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Special Series on the Organization and Management of On-Farm Client-Oriented Research (OFCOR)

OFCOR — Comparative Study No. 4

LINKAGES BETWEEN ON-FARM RESEARCH AND EXTENSION IN NINE COUNTRIES

by

Peter T. Ewell

August 1989

International Service for National Agricultural Research

INTRODUCTION TO THE ISNAR STUDY ON ORGANIZATION AND MANAGEMENT OF ON-FARM CLIENT-ORIENTED RESEARCH (OFCOR)

Deborah Merrill-Sands
Study Leader

Introduction

In 1986, ISNAR initiated a major study on the organization and management of on-farm, client-oriented research (OFCOR) in national agricultural research systems (NARS). The study was developed in response to requests from NARS leaders for advice in this area and was carried out with the support of the Government of Italy and the Rockefeller Foundation. The objective is to analyze the critical organizational and managerial factors that influence the way national research institutes can develop and sustain OFCOR programs to realize their specific policies and goals.

What Is OFCOR?

OFCOR[1] is a research approach designed to help research meet the needs of specific clients, most commonly resource-poor farmers. It complements – and is dependent upon – experiment station research. It involves a client-oriented philosophy, a specific research approach and methods, and a series of operational activities carried out at the farm level. These activities range from diagnosing and ranking problems through the design, development, adaptation, and evaluation of appropriate technological solutions. Farmers are directly involved at various stages in the process.

In this study, OFCOR programs are analyzed in terms of the functions OFCOR can perform within the larger research and extension process. We have identified the following seven potential functions as a framework for analyzing the organization and management of a range of on-farm research programs in nine national agricultural research systems. The functions are:

1) to support within research a *problem-solving approach, which is fundamentally oriented toward farmers as the primary clients* of research;

2) to contribute to the application of *an interdisciplinary systems perspective* within research;

3) to *characterize major farming systems and client groups*, using agroecological and socioeconomic criteria, in order to diagnose priority production problems as well as identify key opportunities for research with the objective of improving the productivity and/or stability of those systems;

4) to *adapt existing technologies and/or contribute to the development of alternative technologies* for targeted groups of farmers sharing common production problems by conducting experiments under farmers' conditions;

5) to *promote farmer participation in research* as collaborators, experimenters, testers, and evaluators of alternative technologies;

6) to *provide feedback to the research priority-setting, planning and programming process* so that experiment station and on-farm research are integrated into a coherent program focused on farmers' needs;

7) to *promote collaboration with extension and development* agencies in order to improve the efficiency of the processes of technology generation and diffusion.

1. The designation *OFCOR* has been used as distinct from *farming systems research* (FSR) because the latter has come to have very different meanings for different people.

Why Is the Organization and Management of OFCOR Important?

Over the last 15 years, many NARS have set up OFCOR programs of varying scope and intensity to strengthen the link between research and farmers -- particularly resource-poor farmers. While significant attention has been given to developing methods for OFCOR, provisions for fully integrating this approach within the research process have been inadequate and the institutional challenge underestimated. With the accumulation of experience, it is clear that NARS have confronted significant problems in implementing and effectively integrating OFCOR into their organizations. In many cases, OFCOR programs have become marginalized and have not had the intended impact on the research process.

Improved organization and management are crucial to overcoming these problems. Effectively integrating OFCOR within a research system implies forging a new research approach which complements and builds on existing research efforts. This is no small task. It involves establishing new communication links between researchers of diverse disciplines, extension agents, and farmers. It requires hiring people with the right skills or systematically training existing staff. It requires changes in planning, programming, review, and supervisory procedures. It creates increased demands for operational funds and logistical support for researchers working away from headquarters. And, it often involves working with one or more donor agencies. All of these make the management of OFCOR more demanding than that of traditional experiment station research.

This study focuses directly on these issues of implementation and institutionalization. We have analyzed and synthesized the experiences of diverse NARS in which OFCOR programs have been established for at least five years. The intention is to provide a body of practical experience upon which research managers can draw as they strive to strengthen OFCOR as an integral part of their research systems.

Operational Strategy and Products

Our approach has been to learn from the experiences of research managers in NARS. We have built the analysis around case studies of nine countries whose NARS have had sufficient time to experiment with and develop diverse organizational arrangements and management systems for implementing OFCOR. By region, the countries are as follows:

Latin America: Ecuador, Guatemala, Panama

Africa: Senegal, Zambia, Zimbabwe

Asia: Bangladesh, Indonesia, Nepal

The case studies are stand-alone products. Each is a comprehensive analysis developed by a team of national researchers with personal experience in the individual OFCOR programs. The cases provide important insights and lessons on the general issues, as well as specific guidance for research policy and the organization and management of OFCOR in their countries. The cases will be published in 1988. A list of the reports follows.

Comparative study papers providing a systematic analysis across the case studies are a second product of the study. Synthesizing the experience of case study NARS, these papers provide practical advice to research managers on organizational and managerial issues central to the effective integration of OFCOR within their research systems. The themes developed are:

1) Alternative Arrangements for Organizing OFCOR: Comparative Strengths and Weaknesses;

2) Integrating OFCOR and Experiment Station Research: Organizational and Managerial Considerations;

3) Organization and Management of Farmer Collaboration in Research;

4) Organization and Management of Linkages between OFCOR and Extension;

5) Organization and Management of OFCOR Research Process and Decentralized Field Operations;

6) Development and Management of Human Resources in OFCOR;

7) Financial Resource Use and Management in OFCOR;

8) Management of Relations with Donors and External Sources of Knowledge;

9) Issues in the Institutional Development of OFCOR in NARS.

We expect these papers to be published during 1988 and 1989. They are working papers presenting the results of the analysis of the nine concrete OFCOR situations. At this stage, they are intended to stimulate discussion and debate; they are not presented as "state-of-the-art" pieces on these topics.

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OVERVIEW OF THE NINE CASE STUDIES

Deborah Merrill-Sands
Study Leader

The OFCOR efforts reviewed in the cases vary in scope, the emphasis assigned to different objectives and functions, and the specific methodologies employed. They all conform, however, to the general definition of OFCOR developed for this study. The cases reflect a variety of institutional settings and strategies for introducing and developing OFCOR. They also reflect the broad range of models used in the organization and management of OFCOR. The profiles below highlight the salient features of each case and Table 1 provides some key descriptive indicators for comparison across cases.

Latin America

Ecuador

OFCOR is conducted by the Production Research Program (PIP, Programa de Investigación en Producción), an autonomous program within the Instituto Nacional de Investigaciones Agropecuarias (INIAP). It has two national coordinators responsible for the highland and coastal macro-regions and 10 regional field teams assigned to different provinces under the administrative auspices of regional experiment stations. Five teams are associated with integrated rural development programs.

Initiated in 1977 with support from CIMMYT, the case is particularly interesting because it allows us to trace the evolution of the organization and management of an OFCOR program from its origins as a pilot project through to its institutionalization as a full-fledged national program.

Guatemala

An OFCOR philosophy pervades Guatemala's 16-year-old agricultural research institute, the Instituto de Ciencia y Tecnología Agrícolas (ICTA). Two units, however, are specifically charged with carrying out OFCOR functions: the Technology Testing and the Socioeconomics Departments. The first is responsible for testing in on-farm trials all technology developed by the commodity programs. The second conducts diagnosis, on-farm monitoring, and special studies.

The 14 Technology Testing Teams are made up of scientists and technicians whose research is coordinated from regional stations but who live and work in designated research areas. The Socioeconomics Department is organized at the national level with representatives in some of the regions. Almost all scientists in the department are agronomists with training in social science methods. Coordination between the two departments is limited.

ICTA's experiences with OFCOR have had a major influence on other countries. What makes Guatemala especially interesting is that OFCOR was not appended onto an existing system. Rather, ICTA was set up from the beginning to incorporate the OFCOR philosophy. Moreover, this case also allows us to examine the organization and management of OFCOR within a regionally organized research system. This is important because a regionalized research system is generally regarded as the institutional setting most compatible with OFCOR's organizational requirements.

Panama

In the late 1970s, the Instituto de Investigación Agropecuaria de Panamá (INIAP) developed a "national plan" through which priority areas for on-farm research were selected. OFCOR is implemented in some of these areas as part of the regular research programs of scientists who also work on-station. In other areas, OFCOR is implemented through projects with full-time staff, developed in collaboration with international agricultural research centers. The projects are variable in organization and operation, and there is no mechanism at the national level for coordinating the diverse OFCOR efforts. What is particularly interesting about Panama's experience is the institutionalization of OFCOR as a research strategy, rather than as a formal program with a discrete OFCOR unit or units.

Africa

Senegal

The Department of Rural Sociology of the Institut Sénégalais de Recherches Agricole (ISRA) initiated an OFCOR program in 1978. It is now part of the Department of Production Systems and Technology Transfer (DRSP, Département des Recherches sur les Systèmes de Productions et le Transfert de Technologies en Milieu Rural), one of the four main research departments established in 1982 after a major reorganization of ISRA under the auspices of a World Bank project. The DRSP consists of a Central Systems Analysis Group (GCAS, Groupe Central d'Analyse Systèmes), three multidisciplinary OFCOR teams located at regional stations, a Bureau of Macro-economic Analysis (BAME, Bureau d'Analyses Macro-Economiques), and a division of thematic research. The case focuses on the OFCOR part of the DRSP, namely the GCAS and the three regional teams.

Senegal is an interesting case because the classic regional team model for implementing OFCOR was modified to include a core multidisciplinary group of scientists, the GCAS, which supports the work of the teams. Also of interest is Senegal's experience blending francophone and anglophone approaches to on-farm research.

Zambia

The Adaptive Research Planning Team (ARPT) conducts OFCOR in Zambia. The ARPT, initiated in 1980, is a national research program under the Research Branch of the Ministry of Agriculture. It is of equal status to and complements the national commodity programs. The ARPT comprises a national coordinator, based at the central research station, and seven teams of scientists and field technicians at provincial experiment stations. Each team is funded by a different donor.

ARPT includes two particularly interesting innovations: the formal integration of sociologists and the inclusion of research-extension liaison officers in the teams.

Zimbabwe

Zimbabwe's Department of Research and Special Services (DR&SS) adopted OFCOR in 1980 as a strategy for reorienting research to meet the needs of small farmers in the communal areas. This was in response to the post-Independence national policy to emphasize agricultural development for this sector.

There is no integrated OFCOR program. Several research institutes and stations and a specialized Farming Systems Research Unit (FSRU) have developed independent initiatives. The case study examines OFCOR in the FSRU and four institutes – the Cotton Research Institute, the Agronomy Institute, the Crop Breeding Institute, and a regional research station. This provides us with an unusual opportunity to analyze the implementation and integration of OFCOR under several distinct models for organizing research, but all within a single institution.

In the institutes, individual scientists carry out both on-farm and station-based research, while scientists in the FSRU specialize in on-farm research. The FSRU consists of a core multidisciplinary team based at the central station and two regional teams staffed by technicians. Their research has had a strong systems perspective emphasizing crop-livestock interactions.

Asia

Bangladesh

The Bangladesh case study concentrates on the on-farm research activities of the Bangladesh Agricultural Research Institute (BARI), the largest unit of the NARS. The On-Farm Research Division (OFRD), created in 1985, has the exclusive mandate for on-farm research in BARI. OFCOR teams are located at 23 stations and substations, from which they direct technicians in 11 farming system research sites and 83 multi-locational testing sites.

The OFRD subsumed four distinct older programs: multi-locational testing of the Soil Fertility and Soil Testing Institute (later renamed the On-Farm Trials Division); cropping system research on the IRRI model; varietal testing and verification of the wheat program; and the adaptive research of the T & V Ex-

tension Research Program. An important aspect of the Bangladesh case study is its analysis of the consolidation of these different approaches to OFCOR under common management.

Indonesia

OFCOR is implemented in Indonesia's Agency for Agricultural Research and Development (AARD) in sub-programs of the commodity institutes, and also in multi-institute projects organized at the AARD level. The case study focuses on two examples of each major type.

The multi-institute projects are an interesting institutional innovation. These projects are staffed by senior scientists seconded from the participating institutes. They maintain contact with their home institutes and return to them at the end of the project. We wanted to examine this arrangement because of its potential for building strong links between OFCOR and station-based specialist scientists, as well as for the long-term integration of the OFCOR philosophy and methodology within the NARS.

The gradual evolution of OFCOR as a research strategy in the NARS is another important aspect of the Indonesian experience. Starting as an informal program of one institute in the early 1970s, OFCOR methods were slowly integrated into other commodity institutes. Specialized teams have only been developed since the early 1980s. OFCOR in Indonesia has been a national initiative which has drawn on a number of approaches to OFCOR, particularly that of the Asian Cropping Systems Network developed in association with IRRI.

Nepal

On-farm research programs of different types have existed in a variety of institutions in Nepal since the early 1970s. Out of the diverse settings of OFCOR in Nepal, we chose five sub-case studies which illustrate the major models of organizing OFCOR:

1) OFCOR implemented through a commodity program – the National Rice Improvement Program;

2) OFCOR implemented through a cropping systems program;

3) OFCOR implemented through a specialized unit – the Farming Systems Research and Development Division (FSR&DD), supported by a separate socioeconomics division;

4) OFCOR implemented as a generalized strategy in two small, externally funded, regional research institutes – Lumle Agricultural Research Centre and Pakhribas Agricultural Centre.

The contrast between the OFCOR programs of the NARS and those of the externally funded institutes make Nepal an especially interesting case.

Table 1
Descriptive Indicators of the Nine OFCOR Studies

Case Studies	National Agricultural Research System		Organization of OFCOR	Years in Operation [3]	Scale of OFCOR: (Scientist Years)	
	Institutional Type	Organization of Research Program			OFCOR as % of NARS Human Resources	Size of OFCOR effort
Ecuador	Semi-autonomous institute (INIAP)	Regional research stations/commodity programs	Production Research Program (PIP)[4] National program with two coordinators and 10 teams based at regional research stations	9	6	14
Guatemala	Semi-autonomous institute (ICTA)	Regional research programs/commodity programs	Technology Testing Department with 14 field teams in 6 regions and national socioeconomics department with limited regional representation	14	34	65
Panama	Semi-autonomous institute (IDIAP)	Commodity programs, regional offices	National OFCOR plan identified target regions where OFCOR is implemented through special FSR projects or part-time on-farm research	7	16	24
Senegal	Semi-autonomous institute (ISRA)	Multi-commodity departments/regional stations	OFCOR, located within Department of Production Systems Research and Technology Transfer (DRSP)[a], consists of 3 regional teams and a Central Systems Analysis Group	4	13	22
Zambia	Ministry (MAWD)	Commodity and factor programs	OFCOR program with national coordinator and 7 provincial teams at regional stations	6	20	38[b]
Zimbabwe	Ministry (MLARR)	Commodity and disciplinary based institutes and stations	OFCOR implemented by - 8 research institutes/stations with combined on-station/on-farm research programs, - Farming Systems Research Unit (FSRU) based at central station with two regional teams	5	18	26
Bangladesh [1]	BARI, semi-autonomous institute of larger NARS with council	Disciplinary departments, commodity programs	On-Farm Research Division (OFRD), with Central Management Unit at headquarters and 24 teams deployed through BARI's network of regional stations, has official mandate for on-farm research. Consolidation of previous OFCOR efforts	9[e]	12	104
Indonesia [2]	Ministry, Dept. of Research (AARD) with multiple institutes and coordinating bodies	Commodity based regional institutes	Two principal modes of implementation: Research institutes conduct OFCOR as part of regular programs OFCOR projects organized at AARD level with staff seconded from multiple institutes	11[f]	n/a	57[c]
Nepal [2]	I NARS ministry II LAC and PAC + externally funded autonomous institutes	I Commodity programs, disciplinary departments II LAC Multi-disciplinary research thrusts PAC Disciplinary departments	I Farming Systems Research and Development Division (FSR&DD) with 6 FSR sites, supported by Socio-Economics Research and Extension Division (SERED). - Commodity programs with multi-location testing and outreach programs II LAC and PAC regional institutes with OFCOR as a generalized research strategy	14[d]	n/a	35[c]

Table 1 (notes)

1. The case study is limited to the Bangladesh Agricultural Research Institute (BARI), the largest of the five institutes coordinated by the Bangladesh Agricultural Research Council (BARC).

2. The data refer only to the subcase studies unless otherwise indicated; NARS-wide data are not available.

3. Base year for all statistical data is 1986.

a. Lumle Agricultural Centre and Pakhribas Agricultural Centre.

b. Programa de Investigación en Producción.

c. The Spanish names for these departments are Prueba de Tecnología and Socioeconomica.

d. Département de Recherche de Systèmes de Productions et Transfert de Technologies en Milieu Rural.

e. Refers to NARS. Several OFR programs with complex histories operate within BARI. The oldest, the On-Farm Fertilizer Program, dates back to 1957. This program was reorganized in the late 1970s, about the same time Cropping Systems Research was established at BARI. The OFRD was not formally consolidated until 1984.

f. Refers to NARS. In 1973, multiple-cropping research in the Central Research Institute for Food Crops took on a systems orientation and was renamed cropping systems research (CSR). CSR moved onto farmers' fields in 1975.

g. Refers to NARS. Cropping/farming systems research was initiated nine years ago. On-farm rice research is 14 years old.

h. Includes six research extension liaison officers seconded from extension.

i. Represents totals for subcase studies only. Not directly comparable to other NARS-wide data.

LIST OF OFCOR CASE STUDY REPORTS

— Zambia: Organization and Management of the Adaptive Research Planning Team (ARPT), Research Branch, Ministry of Agriculture and Water Development. (S.A. Kean and L.P. Singogo)

— Zimbabwe: A Case Study of the Organization and Management of Five On-Farm Research Programs in the Department of Research and Special Services, Ministry of Agriculture. (M. Avila, E.E. Whingwiri, and B.C. Mombeshora)

— Sénegal: Organization et Gestion de la Recherche sur les Systèmes de Production. ISRA. (J. Faye and J. Bingen)

— Ecuador: Un Estudio de Caso de la Oganizacion y el Manejo del Programa de Investigacion en Finca de Productores (PIP) en el Instituto de Investigaciónes Agropecuarias (INIAP). (R. Soliz, P. Espinosa, and V.H. Cardoso)

— Guatemala: Organización y Manejo de la Investigación en Finca en el Instituto de Ciencia y Tecnología Agrícola (ICTA). (S. Ruano and A. Fumagalli)

— Panama: Un Estudio de Caso de la Organización y el Manejo del Programa de Investigación en Finca de Productores, Instituto de Investigaciónes Agropecuarias (IDIAP). (M. Cuellar)

— Bangladesh: A Case Study of the Evolution and Significance of On-Farm and Farming Systems Research in the Bangladesh Agricultural Research Institute (BARI). (M.A. Jabbar and M.D. Zainul Abedin)

— Indonesia: A Case Study on the Organization and Management of On-Farm Research in the Agency for Agricultural Research and Development, Ministry of Agriculture. (J. Budianto, I.G. Ismail, Siridodo, P. Sitorus, D.D. Tarigans, A. Mulyadi, Suprat)

— Nepal: A Case Study of the Organization and Management of On-Farm Research in Nepal. (B.N. Kayastha and S.B. Mathema)

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Glossary of Acronyms

AGRITEX	Department of Agricultural, Technical and Extension Services; the agricultural extension service, Zimbabwe.
ARPTs	Adaptive Research Planning Teams; the on-farm research program, Zambia.
BARI	Bangladesh Agricultural Research Institute.
CAPA	Curso de Producción Agrícola (Agricultural Production Course); an 11-month course for new professionals, held at ICTA, Guatemala.
CART	Communal Areas Research Trials; the on-farm testing program of the Agronomy Institute (DR and SS), Zimbabwe.
COFRE	Committee on On-Farm Research and Extension, Zimbabwe.
CSRTS	Commodity and Specialist Research Teams; applied research teams, Zimbabwe.
DIGESA	Dirección General de Servicios Agrícolas (National Agricultural Services Bureau); the agricultural extension service, Guatemala.
DIGESEPE	Dirección General de Servicios Pecuarios (National Livestock Services Bureau); the livestock extension service, Guatemala.
DR and SS	Department of Research and Specialist Services of the Ministry of Lands, Agriculture and Rural Resettlement, Zimbabwe.
IADB	Interamerican Development Bank.
IARCs	International agricultural research centers.
ICTA	Instituto de Ciencia y Tecnología Agrícolas (Agricultural Science and Technology Institute); the national agricultural research institute, Guatemala.
IFAD	International Fund for Agricultural Development.
INIAP	Instituto Nacional de Investigaciones Agropecuarios; the national agricultural research institute, Ecuador.
IRRI	International Rice Research Institute; an IARC based in the Philippines.
ISRA	Institut Sénégalais de Recherches Agricoles; the national agricultural research institute, Senegal.
KHARDEP	Koshi Hills Area Rural Development Project, Nepal.
NGOs	Non-government organizations.
NRIP	National Rice Improvement Program of the Ministry of Agriculture, Nepal.
OFCOR	On-farm client-oriented research.
OSS	Office of Special Services; a program of the Rockefeller Foundation (USA), based in Mexico in the 1950s.
PDRI	Programa de Desarrollo Rural Integrado; the national integrated rural development program, Ecuador.
PIP	Programa de Investigación en Producción (Production Research Program); INIAP's on-farm research program, Ecuador.
PROGETTAPS	Proyecto de Generación y Transferencia de Tecnología Agropecuaria y Producción de Semillas (Project for the Generation and Transfer of Agricultural Technology and for Seed Production); a project initiated in 1986 in Guatemala with funds from IFAD and IADB.
SAED	Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémé; Senegal river basin authority.
SOMIVAC	Société pour la Mise en Valeur de la Casamance; a regional development agency, Senegal.
T and V	Training and Visit extension system developed by the World Bank.
USAID	United States Agency for International Development.

INTRODUCTION

The Linkage Problem

In most countries of the Third World, agricultural research and extension are separate public institutions with different mandates and different ways of operating. Even in cases where they are formally located in the same ministry, they usually have very different organizational structures and operational procedures. The predominant model for the generation and transfer of agricultural technology is based at least implicitly on systems for breeding, testing, and distributing improved crop varieties. Researchers are expected to develop superior genetic material and/or production techniques, which they then turn over to extension for demonstration and diffusion to farmers.

Top-down systems of this kind have functioned reasonably well to meet the demands of resource-rich farmers, as well as those of both large- and small-scale producers of high-value commodities. These farmers have been able to communicate their needs to researchers, either directly or through producers' organizations, and to assess and adapt the recommendations which come to them through the extension system.

However, the lack of effective links between separate research and extension institutions has impeded the development and transfer of technology which is appropriate for small-scale, resource-poor farmers, particularly those who work in relatively low-potential, heterogeneous agroecological areas. These farmers have no effective organizations through which to make their needs known.

Researchers do not receive enough information about these farmers' conditions and resources to set relevant priorities and goals. At the same time, local extension agents do not receive the information and cooperation they need to first adapt and then diffuse appropriate technology. The lack of good communication between research and extension has particularly limited the transfer of technologies other than improved crop varieties, such as storage and pest management methods. Rather than improved inputs, which are physically distributed, these often consist of concepts which must be reinterpreted and adapted to each new situation (Horton, 1986; Rhoades, 1987).

Extensionists are caught in the middle in many ways. They are often responsible for a broad range of government services in rural areas, of which technology transfer is only one. Seldom do they receive adequate resources for field work and travel. They are obliged to promote whatever technology comes down to them, even if it is not adapted to local agroecological or socioeconomic conditions. They are almost always separated from researchers by wide gaps in educational level, status, salaries and social class. Researchers blame them for their failure to transfer innovations which have shown promise under experimental conditions, and for their apparent inability to provide systematic feedback. Farmers often see them as incapable of providing answers to local problems and needs (Collinson, 1985).

Farming systems research, and especially on-farm research, has been promoted as a means of developing appropriate technology and adapting it to the specific agroecological and socioeconomic conditions of small-scale farmers. Many national agricultural research systems have developed interdisciplinary programs of this kind, with two major objectives:

1) to diagnose needs and constraints at the farm level;
2) to adapt technologies to the agroclimatic and socioeconomic conditions of target producers.

Parallel initiatives within extension institutions have also been launched (Swanson, 1984; Cernea, et al., 1985). The initiatives of both research and extension focus on farm management, and the factors affecting farmers' daily decisions and overall strategies.

It has been hypothesized that these approaches can break down the traditional barriers between research and extension. On-farm research teams should themselves become the critical link: 'Farm-management oriented research/extension personnel can serve in a *research and extension* capacity to work with *farmers and research scientists* in technology development' (Andrew and McDermott, 1985; author's italics).

The achievement of this admirable goal is a major challenge for the managers of both research and extension institutions. On-farm research cannot in itself solve the problems of technology transfer, or substitute for an effective extension system. Indeed, moving researchers off the station into the 'space' conventionally occupied by extension and development institutions requires the careful rethinking of mutual roles and functions, as well as the development of new ways of working together.

This process often brings other organizational and managerial problems into relief. If either the research or the extension institution suffers from poor leadership,

inadequate funding or poor staff morale, linking them will not solve the problem. If effective mechanisms for the joint planning and implementation of tasks related to common goals are not developed, information on farmers' needs will not be used effectively, no matter how many surveys, experiments, trials or demonstrations are carried out (Stoop, 1988). If farmers do not fully participate, the technology developed is unlikely to meet their needs.

Scope of this Analysis

This paper is one of a series in a research project at the International Service for National Agricultural Research (ISNAR) on the organization and management of on-farm client-oriented research (OFCOR) in national agricultural research systems. The paper was also written for a study being undertaken by ISNAR on the links between research and technology technology transfer, and forms part of that study's theme paper series as well (Kaimowitz et al., 1989).

OFCOR is designed to link research and resource-poor farm households more closely. Numerous approaches to this type of research have been developed: 'cropping systems research', 'farming systems research', 'on-farm adaptive research', 'farmer-back-to-farmer', 'farmer-first-farmer-last' (Byerlee et al., 1989; Collinson, 1987; Gilbert et al., 1980; Harwood, 1979; Rhoades and Booth, 1982; Zandstra et al., 1981). What they all have in common is a focus on farmers as the clients of research, an emphasis on diagnosing constraints and setting research priorities in the context of the whole farm system, the design of technological solutions in response to opportunities or constraints identified on farm, and the involvement of farmers at various stages in the research process.

The analysis is built around case studies of national agricultural research systems which have formally included OFCOR as a major activity and have at least 5 years experience with this research approach. Nine countries were included in the study: Bangladesh, Ecuador, Guatemala, Indonesia, Nepal, Panama, Senegal, Zambia and Zimbabwe. Improving cooperation between researchers, extensionists, development agencies and farmers was an explicit goal of most of the programs reviewed. A variety of mechanisms had been developed to link researchers and extensionists in the planning and implementation of various tasks. Nevertheless, forging effective, sustainable links across institutional barriers had proved a major challenge.

The case studies, which are listed in the first section of the references, review the experience of nearly 20 on-farm programs, organized in a variety of ways, following different approaches and using different methods. The word 'program' is used loosely, to describe any organized on-farm activity; it does not necessarily imply the existence of a formal program analogous to a semi-autonomous, multi-disciplinary commodity program of the kind commonly found in national and international institutes. The role of on-farm research as a means of strengthening links between research and extension was a key area of analysis in the case studies. It should be noted, however, that the studies were written from the perspective of research, and do not provide a detailed analysis of the extension institutions with which the on-farm research programs interact.

In Chapter 1, the relationship between on-farm research and extension is contrasted in three countries —Guatemala, Nepal and Zambia. Chapter 2 draws on evidence from all nine countries to analyze the experience with six mechanisms for linking on-farm research and extension. Chapter 3 points out the lessons that emerge from the case studies for research managers using on-farm research as a means of strengthening the links between research and extension.

Assessing the Effectiveness of Linkage Mechanisms

The effectiveness of mechanisms linking on-farm research with extension will be assessed in terms of these questions:

1) How well does the mechanism, or group of mechanisms, facilitate the flow of information on farmers' conditions and needs to researchers — does it improve the system's responsiveness to the needs of its targeted clients?

2) How well does the mechanism facilitate the flow of information and techniques from the research system to resource-poor farmers — does it improve the system's capacity to transfer relevant technology?

3) How sustainable is the mechanism, given the various institutions involved?

Responsiveness to the Needs of Targeted Clients

The diagnosis of farmers' conditions and needs is the basis for setting priorities and planning research. Informal and formal surveys, on-farm trials, meetings, field days and other special events all provide opportunities for researchers to learn from farmers (Biggs, 1989; Ewell, 1988). A number of mechanisms have been used to analyze farmers' needs and then carry the lessons learned into the process of planning and programming research on experiment stations (Merrill-Sands and McAllister, 1988).

Most approaches to on-farm research assign primary responsibility for the functions of diagnosis and feedback to social scientists from the research institution (Byerlee et al., 1980; Zandstra et al., 1981; Byerlee and Tripp, 1988). Some authors have envisioned a much broader role for extensionists in on-farm research programs as the principal 'voice' of the farmer (Johnson and Kellogg, 1984; Johnson and Claar, 1986; Lionberger, 1986). Nevertheless, on-farm research programs have taken over this function in most cases precisely because the professional capacity of extensionists has been judged unequal to the task.

The case studies show that extension agents have participated in the processes of characterization and diagnosis of local farming systems primarily as informants. They have provided information on the agroecological conditions and farming systems in their areas as a preliminary basis for planning research; they have helped to locate farmers for surveys, experiments and field days; and in some cases they have served as enumerators. They have been seen as a resource — as a broadly distributed network of people in day-to-day contact with farmers. However, they have seldom been treated as equal partners, or given co-responsibility for setting priorities or channeling more detailed information into the research system.

Capacity to Transfer Relevant Technology

In the countries studied, the tasks involved in adapting and transferring improved technology to farmers had traditionally been assigned to extension institutions. By developing on-farm research programs, the research institutions have taken on new responsibilities for working directly with farmers. This has changed the demands placed upon extension services: instead of demonstrating a uniform package of technology, extensionists are now expected to adjust the flexible recommendations resulting from on-farm research to suit local variations in agroecological and socioeconomic conditions. This requires training and other resources which have often been beyond the capacity of the extension departments.

Some on-farm research programs have relied on the demonstration effect of on-farm trials and on informal communication among farmers to diffuse technology, with very little contribution from the official extension service. Others have used conventional mechanisms such as technical bulletins and field days to communicate the results of on-farm research to extension agents, who are then expected to diffuse them more widely; special projects have occasionally been set up to link on-farm research with the Training and Visit (T and V) system of extension. Still others have sought more direct collaboration and have defined explicit roles for both researchers and extensionists at established stages in an integrated approach to technology generation and transfer. The rationale for this integrated approach has been that if extensionists are involved in, or at least informed about, the on-farm research program, they will be much more knowledgeable about and confident in the technologies and recommendations produced and, thus, more committed to their transfer and diffusion.

Institutional Sustainability

The case studies report several examples of links between research and extension that have not lasted. Many on-farm research programs have been developed with the support of international agricultural research centers (IARCs) and donors. Linkage mechanisms that have seemed very promising in a pilot project supported with special funding and expatriate staff have not always been successfully incorporated into the procedures of the institutions responsible for maintaining them after support has been withdrawn.

The most successful cases of institutionalization are those where links have been forged simultaneously at several levels of the administrative hierarchies of the organizations involved. Good cooperation at the field level is impossible to sustain unless regular opportunities to meet and work together are actively supported by management. Again, joint goals agreed upon by high-level coordinating committees cannot be realized unless specific operational procedures are worked out at both regional and local levels.

CHAPTER 1
THREE CASE STUDIES

Out of the nine case studies, three exemplified markedly different degrees of integration between on-farm research and extension. Two cases, Guatemala and Zambia, lay at opposite extremes, while one, Nepal, was 'intermediate', representing the kind of situation commonly found in developing countries.

Guatemala provides an example of an on-farm research program developed separately from the extension service, on the assumption that new technology adapted to farmers' conditions would diffuse spontaneously. The limtations of this approach led to the organization of a large project to bring extension into the process, over 10 years after on-farm research had been started. In Nepal, extension agents were involved in various on-farm research activities under the auspices of different agencies, but solid links had proved elusive. Heads of stations or programs had set up links on an ad hoc basis, but a high-level policy commitment and strong leadership from an integrated senior managerial group were lacking. The new national on-farm research program in Zambia was organized from the start with streng research-extension links at various levels of the administrative hierarchy, including the highest level. It is too soon yet to tell whether the Zambian model is successful, but good progress has been made in integrating the research and extension systems, such integration being one of the hallmarks of successful agricultural technology generation and transfer in developed countries.

The material in this chapter draws extensively from Ruano and Fumagalli (1988) in the case of Guatemala, Kayastha and Mathema (1989) in the case of Nepal, and Singogo (1987) and Kean and Singogo (1988) in the case of Zambia.

Guatemala

Guatemala's national agricultural research system was totally reorganized in the early 1970s, because the existing system for the generation and transfer of technology was not meeting the needs of an important group of clients. The agricultural sector of the Guatemalan economy is highly polarized: large-scale farmers, who constituted less than 1 percent of the population in 1970, controlled over 80 percent of the country's cultivable land. Most of their farms are located on good soils on the coastal plain or at mid-elevations, and specialize in the production of high-value export crops. This group has long had privileged access to modern technology, credit and inputs from public and private institutions.

The majority of rural households are concentrated in the highlands. Working on small plots, these small-scale farmers produce food crops both for home consumption and for sale. In the early 1970s, the capacity of this peasant sector to meet the demand for food in the rapidly growing urban areas was deteriorating, and imports were increasing.

Since the 1940s, research and extension services within the Ministry of Agriculture had followed procedures based on models from the USA (Mosher, 1957). Researchers developed programs within their disciplines according to their own interests and judgement. Extension was seen as a 'top-down' program of adult education, spreading information about modern methods of farming. Neither was based on any analysis of the needs of particular groups of farmers. Some of the results were useful to large-scale farmers, but peasant producers received very little benefit.

ICTA: An Institution Integrating On-Station and On-Farm Research

As one response to the mounting crisis in food production, the Instituto de Ciencia y Tecnologia Agricolas (ICTA) was founded in 1973 as a semi-autonomous research institute to generate, adapt and transfer technology appropriate to the conditions of small- and medium-scale farmers. A team of senior national scientists developed an integrated research system which linked on-station and on-farm research in a single process based on the diagnosis of farmers' conditions and needs. They drew heavily on the experience of the Office of Special Services (OSS), which had included extensive on-farm testing in the successful development of improved wheat varieties in both Mexico and Guatemala during the 1950s.

The pioneering institutional arrangements and working methods developed at ICTA had a major impact on on-farm client-oriented research in many other countries. However, no explicit, formal role was provided for extension in the initial plan.

Technology development system. Chart 1 illustrates how ICTA's system has structured both the flow of information from farmers into the research process, and the adaptation and transfer of relevant technology. The agenda for applied research developed by scientists in the commodity programs at the regional experiment stations is based on three types of input. The first is the basic and strategic research carried out by IARC's and universities, and the contributions of other public institutions and the private sector.

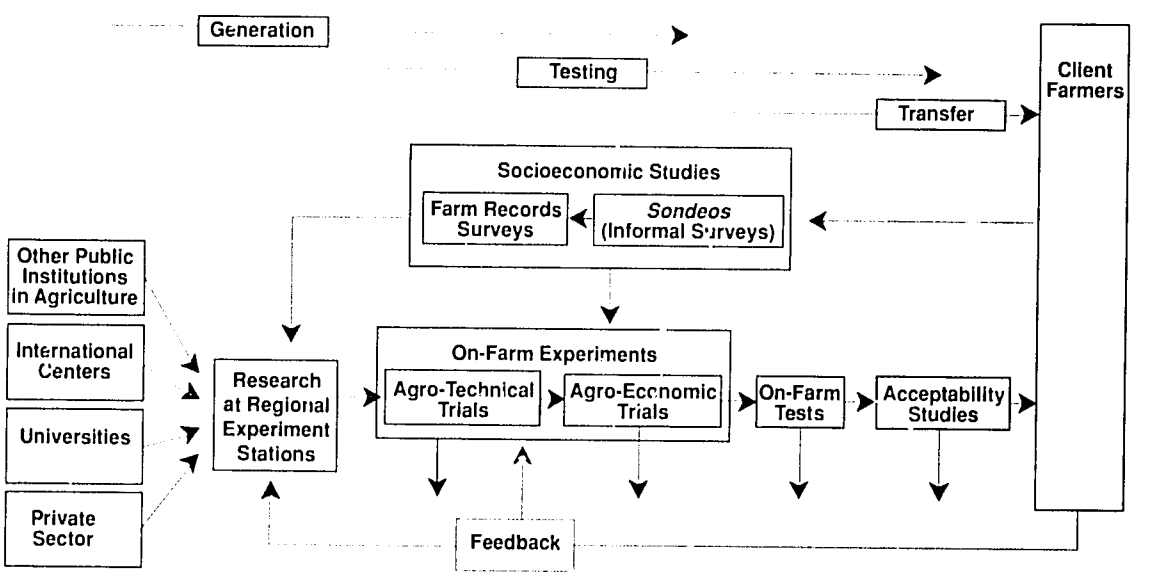
The second is an evaluation of farmers' needs through studies organized by ICTA's Socioeconomics Department: both scientists and senior administrators participate in informal interdisciplinary surveys called *sondeos*; more detailed data on costs and returns are then collected from the farm records of a smaller sample of farmers. The third type of input is feedback from on-farm research: all the technology produced by the stations is run through a standard sequence of on-farm trials, which are the responsibility of the Technology Testing Department. This department is organized as subregional teams, each consisting of five or six agronomists assisted by locally hired technicians.

First in the sequence of on-farm trials are multi-factorial experiments called 'agro-technical trials'. These are designed and implemented by researchers; the farmers contribute land, some labor, and their assessment of the results. Next, the costs and returns of the most promising technologies are compared with those obtained using farmers' current practices in simpler experiments known as 'agro-economic trials'. Technology which passes this stage is then validated in on-farm tests, which follow a simple, standard design, on a larger number of farms. In theory, the information from all three stages is fed back into the process of planning and priority setting at the stations. Finally, surveys known as 'acceptability studies' are carried out to see how many of the farmers who participated in on-farm experiments have actually adopted at least some elements of the new technology, and if so, which.

Here the process stops. The only systematic mechanism for transferring technology to the wider target group of farmers are field days for the neighbors of the participants and for extension workers. The assumption is that good technology spreads spontaneously through informal networks of farmers.

Does good technology spread spontaneously? There is evidence that some new crop varieties have indeed spread spontaneously. Over time, suitable inputs and management practices to accompany the new varieties have also been adapted to local conditions by farmers. An evaluation carried out in the La Maquina area of the coastal plain where an ICTA team had introduced an open-pollinated maize variety found that the extension service had played

Chart 1: Diagram of the Flow of Information Through ICTA's System for the Generation, Testing and Transfer of Technology



Source: Based on Ruano and Fumagalli (1988)

almost no part in its diffusion. The principal mechanism had been the on-farm tests, the results of which had been diffused through the neighbors and friends of collaborators. A second and much more modest influence was exercised by the commercial agrochemical companies promoting improved seeds and pesticides.

This kind of impact is concentrated in areas with high yield potential. Although the beneficiaries are small-scale farmers relative to the large-scale export-oriented sector, they are nonetheless those with relatively privileged access to resources within their communities. The much larger number of resource-poor farmers working on steep slopes and under other marginal conditions are largely left out.

Weak links with extension. These have been a major constraint on the adoption of ICTA's technology. The Dirección General de Servicios Agrícolas (DIGESA), the national extension service for crops, did not change its philosophy and methods in response to the development of ICTA. The service lost its best professionals when ICTA was formed, and lost status relative to the new, highly visible, internationally connected organization (Gostyla and Whyte, 1980). Extension agents were less well educated than researchers, with significantly lower pay and status. They were not formally included in *sondeos*, planning meetings or other mechanisms built into ICTA's system for obtaining feedback from farmers. Researchers were responsible for all on-farm experiments.

DIGESA continued to follow the model of an adult education program, promoting modern methods to 'ignorant' farmers (Ruano, n. d.). Local extension agents remained responsible for a number of bureaucratic tasks besides those directly connected with agricultural production. Until 1982, they played a key role in the processing and approval of applications for credit. In most areas, extension worked quite independently of ICTA. A survey conducted in 1982 found that very few extension agents could explain how the research system worked. Most did not know what its technical recommendations were or, if they did, could not explain their potential economic benefits to farmers (McDermott and Bathrick, 1982).

Good informal working relations developed between ICTA's technology testing teams and local extension agents in some areas, particularly where technology in high demand from farmers was becoming available (Whyte, 1983). ICTA personnel depended on extensionists for the selection of collaborators, and to widen their area of influence. DIGESA and ICTA have different approaches to field days, but often combine them in practice.

Formal mechanisms to involve extension agents in the research work proved difficult to sustain. In one region, extension agents were invited to take part in the implementation of on-farm tests. For 2 years, a special course for researchers new to ICTA — the Curso de Producción Agrícola, or CAPA — included a subcourse for extension agents, so that they would understand the three stages of ICTA's work and convey its results to farmers. Both of these initiatives fell foul of the same institutional bottleneck. Although they were based on formal agreements between the directors of ICTA and DIGESA, local extension managers did not reduce the load of other tasks agents were expected to perform. Work with ICTA came to be seen as an extra burden which could not be sustained.

A New Joint Program

To improve matters, the Proyecto de Generación y Transferencia de Tecnología Agropecuaria y Producción de Semillas (PROGETTAPS), a new program for the generation and transfer of technology and the production of seed, was established in 1986. The program is based on the concept of close links between research and extension (Ortiz, 1987). Funded by the International Fund for Agricultural Development (IFAD) and the Interamerican Development Bank (IADB), it draws on ICTA's earlier experience in collaborating with a World Neighbors project in San Martín Jilotepeque (Ruano, pers. comm.). The program was designed to be implemented jointly by ICTA, DIGESA and the Dirección General de Servicios Pecuarios (DIGESEPE), the national livestock extension service.

Local extension workers are given the title 'promoters', responsible for promoting specific technologies, not for providing general technical assistance. In contrast to the situation in many other countries, the task of promotion has become the full-time responsibility of the extension agents working in the program. Selected farmers, known as 'rural leaders', are trained in the management of new technologies and hired on a half-time basis. One, two or three promoters are tied to each research scientist on the technology testing teams. Each of these promoters is expected to work with 15 to 20 rural leaders. Technology which has already been validated in on-farm trials is demonstrated in 'transfer parcels' managed by the rural leaders on their land. Each rural leader then supervises similar demonstrations on the farms of 20 neighbors. Through this 'branching tree' approach, the work of each on-farm research scientist is expected to reach up to 600 farmers. Farm records surveys permit researchers to evaluate the economic benefits of a new technology, to monitor its adoption, and to provide guidelines for credit.

The project has set up several support activities, including seminars and workshops for training the promoters. Funding for new staff, vehicles and other facilities is provided. A national coordination committee and regional subcommittees has been set up by government decree.

In short, the program is an attempt to draw extension into a structure and approach based closely on what ICTA has already developed. It has expanded the network of farmers exposed to new technology through on-farm trials, but does not envision qualitatively different extension methods. In other words, it is an attempt to broaden and institutionalize the concept of OFCOR as the basis for the diffusion of technology.

Early reports on the implementation of PROGETTAPS indicate that good progress has been made. In only 2 years research teams have carried out validation trials at 3000 sites and rural leaders have laid out about 8000 transfer parcels. The program appears to be reaching the very poor, and farmers' demand for new technology is such that the program has had to organize small-scale seed production units (Ruano, pers. comm.). However, success in the longer term, particularly if external funding is reduced, will depend on close collaboration between institutions with a disappointing history of cooperation. They will need to institutionalize common objectives, a uniform operational approach, and integrated work plans.

Conclusions

ICTA's past provides a clear example of an innovative on-farm research program whose success in meeting the broad range of needs of its target clients was limited by poor links with extension. Its present demonstrates an imaginative approach to overcoming linkage problems.

Responsiveness to the needs of targeted clients. Until PROGETTAPS was formed, the extension service played a very limited role in diagnosis and feedback. The primary responsibility for bringing information on farmers' conditions and priorities into the research processes was given to ICTA's Socioeconomics Department. The social scientists developed an innovative approach, but the department lost most of its senior scientists in the early 1980s after the departure of its first expatriate director. For several years, ICTA was unable to channel a continuous flow of information on changing rural conditions into its research program; nor was extension offered any role in this process.

The agronomists in the technology testing teams were in constant communication with the farmers with whom they worked, and had informal contacts with local extension agents. They provided feedback into the rest of the research system on the performance of particular technologies under farmers' conditions.

Capacity to transfer relevant technology. ICTA has successfully transferred new technology — primarily new crop varieties — onto the farms of producers of basic food crops who had not previously benefited from public sector research. In general, the beneficiaries are the less disadvantaged members of their communities, with privileged access to resources. This subgroup of clients is in a good position to pick up new technology through informal networks and to purchase the necessary inputs. The lack of an effective extension system has limited diffusion to farmers with more limited resources working in more marginal areas. The new joint PROGETTAPS program promises to broaden the coverage and increase the efficiency of the same basic system of diffusion by demonstration.

Institutional sustainability. Before 1986, attempts to link ICTA's on-farm research with extension proved unsustainable. The PROGETTAPS program has been initiated with substantial external financing. Its long-term effectiveness will depend on how solidly it can be incorporated into the regular procedures and budgets of the three institutions involved.

Nepal

Agricultural development in Nepal faces severe constraints. The mountainous topography and lack of roads inhibit communications and make inputs expensive and difficult to obtain. Despite significant investments in research since the early 1970s, production of basic food grains between 1970 and 1981 increased at an average annual rate of under 1 percent — far below the annual population growth rate of 2.7 percent in the same period (Yadev, 1987).

One of the few areas with a relatively high potential is the Tarai, the lowland plain along the border with India. The control of malaria and the building of roads and other infrastructure, opened up the Tarai for settlement, starting in the 1950s. Researchers concentrated on developing high-yielding crop varieties appropriate for conditions in the Tarai. However, most of the rural population lives and farms in the lower potential, heterogeneous hill districts. The generation and transfer of technology capable of increasing their output and incomes has presented major difficulties for on-farm research and extension programs.

The Institutional Structure

In Nepal, extension and most research is carried out under the Ministry of Agriculture. On-farm client-oriented

research is organized in several different research departments and organizations. In each case, extensionists have been asked to perform a role.

The basic units for the extension service are the 75 political districts into which the country is divided. Agricultural District Officers direct extension workers outposted in rural areas, each comprising several villages. Each extension worker is theoretically responsible for an average of 2500 farm households. Technical programs are planned and coordinated both at the national level and in the five development regions into which the country is also divided.

Village-level extension is not an established professional career. At one time, all students of agriculture were required to serve as extension agents for 2 years — a year as an assistant in the middle of their secondary training, and another year as a technician — before being admitted to the university. Then, because of manpower shortages, permanent extension positions were created, with no chance of advancement into research. Salaries and benefits for these extension workers are low, and staff turnover is high. Only during the 1980s have professional subject-matter specialists been appointed in some districts as a part of the T and V system.

The national agricultural research system in Nepal is organized as departments and commodity programs, supported by a network of experiment stations and farms. The case study highlights the on-farm programs of five different research entities: the National Rice Improvement Program, the Cropping Systems Program, which subsequently became the Farming Systems Research Division, and the externally funded Lumle and Pakhribas Agricultural Centres.

Each program has developed its own on-farm and outreach agenda. Each has different types of link with extension, but all participate in nationally organized on-farm demonstration programs as well. Research and extension are coordinated informally at both national and regional levels, but no formal mechanisms for joint planning or evaluation across the sector had been developed at the time of the study.

Outreach Activities of the National Rice Improvement Program

All the major commodity programs in Nepal have outreach activities in the areas immediately surrounding their principal experiment stations. These activities were organized in response to requests for greater technical support from the regional extension officers. The outreach activities also provide the scientists based at the stations with opportunities to obtain first-hand experience of the issues faced by farmers and extension agents in the field.

The outreach activities of the National Rice Improvement Program (NRIP), highlighted in the case study, are typical of those found in the commodity programs. They are part of a larger World Bank program centered on the establishment of a T and V system of extension. Two outreach officers located on the research station administer an on-farm research program designed to adapt crop varieties and other technology to local needs. Implementation of the trials is delegated to local extension agents. The outreach officers provide back-up to the rice subject-matter specialists of the extension service, who in turn provide technical support to the agents at village level. They have also organized regular bi-monthly and bi-annual meetings at the station, when research specialists and the senior extension staff discuss problems identified in the field, potential solutions, and plans for future research. In addition, village-level extension workers are brought to the station for training in problem identification, methods for on-farm trials, and the background of new recommendations.

The Cropping Systems Program

The Cropping Systems Program operated from 1977 to 1985 within the Agronomy Division of the ministry. The program's approach was developed by the International Rice Research Institute (IRRI), working in cooperation with national agricultural research systems in a network covering Asia (De Datta et al., 1978). An integrated approach to research and extension was designed, with the aim of replacing farmers' current production practices with improved cropping systems over large areas. Research and extension were given precise, predetermined roles.

Rigid approach through production programs. Those who developed the approach started from the assumption that a 'submissive approach', which depended entirely on improved technology lying within farmers' existing limitations, would be unlikely to have significant effects on food production. Instead, they proposed an 'interventionist approach', combining improved technology with packages of credit, inputs, irrigation and other improvements. As these services were supplied by separate government organizations in most countries covered by the network, special production programs were set up as 'buffer' institutions to concentrate the necessary resources and to coordinate their use (Zandstra et al., 1981).

The researchers developed a uniform set of methods for the development, testing and promotion of new technologies based on improved grain crop varieties. Target areas for development were selected before research sites, the whole process being directed towards specific,

production-oriented goals (Denning, 1985). The technology generation and transfer process followed a set sequence of steps:

1) site selection;
2) site description — benchmark surveys, crop-cut studies, farmer interviews, and farm management studies;
3) design of improved cropping systems, under controlled conditions;
4) cropping systems testing, in farmers' fields;
5) pre-production evaluation — multi-locational on-farm testing of promising technical alternatives, implemented in cooperation with extension;
6) production programs, to diffuse the innovations over large areas, under the management of extension and development agencies.

Extension became involved only at steps five and six. Pre-production verification trials were designed by researchers, but extensionists were usually involved in their implementation. Eventually, responsibility for managing the production programs was turned over to extension and development agencies.

Success in the Tarai. The program in the Tarai was designed to promote packages of technology based on improved rice and other crop varieties, most of which were already available "on the shelf". National scientists and their expatriate advisors determined which varieties could be fed into on-farm research. Interdisciplinary teams of researchers were given responsibility for the early stages of the process — the selection of sites, the diagnosis of local conditions, the design of improved cropping systems, and the preliminary testing of these systems in farmers' fields.

Detailed manuals explained how extension personnel were expected to carry out their part of the process — the broad testing of promising technology and the administration of input supplies and credit. Senior extension officers were represented at the planning and review meetings held before each cropping season. Initially, the researchers ran pre-production verification trials in pilot areas. Little by little, procedures were simplified and responsibility was handed over to local extension staff.

The researchers were concerned to maintain the consistency of the data collected, and thus discouraged adaptation of the content or design of trials to local circumstances. Analysis was handled centrally, with the result that extensionists could not easily use the results of the experiments they had implemented. Modifications to the original packages were made, but on the recommendations of the researchers, not the extensionists.

The highly structured Cropping Systems Program was reasonably successful in the two of its five sites which were located in the relatively high-potential Tarai. The responsibility for production programs in 22 districts was passed on to extension after 6 years.

Difficulties in the hills. Developing appropriate technology and forging links with extension proved much more difficult in the heterogeneous, densely populated hill regions, with their poor communications facilities. Once again, the goal of the researchers was to have a dramatic impact on production. Sites were chosen on the basis of rapid reconnaissance tours using two criteria — high theoretical potential for the technology the program intended to promote, and low current use of improved technology of any kind. There was no size limit — that is, no specified number of villages or households — and no relationship between the sites selected and the operational zones of extension.

This program encountered several implementation problems. The extension workers regarded the trials they were expected to administer as a burden on top of their regular work. Researchers complained that prescribed steps in the methods to be followed had been omitted, and that extensionists had been careless with trial management and data (Lipinski and Rizal, n.d.). The basic problem was that extension had been handed an impossible task. The high-input technology that researchers were pushing out could not realistically be supported through production programs under resource-poor conditions.

Reorganization: The Farming Systems Research and Development Division

The advisors and planners concluded that the technology being promoted in the hills was too narrowly based on the major grain crops. A broader range of more flexible technologies was needed to provide farmers with productive alternatives. In 1985, the Cropping Systems Program was reorganized with a broader farming systems mandate and elevated to the status of a fully fledged research division. Known as the Farming Systems Research and Development Division, it works exclusively in the hills.

The Cropping Systems Program had been a special program with a production-oriented mandate. Researchers from various commodity programs had worked closely with local extensionists in the target areas. The creation of the new independent division weakened the links with other research divisions and with extension. Its field assistants have been employed directly and, so far, havehad almost no contact with the Agricultural District Officer or other extension personnel in the districts where they work.

Socioeconomic research, which had been an integral part of the Cropping Systems Program, was recently separated from the Farming Systems Division to form the

Socioeconomic Research and Extension Division (SERED). In spite of its name, this group has not worked with extension, except for a single survey of the methods used by different agencies. Its professionals feel over-extended, and have lobbied to have their mandate narrowed by dropping the word 'extension' from the name of the division.

Lumle and Pakhribas Agricultural Centres

The Lumle and Pakhribas Agricultural Centres were established in 1968 and 1973 respectively, in different areas of the hills. Funded entirely by the British Government, their initial purpose was to support the resettlement as farmers of Gurkha mercenaries returning from the British army. Both centers developed their own extension activities to serve specific target areas, and organized both on-station and on-farm research.

The centers later expanded their mandates to include the provision of technology to all farmers, covering larger areas. They have taken advantage of the flexibility provided by external funding to develop some innovative methods and procedures, including the involvement of extension in the planning and implementation of research. Nevertheless, neither of them has established close working relationships with the ministry's regular extension staff, although both centers have recently been officially integrated into the public sector national agricultural research system.

The Lumle Centre has concentrated its work in a single target area surrounding the station. Originally, each commodity section at the center organized its own extension efforts. A farming systems research section was set up with its own field staff, which implemented on-farm trials in selected subdistricts. As the center's activities multiplied, farmers became unsure whom to ask for information on specific topics. In response, the center created a separate extension section responsible for synthesizing information from the researchers and passing it on to farmers. This service completely replaced the work of the ministry's extension agents in the target area. Links with extension in the larger region were developed only in the mid-1980s, with the naming of outreach research staff to feed technology into a T and V program.

The Pakhribas Centre has its own extension programs in two separate target areas, serving a total of about 9000 households by 1986. The center has also established on-farm research as a mechanism for feeding information to extension in the four districts covered by the Koshi Hills Area Rural Development Project (KHARDEP).

Both centers have set timetables for integrating their work more closely with that of the ministry, including extension.

National On-Farm Demonstrations

Two different types of on-farm trials — farmer field trials and minikits — are routinely implemented through the ministry's extension department. Farmer field trials are standardized tests of promising technology. They are designed by scientists in the commodity programs, and run either by researchers on regional stations and farms, or by extensionists on farmers' fields. Data are collected, sent back to the commodity programs and analyzed centrally. For the local extension agents, the trials are simply one more routine task. They have not been authorized to modify the designs in any way, and the results are never analyzed in terms of local conditions. The usefulness of the trials at national level has also been limited. The trials clearly show a wide gap between yields on stations and on farms, but they do not provide enough information on farm-level conditions to identify specific constraints or suggest potential solutions.

Minikits were initially designed as a relatively cheap and easy way to provide feedback to the breeding programs on the performance of different varieties and advanced lines under farmers' conditions. Small packets of seed, sometimes accompanied by measured amounts of fertilizers or pesticides, are distributed through extension to farmers, along with a form which the farmer is expected to fill out with his or her reactions and return by mail. In most parts of the country, few cards are returned and little or no analysis is done of the data from those that are. Extensionists have a role in administering the program, but are not given enough discretion to provide useful feedback. The minikits are an effective mechanism for the wide distribution of new seed, but they are ineffective as a research tool and as a means of demonstrating new technology for extension purposes.

The integrated research and extension programs at the Lumle and Pakhribas Centres use minikits, in a modified procedure, as a tool within their target areas. Instead of distributing just one kind of improved seed, they include local varieties in the package. The extension agents follow up with the farmers and collect the forms, which are analyzed at the local station before being sent on to the national program. Feedback is effectively stimulated on several levels.

Group Treks

Systematic feedback from farmers is difficult to obtain in Nepal, given the difficulties of communications and travel. Several on-farm research programs have met this challenge by organizing group treks at regular intervals. Senior scientists and on-farm researchers travel together through the target areas, interviewing farmers and officials. They assess local conditions and constraints, and put together

work plans for on-farm research on the spot. The Lumle and Pakhribas Centres, where this approach was first developed, include senior extension staff on their treks. Managers of the Farming Systems Research Division sometimes invite Agricultural District Officers on their treks as a formal courtesy, but have on the whole made much less effort than have other programs to draw on the experience of extension personnel.

Conclusions

Personnel from extension participate in on-farm research in Nepal in various ways, but formal links have proved difficult to institutionalize. Although research and extension operate within the same ministry, links at national level are weak. Apex management has not played a strong role in encouraging the integration of the research and technology transfer system as a whole. A recent reorganization which has strengthened the independence of the research branch has, if anything, reduced the formal opportunities for joint planning and coordination.

Responsiveness to the needs of targeted clients. All the on-farm research programs examined in Nepal had accepted primary responsibility for diagnosing needs and constraints at the farm level. The group trek is the primary mechanism for bringing senior researchers directly into contact with farmers on a regular basis. Extension has played only a supporting role.

Capacity to transfer relevant technology. Outreach programs have provided a means of getting information from research into the hands of extensionists, both through the T and V system and through the KHARDEP rural development program. The support of extensionists has been enlisted to extend the coverage of on-farm research. Farmer field trials and minikits have brought new varieties and other technology to the attention of large numbers of farmers. However, these mechanisms have not been flexible enough to give extension an active role in adapting technology to local conditions.

Institutional sustainability. Agricultural research in Nepal, and on-farm research in particular, has been heavily supported by donors and IARCs. Specific linkage mechanisms, such as the group treks at the Lumle and Pakhribas Centres and the production programs of the Cropping Systems Program, have been dependent on external funds. These mechanisms have proved difficult to institutionalize in the ministry, with its highly restricted budget for operations.

Zambia

In Zambia, research and extension are the two branches of a single administrative structure within the Ministry of Agriculture. On-farm client-oriented research has been introduced as a national program in the research branch. Field work is organized through semi-autonomous provincial operational units known as Adaptive Research Planning Teams (ARPTs). Each team carries out on-farm research in a number of small areas which are selected to represent agroecological 'recommendation domains'. The work of these teams is intended to complement that of the Commodity and Specialist Research Teams (CSRTs) which are responsible for applied research on the experiment stations. The managers of the ARPT program have placed a great deal of emphasis on institutional issues and, of the nine countries studied, Zambia has developed the most elaborate set of mechanisms to link research and extension.

The extension service in Zambia is based on the T and V system and is administered by Agricultural Officers at provincial and district levels. Although a formal structure has been created to support this extension system, in many parts of the country its implementation has been inhibited by low population densities and organizational problems.

Improved Links with Extension: An Explicit Goal of ARPTs

Before ARPTs were set up, farmers' needs were brought to the attention of station-based researchers through provincial research tours, followed by meetings of the Provincial Experimental Committees. These tours enabled junior and senior extension staff to meet researchers, but they were not systematic or frequent enough to provide accurate information for setting research priorities. At the meetings, more time was spent discussing administrative problems and bottlenecks than technical research issues.

On a practical, day-to-day level, there was little interaction between research and extension. Extensionists saw the work being done on experiment stations as irrelevant to the needs of the farmers they worked with; researchers blamed extension for not transferring technology to farmers. When the ARPTs were set up in 1980, two explicit goals of the program were:

1) to draw the extension staff into the process of generating and adapting technology;
2) to pass information on to extension, credit, and marketing institutions.

Each provincial ARPT is funded by a different donor, and has experimented with different methods and procedures for organizing on-farm research and linking with extension. The ARPT program was intended to support extension workers in various ways, particularly by sharpening the focus on the conditions of small-scale farmers and the logic of their decision-making. Much has been learned, although surveys of extensionists have revealed widespread confusion as to whether on-farm trials are an adaptive phase of research or a demonstration phase of technology transfer.

Complementary links between research and extension have been established at various levels of the administrative hierarchy. The major points of contact are summarized in Table 1.

National policy and coordination. Cooperation between on-farm research and extension has received high-level support within the Department of Agriculture. Senior staff, including the Assistant Director of Agriculture for Extension, were directly involved in setting up the ARPT program. The Assistant Directors of Research and Extension have adjacent offices. For several years while the ARPT program was first being developed, its national coordinator had his office in the same building as well. This close contact between policy makers and senior administrators permitted frequent consultations over problems as they arose.

Coordination at provincial level. Provincial ARPT committees were set up as a forum for the joint planning and review of on-farm research and extension at the operational level. The meetings are chaired by the Provincial Agricultural Officer, who is the key figure responsible for the ministry's activities in each province, and are attended by both researchers and subject-matter specialists from extension. In theory, these committees are a critical linkage mechanism, but in practice their record has been disappointing. The only kind of decision on which they have had much impact has been the selection of target areas for on-farm research. Reviews of the research programs have been perfunctory, and there is little evidence that plans have actually been altered in response to comments from extension staff. Nevertheless, the committees have kept the subject matter specialists informed about the purpose and progress of on-farm research activities.

Table 1:
Zambia: Links between On-Farm Research and Extension at Various Levels of the Administrative Hierarchy

Administrative Level	Linkage Mechanism
National administration	The Assistant Directors of Agriculture for Research and Extension have been involved in the on-farm research program since it was first established, and confer frequently.
Provincial administration	Provincial ARPT committees are chaired by the Provincial Agricultural Officers, who are the heads of extension in each province. Meetings are attended by subject-matter specialists from extension. The committees recommend sites for on-farm research, and review the on-farm client-oriented research programs. The committees have not been as effective as their creators hoped.
ARPT provincial teams	A Research-Extension Liaison Officer is assigned to each provincial team. A professional employed by extension, he or she is responsible for facilitating the flow of information in both directions.
On-farm research teams	The Trials Assistants, who implement surveys and on-farm experiments, are seconded to ARPTs from extension.
Local extension workers	Contacts between researchers and local extension workers outside the research areas have been limited.

Role of Research-Extension Liaison Officers. In early discussions of the composition of ARPTs, it was suggested that senior professionals from extension should be included as fully fledged members. This suggestion was adopted, but there has been no universal agreement as to what the job description of these officers should be.

The first Research-Extension Liaison Officer, an expatriate, was appointed to the team in Central Province, with funding from the United States Agency for International Development (USAID). He thought that neither ARPT's leadership nor the CIMMYT farming systems research methodology involved extension sufficiently, and he worked to broaden its role. He stressed the importance of taking technology through a testing stage in close cooperation with local extension workers. He organized training workshops, demonstrations and field days, and started a monthly newsletter for extensionists.

In other provinces, the dual responsibilities of the Research-Extension Liaison Officers led to delays in recruitment and confusion over the job description (Hudgens, 1986). For example, no liaison officer was appointed to the team in Eastern Province until 1986, partly because the Farm Management Officer of the World Bank's extension program had nearly identical terms of reference. In fact, however, the latter spent almost all his time organizing the T and V system. A long delay in appointing a liaison officer for Luapula Province hindered interactions with extension. Little by little, the Research-Extension Liaison Officers demonstrated their usefulness, and by 1986 six of them — foreigners as well as nationals — were on the ARPT staff. Interest in filling the posts increased as the provincial ARPTs acquired technologies that were ready for broader testing and validation.

Use of extension workers as Trials Assistants. The single most important linkage mechanism was developed on an ad hoc basis. The program organizers did not at first have a clear plan to post technicians to the research areas to supervise the day-to-day operations of on-farm research. They did not really face this issue until they began to plan the trials for their first major field season in 1981. Rather than hire technicians directly, they decided it would be cheaper and more effective to use extension personnel seconded on a full-time basis.

These people play a critical role in the on-farm research process. They are usually from the areas where they work, speak the local languages, understand local farming practices, and serve as an effective link with village communities. They are responsible for implementing on-farm trials, and also assist in the organization of field days to diffuse the results.

Some extensionists without diplomas are recruited, but the standard of competence is generally high. Most of the Trials Assistants regard the opportunity to work in research as a privilege. Nevertheless, it has taken time to train them to become effective research technicians. When the ARPT program was beginning, training was conducted centrally, with a course for all Trials Assistants given at the central research station. Subsequently, the provincial teams assumed responsibility for providing informal training because it was thought that this would help develop stronger regional teams. The original idea was to rotate local extension workers through the ARPT program, to expose them to the research process and make them familiar with the new technology. In fact, the research teams try to retain them for as long as possible, to save the expense and trouble of constant re-training.

Trials Assistants are paid by the extension branch but supervised by researchers. This joint jurisdiction leads to some conflicts. For example, critical repairs to field housing were delayed while the two administrators argued over who should pay. Nevertheless, good communication at the provincial and national levels makes it possible to resolve issues of this kind before they become serious problems.

Links with non-ARPT extension workers. Contacts between researchers and local extension workers who do not work directly with an ARPT are limited (Edwards et al., 1988). Local agents are used as the main informants in informal, preliminary surveys carried out to demarcate farming systems and recommendation domains. They also help identify new research areas by introducing researchers to farmers and acting as interpreters. Once the research programs are established, however, even routine communications prove difficult to sustain. In Central Province, for example, only half of the extension staff regularly received the newsletter produced by the Research-Extension Liaison Officer for their benefit. Informal contacts between Trials Assistants and their colleagues who are local extension workers have been useful, but this influence has not extended beyond the research areas.

Conclusions

The ARPT program in Zambia has made significant progress in forging links with extension at various levels from the field up to the top of the bureaucracy. However, even in this situation, where senior research managers have given priority to developing strong links through on-farm research, there are still problems. The different methods employed in research and extension have led to problems of overlap and inadequate coordination. Various shortcomings have been identified for each of the linkage mechanisms, and important differences in attitudes and in organizational culture remain. The local extension workers are overworked and underpaid, and staff turnover is high.

Responsiveness to the needs of targeted clients. Extensionists at various levels have opportunities to bring farmers' perspectives and needs into the research process. The Trials Assistants are in constant contact with the farmers who cooperate in the on-farm research program. Nevertheless, as in many other cases reported from the nine countries, it has proved difficult to capture the results of this experience adequately. Only a few of the provincial ARPTs have systematically included the Trials Assistants in their annual research planning and review processes.

The primary responsibility for feedback lies with the social scientists in the ARPTs. The sociologists are organized as a special unit which conducts studies on a multi-provincial basis. They also provide support to the provincial teams for particular pieces of research. Economists are assigned directly to most teams, to conduct surveys and analyze the results of experiments; rather than use local extensionists, they hire and train their own enumerators. Some scientists argue that the economists on the teams should be replaced by Research-Extension Liaison Officers, who would be agronomists with some training in economic analysis.

Capacity to transfer relevant technology. During their first years, the ARPTs concentrated on the development of technology, on experiment stations and in farmers' fields. The program was only 6 years old at the time of the study, and the process of verifying promising results in broader on-farm tests was just starting. The choice of sites had been organized through local extension workers, under the coordination of the Research-Extension Liaison Officers. Where possible, demonstrations were located on the land of the contact farmers working with the T and V system. Lengthy discussions on the technology to be demonstrated were held with the subject-matter specialists. It was still too early to assess the effectiveness of the transfer process.

A variety of mechanisms are used to transfer preliminary information from the ARPTs to extension workers. Researchers participate in training courses for extensionists. ARPT agronomists and subject-matter specialists collaborate in the revision of formal recommendations. Scientists from both branches contribute material to newsletters for the field-level staff.

The T and V system creates incentives and formal settings for interaction, but also places very strict controls on the time and activities of extension workers. Unless they work directly in the research areas, they have few opportunities to receive information from ARPT researchers outside a few formal events.

Institutional sustainability. The ARPTs and extension depend on several donors with different approaches and priorities. Although formal linkage mechanisms have been put in place at national level — Provincial Coordinating Committees, Research-Extension Liaison Officers, the secondment of Trials Assistants to provincial ARPTs — their effectiveness has varied considerably among teams. Moreover, a great deal of administrative time has been spent on keeping critical linkages functioning. A strong commitment to research-extension links by senior administrators will be required if these are to be sustained once donor support ends.

CHAPTER 2
MECHANISMS LINKING ON-FARM RESEARCH AND EXTENSION

Six types of linkage mechanism were identified in the case study programs. They are not mutually exclusive and are usually found in various combinations with one another. These linkage mechanisms are:

- informal cooperation at field level;
- national and regional research-extension coordinating committees;
- participation of extension field staff in the implementation of surveys and trials;
- participation of senior extension specialists as scientists in on-farm research, or of researchers as outreach officers in extension programs;
- participation of on-farm research staff in rural development projects;
- integrated on-farm research and extension programs.

The first and second linkage mechanisms provide opportunities for staff members to talk — to exchange information and ideas, and to plan joint activities. Such mechanisms are essential, but they must be backed up with more formal arrangements if shared programs are to be effective.

The third and fourth mechanisms involve the secondment of staff between extension and on-farm research programs. Direct collaboration of this kind is an effective way to pool experience and to get on-farm research activities moving. In the longer run, joint staffing often proves difficult to administer as seconded personnel lose their identity and become isolated from normal career opportunities in their parent institutions.

The last two mechanisms involve the joint participation of research and extension in integrated programs.This might seem to be the ideal solution, but in practice it is difficult to maintain the focus and continuity of research goals in the face of the strong, short-term pressures to produce quick results experienced in a development project.

In this chapter the experience with these six mechanisms is discussed, and their effectiveness is assessed in terms of three basic criteria:

1) their responsiveness to the needs of targeted clients;
2) their capacity to transfer relevant technology;
3) their institutional sustainability.

Informal Cooperation at Field Level

Examples from the Case Studies

The on-farm research field staff in all the programs studied depended heavily on the informal cooperation of local extension agents for assistance in such areas as securing the cooperation of local leaders, identifying collaborators and organizing field days. Obviously, the success of any link depends on good working relationships between the people involved. Nevertheless, informal exchanges of information between people cannot by themselves serve as dependable linkage mechanisms. As the experience in Guatemala demonstrates, informal cooperation must be supported by formal mechanisms, or researchers and extensionists will inevitably drift into the routine procedures of their parent institutions. In turn, many of the formal mechanisms function best when informal cooperation is already strong.

The Programa de Investigación en Producción (PIP), the on-farm research program in Ecuador, provides another good example of the limitations of unsupported informal cooperation. Several of the provincial PIP teams had shared offices with extension agents from the Ministry of Agriculture. They consulted each other about issues such as the selection of farmers, and organized joint field days, but various barriers prevented close collaboration.

First, the extension system was divided into operational regions which did not correspond with the recommendation domains developed by PIP. Second, the extensionists' experience in conventional programs had put them in contact with relatively large and prosperous farmers, not the resource-poor target group PIP was trying to reach. Third, the national extension program had been extensively reorganized several times. The resulting shifts in responsibilities made it difficult for researchers to develop and maintain working relationships with senior specialists. Finally, the day-to-day operating procedures of the two institutions did not mesh easily. The field extension

workers were busy with their own tasks, and their budgets were limited. Their schedules did not give them enough flexibility to visit research sites with any frequency, even if the on-farm research teams offered transportation.

Assessment

Responsiveness to the needs of targeted clients. Informal contacts with extension agents and other officials with experience at village level are a valuable first step through which on-farm researchers can learn about local farming systems and the constraints faced by farmers. They can also provide valuable introductions into the local community. Nevertheless, care must be taken to avoid introducing extensionists' biases into the research agenda. Extensionists often work with relatively prosperous farmers who are influential members of their communities. Over-reliance on their assistance can bias the samples and research priorities selected away from the needs of resource-poor farmers (Ewell, 1988; Biggs, 1989).

Capacity to transfer relevant technology. Informal field visits, supplemented with regular events such as field days, can be valuable mechanisms for transferring technology to extensionists in the immediate areas where on-farm trials are conducted. New crop varieties and some other technologies will then diffuse spontaneously through the informal networks of farmers. Nevertheless, as the experience in Guatemala shows, extension activities which are based on more formal links are necessary to transfer more complex technologies and to reach clients in marginal areas.

Institutional sustainability. Links which depend on informal, personal contacts between individuals fluctuate in their effectiveness not only according to changing circumstances in the field, such as staff turnover, but also according to the degree to which they are encouraged and supported at more senior levels. They are often invoked as evidence of a working relationship when in fact the institutions involved have not succeeded in developing more permanent mechanisms for cooperation.

National and Regional Research-Extension Coordinating Committees

Examples from the Case Studies

Coordinating committees with members from both on-farm research and extension institutions had been set up in several of the case study countries at both national and regional levels.

National coordination in Zimbabwe. Prior to independence in 1980, research and extension in Zimbabwe were organized to serve the needs of European farmers in the large-scale commercial sector. A major policy of the new government was to expand their mandates to meet the needs of African farmers in the communal areas. The communal areas are a legacy of colonial land policy, which authorized the private ownership of commercial farmland for the benefit of the white settlers, and recognized traditional communal patterns of land tenure for the African population in the remaining, more marginal areas of the country. Today, the communal areas consist of 170 separate territorial units. About 760 000 households farm and raise livestock on this land, much of which has very low productive capacity.

The Department of Agricultural, Technical and Extension Services (AGRITEX) was formed in 1981 by uniting the staff and facilities of two organizations. One of these organizations had served the commercial farmers and had long worked in close association with research, while the other had been a much less technically oriented division of the ministry responsible for Tribal Trust Lands, which had supported the African farmers.

There was a substantial exodus of experienced staff during the reorganization. Nevertheless, AGRITEX was one of the few agencies with an established structure in the communal areas, so heavy demands were placed on it by numerous agencies trying to comply with political directives to work there. Among the most demanding were the semi-autonomous institutes of the Department of Research and Specialist Services (DR and SS) of the Ministry of Lands, Agriculture and Rural Resettlement. These institutes had set up entirely separate and uncoordinated on-farm research programs.

Various seminars and workshops to address the problem were organized sporadically, but there was no forum for regular consultation or coordination until the Committee on On-Farm Research and Extension (COFRE) was set up in 1986 at the initiative of research and extension staff working in the communal areas. The committee consists of the deputy director of AGRITEX, and senior representatives from each of the research institutes of DR and SS working in the communal areas. It has been effective because its members have the authority to implement the decisions made. It has also been strongly supported by the Directors of DR and SS and AGRITEX, and resources have been allocated as required to carry out joint field activities.

The first coordinating body to cut across the decentralized structure of DR and SS, the committee immediately had a positive impact in several areas. It published a general directory of on-farm trials and demonstrations, to avoid overlap and duplication of effort. It organized joint field monitoring tours for senior staff from both research and extension. Specific research proposals and extension recommendations are now discussed at subcommittee meetings of specialists in the major commodities. This is a way of getting proposals screened and, if necessary, modified at an early stage, at a forum where it is not humiliating for a scientist to back down. Meetings between research and extension staff are held in each province to discuss their results and plans in the light of the comments made by the sub-committee. Workshops on special topics are held at intervals. The coordinating committee has been well received because it ties national plans to the concrete products of both research and extension at regional level.

Regional committees. In Zambia, one of the mechanisms linking the ARPT on-farm research program with extension is the provincial coordinating committees. As we have already seen, these have not been as effective as was first hoped. Few extension administrators or senior staff realize the power they could wield by taking a more active role in their meetings. Nevertheless, the committees have been far more effective than their counterparts in Guatemala and Ecuador, which are regional committees in form only. They have had no effective influence and seldom even meet.

Assessment

Coordinating committees can be an effective linkage mechanism if several conditions are met. At the very least, the objectives of the committee must be clear and there must be general agreement among members over what needs to be done. Members must have the authority and the budget allocations needed to implement the decisions made. There must be enough flexibility in the agenda of each agency to accommodate new joint tasks.

Responsiveness to the needs of targeted clients. As the experience in Zimbabwe shows, a coordinating committee can catalyze the translation of a national policy favoring a particular client group of farmers into coordinated research and extension programs.

Capacity to transfer relevant technology. Coordinating committees can be a valuable means of generating the consensus and will needed if research and extension are to cooperate in developing and disseminating a new technology. Much depends on whether the new technology is seen by both parties as having a high potential to benefit the welfare of targeted clients. The participation of on-farm researchers and extensionists on committees to approve the release of new plant varieties or modify technical recommendations to farmers can facilitate the work of both groups. This has been an effective function of COFRE in Zimbabwe. In Zambia, meetings convened to revise recommendations have been one of the few occasions which have brought subject-matter specialists from extension and on-farm researchers together.

Institutional sustainability. As a mechanism, committees are usually formal, representing some degree of institutionalization. Yet, to be sustainable, they have to be incorporated into the regular procedures and staff responsibilities of the institutions involved. Coordination committees that exist in name only are all too common in research and extension systems. Such committees also need to be flexible and dynamic. Their composition may need to change to reflect the nature of the technology currently being transferred, or the kind of information currently sought from farmers and extension agents. If committees become routinized, members will come to feel that membership does not contribute to their work and attendance at meetings will decline. Thus, the effectiveness of the committee as a linkage mechanism is reduced.

Participation of Extension Field Staff in the Implementation of Field Surveys and Trials

Examples from the Case Studies

In a number of the programs reviewed in the case studies, field-level extension staff were directly involved in on-farm research, both as interviewers in surveys and as assistants in the day-to-day management of experiments. There are two ways in which this can be done: routine tasks can be delegated to extension agents in addition to their regular duties, or extension agents can be formally seconded to the research agency to perform certain tasks.

Delegation of research tasks to extension agents. Delegation is a tempting option, because it allows the geographical coverage of a research program to be increased through the use of existing extension personnel. Nevertheless, the case studies show that unless researchers work closely with them, extension agents are rarely able to manage experiments successfully. When the management of experiments is added to their normal duties, extension agents do not have the time, training, experience, mobility or motivation to keep loss rates and coefficients of

variation down. It is a recipe for frustration — everyone involved ends up feeling they are wasting their time.

The problems of obtaining good data from the farmer field trials and minikit program in Nepal have already been discussed. The case study from Zimbabwe provides another good example of this problem. The Agronomy Institute, a division of the research unit of DR and SS, instituted an on-farm testing program immediately after independence in 1980. Called the Communal Areas Research Trials (CART), the program's goal was to adapt existing technology to the conditions of resource-poor farmers in the communal areas. Experiments on a range of different crops were scattered widely. They were designed by the research staff, but their routine management was left to local agents of the extension agency (AGRITEX) and to the farmers themselves. Assistants were trained at annual 4-day workshops on trial design and data collection.

It was not an effective strategy. The research scientist in charge was forced to travel constantly, but still did not have time to think through the experimental design appropriate for each site or to interact with the extension agents and farmers. Many trials were lost altogether, and few useful data were fed back into the research process. Almost no technology immediately suitable for transfer to farmers was identified. The program was reorganized in 1984 with an increased focus on applied research. A greatly reduced number of trials were clustered in a few representative areas under the direct management of technicians from the research institute who were outposted to the sites. The results became much more valuable.

Secondment of technicians from extension to on-farm research. The ARPT program in Zambia is the only instance in the case studies in which the technicians responsible for on-farm trials are formally seconded from extension. Once trained, these Trials Assistants become very effective members of the field research teams. They speak the local languages, and understand local agronomic practices and food preferences. However, the mechanism has not functioned effectively as a link with extension agents outside the areas where the ARPT field teams have conducted on-farm trials.

Assessment

Research organizations need field technicians when they set up on-farm research programs far from their normal bases of operation. Extension agents can meet this need at relatively low cost, but careful management is required if they are to produce satisfactory research results and also serve as a link with the extension system as a whole.

Responsiveness to the needs of targeted clients. If extension agents are local people who speak the farmers' language and are familiar with local farming practices and constraints, then their participation in the research process can increase its responsiveness. However, the experience in both Nepal and Zambia demonstrates that merely including extensionists in on-farm research does not guarantee that their knowledge and experience will actually be used in research priority setting and planning — if this is to happen, specific feedback mechanisms to higher levels must be developed and managed.

Capacity to transfer relevant technology. Participating in on-farm research can help extensionists understand a new technology and explain it to farmers, but this is only effective if the data are analyzed and interpreted in terms of local conditions. Extension agents almost inevitably have lower status and educational levels than researchers. If this mechanism is to be effective, they must be respected as valuable team members, not used simply as cheap labor to increase the number of trials that can be run. Their direct experience with research can also help them explain results to other extensionists who do not take part directly. This influence will not extend beyond the immediate areas where research is carried out unless extension personnel are rotated through the on-farm research program or participate in formal training courses.

Institutional sustainability. The incorporation of field staff from extension into on-farm research can be sustained on a regular basis only if their other responsibilities are reduced, and if permanent funding arrangements are made. Mechanisms which ensure the flow of information in both directions must be developed if the link is to improve the effectiveness of both institutions.

Participation of Senior Extension Specialists as Scientists in On-Farm Research or of Researchers as Outreach Officers in Extension Programs

Examples from the Case Studies

Senior extension personnel can serve as valuable members of on-farm research teams. They can facilitate flows of information in both directions: summarizing reports on farmers' conditions from local extension agents for use by researchers, and synthesizing the results of research into communications materials for extensionists to use in the field. Outreach officers from research can play analogous roles in extension programs. On the other hand, it is not easy to work in a job where responsibilities and lines of responsibility are split between two institutions.

Partial participation in Nepal and Zimbabwe. In Nepal, the British-funded Lumle and Pakhribas Agricultural Centres have their own extension programs in selected target areas. Their extension professionals participate in both the planning and analysis of on-farm research, although they are not fully integrated with field research activities. Outreach officers from the commodity programs have worked within extension programs, although this role has not become permanent.

In Zimbabwe, the cotton specialist of AGRITEX, the extension service, has his office on the experiment station of the Cotton Research Institute, a division of DR and SS. He participates in both research and training for the communal areas, and develops messages for AGRITEX's radio programs.

Research-Extension Liaison Officers in Zambia. These officers are fully fledged members of some of the provincial ARPTs. They are involved in a wide range of activities, including the planning and implementation of on-farm demonstrations, the organization of field-days and in-service training programs, the production of regular newsletters for distribution to researchers and extension workers, and the preparation of extension materials. The divided responsibility and ambiguous job descriptions for these positions makes them difficult to fill.

Assessment

Most links between research and extension require communication between different institutions and between people of different status and educational level. The few cases where professionals from extension have been brought in to participate as equals in on-farm research programs show this to be a promising strategy.

Responsiveness to the needs of targeted clients. Senior professionals from the extension department have both the mandate and the stature to keep on-farm research programs focused on farmers' priority needs. Outreach officers from research are well placed to alert the research group to technology adoption problems encountered by extension agents.

Capacity to transfer relevant technology. Full-time specialists with a clear understanding of the structure and needs of the extension system expedite the flow of useful information and technology from on-farm research. Outreach officers from research are in a good position to synthesize experimental results into a useful form.

Institutional sustainability. In spite of these advantages, it is difficult to work for one institution and operate in another. Research and extension are parallel branches of the same organization in Zambia, the only example in which this mechanism is well developed, and even there the position of the Research-Extension Liaison Officers has been ambiguous. The long-term sustainability of cooperative participatory arrangements between research and extension probably depends on whether or not the two groups as a whole are developing shared goals and operational procedures. If they are drifting further apart, with the result that rivalry is developing between them, participatory arrangements are unlikely to survive.

Participation of On-farm Research Staff in Rural Development Projects

Examples from the Case Studies

Integrated rural development projects have often sought out on-farm research programs to cooperate in the development of locally adapted technology. The advantage of these arrangements is that researchers and extensionists can collaborate closely under a single funding and management structure. However, there are some dangers. Development programs are vulnerable to frequent shifts in the goals and focus of their donors. They often ask researchers to work on whatever problems are most pressing at the moment. This can conflict with broader, long-term research goals, and make it difficult to accumulate and interpret data according to consistent criteria.

Coordination with regional development agencies in Senegal. For over 20 years, on-farm research in Senegal has included the issue of technology transfer on its agenda. Integrated research and extension programs known as *unités expérimentales* (experimental units) were designed by French researchers in the 1960s to raise groundnut yields through the diffusion of tested technology (Bingen and Faye, 1985; Fresco and Poats, 1986). This was the background for the on-farm research program set up by the Institut Sénégalais de Recherche Agricole (ISRA) in the 1980s with funding from USAID and the World Bank.

Extension services were organized within regional development agencies for Senegal's major river basins. They developed two different kinds of link with on-farm research at ISRA. The Senegal River basin authority, SAED, signed contracts with ISRA for particular lines of research designed to contribute to well-defined development objectives. On-farm experiments were organized jointly by research scientists and extension agents. The trials were used as an opportunity to train

SAED's field staff in farm-level conditions. In the Casamance River basin, collaboration between ISRA and the Société pour la Mise en Valeur de la Casamance (SOMIVAC) was mandated by two separate donors. USAID made the disbursement of the second phase of funding contingent upon the establishment of a formal protocol between research and extension. A liaison committee was established to implement the agreement.

Joint activities consisted primarily of regular meetings between senior researchers and senior management in the agency. These had several positive results. SOMIVAC agreed to redefine its operational zones, which had been based solely on soils and hydrographic data, using an alternative system developed by the on-farm research team which included socioeconomic criteria. Several lines of research on the local experiment station were initiated in response to needs identified by the development workers.

A major weakness was that the meetings were attended primarily by senior personnel from both agencies, most of whom were expatriate scientists. Neither field-level extension workers nor farmers were directly involved. Because the link was not institutionalized, the process of active coordination did not survive the departure of a few key individuals.

Quite separately, an appraisal of the project by the World Bank recommended the appointment of a Research-Extension Liaison Officer. The proposal was never fully discussed with either ISRA or SOMIVAC, and neither agency would appoint a person to fill the position.

Providing manpower to rural development in Ecuador. Five of the 10 regional PIP teams in Ecuador have participated directly in projects of the Programa de Desarrolo Rural Integrado (PDRI), the country's integrated rural development program. Researchers assigned by the Instituto Nacional de Investigaciones Agropecuarios (INIAP) work closely with the projects' extension staff. Farmers volunteer as collaborators at meetings convened for broader purposes by the project. The major advantage of the close association of research with other aspects of the project is that locally tested technology is provided to the beneficiaries in an integrated package of inputs, credit and advice. A disadvantage has been that, under pressure to show short-term results, on-farm research scientists have been drawn into service functions such as the multiplication of seed and the distribution of inputs. Restrictions on the projects' budgets have further reduced the range of subjects researched.

Joint management in Indonesia. The Upland Agriculture and Conservation Project in Indonesia is a regional development project managed cooperatively by the several agencies involved, including both research and extension. The research agenda of the project is designed and monitored by a technical advisory team of senior research scientists, who have identified component technologies for adaptation and testing on-farm. Extension staff are consulted in the planning and implementation of on-farm experiments as frequently as once a week. Once promising technology is identified, special training courses for field extension workers are held in the target areas. The field extension workers are then responsible for implementing pre-production verification trials and for instructing farmers on how to apply the new technology.

Assessment

All the on-farm research programs that have collaborated closely with large-scale rural development projects have experienced a tension between the advantages of more efficient links with technology transfer and support systems on the one hand, and the disadvantages of losing autonomy and being subject to the pressures of the short-term production goals of the development projects on the other. Conflicts can easily arise because of the differing goals, methods and operational time frames of the research programs and the development projects.

Responsiveness to the needs of targeted clients. Rural development projects are planned on the basis of an assessment of local conditions and needs. When they are targeted at increasing productivity on small farms, their managers often find that little appropriate technology is available. Adaptive on-farm research teams are often called in after the targets and goals have been set. This provides the on-farm research program with clear objectives, but also reduces its flexibility to develop and adjust its own agenda on the basis of its experience with farmers.

The integration of on-farm research with development projects has another cost. Almost invariably, the link between on-farm adaptive research and the applied research carried out on experiment stations weakens. On-farm research comes to be viewed as an extension rather than a research activity, and opportunities for communication and interaction become more limited. As a result, feedback on farmers' needs is inhibited, with potentially negative consequences for the relevance of applied research (Merrill-Sands and McAllister, 1988).

Capacity to transfer relevant technology. Although providing feedback to research may be more difficult in these situations, it becomes much easier for on-farm research to contribute to technology transfer. Projects provide established channels through which technology can be transferred to farmers, along with the necessary credit and inputs. Links are clearly most successful when there is technology 'on the shelf', ready for local adaptation.

Institutional sustainability. Development projects are normally funded by donors for relatively limited periods. Funds for personnel, vehicles, travel allowances and other operating costs facilitate close working relationships between research and extension. These are vulnerable to major changes in a project, or to its termination, unless special efforts are made to incorporate the linkage mechanisms into the regular procedures of the institutions involved, and unless sufficient funds are provided through regular channels.

Integrated On-Farm Research and Extension Programs

Examples from the Case Studies

The case studies document two types of program designed to bring on-farm research and extension together in an integrated system: production programs, and T and V extension.

The approach of the production programs developed by IRRI through its Asian Cropping Systems Network was described with respect to Nepal in Chapter 1. Successful progress through the research, extension and implementation stages is limited to regions with two basic characteristics: the yield potential of the major grain crops in the improved system must be high, and the distribution of the necessary inputs must be feasible.

The T and V system of extension is a highly programmed system developed in the late 1970s by the World Bank (Benor and Baxter, 1984). It has been financed and promoted in many countries throughout the Third World. According to the model, village-level extension workers deliver technological messages to selected contact farmers according to a regular schedule. These farmers are expected to pass the information on to others in their area. The extension workers attend fortnightly training sessions, each of which is focused on messages appropriate to farmers' activities at the current stage of the growing season. T and V is a rigid, hierarchical system which emphasizes continuous monitoring and evaluation. Some countries have included on-farm research directly in their T and V system; others have depended on cooperation with on-farm work implemented by research institutions.

The spirit underlying the top-down structure of the T and V system is very different from that of most on-farm research programs, with their emphasis on flexible, adaptive research. Nevertheless, T and V systems create an institutional demand for locally adapted technological 'messages' to present at the regular extension meetings. Several of the on-farm research programs in the case studies had developed mechanisms to satisfy this need for a constant stream of information.

A successful T and V program in Bangladesh. The most successful example in the case studies of a program of this type developing effective research-extension links through on-farm research is the Extension and Research Project of the Bangladesh Agricultural Research Institute (BARI). It was initiated in 1978 in the high-potential northwestern region of the country. Extension activities had previously been scattered between eight specialized organizations, each with its own mandate and methods. The World Bank provided substantial funding to reorganize them into a single T and V system, supported by new facilities, staff, vehicles, training and operating expenses for both research and extension.

The primary goal of the research project was to provide answers to the many questions posed by farmers and extension workers. Other objectives included delineating the areas where existing packages of improved seeds and practices were and were not appropriate, developing agronomic recommendations for local varieties, and identifying the potential for new crops within existing farming systems.

It took some years for BARI and the new extension organization to develop effective mechanisms for joint planning and coordination. In 1980, a 2-day meeting was called to discuss links between agencies, to plan the on-farm research program for the following year, and to set supply and equipment needs. It was over in less than 2 hours, because nobody present knew how to prepare or carry out an exercise of this kind. The approach used by IRRI's Cropping Systems Network was subsequently adopted precisely because it provided clear guidelines on how to proceed.

The hierarchy of coordinating committees created on paper under the T and V model never functioned, because the senior administrators named as their chairmen did not have the time or incentive to organize them. Because the researchers and extension workers felt the need to coordinate their activities, they organized their own technical committees at regional and district levels. These became important bodies which met 5-10 times a year.

As they gained experience, the researchers instituted a number of important innovations. They involved personnel from extension directly in site selection and diagnostic surveys, and in the design and testing of cropping patterns. They made an effort to identify innovative farmers, learn

what they were doing, and pass the results laterally along to farmers in other areas. They developed flexible procedures for on-farm research which were later adopted by other divisions of BARI. At the same time, they satisfied their specialized mandate by organizing field days and training programs for extension workers, and by providing various kinds of information to the extension system.

Other experiences. The basic challenge of the T and V system is to provide enough new information to farmers to justify the cost. Experience in both Zambia and Nepal suggests that unless farmers receive concrete benefits, they become bored, refuse to be contact farmers, and stop attending meetings (Sutherland, 1986). The system has worked best in densely populated regions where production systems are relatively homogeneous, so that a single technical message is appropriate for a large number of farmers, and where the ratio of closely supervised local extension workers to farmers is high. It has been much less successful elsewhere, in part because it becomes impossible to identify enough widely appropriate technology to send down through the complex structure (Howell, 1988).

Assessment

Both production programs and T and V provide a framework for establishing links between on-farm research and extension. Both are organized hierarchically, with set roles fixed for all parties in advance. Production programs are initiated from the research side, and include mechanisms for extensionists and input-supplying agencies to carry the technology on to farmers. T and V systems are initiated from the extension side, and include mechanisms to obtain the necessary technological messages from researchers.

Responsiveness to the needs of targeted clients. The cropping systems programs in the case studies did not involve extensionists in the selection of sites or in surveys of farmers' practices and constraints. T and V systems operate within hierarchical, formalized organizational structures which emphasize the close supervision of local extension workers. Neither system facilitates feedback from farmers to researchers, either through extensionists or directly.

Capacity to transfer relevant technology. Both systems are oriented towards increasing production as rapidly as possible, and have developed a variety of linkage mechanisms to move technology to farmers. Both are successful primarily in high-potential areas with relatively homogenous farming systems. Resource-poor farmers in more heterogenous farming systems tend not to benefit. Both are biased towards the introduction of packages of new technology with associated inputs.

Institutional sustainability. Production programs and T and V systems have been funded by external donors. Many of their linkage mechanisms depend on vehicles, maintenance, reliable travel funds for regular meetings, and other recurrent costs, as well as on a continuous supply of technical inputs and messages. Unless the usefulness of these mechanisms is clearly demonstrated, they will become vulnerable as the programs are institutionalized and unless national programs are firmly committed to meeting their operating costs.

CHAPTER 3
GENERAL LESSONS

Conditions for Building Effective Links

Ideally, an effective program of research and extension for the adaptation and transfer of technology to small-scale farmers should be based on the following conditions:

1) a shared analysis of target farmers' conditions and problems;
2) technical alternatives to farmers' current practices which can be successfully adapted to local circumstances through on-farm research;
3) well-trained and committed professionals in the institutions responsible for both research and extension;
4) a clear division of responsibilities, assigning to each institution a set of tasks for which it has a relative advantage;
5) effective linkage mechanisms, together with administrative and budgetary support, which allow researchers and extensionists to plan and carry out coordinated programs.

None of the countries in the case studies met all these conditions. Only in a few cases had research and extension even attempted to organize joint activities directed towards common goals. In most cases, public research institutions had set up on-farm programs on the assumption that this would overcome the most important barriers to getting improved technology to small-scale farmers. Often there was a feeling that this was necessary precisely because the extension institutions were not doing their job effectively.

On-Farm Research: No Substitute for Extension

The on-farm research programs documented in the case studies made important contributions towards improving the process of defining the needs of resource-poor farmers; it would seem that they are better suited for this role than extension services, which are sometimes biased in favor of more prosperous farmers. In many cases they also successfully adapted technology and transferred it to small-scale farmers within their immediate project area. Recommendations tailored to location-specific circumstances have been developed — a great improvement over the blanket technology packages extension services often promote.

However, the coverage of on-farm research is not broad enough. Widespread impact is limited by the chronically weak links between on-farm research and extension. The case study experiences argue forcefully that on-farm research cannot substitute for extension. Good institutional cooperation is crucial if new technology is to be broadly verified and transferred to a full range of clients.

Anticipating the Need for Links with Extension

Links with extension were a secondary priority in many on-farm research programs, and virtually all the case studies concluded that this had been a weak area in the implementation of on-farm research. Often, managers had failed to think about links with extension until technology was ready to transfer. Thus, one of the major conclusions of this comparative study is that on-farm research programs need to pay more attention to forging links with extension or other technology transfer agencies, if the process of transferring and diffusing technology is to become more effective.

Links between on-farm research and extension are likely to be more effective when they are built in at the early stages of an on-farm research effort, rather than when they are hastily created, as on-farm research produces technologies for widespread verification and demonstration. Establishing links at an early stage, while it may appear wasteful when there is as yet little technology to transfer, has two important advantages: it allows extension to contribute to the planning of research and hence increases the likelihood that research will be relevant to clients' needs; and, more important still, it means that the structures

and procedures for technology transfer will be in place when they are needed — the research and extension staff responsible for linkages will be better trained and motivated, and will share a common sense of purpose.

Indeed, the early establishment of linkage mechanisms may exert a positive demand for relevant technology on the adaptive and applied research system, increasing the pressures on the system to perform.

Targeting Resource-Poor Farmers

Equity was a major concern in all the case studies. The on-farm programs had attempted to develop technology appropriate for resource-poor farmers in marginal agro-ecological zones. The record was a mixture of success and failure, but it must be recognized that this is a challenging problem even in developed countries with well-established institutions. On-farm research programs as different in their philosophies as ICTA in Guatemala and the production programs in Nepal were most successful with relatively prosperous small-scale farmers working under relatively favorable conditions. Links with extension had not contributed much, in part because most extension institutions are biased toward so-called 'progressive' farmers, who are in a position to adopt yield-enhancing technologies. On-farm research programs had partially compensated for this bias in the area of diagnosis and prioritization of farmers' needs.

Alternatives outside the public sector need to be explored carefully. Non-government organizations (NGOs) often have a long-term, focused commitment to development in poor rural areas and are less hampered by bureaucratic constraints (Sagar and Farrington, 1988). In the case studies, there were several examples of successful cooperation between on-farm research programs and NGOs. In Guatemala, World Neighbors effectively transferred ICTA's adaptive research results to one area of the highlands. Once methods and procedures have been worked out on a pilot basis in collaboration with an NGO, they could be transferred to the public extension service.

The Status Problem

There is a hierarchy of prestige in agricultural science throughout the world. Maintaining effective two-way communication between lower-status field researchers in on-farm programs and their higher-status colleagues on experiment stations, even in the same institutions, was a real problem in all the programs studied (Merrill-Sands and McAllister, 1988). The gap in status between researchers and extensionists is even greater and more deeply entrenched; in addition, there is often a wider institutional boundary to cross. On-farm research programs have tended to view extensionists as implementors rather than as partners. There is little evidence that the needs identified by extension institutions played a significant role in setting the research agenda of the on-farm programs. Moreover, the emphasis on adaptive research responsive to local conditions has put new demands on extensionists without providing them either with a more efficient structure or with additional resources to carry them out effectively.

The use of Research-Extension Liaison Officers in on-farm teams, as in Zambia, is an interesting development in the search for ways of bridging the status gap between research and extension. Although their intermediate position between the two leads to organizational and personnel problems, their role as packagers and consolidators of technology can provide extension with a professional contribution to make to the transfer of technology and its fine tuning to local conditions. The problems encountered in defining the role of such officers — awkwardly straddled between organizations with different objectives and procedures — shows their task to be a complex one.

One of the lessons emerging from the case studies is that, when setting up on-farm research programs, managers must not to do so at the expense of the existing extension service. The transfer of prestigious tasks or senior staff from extension to research can be demoralizing for extension programs, and thus reduce the chances of developing effective links in the future. Seconding staff from the extension service to the research program may help overcome this problem — as long as such officers are seen as still 'belonging' to extension, and not as outsiders.

In the short term, managers must recognize that programs attempting to integrate the work of professionals, technicians and farmers across institutional boundaries and in defiance of status differences will encounter problems. In the longer term, emphasis must be placed on upgrading extension: more equal education, better training and more joint appointments are some of the measures needed

Developing Linkage Mechanisms

Better ways of working together despite the difficulties need to be developed. The linkage mechanisms analyzed in the Chapter 2 provide a good starting point. The first two — informal contacts in the field and formal committees at higher levels of administration — are necessary first steps for any kind of collaboration. They provide a basis for communication about common goals and a framework for joint planning. The next two — secondment of junior and/or senior staff to specific research or extension programs — have a mixed record of effectiveness. They have been most successful in cases where the roles and job descriptions have been realistically and clearly defined. The last two — which involve joint participation in common projects — clearly facilitate the transfer of technology, but have often suffered from unrealistic expectations and excessively rigid structures.

Links at Multiple Levels: A Key to Success

The most successful cases of integration of on-farm research and extension are those in which links have been forged simultaneously at several levels of the administrative hierarchy of the organizations involved: technicians in the field, scientists and administrators at regional level, and high-level national committees. It is clear from the case experiences that on-farm research alone cannot solve the linkage problem.

When links at multiple levels are in place, a strong apex management group can develop that not only combines the viewpoints of research and extension, but also has access to the structures and mechanisms needed to implement its vision. In Zambia, senior extension staff were involved in the initial planning of ARPTs. Provincial Agricultural Officers also provide administrative support and supervision in the field. This has helped to keep the ARPTs actively pursuing stronger links with extension.

It is too early to gauge the success of the Zambian experiment, but Research-Extension Liaison Officers working in the field may provide the crucial link between on-farm research and extension. Often seconded from extension, yet committed to the technology developed by the on-farm team, they are well placed to become product champions, enlisting the cooperation of the extension service in the verification stage and thereby broadening the impact of on-farm research.

The Sustainability Issue

The sustainability of a linkage mechanism should be judged in the context of how well the mechanism contributes to an effective working relationship between research and extension institutions over the longer term. For example, an expatriate Research-Extension Liaison Officer who is working as part of a donor-funded project may stay in the job for only a few years, after which his/her position may not necessarily be replaced by a national staff position. Nevertheless, if he/she organizes workshops which lead to a regular program of joint planning and review, then the post will have been an effective mechanism. This kind of progress, however, requires leadership from senior management. Clear goals must be set, linkage mechanisms must be supported with the necessary resources, and incentives must be created to reward cooperation.

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