

Building on an earlier exploratory study, in 2007–2008 the CGIAR's Standing Panel on Impact Assessment (SPIA) undertook an initiative in collaboration with seven CGIAR centers to augment the evidence of policy-oriented research (POR) impacts within the CGIAR system and to further the development of methodologies in this challenging area of impact assessment. Seven case studies were commissioned. This impact brief describes the major results that emerged from the International Center for Agricultural Research in Dry Areas (ICARDA). The summary version of the full case study report can be found in: Shideed, K., Mazid, A., Ahmed, M. A. M., and Zahir, Z. 2008. Returns to policy-oriented agricultural research: the case of barley fertilization in Syria. In: CGIAR Science Council. 2008. *Impact Assessment of Policy-Oriented Research in the CGIAR: Evidence and Insights from Case Studies*. A study commissioned by the Science Council Standing Panel on Impact Assessment CGIAR Science Council Secretariat: Rome, Italy. (Available at <http://impact.cgiar.org/>)



# SCIENCE COUNCIL BRIEF

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ICARDA

## Changing Barley Fertilization Policy in Syria: the Role of Collaborative Policy-oriented Research

Barley is a major feed crop in Syria, accounting for 96 percent of the area devoted to rainfed forage crops, 40 percent of the total cereal area, and 27 percent of the total cropped area. Although barley is well adapted to dry areas (200–350 mm annual rainfall), its yield levels were very low because of the limited use of fertilizer and other inputs.

A collaborative policy-oriented research (POR) project launched in 1984 by the International Center for Agricultural Research in Dry Areas (ICARDA) and the Syrian Ministry of Agriculture and Agrarian Reform (SMAAR) was designed to assess the profitability of fertilizer use in barley production and to provide evidence that could be used to inform the government's fertilizer allocation policy. This brief is based on a longer study<sup>1</sup>, which presents evidence to support the attribution of changes in Syria's barley fertilization policy to the collaborative ICARDA/SMAAR research project.

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### Farming systems and agro-ecological zones in Syria

Although generally dry, Syria encompasses a great diversity of agro-ecological conditions. The country is divided into five agricultural zones according to the expected annual rainfall and the resulting suitability for rainfed crop production.

Barley is grown exclusively as a rainfed crop in Zones 2, 3, and 4, where it has historically occupied an average of about 1.5 million ha annually. In Zone 2, where rainfall ranges from 250 to 350 mm in not less than 2 out of 3 years, it is possible to harvest two barley crops every 3 years and to grow wheat and legumes, in addition to various summer crops. The main crop in Zone 3, with annual rainfall of at least 250 mm in half the years, is also barley, but legumes can be grown. Zone 4 is marginal for agricultural production, with annual rainfall of 150–200 mm.

Between 1961 and 1989, the barley area expanded at an annual rate of 4.4 percent, while yields declined by 1.9 percent *per annum*. The barley area reached a record high of 2.9 million ha in 1989, as a result of government encouragement for an expansion in barley area and promotion of continuous barley cultivation to increase production. In contrast, since 1990, the barley area has declined rapidly at an average rate of 5.5 percent *per annum*, to reach about 1.3 million ha in 2005, while yields have increased at 1.5 percent *per annum*. Despite the declining trend in barley area since 1989, total production rose until 1997. This yield increase is attributed mainly to the rapid diffusion of barley fertilization, especially in Zone 2.

### Fertilizer allocation policy in Syria

Fertilizers are allocated to farmers by the government based on planned crop area, giving priority to strategic crops. The quantity of fertilizers and other inputs available to farmers is pre-determined according to a recommended crop plan, and a formal crop license is issued to every farm at the beginning of each cropping year.

This allocation policy meant that irrigated crops and rainfed wheat in the high-rainfall zones received most, if not all, their fertilizer requirements. Barley, a rainfed crop grown mainly in the drier zones, was excluded from fertilizer allocation until 1989, when a change in government policy allowed fertilizer to be allocated to barley producers in Zones 2 and 3. The Agricultural Cooperative Bank provides both loans and inputs to farmers. Since 1989, fertilizer loans have been provided to barley farmers in Zone 2. No loans are provided to barley farmers for fertilizers in Zone 3, although fertilizer is now available for barley in this zone, while neither fertilizer nor loans are available to farmers in Zone 4.

### The POR project

The ICARDA/SMAAR project began in 1984 and continued until 1989, with the Syrian Soil Directorate, which is part of SMAAR, as the principal national partner. The project aimed to initiate a policy dialogue, and to persuade policy-makers to allocate fertilizer to barley, especially in Zone 3. The main outputs of the research project were:

- Appropriate recommendations for fertilizer application on barley for each zone in the lower rainfall areas
- Analysis of the risk of fertilizer use on barley in the lower rainfall areas

- An economic decision support tool for use by policy-makers to allocate limited fertilizer supplies more efficiently.

### Establishing the policy influence

In order to assess the extent to which national policy was influenced by the POR, policy-makers, partners, and other stakeholders were interviewed in 2007 to gauge their perceptions as to how the policy change took place and the role played by the different institutions involved. A total of 18 people were interviewed from partner institutions, including people responsible for the research (8), extension services (2), the farming communities (1 farmer), and relevant policy-making bodies (7 respondents). The interview covered the policy-making process, the institutions involved, the evolution of barley fertilization policy, the relationship between research and the policy-making process, and the perceived role of the project.

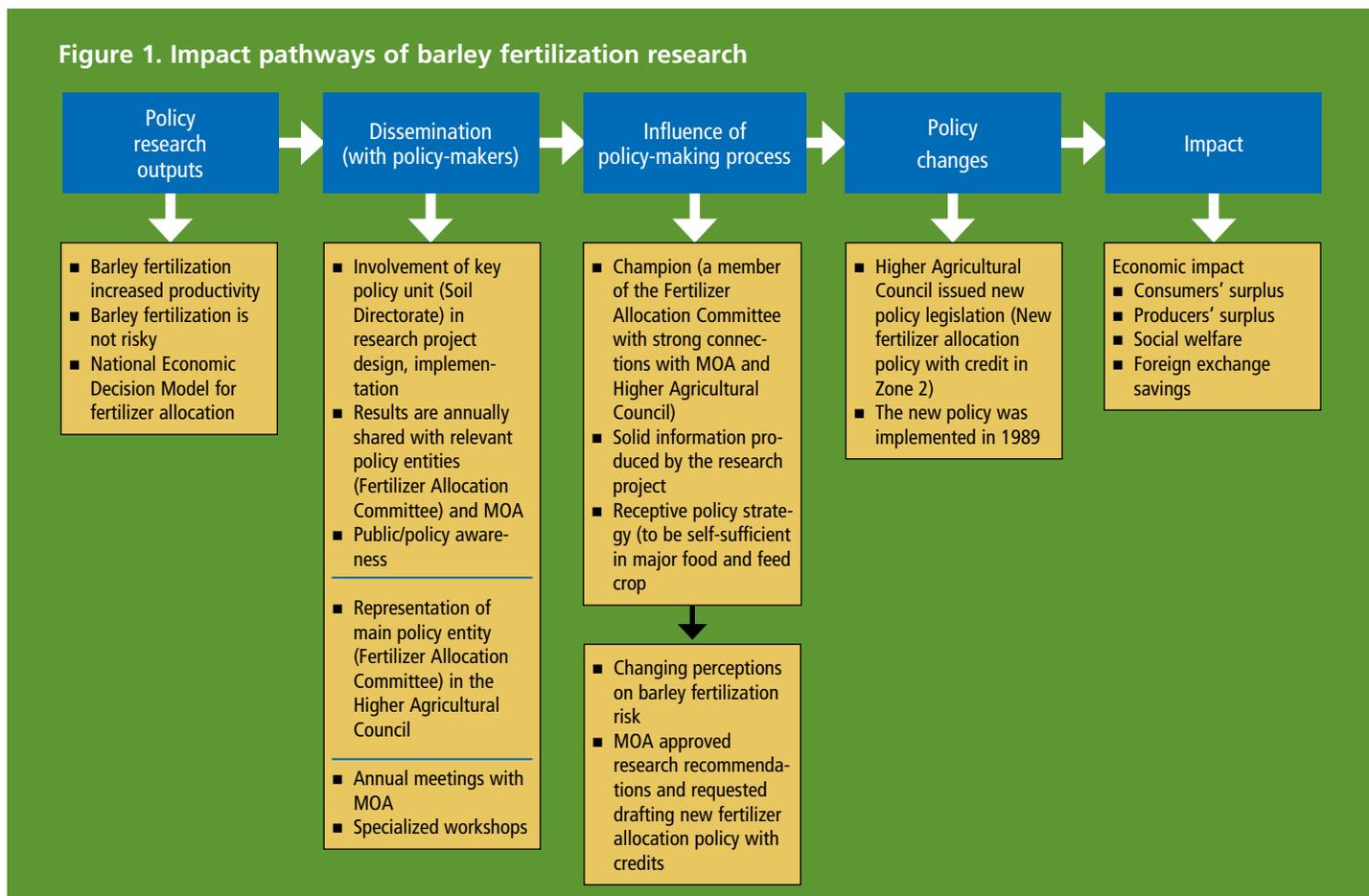
The main outcome of this survey is the clear attribution of the policy change to the influence of the POR. The role of the Soil Directorate was critical, as the allocation of fertilizer is based on the results of research conducted by this organization. Respondents highlighted the role of the Director of the Fertility Division within the Soil Directorate as a 'champion' in adopting the POR findings and convincing policy-makers to act. (See Figure 1).

While the government took account of the findings of the POR, they did not switch fertilizer supplies away from other crops, but allocated fertilizer to barley from additional fertilizer imports. Hence, the results of the POR were partially adopted by policy-makers: reallocation of fertilizer away from wheat and cotton and towards barley was not adopted.

### Quantifying the impact

Data from separately conducted farm surveys indicate that over half of the farmers interviewed in Zone 2 reported that they had, in fact, applied some fertilizer to barley before the policy change in 1989. However, fertilizer use was relatively limited in terms of area coverage and level of application before that date. In contrast, fertilizer adoption was negligible in Zone 3 before the policy change because of low rainfall. Because the government was the only source of fertilizer during that time, some farmers were apparently shifting fertilizer officially allocated to other crops to their barley. Although data on rates and extent of

**Figure 1. Impact pathways of barley fertilization research**



barley area fertilized are unavailable, barley fertilization before the policy change was undoubtedly inadequate and only covered a small part of the barley area, in the relatively favorable zone.

In this POR impact assessment study, the returns to POR in the output market were assessed based on the economic surplus model commonly used in the impact assessment literature. The returns to increased fertilization of barley from the policy change were measured as the change in economic welfare resulting from barley fertilization. The net change in economic surplus was defined as the sum of changes in consumers' and producers' surpluses resulting from the increase in barley supply (output) minus the costs of research, extension, and additional inputs (fertilizer and labor for distribution of fertilizer and additional harvesting and transportation). The fertilizer cost is calculated on the basis of the quantities of fertilizer applied to barley and the import price.

The role of the POR was to hasten the change in policy. According to the stakeholder interviews, the POR

brought the policy change forward by at least 15 years. The benefits of the POR were assumed to begin in 1989 when the government began allocating fertilizer to barley producers in Zones 2 and 3. To estimate the value of the POR, the net present value (NPV) of this earlier benefit stream was contrasted with the lower NPV generated from a later change in the policy. A discount rate of 5 percent, comparable to the borrowing rate in Syrian commercial banks, was used to calculate the NPVs. Estimates of the internal rate of return (IRR) and benefit–cost ratios (BCRs) are presented in Table 1.

Based on the economic surplus model estimates, the NPV of the change in consumers' surplus exceeded US\$37 million, with an average annual flow of US\$1.34 million. The NPV of the change in producers' surplus approached US\$37.76 million (Table 1). Net economic surplus was equivalent to US\$73.42 million. The IRR to investment in research and extension was 70 percent. These are respectable levels of returns to research and compare to returns obtained in other cases, such as sorghum in Sudan, and rice cultivation in Viet Nam<sup>2,3</sup>. However, the BCR of the POR in barley of

**Table 1.**  
**Welfare changes associated with the POR on barley fertilization in Syria**

Welfare indicator <sup>1</sup>	NPV (US\$ million)	Average annual flow (US\$ m)
Change in consumers' surplus (CS)	37.5	1.4
Change in producers' surplus (PS)	37.8	1.4
Economic surplus (CS+PS)	75.3	2.7
Net economic surplus <sup>2</sup>	73.4	2.6
Foreign currency savings	54.5	1.9
Internal rate of return (IRR)	70.2	—
Benefit–cost ratio (BCR) <sup>3</sup>	41.0	—

1. Benefits began in 1989 and continue to 2016 in the case with the POR, and are assumed to begin in 2004 in the counterfactual case without the POR. The benefit streams are calculated as the gross economic surplus [(CS+PS) minus fertilizer, extension, and other adoption costs. The period of 1989–1999 is calculated in accordance with the procurement price policy, under which the government provided price support and output procurement.
2. Net economic surplus is equal to economic surplus (CS+PS) minus research, fertilizer, and other adoption and extension costs.
3. The NPV of the POR is calculated from the difference between the 'with' and 'without' POR benefit streams described in Note 1. The BCR is derived by dividing this NPV by the NPV of the research cost. The discount rate used in computing the NPVs is 5 percent.

41 is significantly below that reported for rice policy changes in Viet Nam where estimated BCRs ranged from 56 to 187. The difference is explained by the differing sizes of the markets for the two commodities.

Besides greater food/feed security, a major objective of the change in Syrian government policy was increased import substitution, so an important indicator of impact of the change is the savings in foreign currency that would have been spent on barley imports. These savings amount to about US\$54.5 million over the period 1989 to 2016, with an average annual flow of almost US\$2.0 million.

Several factors explain these high estimated levels of benefits. First, the barley sector in Syria is fairly large in terms of area and output. Second, following the policy change the diffusion of fertilization was rapid, especially in Zone 2, reaching a ceiling of 90 percent of all barley farmers within a few years, and the yield gains were high despite the variability of yield over time caused by variable rainfall. Third, the flow of benefits continues

for a reasonably long period of time (28 years). Finally, the research duration was short (only 4 years), with a low annual cost of only US\$0.22 million on average.

## Conclusions and lessons learned

This POR aimed to create an enabling policy environment for the adoption of barley fertilization in Syria. The returns to the POR are substantial, with a high rate of return to public research investment in dry areas. Increased investments in marginal dry areas, in the form of increased fertilizer allocations to Zone 3, have led to the intensification of barley production, increased yields and farm incomes, and enhanced farm feed security. Given the high poverty incidence in this zone, the research and the policy change have had an important equity dimension, raising the incomes of some of Syria's poorest people.

This study has generated several important lessons:

- Policy-makers only partially adopted the results of the POR. The government rejected reallocation of fertilizer from wheat and cotton as these crops were considered strategic commodities. There may therefore be limits to policy influence when research findings confront deep-seated commitments, such as the notion of strategic crops in Syria.
- The design of the POR project reflected the importance of having a relevant and effective national institution as a partner. The involvement of the Soil Directorate significantly leveraged influence through the leading role of the 'champion' in effectively communicating the results of the POR to policy-makers.
- Building the mechanism of policy influence into the project design and implementation, and harnessing the ability of POR to develop sound research outputs that squarely address the concerns of policy-makers, sets the stage for successful POR.

## Notes

- 1 This brief is a summary of research reported in full in: Shideed, K., Mazid, A., Ahmed, M.A.M., and Zahir, Z. 2008. Policy influence and returns to policy-oriented agricultural research: the case of barley fertilization in Syria. International Center for Agricultural Research in the Dry Areas (ICARDA) and the Syrian Ministry of Agriculture and Agrarian Reform (SMAAR): Aleppo and Damascus, Syrian Arab Republic. 58 pp. (Unprocessed manuscript).
- 2 See, for example, Ahmed, Mohamed, M., Masters, W.A., and Sanders, J.H. 1995. Returns from research in economies with policy distortions: Hybrid sorghum in Sudan. *Agricultural Economics*, 12, 183–192.
- 3 See Ryan, J.G. 1999. *Assessing the Impact of Rice Policy Changes in Viet Nam and the Contribution of Policy Research*. Impact Assessment Discussion Paper No. 8. International Food Policy Research Institute (IFPRI): Washington, DC, USA.