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Food, income, and livelihoods: Impact of new agricultural technologies in Africa

Egypt, Ethiopia, Sudan and Yemen have a combined population of 195 million, of whom 72% live in rural areas. All four economies are largely agriculture-based; but most farmers use traditional crop varieties and farming practices, and operate at subsistence level. ICARDA is working with national research and extension agencies to develop and promote new farm technologies designed specifically for resource-poor smallholders.

One project, supported by the International Fund for Agricultural Development (IFAD), focuses on four key crops – wheat, faba bean, chickpea and lentil. It involves applied research as well as training and technology transfer, aiming to increase farm productivity and sustainability, and thereby improve food security, income and livelihoods of the rural poor.

New crop technologies are helping to improve income and livelihoods for subsistence farmers in Africa and elsewhere.

Has the project met its objectives? To find out, ICARDA and national research centers conducted a series of adoption and impact studies, interviewing over 900 households in the four countries. The studies clearly documented the impacts of the project on rural welfare. They also helped identify the factors driving adoption, and the technical, socio-economic and policy constraints that hinder the diffusion of new technologies.

Technology packages

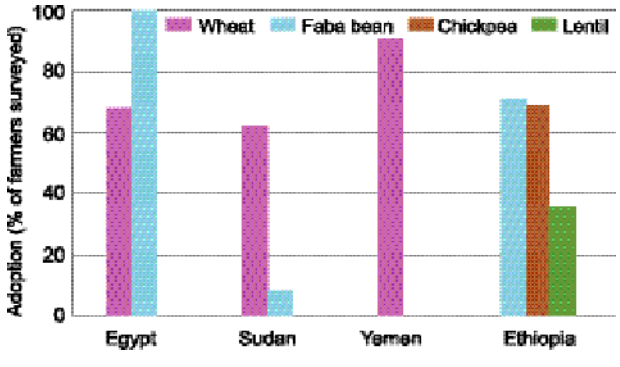
The ICARDA-IFAD project introduced a number of technology 'packages', each consisting of an improved crop variety and improved management methods (tillage, seeding rate, planting date, fertilizer application rate, weed and pest control, irrigation schedule) to maximize the benefits from the variety. Packages were developed for different crops, and different varieties of each crop.

- **Faba bean**: three varieties in Egypt (Misr 1, G674, G420), three in Sudan (Hudeiba 93, Basabeer, SML), two in Ethiopia (Mesay, Degaga)
- **Wheat**: three varieties in Egypt (Sakha 93,G168, Sids 1), five in Sudan (Imam, Neilin, Sasareib, Wadi el Neil, Debeira), one in Yemen (Gonaimi)
- **Chickpea**: four varieties in Sudan (Shendi, Atmor, Burgaig, Wad Hamid), two in Ethiopia (Arerti, Shasho)
- **Lentil**: one variety in Ethiopia (Alemaya)

Adoption patterns

Adoption levels varied widely, within and between countries, between different technologies, even between different components of a 'package'. Most farmers tended to adopt specific components (particularly improved variety, sowing method, and pest control) rather than the complete package. But there was substantial adoption of complete packages in areas with relatively higher-input or intensive agriculture. For example, in Egypt, the complete packages for wheat and faba bean were adopted by 53% and 33% of farmers, respectively.

Figure 1. Adoption of improved varieties



Adoption constraints

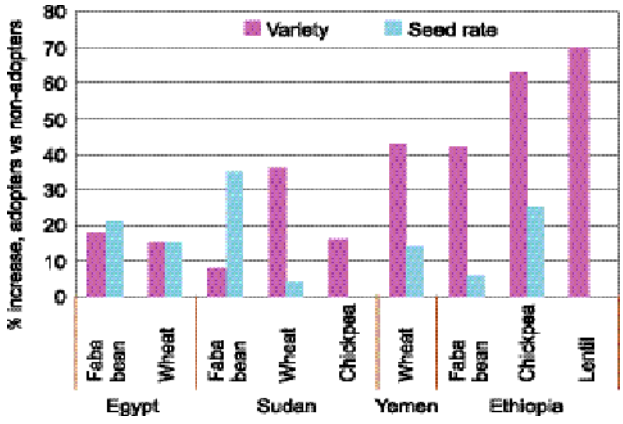
The study also identified the main constraints to wider dissemination of new technologies: inability to make the initial investment; lack of farmer awareness; weak extension services; unavailability of seed and fertilizer. One key constraint in all four countries is lack of policy support to develop input/output markets and lack of financial incentives to encourage poor subsistence farmers to adopt new technologies. Risk aversion is an important factor, causing farmers to adopt new packages in stages, one component at a time, leading to slow growth in adoption.

Crop yields

Farmers who adopted technology packages (or components) obtained yields 8 to 70% higher than non-adopters. This advantage was seen in nearly all crops and technology components.

- The components offering the highest gains were improved variety, optimal seeding rate (e.g. 35% for faba bean in Sudan), and optimal sowing date (135% for lentil in Ethiopia, data not shown).
- Variations in adoption and impacts across locations, caused by differences in biophysical and socio-economic environment, suggest there is considerable potential for even greater impact.

Figure 2. Yield gains from new technologies



Income

Adopters earned significantly higher net returns than non-adopters:

- Egypt, wheat: $1190 per hectare, 43% more than non-adopters
- Egypt, faba bean: $962 per hectare, 173% more
- Sudan, wheat: $510 per hectare, 280% more;
- Sudan, chickpea: $496 per hectare, 73% more
- Ethiopia, lentil and chickpea: $451 and $551 per hectare, 17% more;
- Ethiopia, faba bean: $164, 52% more than non-adopters
- Yemen, wheat: $ 316 annual per capita income, 8% higher than non-adopters

Food security

Food security was measured in terms of per capita harvest, i.e. grain harvested divided by family size. Per capita wheat harvest among technology adopters averaged 991 kg in Egypt, 322 kg in Sudan and 188 kg in Yemen: 127%, 96% and 38%, respectively, higher than non-adopters. For faba bean the corresponding figures were 38% in Egypt, 8% in Sudan and 39% in Ethiopia. The gain is particularly significant in Ethiopia, where faba bean – a major source of dietary protein – is grown by subsistence farmers without irrigation in drought-prone, traditionally food-insecure areas.

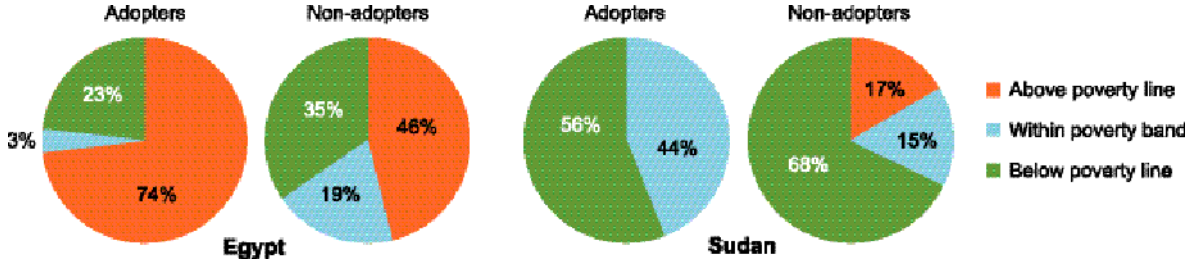
Employment

The impacts of the technology packages on labor requirement – and by implication, on employment – were variable. Together, the crop management technologies (plowing, sowing, weeding, irrigation and harvesting components) reduced labor requirement by 1.5% in chickpea and 7.8% in lentil in Ethiopia; but increased it by 44% in Yemen. Labor requirements were reduced for some operations (plowing chickpea and lentil in Ethiopia, harvesting lentil in Ethiopia, harvesting wheat in Yemen) but increased for others, such as lentil sowing and weeding, chickpea weeding and harvesting in Ethiopia and wheat irrigation in Yemen. This variation reflects the diversity (in both biophysical and economic terms) of smallholder farming environments.

Poverty

To measure the impact of the project on poverty, we classified the survey sample (915 households) into three groups: below the poverty line, within a 'poverty band', and above the poverty line. These correspond to per capita income of below 99 US cents per day, $1 to 1.20, and above $ 1.20. By adopting the new technologies, a significant percentage of households moved up at least one 'wealth class' – 12% of households in Egypt and Sudan, 7% in Yemen, 3% in Ethiopia. Figure 3 illustrates this shift in Egypt and Sudan.

Figure 3. How new technologies have reduced poverty



The ICARDA-IFAD project has made substantial impacts on crop productivity, food security, farm income and poverty in each of the four target countries. Given the project's short duration (3 years), it is clear that many farmers are still experimenting with the new technologies, as reflected in the wide variation in adoption rates. The project has laid the base for greater efforts to promote these technologies, and multiply the impacts. Lessons learned during the study are already feeding into other R&D programs aiming to improve rural livelihoods in one of the world's poorest regions.

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