benefits for a 24-year period, 1977-2000.

In 1997, gross benefits to the nine countries were about US\$92.5 million – thirteen times the total research expenditure by ICARDA and the NARS. The internal rate of return (IRR) was higher than 20% in every country. In Morocco, the biggest producer, gross benefits were \$32 million in a single year, with an IRR of 51%. These numbers represent only the value of the extra grain produced. There are additional benefits, harder to quantify – improving food security in drought-prone areas; creating a cadre of trained researchers; empowering poor farmers.

## Have we made a difference?

The analysis shows that ICARDA's barley research has had an enormous impact on developing countries worldwide.

- Significant improvements in barley productivity, food and feed security.
- Stronger national research institutions.
- New research tools and methods that are applicable to other crops and other areas.

Investment in agricultural research can yield substantial returns. And contrary to conventional wisdom, rates of return can be extremely high in poor, low-rainfall areas – provided the science is done right.