On-farm Adaptive Research in Asia

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Introduction

In the late 1980s ICRISAT became involved with the Indian national agricultural research system (NARS) in on-farm research on groundnut, pigeonpea, and chickpea, with the major objective of transferring improved production technology to farmers in the semi-arid tropics of India. The results obtained were promising; trials on farmers' fields over a 3-year period showed increases in groundnut yield over traditional systems of 32% from the use of improved varieties, 25% from the use of improved cultural practices, and 50-150% from the combination of these two factors. Several Asian countries expressed interest in this approach, and funds were provided by the United Nations Development Programme (UNDP) for ICRISAT to organize a meeting with NARS representatives from Asia, to formulate proposals for on-farm adaptive research on ICRISAT mandate legumes. Based on the recommendations of this meeting, ICRISAT prepared a project proposal which was submitted to the UNDP for possible funding. This was approved by UNDP as a component of the UNDP/FAO RAS/89/040 project, to support adaptive on-farm research on ICRISAT mandate legumes in Indonesia, Nepal, Sri Lanka, and Vietnam. The main objectives of this project are:

- To assist the NARS to assemble information from research and extension sources within the project countries and the region that could be used in generating production technologies;
- To generate and test crop production technology under research station and farmers' field situations;
- To modify the most effective production technologies to suit real farm situations;
- To enhance the adaptive research capabilities and interest of NARS in legumes production.

We followed a four-stage approach: identifying the constraints, finding suitable technologies or solutions, evaluating the solutions in single-factor or multifactor diagnostic experiments, and finally formulating a basket of technology options for the farmers.

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Diagnostic surveys

The target areas for on-farm research were chosen by the national program administrators based on the cropped area, potential for improvement, and other factors that could eventually facilitate the adoption of improved technologies. Diagnostic surveys, using rapid rural appraisal methods, were conducted in the target areas by multidisciplinary teams of scientists from the national programs and ICRISAT. The survey teams included agronomists, breeders, entomologists, economists, pathologists, and soil scientists. The teams visited the target areas and discussed the project with farmers and village leaders. The interviews were informal, but each team member had a check list of questions designed to provide an understanding of the local agroecosystems and agronomic and crop management practices, and to identify the causes of low yield.

Plans for on-farm and supportive back-up research to address the farmer-perceived production constraints were then prepared. For example, the farmer-perceived constraints to groundnut production in two provinces in southern Vietnam are shown in Table 1. The survey team prepared experimental plans for addressing the biotic and abiotic constraints. Suggestions were also made to the concerned

Table 1. Farmer-identified constraints to groundnut production in Tay Ninh and Long An provinces, southern Vietnam.

Constraint	Ranking[1]		
	Tay Ninh Province	Long An Province	Overall priority
Socioeconomic			
Lack of cash for input	**	** *	High
Lack of irrigation	*	** *	Medium
High cost of input	-	* *	Low
Input not available	-	*	Low
Unstable/low price for groundnut	*	*	Low
Spurious pesticides	-	*	Low
Abiotic			
Lack of coconut ash	* * *	* *	High
Lack of farm machinery	**	* *	Medium
Quality of canal water	-	* *	Low
Biotic			
Weeds	**	**	Medium
Leaf eaters *[Helicoverpa* and *Spodoptera)*	***	** *	High
Damping-off disease	**	**	Medium
Lack of high-yielding variety	***	***	High
Yellow leaf disease (?)	*	**	Low

1. Ranking based on yield loss and temporal and spatial occurrence of the problems: * = low, *** = very high importance.

Table 2. Single-factor diagnostic experiments for groundnut on-farm research in Nepal.

Type of experiment	Treatment	Purpose
Seed dressing with fungicides	Thiram + Vitavax (50:50) 3 g kg^{1} (just before sowing)	To determine whether seedling disease is a constraint
Seed dressing with insecticides	Chlorpyriphos (12.5 mL kg^{-1} seed)	To determine whether soil insects (white grubs) reduce plant stand
Rhizobium inoculation	New culture of NC 92	To see if *Rhizobium* can improve pod yield, particularly in rice fallows
Foliar diseases control	Daconil® (chlorothalonil) 50-60 days after sowing or when around 10 spots $plant^{-1}$ appear	To determine whether foliar diseases are a constraint
Insect pest control	Folithan/Sumithion® 0.5% at 40 days or when insects present	To determine whether insect pests are a problem
Micronutrient spray	Tracel® spray, 30 days after sowing	To determine whether micronutrient deficiency reduces yield
Optimum seed rate (plant population)	60 kg ha^{-1}; 40 x 20 cm spacing	To observe the effect of plant population on pod yield
Gypsum application	400 kg $ha-^{1}$ at peak of flowering with second weeding. Placed near the base of plants on both sides of a row	To determine the role of gypsum in pod filling and pod yield

government authorities to consider how to alleviate the socioeconomic constraints faced by farmers.

Planning meetings

Planning meetings were held in each of the project countries, usually after the diagnostic surveys, and involved the survey team members and administrators, extension staff, and research scientists from the national program. The participants reviewed existing information, and documented the available technology and current ideas as to solutions. The farmer-identified constraints were matched with the available solutions and technology options, and plans were prepared for both on-farm research and supportive back-up work in research stations. Most of the on-farm trials planned were single- or two-factor diagnostic experiments (Table 2). In Indonesia, however, the

NARS scientists were of the opinion that they had some of the technology options needed, and these were combined into sets of production packages and compared with farmers' practices.

On-farm research

The on-farm research in each country followed a farmer-participatory approach. The extension staff and scientists discussed the diagnostic experiments with the farmers and explained the rationale behind the selection of each factor; and they ensured farmer input into the trial design and management. The farmers agreed to implement and manage the individual trials. Research scientists' inputs were to monitor the progress of trials, and to provide timely advice and suggestions on the operations to be undertaken.

On-station research

Whenever the identified production constraints were complex and needed controlled experimentation, experiments were proposed to be conducted by scientists before the farmers tested the technology package. These back-up research plans included, for example: identification of suitable pre- or post-emergence herbicides, determination of the optimum need-based fertilizer requirements for different soils, optimum plant populations for different areas, optimum irrigation schedules, etc. In some cases, the long-term back-up research included varietal development and identification of suitable varieties for different locations/situations.

Results

In countries where single-factor or two-factor diagnostic trials were conducted, the treatment factors that showed consistent yield advantages were combined into sets of improved practices, and then compared with farmers' practices. The national program scientists in Nepal have formulated packages of improved practices for groundnut, chickpea, and pigeonpea. The Vietnamese scientists will formulate the packages after considering the 1993 results. Results from trials in Sri Lanka have not been consistent, and the trials are being repeated. In Indonesia, farmers' practices were compared with both low-input and high-input packages of practices. Average groundnut yields for 1991/92 are shown in Table 3.

During 1993 the Indonesian scientists tested the improved package on a large scale (about 25 ha) to disseminate technology more widely in the village and in nearby villages.

Table 3. Groundnut yields in farmers' fields in Indonesia, 1991/92.

Target district	Yield (dried pods, t ha^{-1})			Yield increase (%) from	
		Improved production			
	Farmers' practices	Low-input package	High-input package	Low-input package	High-input package
Tuban	1.24	1.46	1.94	17.8	56.5
Subang	1.23	1.56	1.62	26.8	31.7

Future plans

We realize that on-farm research is an important activity for the network. However, there are limitations on staff and resources from NARS and the AGLOR Special Project. Therefore, we would like to have your views on how we should proceed with this activity to obtain the best possible results from past and future inputs. Some possibilities could be:

- To provide support for large-scale testing of legumes production technology in Nepal and Vietnam;
- To request Indonesian NARS to take over the development-oriented activity to popularize the improved production technologies;
- To extend the project to one or more new countries.