

E C O N O M I C S

Working Paper 93-01

# **Institutionalizing the Role of the Economist in National Agricultural Research Institutes**

Derek Byerlee and Steven Franzel



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**C I M M Y T**

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# **Institutionalizing the Role of the Economist in National Agricultural Research Institutes**

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## Contents

<b>Page</b>	
iv	Tables
iv	Figure
v	Abstract
vi	Preface
1	Introduction
3	Evolution of the Role of the Economist in Agricultural Research Institutes
4	Relevant Research Activities of Economists in Agricultural Research Institutes
7	Developing Effective Multidisciplinary Research Programs
10	Additional Activities of Economists in Agricultural Research Institutes
11	Lessons for the Successful Institutionalization of Economics as a Discipline in Agricultural Research Institutes
16	Conclusions
18	Annex A. Evolution of Economists in Agricultural Research Institutes in Industrialized Countries
20	Annex B. Development and Achievements of Economists in Agricultural Research Institutes in Pakistan
25	Annex C. Economists in the Institute of Agricultural Research, Ethiopia
30	References

## Tables

### Page

- 2 Table 1. Examples of recent status in social science capacity in national agricultural research systems, late 1980s
- 5 Table 2. Potential research areas and clients for economists in national agricultural research institutes
- 22 Table B1. Comparison of profitability (rupees/ha) of farmers' technology and the recommended package of technology, Swat, Pakistan
- 27 Table C1. Labor requirements for the recommended weeding practice versus the farmers' weeding practice during the peak labor period, Bako area, Ethiopia, 1985-86
- 29 Table C2. Impact of different product price assumptions on profitability of fertilizer, Ethiopia, 1984-87

## Figure

- 23 Figure B1. Schematic representation of factors affecting wheat planting in the cotton-wheat rotation, Punjab, Pakistan

## **Abstract**

The evolution of the role of economists in agricultural research institutes (ARIs) over the past two decades is described. A framework for determining relevant research activities for economists in ARIs is presented, with emphasis on the need to develop multidisciplinary research programs in close collaboration with commodity/ disciplinary researchers from the agricultural sciences. Several guidelines for the successful institutionalization of economics as a discipline in ARIs are provided: 1) establish a separate economics program under strong leadership; 2) conduct joint interdisciplinary research projects among departments; 3) the principal orientation of the research system should be to solve farmers' problems; 4) mutual reliance among technical scientists and economists should be fostered; 5) economists should specialize in a particular commodity or farming system; 6) economists must maintain a strong farmer and field orientation; 7) research methods must be simple and results reported rapidly; 8) expatriate advisers can play an important role in the growth of economic research in ARIs. The paper concludes with two annexes, which are case studies of the experiences and achievements of recently created economics programs in ARIs of Pakistan and Ethiopia.

## **Preface**

**This paper grew out of our experiences of several years of helping to build social science capacity in the agricultural research systems of Pakistan and Ethiopia. We believe that these experiences showed that social scientists can play a valuable role in making agricultural research more effective in developing appropriate technologies for small farmers. Annexes B and C provide background and examples from Pakistan and Ethiopia, respectively. More details are given in the books edited by Byerlee and Husain (1992) and Franzel and van Houten (1992).**

**In the body of this paper, we try to synthesize, from our experiences, the role of social scientists in agricultural research institutes and some lessons on how to realize this role most effectively. Many national agricultural research systems are struggling to build a social science capacity. We hope the guidelines provided here will help research managers and social scientist themselves to define and implement strong and truly interdisciplinary research programs.**

# **Institutionalizing the Role of the Economist in National Agricultural Research Institutes**

Derek Byerlee and Steven Franzel

## **Introduction**

Agricultural economists and other social scientists have always had a tenuous existence in Agricultural Research Institutes (ARIs), both in developed and developing countries. Although the principal objective of ARIs is quite clear — the generation and diffusion of improved technologies for use by farmers — the role of economists in this process has not always been readily apparent. Until recently no economists were on the staff of most ARIs in developing countries. For example, in a 1986 survey of ARIs in rice-growing areas of Asia, 65% of the ARIs were found to have no economists and 15% had only one (Flinn and Ranaweera 1987). Even in those few ARIs with economists, there is often a lack of appreciation by technical scientists, research managers (nearly always from technical science disciplines), and even the economists themselves (mostly newly recruited) of their potential role in the technology generation process.<sup>1</sup>

During the 1980s there has been a rapid increase in the number of economists working in the national agricultural research systems (NARSs) of developing countries (Table 1). Much of this increase has been associated with the implementation of Farming Systems Research (FSR) programs (in many cases donor funded), although the example of the international agricultural research centers (IARCs), where economists and other social scientists make up about 5% of the research staff<sup>2</sup> and where their role is now well established, has also played a part.

The number of economists in ARIs has increased substantially in recent years. Most of these economists are young and inexperienced relative to the established technical scientists at these institutes; thus, even though their numbers are increasing, their productivity and perhaps their very futures are still jeopardized by uncertain funding (dependence on donor support), the lack of a clearly defined role, and a lack of seniority in the system. In a recent assessment of disciplinary capacity in 64 NARSs by CIMMYT staff, social science received by far the lowest ranking of the four disciplines surveyed (plant breeding, crop protection, agronomy, and social science). Only 17 NARSs were rated as having a sustainable capacity to make an effective social science contribution to the research program, and 25 had zero or negligible capacity.

The purpose of this paper is to discuss the role of economists in ARIs and provide guidelines for the integration and institutionalization of economists in the research programs of ARIs. We begin by examining the evolution of the role of economists in

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<sup>1</sup> In this paper we use the term "technical scientist" to refer to scientists from physical sciences (e.g., agricultural engineering and irrigation) and biological sciences (e.g., plant breeding and animal husbandry).

<sup>2</sup> Excluding the institutes charged with policy research (the International Food Policy Research Institute) and support to national agricultural research systems (International Service for National Agricultural Research), which are staffed largely by social scientists.

ARIs. Next, we present a conceptual framework for identifying relevant research activities for economists in ARIs, focusing on the need to develop multidisciplinary research programs in close collaboration with commodity/ disciplinary researchers from the agricultural sciences. Finally, we present some key lessons for building an effective economics research capacity in ARIs. Two annexes provide case studies of the experiences and achievements of recently created economics programs in ARIs of Pakistan and Ethiopia.

Although the paper focuses on economists in agricultural research, the discussion provides a broad framework for viewing the role of all social scientists, whether they are agricultural economists, rural sociologists, geographers, or anthropologists. In the foreseeable future, most research institutes will have a very low ratio of social scientists to technical scientists. These institutes will not be able to afford to define a distinct role for each social science discipline, although sociologists and anthropologists can and should contribute their own disciplinary skills to the establishment of an effective social science program (Tripp 1985, Rhoades 1984, IRRI 1982).

**Table 1. Examples of recent status in social science capacity in national agricultural research systems (NARSs), late 1980s**

Region/country	Capacity in NARSs
<b>Latin America</b>	
Guatemala	Pioneer in integrating social scientists into on-farm research (OFR) teams.
Panama	Had six economists in 1987. Has moved from budgetary/ planning activities into OFR.
Costa Rica	Newly established economics unit in agricultural research service.
<b>Asia</b>	
Pakistan	Recently hired more than 20 economists and sociologists based at five major research stations. Mandated to conduct interdisciplinary research on technological issues.
India	Recently posted more than 50 economists to regional and zonal research stations to conduct interdisciplinary research. Also cropping systems program is recruiting more than 25 economists to participate in cropping systems research.
<b>Africa</b>	
Ethiopia	Number of economists increased from 2 in 1977 to 15 in the late 1980s. Fully institutionalized into research planning and technology evaluation. Strong central leadership.
Kenya	Number of economists increased from 3 in 1976 to 14 posted to 8 research stations. High staff turnover.
Tanzania	By 1987, 16 economists were working in farming systems research projects at each station.

Source: CIMMYT staff (personal communication).

## Evolution of the Role of the Economist in Agricultural Research Institutes

The issues involved in institutionalizing the role of economists in ARIs are not unique to developing countries, nor can they be considered a problem only of recent years. A brief review of the role of the economist in agricultural research in industrialized countries (Annex A) shows how farm management in the US and Europe has moved away from the strong orientation to problem-solving and multidisciplinary collaboration that is needed for the analysis of technological issues in whole farming systems (Barker and Whyte 1983). In developing countries, the IARCs have demonstrated the role that economists and other social scientists can play in the technology generation process, as well as in the development of methods for effective participation in this process.<sup>3</sup> Most of the early work of economists in IARCs was farm-level research that had the specific objectives of designing technology and evaluating and measuring adoption. This work contributed to the approaches and methods of FSR, which were widely implemented in NARSs in the late 1970s and the 1980s. Economists at IARCs have also taken on a broader range of activities related to the allocation of research resources, consequences of technology adoption, and policy-related issues (e.g., Ryan 1984, Barker 1981).

With the exception of a very few countries such as Brazil and Guatemala, social science departments were not established in ARIs of developing countries until the 1980s. In part this reflected the western training of many agricultural economists. Their education had focused on production economics and farm management tools that had lost much of their applicability to the multidisciplinary, problem-solving approaches needed for economists to participate effectively in technology generation (Annex A). The micro-level tradition of agricultural economists, especially in the 1960s and 1970s, reflected an emphasis on farm planning for individual farms. But this approach was not cost-effective in the context of the multitude of small farms of developing countries (Collinson 1981, Eicher and Baker 1992), especially when it was recognized that improved technology rather than reallocation of resources was the main vehicle for improving small farmers' productivity (Schultz 1964).

Even where economists were involved in generating technology, they were usually engaged in a "reactive role," evaluating technology after its development. A good example of a well-meaning agronomist's view of the role of the economist in technology generation is found in Cocks' (1979) description of the activities of economists and agronomists in the ideal world of "Bongoland." Cocks assigns economists the tasks of evaluating the profitability of the technology and exploring the market potential for the increased production, but no role in designing the technology.

A role for economists in technology generation in the design stage was explicitly recognized with the development of the farming systems approach to research in the late 1970s. The increasing emphasis on small farmers and the early experiences of the

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<sup>3</sup> Beginning in the mid-1960s, the first economist was posted to the International Rice Research Institute. Since then all IARCs have established economics research activities aimed at technology generation and diffusion.

IARCs and NARSs (Norman 1980, Hildebrand 1976, and Zandstra et al. 1979) gave the approaches and methods of FSR a natural appeal among donors and NARSs. By the mid-1980s almost all countries had implemented FSR projects in one form or another. Since one of the essential characteristics of FSR was the establishment of a multidisciplinary approach to research, involving teams of both technical and social scientists, many ARIs were encouraged for the first time to hire economists. For example, from less than two economists in the 1970s, there are now 15 or more economists each in the ARIs of Kenya, Ethiopia, and Tanzania, and over 25 in Pakistan (Table 1). Even in India, where many economists have always worked in the university research system but where the tradition of multidisciplinary research with technical scientists has been limited (Flinn and Ranaweera 1987), recently economists have been hired for a number of new regional research stations, for the explicit purpose of participating in technology design and evaluation (Rastogi 1983).

Another trend in NARSs, especially in Latin America, has been to hire economists in the central office to participate in planning and budgeting for the whole national research system. This trend is partly a result of the increasing accountability required of those who allocate resources to agricultural research, and partly a result of declining real budgets in some countries. It also reflects the increasing number of NARSs that are headed by economists, another new development of the 1980s. In 1989 the NARSs of Argentina, Colombia, and Mexico were all headed by economists, although in no case did they reach this post from a career within the institute.

### **Relevant Research Activities of Economists in Agricultural Research Institutes**

The basic objective of an ARI is to develop, test, and disseminate improved technologies to help increase productivity in the agricultural sector and to improve the welfare of farm households. Economists located in a research institute therefore should organize their work to contribute directly to this objective. Research activities and methods of economists in ARIs will often be quite distinct from the more conventional policy-oriented or disciplinary research that usually is conducted in specialized economics research institutes or universities.

Table 2 presents a framework for viewing the potential research areas of economists in ARIs and the clients for each area, both within and outside the institute. Research areas are presented under two broad categories:

1. Research aimed at improving the *internal efficiency* of research in producing the technology — that is, providing information and analysis to ensure that research resources are expended effectively to develop appropriate, improved technology.
2. Research aimed at the *external efficiency* of research systems in technology utilization — that is, providing information and analysis to help remove constraints that impede or slow the utilization of appropriate, improved technology at the farm level.

In the internal efficiency category, the most important function of an economist is to help involve farmers in the research process and to bring a farm-level economics perspective to research. This was the major motivation for the development of the FSR approach in recent years. Relevant activities of economists in FSR include:

- 1) conducting diagnostic surveys to help plan commodity and disciplinary research;
  - 2) actively participating in the implementation of on-farm trials;
  - 3) increasing the participation of farmers in the design, implementation, and evaluation of on-farm or on-station trials;
  - 4) carrying out economic analyses of experimental results; and
  - 5) monitoring farmers' adoption and experiences with the new technology.
- Each of these activities aims to improve the chances that the technologies developed will be acceptable to farmers. The principal clients for the information generated by these farm-level activities are the institute's research scientists and managers. In addition, the economist has an important role in integrating information from various sources (e.g., farm-level surveys, secondary statistics, on-farm experiments), not only to develop appropriate technology, but also to address concerns of equity (who are the clients of

**Table 2. Potential research areas and clients for economists in national agricultural research institutes (ARIs)**

Research areas	Clients within ARI		Clients outside ARI		
	Scientists	Managers	Extension	Institutions affecting technology utilization	Policy makers
<b>A. Increasing internal efficiency of research system</b>					
1. Increasing farmer participation in research (conducting surveys, on-farm trials)	••	••	•	•	
2. Analyzing research resource allocation	•	••			
3. Documenting research productivity	•	••	•		••
<b>B. Increasing external efficiency of research system</b>					
1. Analysis of institutions affecting technology utilization (e.g., seed production, produce marketing)	•	•	••	••	••
2. Analysis of policies affecting technology utilization (e.g., prices)	•	•	•	••	••
<b>C. Subsector studies</b>	•	••	•	•	••

Note: •• indicates primary client; • indicates secondary client.

the research program?) and, increasingly, to incorporate environmental costs or so-called externalities into technology design and evaluation (e.g., possible downstream effects of soil erosion).

Improving the orientation of research toward the needs of small farmers is especially critical since often there are significant gaps in the relationship between researchers in developing-country research systems and small farmers. In some cases, these gaps arise from the cultural and educational backgrounds of researchers from urban areas, who have had little day-to-day exposure to the farm population or to the complexity of small farming systems and problems. In addition, farmer organizations in most countries either do not exist or cannot provide effective feedback on farmers' problems for setting research priorities.

Two other possible research areas for economists aiming at improving *internal* efficiency of the ARI are to conduct studies to 1) improve the allocation of research resources across commodities, regions, and target farmer groups to better meet the objectives of the ARI, and 2) document the adoption of new technology, assess its impact, and measure the returns to research investments. These activities will require less farm-level work, although they still require considerable multidisciplinary collaboration. The principal clients for these functions are research managers and policy makers responsible for broad decisions concerning the allocation of resources to agricultural research.

To contribute to the *external* efficiency of research, economists provide information and analysis to change the institutional and policy environment that constrains the use of new technology. One potential function for economists is to examine the organization and performance of institutions responsible for disseminating the technology, such as seed production, input distribution, extension, and product marketing. The principal clients for this information are the managers of these institutions as well as the policy makers who finance them. A second function of economists might be to conduct analyses of specific policies that limit technology adoption and dissemination, such as government-set input prices, product prices, or regulations restricting the movement of produce. Some of these analyses are based primarily on data from the farm level, such as an analysis of the effect of nutrient-specific fertilizer subsidies on the profitability and response to fertilizer use by farmers. Other analyses, such as those on output prices, depend heavily on macro-economic data.

Another possible activity of economists in ARIs (Table 2) is to conduct subsector background studies focused on a single commodity or group of commodities. These studies describe processes and trends in the subsector, extending from input use to final consumption, and examine the policy and institutional environment influencing these processes and trends. Subsector studies need not (and often will not) be aimed at solving a specific problem; rather, they aim to provide a general understanding of important trends in the subsector for all persons responsible for improving its performance, including agricultural researchers, research managers, extension staff, policy makers, and staff of other organizations affecting the subsector (Shaffer 1980). Thus subsector studies can help to formulate an overall strategy for development of the

subsector and contribute to improving *both* the internal and external efficiency of research.<sup>4</sup> Subsector background studies are especially important for ARIs when a commodity or region is changing rapidly changes due to demand or supply factors or policy reform, and when these changes may have important implications for the research strategy for that commodity.

In deciding how to allocate their time and resources among this broad range of potential activities, economists in an ARI must assess their own comparative advantage relative to economists working in specialized economics research institutes, extension services, policy analysis units, and universities. The comparative advantage of economists in ARIs arises out of three major opportunities:

1. The potential for interaction with technical scientists in the research institute, and hence the ability to acquire technical (e.g., agronomic) skills and knowledge critical for conducting multidisciplinary research.
2. The opportunity for close contact with farmers in the course of planning, testing, and verifying improved technology.
3. The opportunity to specialize in particular commodities or farming systems that are the mandate of the institute and, hence, the potential to integrate a broad range of information on those commodities or systems.

These factors give economists at research institutes a strong comparative advantage in functions that improve the internal efficiency of research, especially activities that increase farmers' participation in developing and disseminating new technology. They also provide a comparative advantage in conducting farm-based studies examining the performance of organizations and policies that have a direct impact on the dissemination of technology (e.g, input supply). However, the factors listed above provide less of an advantage for macro-policy analyses, such as studies of price policy, trade, or consumption issues. In fact, the location of ARIs away from national-level policy makers and sources of secondary data is in many cases a disadvantage for macro-policy analysis.

### **Developing Effective Multidisciplinary Research Programs**

To participate effectively in the process of technology design and evaluation, the first priority of an economist in an ARI must be to develop strong multidisciplinary collaboration. This task is not easy because of the different orientation and training of technical scientists and economists. Technical scientists tend to focus on narrow,

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<sup>4</sup> For example, in a study on the coffee subsector, information on export markets for different qualities of coffee may be important to assist coffee breeders to develop varieties that meet market preferences, thus improving the internal efficiency of research. Recommendations on price policy aimed at rewarding farmers for higher quality coffee may increase the adoption rate of these newer varieties, thus enhancing the external efficiency of research.

well-defined problems, giving less attention to the context in which those problems must be solved. Economists, on the other hand, tend to be more holistic and to integrate a wider range of information, especially the socioeconomic context in which problems must be solved. However, economists often do not develop sufficient knowledge of the technical dimensions of the problem.

In our experience, it is easier to initiate multidisciplinary collaboration at the stage of technology verification and evaluation. However, at this stage it is often too late to make changes to the research program that would result in a technology more consistent with farmers' circumstances. Hence the challenge is to involve the economist in research projects gradually, from the initial design stage.

Effective involvement of economists in technology design and evaluation requires a considerable amount of work across disciplines. Flinn and Denning (1982) distinguish two types of cross-disciplinary approaches: 1) multidisciplinary, in which individuals from different disciplines establish common objectives but conduct essentially separate disciplinary subprojects, and 2) interdisciplinary, in which disciplines work as a team and make key decisions jointly at each stage of the research project. We believe that the interdisciplinary approach is often needed in research aimed at the development of improved technologies.

Experience in many national research programs has shown that an effective approach to establishing interdisciplinary cooperation in the development of new technology is on-farm research or farming systems research (e.g., Byerlee, Collinson et al. 1982, Tripp et al. 1990, Simmonds 1985). The farming systems perspective implies that problems will be diagnosed and appropriate solutions selected in the context of the whole farming system, by considering both physical interactions (e.g., crop rotations or fodder use of crop residues) and socioeconomic interactions (e.g., resource competition or multiple objectives of farm families). By working in farmers' fields, a neutral ground away from the experiment station and office, the technical scientist, the social scientist, and the farmer arrive at a common understanding of the problem.

The strong base the economists have developed in farming systems research is now being increasingly employed in designing technologies for natural resource management. At the diagnostic stage, economists can help technical scientists to define their research programs by eliciting and explaining farmers' decision making processes and strategies for managing their resource base (Fujisaka 1991). *Ex-ante* analysis of resource-conserving technologies — for example, determining the maize yield increase required to cover the costs of establishing and maintaining alley cropping systems — is also important for setting research priorities (Swinkels, Muturi, and Franzel 1992). In designing technology interventions to address sustainability, an additional issue is how to use policy and institutional processes to create incentives for farmers to make decisions that are beneficial to them and consistent with societal objectives (e.g., in the management of community research).

While the role of the economist in on-farm research is now well established and generally widely accepted, the economist's role in on-station research aimed at developing new technologies is still not well defined in most ARIs. One obvious way of improving this situation is to develop better links between on-farm and on-station research — poor links are a weakness in many research programs (Merrill-Sands et al. 1989). Feedback from on-farm experiments, surveys, and visits by farmers to trials on the experiment station can provide valuable information to station-based researchers in defining problems and developing solutions (Sperling 1988). For example, on-farm experimentation often provides unique information on varietal performance under farmers' management and on farmers' assessment of a variety's maturity, palatability, home processing quality, storability, and so on. Such information is important for defining breeding priorities and conditions under which promising varieties should be evaluated (e.g., fertility, planting date, etc.); however, this type of feedback is often limited by the separation, both institutional and physical, of on-farm research and commodity research programs.

In the long run it is desirable that economists have more direct collaboration with on-station scientists independently of the feedback from on-farm research. Diagnostic surveys can be as important in setting priorities for on-station research as they are for on-farm research. For example, special surveys may be done to help estimate weights for pest losses for the purpose of setting plant breeding priorities (e.g., Galt 1977, Ruiz de Londoño et al. 1978).<sup>5</sup> There are also considerable opportunities for economists to participate in the evaluation of on-station varietal trials, especially the stability of varietal performance and the potential trade-offs between yields and risks (Anderson 1974, Barah et al. 1981). Finally, economists have begun to analyze plant breeding as an economic process that has well-defined inputs and outputs and that can make use of a range of alternative techniques (Brennan 1989). Since about half or more of the resources of most commodity research programs are invested in plant breeding, this type of work has considerable potential to improve the efficiency of commodity research programs. However, such work will require economists to develop an even stronger understanding of biological processes, and close collaboration with plant breeders.

Interdisciplinary collaboration of economists and technical scientists is not easy to achieve. The economist usually is a late-comer to the research team at an ARI and often has difficulty in inserting him/herself into ongoing research activities, especially where technical scientists and research administrators have serious doubts about economists' role (Maxwell 1986). The economist is also often more junior, less experienced and less well-trained for the job at hand than the technical scientists who generally lead the research projects. In addition, in examining farmers' assessment and adoption of new technologies that have not been fully successful, the economist is often seen by the technical scientist as a critic. Whereas technical scientists tend to blame lack of adoption

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<sup>5</sup> While these surveys may be undertaken as part of an OFR program, the research domain of a breeding program is often much larger than that of an area-specific OFR program and thus justifies larger, more specialized surveys. In some cases where OFR programs are operating in several areas, it may be possible to aggregate the results for the purpose of setting breeding priorities (e.g., Byerlee, Heisey, and Hobbs 1989, Edwards et al. 1988, Haugerud and Collinson 1990).

on poor extension, lack of inputs, or price policies, economists more often find fault with characteristics of the technology itself. Finally, the policies or administrative procedures of the research system often do not reward interdisciplinary work. Many economists still see their professional rewards in providing policy advice or publishing journal articles rather than undertaking the very specific research tasks most useful to an ARI.

### **Additional Activities of Economists in Agricultural Research Institutes**

A common activity of economists, aside from their role in technology development, is documenting the impacts of the research system to support research administrators' requests for continued funding. Most often this work involves measuring the adoption of technology at the farm level, although there is increasing emphasis on formally estimating the returns to investment in agricultural research. Formal studies of returns to research require a fairly high level of analytical skill that is often beyond the capacity of the relatively junior economists posted to ARIs. However, many ARIs are now requiring more rigorous analysis of research impacts, and the number of formal economic studies of costs and benefits of agricultural research is increasing rapidly (see, for example, Karanja 1990, Macagno and Gómez Chao 1992, and Morris, Dubin, and Pokhrel 1992).

The analysis of research resource allocation within and across ARIs became an important activity for many research programs in the 1980s. Formal methods for this type of analysis are available (e.g., Scobie 1984, von Oppen and Ryan 1985, and Davis, Oran, and Ryan 1987), although with some exceptions they have not been applied widely by ARIs. Recently economists in some NARSs have undertaken system-wide analyses of research resource allocation using formal economic methods (e.g., Norton 1987). As budgets in many research systems become more restricted, it is likely that this activity will increase.

Finally, economists in ARIs may have a role in policy-related research. In agricultural research, it is always a dilemma to decide how much a technology should fit the policy environment, and how much effort should be made to change policies to fit the technology. In the past, economists schooled in the FSR approach probably have been too conservative in assuming that the policy environment is fixed. Often this assumption imposes undue constraints on the kind of technology that can be developed (e.g., technologies cannot require inputs that farmers cannot obtain), when the more appropriate approach might be for economists to conduct research with the aim of changing policies (i.e., making the appropriate inputs available).

Nonetheless, given the early stage of development of most economics research in ARIs, the involvement of ARI economists in policy-oriented work must be considered carefully, largely because their comparative advantage lies in activities that aim to improve the internal efficiency of the ARI. In addition, policy analysis will often require somewhat different analytical skills than the multidisciplinary work discussed

above, in which familiarity with the technical aspects of crop and livestock production and farmer circumstances are more important. However, as on-farm research programs become established in different production zones of a country or region, the information that is assembled on local farmers' circumstances and technological responses under farmers' conditions can be used to construct a unique database. This database can be valuable in analyzing policy issues to support the adoption of improved technologies (e.g., Franzel, Colburn, and Getahun 1989, Martínez, Yates, and Sain 1991, and Byerlee, Heisey, and Hobbs 1991).

The comparative advantage of economists in ARIs diminishes rapidly in moving away from policy analysis based on farm-level data toward macro-policy analysis. In our judgement, economists in ARIs have little comparative advantage in undertaking marketing studies, except those aimed at defining desirable varietal characteristics (e.g., grain quality, storability) that may be critical to plant breeding decisions. Nonetheless, because of the long-term payoff to much agricultural research, an understanding of long-term trends in commodity supply and demand is often important in setting research priorities. For this reason some programs give more emphasis to commodity sector analysis (e.g., Morris, Alvarez, and Espinoza 1990), although such studies are best undertaken in collaboration with economists from other institutions having a comparative advantage in macro-policy analysis and closer ties with policy makers.

### **Lessons for the Successful Institutionalization of Economics as a Discipline in Agricultural Research Institutes**

For reasons discussed above, simply placing economists in a research institute usually will not produce an effective interdisciplinary research program that contributes to the overall objectives of the institute. The most likely result is that the economists will become isolated and develop a research program that differs little from traditional economics research in universities or specialized economics research institutes (Maxwell 1986). The experiences of establishing capacity in economics in ARIs in Ethiopia and Pakistan, discussed in Annexes B and C, as well as numerous experiences from other countries, provide some valuable lessons for establishing a successful interdisciplinary economics research program in ARIs.<sup>6</sup> We summarize these lessons below in a series of rules.

#### **1. Separate economics program under strong leadership**

Since most economists are more junior than the technical scientists with whom they work, and since their role often is not appreciated initially by research administrators, the placement of junior economists in commodity- or resource-oriented research programs under the leadership of a senior technical scientist is usually unsuccessful, at least when economics capacity is first being established. A separate department provides a minimum critical mass for developing economics-related activities. The department head must play an important role in defining the program of work for

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<sup>6</sup> For similar lessons in an IARC, see Horton (1984).

economists, ensuring that they have the means for conducting the work, reviewing their research output, and negotiating with other department heads and research managers to facilitate interdisciplinary collaboration (see Annexes B and C). In addition, strong leadership is needed to protect the program from becoming the destination of research administrators' miscellaneous requests (for example, to compile data for a visiting donor review team or study the cost of production for the experimental dairy farm).<sup>7</sup>

The appropriate organizational structure will depend on many factors, including the number of social scientists and the size of the country. In a large country, such as Ethiopia or Pakistan, probably the best approach is to establish a central unit and post economists to the main research stations. The central unit would have the dual role of 1) coordinating and organizing network activities among the economists posted to the ARIs and 2) conducting research at the national level which would cut across commodities or regions (for example, studies on research resource allocation and impacts) (Staatz 1989). Without this central unit and leadership, experiences from countries as diverse as Mexico and Kenya show that an effective capacity in economics research is unlikely to be established.<sup>8</sup> In a small country, there probably will not be a sufficient number of economists in the foreseeable future to follow this model. Rather than distribute a few isolated economists around the country, it may be better to have one central unit to serve needs of all research stations. While this alternative is likely to lead to weaker collaboration with technical scientists, it seems the only way to build a critical mass and reduce the very high staff turnover that characterizes many newly established economics programs.

## 2. Joint interdisciplinary research projects among departments

Most research projects of economists at ARIs should be prepared and executed with technical scientists. Only occasionally does the economist take on a specific topic within his or her own discipline. Institutional mechanisms are available to facilitate the preparation and implementation of joint research projects. For example, in Ethiopia the Institute of Agricultural Research 1) issued a formal document outlining the mode of collaboration between the departments of Agricultural Economics and Agronomy in conducting surveys and on-farm trials; 2) conducts annual planning meetings where researchers present their proposals and often are required to justify them in the context of farm survey results; and 3) encourages the head of each research station to ensure that members of different disciplines work together effectively at the field level. These measures have been facilitated by the strong commitment of the entire research system to a farming systems approach to research.

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<sup>7</sup> Leadership capabilities have much to do with personality. Nevertheless it is important to give persons in leadership positions detailed terms of reference that permit them to develop their leadership skills and to guide their staff (Franzel 1992).

<sup>8</sup> In the Institute of Agricultural Research, Ethiopia, interdisciplinary teams were formed within the Department of Agricultural Economics to ensure that interdisciplinary research took place. Once these teams succeeded in demonstrating the benefits of interdisciplinary research, the technical scientists joined their disciplinary departments and interdisciplinary research continued through interdepartmental collaboration (Franzel 1992).

Participation of technical scientists and economists in each other's training programs and workshops and seminars is also important in facilitating interdisciplinary research (Staatz 1989). Economists should seek opportunities to give presentations on their work at regularly scheduled commodity and disciplinary workshops. In addition, in many countries, economists have conducted workshops for agronomists on the economic analysis of experimental data, which has greatly facilitated an awareness of the economic dimensions of their work.

### **3. Problem-oriented research system**

The recommendation in favor of a separate economics program may appear to contradict the emphasis on interdisciplinary research. However, effective interdisciplinary collaboration is compatible with strong disciplinary or commodity departments when the *whole research system* has a problem-solving orientation — that is, the principal orientation is to solve the farmers' problems in a certain region or for a certain commodity, as opposed to serving the interests of a particular discipline. The research station manager, not the department head, should be responsible for accepting and rejecting scientists' research proposals in terms of the overall objectives and mandate of the ARI.

### **4. Mutual dependence among technical scientists and economists**

It is not sufficient that technical scientists and economists participate together in multidisciplinary activities; it is also necessary that they depend on each other's contributions for successful completion of their own work and achievement of rewards. In programs where economists' activities are restricted to conducting surveys, their dependence on other scientists for technical input into the surveys can create more problems than it solves. Rather, diagnostic surveys should be joint exercises by economists and technical scientists, who coauthor all reports. At the same time, economists should assist technical scientists to implement on-farm trials by selecting farmers; promoting farmers' participation in trial design, implementation, and evaluation; and conducting an economic assessment of the results.

### **5. Specialization**

An economist in a research institute needs to establish a speciality in a particular commodity or in a given farming system, and to develop the appropriate expertise as well as working relations with technical scientists in that speciality. This specialization contrasts with the general tendency of economists, which is to take on a variety of often unrelated activities or, worse, to specialize in a particular analytical technique and then look for problems to which the technique can be applied.

There are three major reasons why it is important for an economist working at an ARI to specialize. First, as pointed out earlier, most economists are initially more junior than their colleagues in the technical sciences, who are generally highly specialized; economists must develop expertise in a specific area to contribute constructively to

discussions of research priorities and experimental design. Second, the economist in a research institute should have a basic understanding of the biological processes in crop/livestock production, and this knowledge is developed more easily through specialization in a given commodity or farming system. Finally, effective interdisciplinary collaboration depends heavily on good personal relationships with fellow scientists. These relationships are easier to establish when economists work with the same scientists over a long time.

Because the number of economists is small relative to the wide range of activities mandated for ARIs, economists must choose commodities and farming systems carefully and work with only a subset of the technical programs. For example, in Pakistan (Annex B), where economists make up as little as one percent of the total number of researchers at one large ARI, a deliberate decision was made to focus on cereal and oilseed crops within specific cropping systems. In this way economists have established a certain credibility in those commodities and systems in which they specialize. Nonetheless, pressures from various sources have often led researchers to deviate from these priorities to look at the problems of minor but politically important problems or systems.

## **6. Strong farmer and field orientation**

The economist at an ARI, more than at any other institution, needs to be strongly oriented to field work. While sometimes an economist is viewed as solely an office-bound “number cruncher,” he or she — more than researchers in any other discipline — must spend a great deal of time in the field in contact with farmers. Economists who have intimate knowledge of local farmers’ conditions, combined with sensitivity to biological issues in crop or livestock production, are a valuable asset to the institute. As a general rule, economists, especially younger staff, should spend half of their time in field work, conducting surveys as well as on-farm experiments.

An important issue for economists is how to balance their field activities between survey work and the implementation of on-farm trials. The participation of economists in on-farm trials ensures that they become sensitive to biological and experimental issues critical for planning research and formulating recommendations, builds credibility among technical scientists, and fosters a mutual dependence between economists and technical scientists. However, as interest in on-farm research has increased, in some countries economists have tended to spend too much time in the day-to-day running of on-farm experiments, and they have lost their comparative advantage relative to technical scientists.

## **7. Need for simple and rapid research methods**

The economist at an ARI must adjust research and reporting methods so that the analytical procedures can be understood easily by the technical scientist and results are available in time to be incorporated into decisions on experimental design. This means that the use of disciplinary jargon, a particular fault of economists, must be minimized.

When disciplinary terms are used, they must be defined carefully. Likewise the economist must reform old habits of taking a year or more to analyze and report results of a farm survey. These requirements call for relatively simple research methods and well-focused farm-level surveys. Informal, rapid rural appraisals are ideal starting points for identifying farmers' problems and fostering interdisciplinary interaction among researchers. The widespread availability of microcomputers at ARIs in most countries has greatly sped data analysis and report writing.

This emphasis on simple analytical methods and rapid availability of results might appear to compromise economists' ability to contribute to their discipline. However, experience has shown the opposite. Economists can conduct additional analysis of data after preparing an initial report for the technical scientist or research manager. Furthermore, when a larger research project is carefully broken down into manageable pieces, a long-run research strategy can be articulated and pursued. The additional insight gained from close and frequent contact with farmers and a knowledge of biological responses often place an economist working in a research institute in a unique position within the discipline. Certainly the experience of economists at IARCs over the past two decades suggests that there are ample opportunities to contribute to the discipline and, in fact, to lead the way in developing theory and methods in the economics of agricultural research and technical change.

#### **8. Role of expatriate advisers**

Expatriate economists working in donor-assisted projects or IARCs can play an important role in the growth of economics research in the ARIs of developing countries, although advisers have not always been successful (Byrnes 1989). The primary objective of placing expatriate economists in ARIs should be to help ARIs build a capacity for economic research but not to conduct the research itself. A corollary is that the adviser should not usually serve a particular research station but should assist local economists at several stations. Advisers have an additional role to play in networking (e.g., promoting interaction among economists from different stations, or even neighboring countries, through workshops and study visits) and in training (e.g., organizing short courses for scientists). However, for this strategy to be effective, the long-term nature of institution building should be recognized. To improve the probability of success, both donors and advisers should make a commitment for at least five years.

## Conclusions

The number of economists and other social scientists in NARSs increased rapidly in the 1980s. Only a decade ago, few NARSs based any economists at ARIs. Now most NARSs are at least beginning to develop an economics capacity. However, both the number of economists and their experience are still very low relative to plant breeders, agronomists, and other technical disciplines at ARIs. A sustained effort is needed if economists are to become more effective partners in the process of technology development and dissemination.

The surge in interest in FSR during the 1980s provided an excellent opportunity for economists to work in a multidisciplinary setting in ARIs. The FSR approach also provided a set of methods that can be usefully applied at the farm level to diagnose constraints and to design and test appropriate technological interventions. This approach is broader than the farm management and production economics approach, which has a very limited problem-solving orientation in the context of agricultural research decision making. However, some of the tools of farm management, such as partial budgeting, have been adapted in the FSR approach and applied widely (e.g., CIMMYT 1988). Although interest in the term "FSR" has lessened in recent years, the principal characteristics of FSR (interdisciplinary team work and an orientation to farmers) and its main activities (diagnostic surveys and on-farm trials) have become important features of many ARIs. As less attention has been focused on FSR, more attention has been given to research on sustainable agriculture, with a strong orientation to conservation of the natural resource base. However, to be effective this research will need to draw on the methods and lessons of FSR (Harrington 1991, Tripp et al. 1990). The need to analyze the tradeoffs in natural resource management over the longer term will only add to the priority for building economics capacity in ARIs.

We have distinguished between the role of economists in improving the internal efficiency of ARIs (that is, ensuring that research resources are used more effectively to generate technologies), and their role in improving the external efficiency of ARIs (that is, providing information and analysis to remove institutional or policy constraints on the adoption of appropriate improved technology). The economists' role in improving internal efficiency — especially by increasing farmers' participation in research — is recognized more widely. However, other activities to improve internal efficiency, such as economic analysis of research resource allocation between commodity programs or between regions, are still in their infancy in most ARIs. Economists in ARIs should be cautious in allocating substantial resources to policy analysis, especially at the macro-level, where economists in ARIs appear to have little comparative advantage. However, we recognize that institutional and policy constraints are often a major impediment to the adoption of improved technology and that economists working at the farm level can provide valuable information that may help alleviate input supply constraints and institutional rules on the use of credit, irrigation water, etc.

The two case studies of NARSs discussed in Annexes B and C — Ethiopia and Pakistan — show that economics capacity can be developed in ARIs in the space of a few years, when there is a commitment on the part of research leadership. In both cases, economists already have played a useful role in validating technology on the farm, feeding back information to on-station research, and, in some instances, significantly altering research priorities. However, in neither case can economics as a discipline be regarded as fully institutionalized into the research system, especially in Pakistan.

We also provide some guidelines for the successful institutionalization of economics into ARIs. We recommend that economists be located in a separate disciplinary department but that most of their research activities be developed and executed jointly with technical scientists from other departments. In addition, individual economists will need to specialize in a specific commodity or target region. They will need to develop in-depth knowledge at the farm level in that speciality as well as to become familiar with the technical aspects of crop or livestock production. The use of simple, understandable research methods and quick turnaround of results are also critical to the success of economists working in ARIs.

Over the next decade, the role of economists in NARSs is likely to increase as research managers and those who fund research place greater emphasis on justifying research priorities and demonstrating impacts at the farm level. The development of economics capacity will require sustained support from research administrators and sometimes donors, as well as greater recognition within the agricultural economics profession of the contribution of multidisciplinary, problem-solving research.

## **Annex A**

### **Evolution of Economists in Agricultural Research Institutes in Industrialized Countries**

In the US in the early 1900s, farm management departments staffed by technical agricultural scientists emerged in several land-grant universities, in recognition of the need to develop teaching programs on the interrelationships among enterprises found on farms. By the 1920s, production economics was an important influence in farm management (Case and Williams 1957), and questions of appropriate farm technology were central to the orientation of farm management or production-related research (Dobbs 1987). In the post-World War II years, several holistic, multidisciplinary research and extension programs were launched with an emphasis on technology generation (Case and Williams 1957). However, by the 1950s, as the use of specialized analytical tools and quantitative methods increased, farm management was “looking more and more like a subfield of production economics...without the multidisciplinary breadth required to handle the problems...of technical, institutional and human change” (Johnson 1982).

The decline of holistic, multidisciplinary research occurred in part because 1) “the agricultural economics department made the mistake of confining the program (i.e., farm management) to its own turf” (Johnson 1982); 2) there was a tendency to focus on farm reorganization rather than on production technology, where collaboration with technical scientists was especially important; and 3) the emphasis on large farmers encouraged a brand of farm management that “emphasized production technology uncluttered with firm/household interrelationships” and other such topics (Johnson 1982). In addition, advances in computer technology and the application of econometrics and mathematical programming contributed to increasing disciplinary specialization among economists (Dobbs 1987). Thus in recent years farm management research has emphasized such issues as “what farmers ought to do, through use of techniques such as budgeting, program planning, etc.” (Gilbert, Norman, and Winch 1980) and has given little attention to physical and biological processes in crop or livestock production. The potential role of economists as synthesizers and integrators of data from a wide range of sources has not been realized in present-day farm management (Dobbs 1987).

Because of these developments, in the mainstream of agricultural economics in the US today little multidisciplinary work focuses on technology development, although economists in applied research and extension programs at regional research stations are still involved in technology generation.<sup>9</sup> In addition, an increasing share of applied and adaptive research in the US and other developed countries is done by the private sector, where scientists have strong financial incentives to develop technologies appropriate to farmers’ needs.

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<sup>9</sup> This research also tends to be reported in regional journals rather than the journal of the national association.

Uncertainty about the role of the economist in ARIs and problems in implementing interdisciplinary research abound in literature from Europe as well. Wragg (1970) laments the "virtual complete failure on the part of economists to exercise a strong decisive influence" in applied agricultural research in the United Kingdom. Cooper (1961), an agronomist, comments on the poor preparation of UK economists for work in ARIs, expressing doubt about the "active participation of economists in crop research unless they have other appropriate disciplines besides economics."

Most economists in developing-country ARIs received their graduate training in the US or Europe or used teaching materials derived from US and European farm management courses, developed at a time when farm management had shifted from an emphasis on technology generation and whole-farm analysis to applying specialized techniques to farm resource allocation. Thus the training of most economists in developing countries was inadequate to meet the needs of ARIs.

## **Annex B**

### **Development and Achievements of Economists in Agricultural Research Institutes in Pakistan**

#### **Background**

Agricultural research in Pakistan is largely the mandate of the four provincial governments. Each province has a research section within the Ministry of Agriculture and operates several research stations. In addition, the Pakistan Agricultural Research Council (PARC) was formed by the federal government in 1976 to coordinate research, as well as to conduct research that would complement work done at the provincial research institutes. Until 1982 only two economists (both under provincial employment) were located in ARIs, out of a total of more than 1,000 scientists. Economists in universities and specialized research institutes undertook modest levels of farm management research, but this work did not have a strong problem-solving orientation.

Recognizing the glaring weakness of economic analysis in technology design and evaluation, PARC undertook to develop a capacity in economics. In 1982 an agreement was signed with the World Bank to strengthen agricultural research in key areas; one of these areas was social science. Under the World Bank project, Agricultural Economics Research Units (AERUs) were set up in five major ARIs to provide input from economics into the process of technology development. In addition, PARC posted a small group of social scientists to its headquarters. Each AERU consisted of two to four economists (or, in two cases, sociologists), recruited by PARC. Since all but one of the five ARIs were under the provincial government, the economists based in the AERUs were funded and administered by a different organization (PARC). This arrangement added to the complexity of integrating the newly posted economists into the research programs of the ARIs. By 1987 a total of 20 social scientists, all with MS degrees, were posted to the five ARIs and to the PARC headquarters. Until quite recently, CIMMYT economists based in Pakistan collaborated actively with the PARC economists, providing both formal and informal on-the-job training.

#### **Establishing Multidisciplinary On-farm Research**

Since there was no precedent for economics research in the ARIs, the newly recruited economists had to establish a program of work and sell their product. At first they emphasized participation in the on-farm research activities being initiated in several areas, which focused on basic food crops. Hence they participated in a series of diagnostic surveys. Soon it became clear that the most important product of these diagnostic surveys was the identification of key system interactions (Byerlee and Husain 1992). In irrigated areas, for example, these interactions revolved around the increasing intensity of cropping and the compromises made by farmers in managing crops in the system. In rainfed and mountainous areas, crop-livestock interactions were often a major influence on crop management. These interactions were not widely appreciated by technical scientists in the commodity research teams, who had little incentive to look beyond their own commodities.

The most powerful mechanism for generating communication among researchers from several disciplines who worked with different commodities was the informal diagnostic survey. These surveys usually involved a team of 10 or more technical and social scientists; wherever possible, technical scientists were recruited from the commodity research programs to represent the major commodities in the system under study. The surveys usually lasted about one week. Each day the team would divide into groups of two to three scientists to visit a few villages where they interviewed farmers and observed their fields. The interviews were informal but followed a set of guidelines. After the daily field work, the whole team would meet to pool findings, discuss key constraints in the system and opportunities for increasing system productivity, and plan the next day's activities, including revision of the interview guidelines. The informal survey usually was followed by a formal survey, largely the responsibility of the economists, and on-farm experiments, mostly implemented by the technical scientists.

Because of the very low ratio of economists to technical scientists (1:175 at one ARI), the economists did not have the luxury of focusing on individual target regions but rather undertook diagnostic surveys over a number of often quite different farming systems (see Byerlee and Husain 1992). Consequently, the economists participated relatively little in the on-farm experimental program in each target area and had little influence on the content and implementation of on-farm trials. In one province, an annual meeting was held to plan on-farm trials and the economists participated actively in presenting results of formal surveys and discussing research priorities. In other cases, the results of the formal surveys were not always fully considered in trial design; however, the agronomists running the trial program were always involved in the informal survey.

The diagnostic surveys also provided useful information for on-station research programs, especially for varietal development, even though the only mechanisms for influencing the direction of on-station programs were written reports and informal exchanges with station scientists.

### **Examples of the Contribution of Economists to On-Farm Research**

#### **Maize research priorities in the Swat Valley**

Farmers in the Swat Valley and many other areas of northern Pakistan use somewhat unconventional maize production practices. They broadcast maize seed at a rate of three or four times the recommended rate, and then thin surplus plants, sometimes up to harvest time. After extensive demonstration programs were carried out in the 1970s, farmers adopted new varieties and moderate doses of fertilizer. However, the rate of adoption of the recommended practices of line planting, lower seed rate, early thinning, and insecticide was practically zero.

In the 1980s, extensive on-farm research with a farming systems perspective was initiated to resolve these issues. It was hypothesized that a major rationale for farmers' unconventional practices was the dual production of grain and fodder (provided by green maize thinnings and dry stover). The program therefore focused on quantifying

the relative importance of fodder production in the system and evaluating alternatives. By counting plants at regular intervals during the growing season and interviewing farmers about fodder fed to animals, researchers estimated that 45% of the total value of maize production was provided by fodder (Byerlee, Iqbal, and Fischer 1989). When the value of this fodder was taken into account, the farmers' traditional maize management system was found to be more profitable than the recommended system, even though the latter provided 1.5 t/ha higher grain yields (Table B1). An alternative system of planting separate plots for grain and fodder production was also found in on-farm experiments to be inferior to the farmers' system.

After considerable experimentation, an improved variety was identified which performed well under farmers' management and provided good grain and fodder yields. This variety was adopted by about 90% of the farmers in the villages where the research was conducted. This research had only a modest impact for farmers (the improved variety yielded some 10-15% more grain than the farmers' varieties). However, it helped set priorities for maize breeding (i.e., the need for varieties with good grain and fodder yields and an ability to tolerate high densities) and avoided further waste of resources on demonstrating inappropriate technology to farmers.

#### **Wheat varieties for multiple cropping systems**

Conflicts in management of crops grown in multiple cropping systems arise from increasing cropping intensity in irrigated areas. In the southern Punjab, cotton, a summer crop, and wheat, a winter crop, traditionally were planted in separate fields. However, with increasing supplies of irrigation water and earlier-maturing semidwarf wheats, double cropping of cotton and wheat became the norm. The diagnostic survey identified late planting of wheat after cotton as the major constraint in the system. The planting date for wheat could be related to a number of factors, such as cotton variety and management practices used on the preceding cotton crop (Figure B1). The key issue analyzed was the relative merit of seeking an earlier-maturing cotton variety versus earlier-maturing wheat varieties to alleviate the constraint of late planting. In general it was concluded that the major adjustment would have to be made in the wheat crop, although earlier-maturing cotton varieties were available. However, it appeared that farmers, especially small farmers, were reluctant to manage different wheat varieties

**Table B1. Comparison of profitability (rupees/ha) of farmers' technology and the recommended package of technology, Swat, Pakistan**

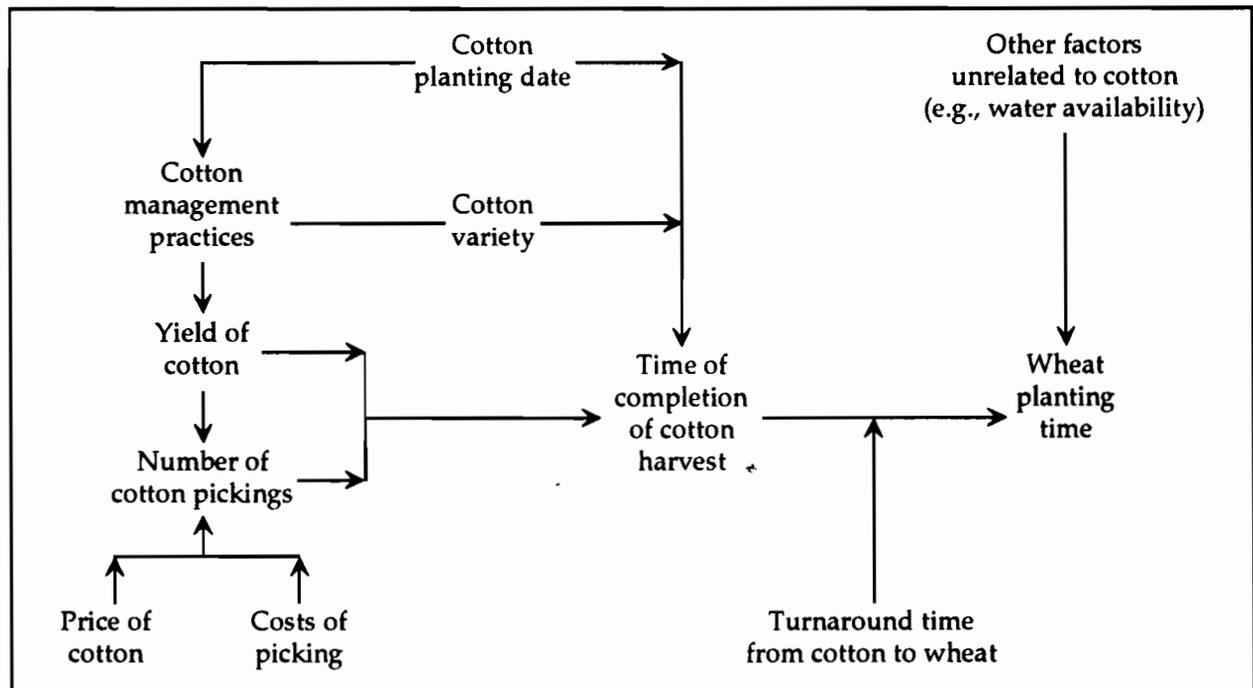
	<b>Farmer technology</b>	<b>Recommended package of technology</b>
Total variable costs	995	2,387
Gross revenue		
Grain <sup>a</sup>	5,320	7,315
Fodder <sup>b</sup>	5,000	3,000
Gross margin	9,325	7,928

Source: Byerlee, Iqbal, and Fischer (1989).

for different planting dates. They preferred wheat varieties that performed well over a range of planting dates. Partly as a result of this research, wheat breeders now give more attention to varieties that provide stable yields over a wide range of planting dates; a national trial has been implemented to screen varieties for performance at different planting dates.

### Impacts of mechanical harvesting

In two study areas, the potential for mechanical harvesting in wheat and cotton was under evaluation (Smale 1987, Shafiq, Longmire, and Sharif 1991). Economists, concerned about the possible employment impacts of mechanical technologies, conducted studies to assess the profitability for farmers and for the country of adopting mechanical harvesting and to examine the possible social impacts of labor displacement. For both studies the interview teams comprised male and female social scientists, who interviewed male farmers and harvest laborers. In the case of cotton, these laborers were all women, mostly from landless rural households. Two million persons were estimated to be employed annually in cotton picking. The study confirmed that the introduction of mechanical cotton harvesters would have major implications for these women, since their earnings from picking cotton constituted a significant share of total annual household income. One mechanical harvester was estimated to displace 500 women laborers, each of whom picks cotton for two months of every year. In addition, mechanical harvesting was not profitable from the viewpoint of the country, when account was taken of the overvalued exchange rate and credit subsidies. The results of this study led the breeding program to de-emphasize the development of cotton varieties suitable for mechanical harvesting.



**Figure B1. Schematic representation of factors affecting wheat planting in the cotton-wheat rotation, Punjab, Pakistan.**

Source: Byerlee, Akhtar, and Hobbs (1987).

## **Other Activities of Economists in Pakistan's Agricultural Economics Research Units**

### **Monitoring acceptance of research results**

Economists in the AERUs have come to play an important role in monitoring farmers' acceptance of research results and measuring the impact of research. The AERUs now conduct regular surveys that document the varieties grown in Pakistan's major cropping systems. These surveys not only measure adoption of new varieties, but also assess the impact in terms of greater productivity (Sharif et al. 1992). In some cases, these assessments have noted the lack of impact and have provided feedback to breeders on farmers' requirements. For example, wheat varieties recommended for the drier areas were not appropriate to farmers' requirements for straw production and grain quality.

### **Institutional and policy analysis**

Although the major activity of the economists in ARIs in Pakistan has been in on-farm research, especially diagnostic surveys, over time they have begun to initiate work in other areas. In particular, they have investigated policy issues constraining the utilization of available technologies. From the diagnostic surveys, it became clear that Pakistan's food security was threatened by the widespread planting of rust-susceptible wheat varieties. In wheat, rust pathogens continually evolve; under conditions in Pakistan, varieties need to be replaced on average about every five to seven years to reduce the risk of a large rust epidemic. The average age of varieties in farmers' fields was observed in diagnostic surveys to be more than 10 years, even though newer resistant varieties were being released almost every year.

Economists from the various ARIs collaborated in an integrated study of the factors leading to slow replacement of varieties in farmers' fields (Heisey 1990). This study consisted of an in-depth review of yield gains in wheat breeding, the performance of the seed industry, farmers' informal seed exchanges, farmers' criteria for selecting varieties, and the role of extension and other agents in diffusing information on new varieties. The results generated by this study provided a number of recommendations for improving the rate of uptake of new varieties by farmers. Many of these recommendations were discussed in annual meetings of wheat researchers, but a major constraint on utilization of the results was how to communicate the recommendations to the wider audience of decision makers in the seed industry, the extension service, and the statistical service responsible for collecting varietal information on a regular basis. This highlights one of the difficulties of economists in ARIs in conducting policy-oriented research — how to ensure that results of such research are used by decision makers outside of the ARI.

### **Concluding Comment**

Overall, much progress has been made in establishing an economics research capacity in ARIs in Pakistan. However, the low number of economists relative to technical scientists, their relatively junior status, and the placement of economists at ARIs under a different salary and support structure than the technical scientists with whom they work, have inhibited close interdisciplinary collaboration. In the future there is a need to strengthen economists' participation in research planning meetings, as well as to increase the farmer and problem orientation of the whole research system.

## Annex C

### Economists in the Institute of Agricultural Research, Ethiopia

#### Evolution

The Institute of Agricultural Research (IAR) was established as a parastatal in 1966 with the mandate to undertake and coordinate agricultural research in Ethiopia. In 1968, the Department of Agricultural Economics (DAE) was initiated with the appointment of an expatriate economist from the Food and Agricultural Organization (FAO) and an Ethiopian economist. The economists conducted farm management surveys aimed at recording and better understanding the stocks and flows of resources used by small farmers, but the research had little problem-solving orientation.

In 1978, the first multidisciplinary farm surveys were conducted. Major production constraints in two zones, Holetta and Bako, were identified and information on resource utilization was collected. These studies were used by the DAE to initiate a program to test packages of innovations in farmers' fields. The packages usually included improved varieties, fertilizers and rates, and modified cultural practices. However, the adoption of the innovations was low, and researchers felt the need for 1) survey methods that focused more on farmers' problems and opportunities and 2) greater farmer participation in the development and testing of new technologies. They also recognized that interaction between economists and researchers from other disciplines was limited and that the DAE had little influence on the research programs of other disciplines.

From this experience, on-farm research programs with diagnostic surveys and on-farm experiments were initiated in 1984 at two research stations (Nazret and Bako), with financial assistance from the International Development Research Centre (IDRC) and technical assistance from CIMMYT. The DAE hired agronomists to ensure that the on-farm research was interdisciplinary. Satisfied with the results of the program, IAR management decided to extend it to five additional research centers in 1985 and 1986 (Holetta, Awasa, Jima, Adet, and Sinana). In 1988, the two agronomists in the DAE were transferred back to the Agronomy Department, since it was realized that effective interdisciplinary collaboration across departments had been established.

By 1989, the DAE included one researcher at the MSc level, 11 at the BSc level, and one expatriate adviser. The principal activities of the staff were conducting 1) informal and formal surveys for planning experimentation; 2) special surveys to examine particular problems of farmers in depth, including marketing, peak-period labor use, and adoption of new technologies; and 3) on-farm verification trials.

By late 1989, 15 informal surveys, five formal surveys, and eight special surveys had been completed and written reports made available. Another 18 surveys, mostly special-purpose surveys, were underway. The number of on-farm trials grew from 7 trials at 33 sites in 1984 to 60 trials at 466 sites in 1989. About two-thirds of these were verification trials led by DAE staff, whereas the other one-third were trials organized

by other departments with the collaboration of DAE. In addition to the surveys and experiments, DAE economists were also involved in a number of other activities, including economic analyses of data from on-station and on-farm agronomic experiments.

The activities of economists influence the IAR and the farming community in several ways, as discussed in Franzel and van Houten (1992). Some examples are provided below.

### **Providing Breeders with Information on Characteristics of Needed Varieties**

In the Bako area of western Ethiopia, smallholders cultivate farms averaging 1.5 ha and maize is the most important crop. Previously maize breeders focused exclusively on the development of late-maturing varieties to take full advantage of the long rainy season. However, in 1985 survey results showed that family food shortages, just before the main maize harvest, were an important problem. After consulting with farmers, the survey team recommended that breeders develop an early maturing maize variety adapted to the area (Legesse et al. 1987). On-farm testing of early maturing maize varieties began in 1986, and in 1988 the variety that performed best, Guto, was released (Benti 1988). This variety is in great demand; farmers use it not only to avoid the food shortage but also for intercropping and double cropping. A survey of 89 farmers who had been given Guto seed for planting in 1989 indicated that farmer acceptance was high. Following the 1989 harvest, 78% intended to plant it in 1990 and 67% had reserved seed (Asfaw et al. 1990).

### **Providing Agronomists with New Information on Farmers' Problems**

In the Nazret area, smallholders cultivate farms averaging 2.6 ha. Principal crops include maize, teff (*Eragrostis tef*, a local cereal), sorghum, and haricot beans. Feedback from surveys and on-farm trials has led to new research directions and modifications of current recommendations concerning haricot beans. Farmers do not normally weed their haricot beans; surveys showed that, at the time when beans require weeding, farmers prefer to devote time to land preparation and planting for teff and to weeding maize (Tilahun and Teshome 1987). On-farm verification trials of improved haricot bean varieties revealed that farmers use high seed rates to suppress weeds. On-station experiments are now exploring the relationship between variety, seed rate, and weeding requirements. Researchers will use this information to propose new varieties and seed rates that increase yields and reduce weeding labor. Recommended seed rates have been adjusted upward, reflecting the effectiveness of high seed rates in suppressing weeds (Tilahun, Teshome, and Franzel 1990).

### **Providing Feedback to Researchers on the Performance of New Technologies**

Three examples below highlight the importance of verification trials in providing feedback to researchers on the performance of new technologies under farmers' conditions. Nazret researchers initiated on-farm verification trials of sorghum varieties

in 1984, but the improved varieties were destroyed by birds. Sorghum researchers had expected farmers to guard against birds, but this was not feasible given available labor. On-farm trials of bird-tolerant varieties were initiated, and in 1987 Seredo, the variety most appreciated by farmers for its low susceptibility to bird damage, was approved for release (Tilahun et al. 1990).

In Bako, economists conducted a verification trial comparing the center's weed control recommendation for maize, two hand weeding, with farmers' weeding practice, which involves hoeing, oxen cultivation, hand weeding, and slashing. There were no significant differences in yields between the two practices. Since farmers' own practices required lower labor inputs during peak periods than the Bako research center's recommended practices (Table C1), farmers strongly preferred their own practices (Legesse et al. 1987). These results led researchers to seek improvements in weed control that are more effective and at the same time compatible with seasonal labor constraints. An on-farm verification trial initiated in 1988 compares two herbicides with farmers' weeding practices; a second on-farm trial explores the effect of different oxen cultivation practices on weed infestation; a third on-farm trial assesses the effectiveness and acceptability of a manually operated wheel hoe.

Feedback from on-farm trials has also confirmed the appropriateness of some new technologies. For example, to address the dry season shortage of feed for livestock, permanent fodder legumes (Rhodes grass and *Desmodium uncinatum*) established in maize were tested with farmers. Results showed a high degree of farmer acceptance — the fodder intercrops had no negative effect on maize yields during the year of establishment, and fodder production was sufficient to partly alleviate feed shortages.

**Table C1. Labor requirements for the recommended weeding practice versus the farmers' weeding practice during the peak labor period, Bako area, Ethiopia, 1985-86**

Operation	Labor requirement (workdays/ha) <sup>a</sup>			
	Recommended practice		Farmers' practice	
	During peak period	Outside peak period	During peak period	Outside peak period
1st hoeing	28	0	28	0
2nd hoeing	28	0	0	0
Oxen cultivation	0	0	2	0
Hand pulling	0	0	14	0
Slashing	0	0	0	23
Total	56	0	44	23

Note: Data are averages of the two years.

a A workday is equivalent to eight hours.

## **Formulating Recommendations Appropriate to Small Farmers**

Throughout Ethiopia, economists have synthesized survey and on-farm trial results to formulate recommendations more appropriate to farmers in their areas. For example, in the Nazret area, on-farm fertilizer trials on maize were conducted between 1984 and 1986. In the wetter areas of the region, 46:46 N:P<sub>2</sub>O<sub>5</sub> kg/ha was found to be the optimal economic dosage. Fertilizer use was not found to be appropriate for the dry areas, because of the high risk of crop failure. The research also had important implications for policy makers — new types of fertilizer were required for the area so farmers could apply equal quantities of nitrogen and phosphorus.

## **Making Recommendations to Policy Makers**

The primary clients of DAE's work are IAR staff, but economists also make recommendations to policy makers. Survey reports are circulated to policy makers and informal discussions are sometimes held with them. For example, a survey of coffee-growing areas of Manna and Gomma Weredas, conducted at Jima Research Center in 1987, noted that communally held coffee farms were extremely inefficient and recommended that they be disbanded. Farmers were obliged to work as many as two days per week on these farms without compensation and consequently lacked time to manage their own farms properly (Kassahun, Franzel, and Tesfaye 1988). In 1988 the Ministry of Coffee and Tea Development announced that the common holdings would be abolished and the land redistributed to farmers.

Another IAR study examined the impact of grain marketing policies on smallholder production. The study used data from diagnostic surveys and other secondary sources. In the surplus producing areas of Ethiopia, farmers were required to fulfill grain quotas of the Agricultural Marketing Corporation (AMC); for these quotas they were paid prices well below prevailing local market prices. The study focused on the impact of fixed producer prices and quotas on farmers' incomes, fertilizer use, cropping patterns, and product quality. The impact of restrictions on market locations and on grain trade between areas was also examined. Concerning fertilizer use, the study reported that AMC prices needed to be increased to close to their import parity level in order to provide farmers with incentives to use purchased inputs for increasing production. Data from on-farm fertilizer trials showed that at AMC prices, fertilizer use was profitable at only 18% of the 72 trial sites (Table C2). At local market prices, however, fertilizer was profitable at 78% of the sites (Table C2). If prices were changed from AMC prices to local market prices, yields at optimal fertilizer levels would increase by 19% to 37%, depending on the crop. In 1990 the government ended the quotas and the fixed prices.

In the two examples given above it is not possible to assess the extent to which IAR's research reports actually influenced policy makers. Certainly, changes in global political alignments in the late 1980s had more to do with market liberalization and the breaking up of commonholdings than did the arguments of researchers. Nevertheless, it is known in some instances that policy makers used data from IAR reports in policy debates to support reforms.

## Synthesizing Information on Specific Commodities

Although most of the DAE's work was focused on the target regions or systems covered by the individual research stations, recently economists have begun to synthesize the results of OFR for a given commodity from several research stations (e.g., Franzel et al. 1989, Hailu, Franzel, and Mwangi 1989, Legesse, Mwangi, and Franzel 1989). These syntheses provide a broad overview of the status of technology adoption and research priorities for that commodity.

One of the most useful functions of economists is to provide the farmers' perspective at annual research proposal review meetings. At these meetings, researchers present their new proposals to a committee chaired by the research center or institute manager. These meetings are held at the research center, at the regional level, and at the national level. Each meeting is an important forum for promoting both discussion among disciplines and interdisciplinary research. Frequently the committee asks the economists to give their opinions on the relevance of a research proposal to farmers' problems and circumstances. Data from survey reports are often cited in these discussions. In many cases, prior to the meeting the researcher proposing the project has already consulted the economist on the relevance of the experiment and treatments to farmers' needs and circumstances.

The most important impact of economists in IAR concerns the information and feedback provided to center scientists in formulating their own research programs. In general, IAR scientists understand the role of diagnostic surveys and on-farm trials and use information from them in planning their research programs and experiments. Since 1984, the research of IAR scientists has become more focused on farmers' problems and on solving those problems in ways acceptable and feasible for farmers. Much of this change is a result of the adoption of the FSR approach, which entered the research system through the DAE and is now accepted widely at all levels of the research system.

**Table C2. Impact of different product price assumptions on profitability of fertilizer, Ethiopia, 1984-87<sup>a</sup>**

	Number of trials	Number of sites	Percentage of sites where fertilizer is profitable to farmers at AMC prices	Percentage of sites where fertilizer is profitable to farmers at market prices
Wheat	10	28	43	79
Tef	2	9	0	100
Maize	9	35	3	72
Total	21	72	18	78

Source: Franzel, Colburn, and Getahun (1989).

a AMC prices used in analysis are the revised prices, 1988. Local market prices are average annual market prices during the year in which the trial was conducted. Fertilizer treatments included various combinations of nitrogen and phosphate.

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