OFCOR
Comparative Study
No. 2

International Service for National Agricultural Research

The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, Netherlands, on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a non-profit autonomous agency, international in character, and non-political in management, staffing, and operations.

Of the thirteen centers in the CGIAR network, ISNAR is the only one that focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on research policy, organization, and management issues, thus complementing the activities of other assistance agencies.

ISNAR has advisory service, research, and training programs.

ISNAR is supported by a number of the members of CGIAR, an informal group of approximately 43 donors, including countries, development banks, international organizations, and foundations.

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

OFCOR – Comparative Study No. 2

ORGANIZATION AND MANAGEMENT OF FIELD ACTIVITIES IN ON-FARM RESEARCH: A REVIEW OF EXPERIENCE IN NINE COUNTRIES

by

Peter T. Ewell

September 1988

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 which influence how 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 diagnosis and ranking of 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 efficiency of the technology generation and diffusion processes.

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 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 of the Study

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. 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.

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 I 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 Department and the Socioeconomics Department. 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, the ICTA 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 has generally been regarded as the institutional setting most compatible with the organizational requirements of OFCOR.

Panama

In the late 1970s, the Instituto de Investigación Agropecuaria de Panamá (IDIAP) 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 Agricoles (ISRA) initiated an OFCOR program in 1978. It is now part of the Department of Production Systems and Technology Transfer (DRSP, Departement des Recherches sur les Systèmes de Production 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 Systemes), 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, Fecali 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 Extension 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 — Tarnale 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 I
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 per Year)	
	Institutional Type	Organization of Research Program			OFCOR as % of NARS Human Resources	Size of OFCOR effort
Ecuador	Semiautonomous institute (INIAP)	Regional research stations/commodity programs	Production Research Program (PIP)[5]: National program with two coordinators and 10 teams based at regional research stations	9	6	14
Guatemala	Semiautonomous 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	Semiautonomous 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	Semiautonomous institute (ISRA)	Multi-commodity departments/ regional stations	OFCOR, located within Department of Production Systems Research and Technology Transfer (DRSP)[4], 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[6]
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, semiautonomous 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[f]
Nepal[2]	I. NARS: ministry II. LAC and PAC:[a] 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-locational testing and outreach programs. II LAC and PAC, regional institutes with OFCOR as a generalized research strategy.	14[g]	n/a	35[f]

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 1985.

a. Lumle Agricultural Centre and Pakhribas Agricultural Centre.

b. Programa de Investigaciones en Producción

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

d. Département des Recherches sur les Systèmes de Productions et le 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
(forthcoming in 1988)

- 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) OFCOR Case Study No. 1. Now available.

- 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)

- Senégal. Organisation et Gestion de la Recherche sur les Systemes de Production, ISRA. (J. Faye and J. Bingen)

- Ecuador: Un Estudio de Caso de la Organización y el Manejo del Programa de Investigación en Finca de Productores en el Instituto Nacional de Investigaciones 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 Agrícolas (ICTA). (S. Ruano and A. Fumagalli) OFCOR Case Study No. 2. Now available.

- Panamá: Un Estudio de Caso de la Organización y el Manejo del Programa de Investigación en Finca de Productores en el Instituto de Investigacion Agropecuaria de Panamá (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)

Table of Contents

List of Tables and Charts

Acknowledgements

This paper is based on the case studies listed in the first section of the bibliography. The work of the authors, all of whom have been closely associated with the projects studied, is gratefully acknowledged. I apologize for any and all errors of fact and interpretation. References cited directly in the text are also listed, but this is not in any way intended as a review of the voluminous literature of on-farm research. A bibliography of materials related to the cases and the issues raised will be available from ISNAR.

This paper is the result of intense collaborative effort. All of the concepts and interpretations of the material from the case studies have been discussed at length in a series of meetings and discussions with Deborah Merrill-Sands, Stephen Biggs, Susan Poats, Jean McAllister, and James Bingen.

Comments on an earlier draft by Marcelino Avila, Michael Collinson, Diana McLean, Willem Stoop, and Robert Tripp were greatly appreciated.

Peter T. Ewell is a consultant on the staff of ISNAR's OFCOR project and has coordinated the case studies from Latin America. In addition to this paper, he is preparing another which compares the links between OFCOR and extension in the nine cases. An agricultural economist, he has done on-farm research in Mexico and with the International Potato Center (CIP) in Peru. His address after January 1, 1989 will be:

International Potato Center (CIP)
Region III
P.O. 25171
Nairobi, Kenya.

Glossary of Acronyms

AARD	The Agency for Agricultural Research and Development of the Ministry of Agriculture of Indonesia.
AGRITEX	Department of Agricultural, Technical, and Extension Services; the Extension service of Zimbabwe.
ARPT	Adaptive Research Planning Teams, Zambia's on-farm research program.
BARC	Bangladesh Agricultural Research Council.
BARI	Bangladesh Agricultural Research Institute.
CATIE	*Centro Agronomico Tropical de Investigacion y Enseñanza* (Tropical Agriculture Research and Training Center); a regional agricultural research center with headquarters in Costa Rica.
CIAT	*Centro Internacional de Agricultura Tropical* (International Center for Tropical Agriculture); an international agricultural research center with headquarters in Colombia.
CIMMYT	*Centro Internacional de Mejoramiento de Maiz y Trigo* (International Maize and Wheat Improvement Center); an international agricultural research center with headquarters in Mexico.
CIP	*Centro Internacional de la Papa* (International Potato Center); an international agricultural research center with headquarters in Peru.
CIRAD	*Centre de Cooperation Internationale en Recherche Agronomique pour le Développement* (Center for International Cooperation in Agricultural Research for Development); an agency of the French government.
CRSP	Cooperative Research Support Project; a program through which USAID provides funds to U.S. universities for research on target commodities in the Third World.
DR & SS	Department of Research and Specialist Services, of the Ministry of Lands, Agriculture, and Rural Resettlement of Zimbabwe.
FSR & DD	Farming Systems Research and Development Division of the Ministry of Agriculture of Nepal.
FSRU	The Farming Systems Research Unit of DR & SS, in Zimbabwe.
IADS	International Agricultural Development Service; a non-profit service created by the Rockefeller Foundation which provided contract services to agricultural programs in the Third World. It was merged with the Agricultural Development Council and Winrock Farms to form Winrock International in 1985.
ICTA	*Instituto de Ciencia y Tecnologia Agricolas* (Agricultural Science and Technology Institute); the nationalagricultural research institute of Guatemala.
IDA	International Development Agency; an affiliate of the World Bank which offers low-interest loans to low-income countries.
IDB	The Interamerican Development Bank.
IDIAP	*Instituto de Investigacion Agropecuaria de Panamá* (Panamanian Agricultural Research Institute); the national agricultural research institute of Panama.
IDRC	International Development Research Centre; an agency governed by an international board and funded by the Canadian government to support research in developing countries.
IFAD	International Fund for Agricultural Development.
ILCA	International Livestock Center for Africa; an international research institute with headquarters in Ethiopia.
	(National Agricultural Research Institute); the national agricultural research institute of Ecuador.
INIAP	*Instituto Nacional de Investigaciones Agropecuarias* (National Agricultural Research Institute); the national agricultural research institute of Ecuador.
IRRI	International Rice Research Institute; an international agricultural research center with headquarters in the Philippines.
ISRA	*Institut Sénégalais de Recherches Agricoles;* (Senegalese Agricultural Research Institute); the national agricultural research institute of Senegal.

LAC	Lumle Agricultural Centre; a research and extension institute in Nepal supported by the British government through ODA.
NARS	National Agricultural Research System; a generic term for the complex of public and private institutions engaged in agricultural research in a country.
NRIP	The National Rice Improvement Program of the Ministry of Agriculture in Nepal.
ODA	The Overseas Development Administration of Great Britain.
OFCOR	On-farm, Client-Oriented Research, a term developed by this project to describe a range of on-farm research programs which focus on farmers as their principal clients.
OFR	On-farm research.
OSR	On-station research.
PAC	Pakhribas Agricultural Centre; a research and extension institute in Nepal supported by the British government through ODA.
PDRI	*Programa de Desarrolo Rural Integrado;* the national integrated rural development program of Ecuador.
PROGETTAPS	*Proyecto de Generacion y Transferencia de Tecnologia Agropecuaria y Produccion 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 IDB.
RELO	Research-Extension Liaison Officer in Zambia.
SERED	Socio-economic Research and Extension Division of the Ministry of Agriculture of Nepal.
USAID	The United States Agency for International Development.

I. Introduction

Over the past 15 years, many national agricultural research systems (NARS) have initiated new on-farm research activities in cooperation with international research centers and donors. These have been targeted primarily at resource-poor farmers living in marginal agroecological regions, whose needs have not been adequately addressed by the research of specialized departments and commodity programs working on experiment stations. There has been much excitement as a number of new approaches have been developed: 'farming systems research', 'cropping systems research', 'on-farm research with a systems perspective', and a number of others (Merrill-Sands, 1986).

Since 1986, ISNAR has been engaged in a major research project designed to draw practical lessons from the experience of on-farm, client-oriented research programs in nine national institutes. The acronym 'OFCOR' was coined to describe a range of research activities which use a closely related but somewhat confusing set of terms to describe what they do. What they have in common is a focus on the needs of resource-poor clients and a commitment to giving farmers a voice in the development of technology designed to meet their needs.

The OFCOR programs[1] in the case studies have broadened the research agenda beyond the specialized problems of improving the potential yields of individual crops. They have expanded the scope of adaptive research to include issues such as the development of varieties appropriate for multiple cropping, the use of patchy micro-environments for particular uses, such as early plantings, the efficient combination of crops and livestock on small farms, and many more. Farmers have been involved in the process through surveys, on-farm experiments, and meetings of various kinds. Social scientists, who in the past have played limited roles in most agricultural research institutes, have made a range of contributions. These have included the diagnosis of farmers' current practices, needs, and constraints; the selection of collaborators for experiments; and special studies of various kinds.

Up to now, studies of on-farm research have emphasized methodologies to develop technologies appropriate to farmers' conditions. They have paid less attention to the problems of institutionalization -- on how to sustain a dynamic orientation to the needs of resource-poor farmers within the context of their larger research systems (Heinemann and Biggs, 1985). The development of effective OFCOR has faced complex and unfamiliar problems of organization and management. These institutional issues have become increasingly important as support from donors for special pilot projects is reduced and on-farm research is incorporated into regular programs of the NARS. Much valuable experience has been accumulated on how management can contribute to the development of stable OFCOR programs with a long-term impact within their institutions.

This paper is one of a series comparing and analyzing the concrete experiences with OFCOR of national institutes in the nine countries studied. It is focused on how the field staffs have been organized, both in relation to other parts of the system and internally. It analyzes how the research process has been managed, and the procedures used for planning, programming and review. The organizational implications and management requirements of different methodologies are discussed, although it has not been a goal of the study to evaluate the effectiveness or efficiency of different research methods, or to assess their impact. Closely related topics are analyzed in separate papers: the linkages between on-farm and on-station research (Merrill-Sands and McAllister, 1988), the experience of the participation of farmers (Biggs, 1988), and the linkages between OFCOR and extension institutions (Ewell, 1988).

On-farm research has been organized in various ways in the nine case studies. Some research institutes have set up separate units with their own staff, others have organized new activities out of existing research centers. There is a trade-off between staying in close contact with farmers and their local conditions and maintaining effective linkages with scientists in commodity programs and other departments. One way or another, teams of scientists and junior staff must work out in the field, far from established centers, to carry out surveys, experiments, and other activities. Special skills and training are required. Flexible and reliable systems of logistical support must be provided.

Dynamic interdisciplinary cooperation has proved

[1] On-farm research is organized in a variety of different ways in the case studies and only some of them have OFCOR 'programs' with a formal structure analogous to that of a commodity program. The term 'OFCOR program' is used very broadly in this paper to refer to sets of activities which share certain characteristics, although they are defined and organized differently in each case.

difficult to sustain. Many incentives tend to pull natural scientists away from joint projects back to the agendas of their individual disciplines, where the standards and procedures of scientific research are clearly defined. Social scientists have played important and visible roles in the diagnostic phases of newly established OFCOR projects. Nevertheless, they constitute a small proportion of the on-farm research staff in most of the case studies, and they tend to get drawn away from field research into planning departments, ex-post-facto evaluations, and other functions. Training field agronomists in some simple techniques of analysis used by social scientists has been a very imperfect substitute for the active involvement of experienced professionals.

The targeting of on-farm research to particular regions, agro-ecological zones, and types of farmers involves difficult choices. National administrators and donors often put pressure on OFCOR to expand rapidly into many administrative regions of a country. This often leads to problems. Researchers can become over-extended, and opportunities for cooperation between administrative zones with similar agro-ecological conditions are often neglected. The targeting and selection of farmers as collaborators within regions is a chronically weak area in the programs studied. Various reasonable criteria for the selection of farmers are cited — including agro-ecological zone, cropping pattern, production system, and household type — but they are seldom applied systematically. Critical choices are made on an ad hoc basis under heavy short-term pressure to show rapid progress.

Many successfully established programs have subsequently suffered from a gradual process of stagnation. Very high expectations are established in the first years, in the flush of excitement of a new program with the ambitious, often unrealistic goal of bringing scientific technology to resource-poor farmers in many areas simultaneously. New methods and techniques are tried in an adventurous spirit of dedication and self-sacrifice. A stream of international visitors and conferences buoys confidence. Then, as the years go by, the intrinsic difficulties of carrying out research in isolated rural areas begin to weigh heavily, the original staff moves on, and enthusiasm wanes. Unless senior managers take active countermeasures, OFCOR can slide into mere routine programs of on-farm testing.

For their field staff, many OFCOR programs have depend heavily on young scientists recently graduated from the universities, and also on various types of technicians. This presents two serious challenges for managers. The first is to provide continuous training to stay ahead of turnover and to maintain expertise. The second is to support on-farm researchers in their interactions with their senior colleagues in the commodity programs and departments, to make sure that their findings and experience with farmers are given due weight in the planning, programming, and review of the larger research program.

The importance of leadership and coordination by both senior and field-level managers cannot be overstated. They can play active roles to help on-farm researchers to cope with predictable problems, and to maintain enthusiasm for on-farm research. They can prevent methodological stagnation by encouraging innovation, and by legitimating the analysis and presentation of many types of data. They can encourage interdisciplinary cooperation at all stages of the research process. They can make sure that mechanisms which encourage linkages of on-farm research with on-station research, extension, and farmers are explicitly included in all planning, programming, and review processes. Above all, they can constantly insist that both on-farm and on-station researchers maintain their focus on the client: on the resource-poor farm household.

II. The Organization and Management of Field Operations

Modes of Organization

The research institutes in the case studies have organized OFCOR in a variety of different ways. The organizational options available when an program is first developed, and the implications of the choices made, are analyzed in a separate paper in this series (Merrill-Sands and McAllister, 1988). The nine cases studies examined in this project were chosen as examples of national research systems with well-established on-farm research programs. In over half of them, scientists specialized in OFCOR were located in a special unit with its own professional and administrative identity. In the others, on-farm research activities were carried out by scientists attached to some other organizational framework. Four basic types of arrangements were found:

1. Semi-independent OFCOR field teams. On-farm research is carried out by a number of semi-independent teams located in target areas. Various mechanisms are used to link their work to regional experiment stations.

2. OFCOR units based in experiment stations. Special OFCOR units are based in regional or national experiment stations. The actual on-farm research is carried out in designated areas by technicians.

3. Scientists responsible for both on-station and on-farm research. Scientists are responsible for both on-farm and on-station research. Administratively there is no separate OFCOR department or division -- OFCOR goals and methods are incorporated into the programs of other research divisions.

4. Special projects. OFCOR is set up within specially funded projects, often tied to regional development programs. Scientists are seconded from research institutes for the life of the project.

Profiles of the Organization of Field Research in the Case Studies

The organizational positions of the OFCOR field researchers within the structure of their larger organizations in the nine case-study countries are illustrated in schematic diagrams in Charts 1 through 9. They show the position of the field staff relative to other units from which they receive resources and support, or with which they coordinate activities. Because they show both formal and informal relationships, these diagrams do not correspond exactly to the purely administrative structure reflected in the formal organizational charts of the institutes. Sub-cases within countries are shown separately where significant differences were found. The four key levels in all cases are

1. national coordination or direction;
2. support from international donors and research centers;
3. regional coordination or implementation;
4. actual on-farm research operations.

Ecuador (Chart 1). On-farm, client-oriented research in Ecuador is the responsibility of a special program called the Production Research Program (PIP) of INIAP, the semi-autonomous national agricultural research institute. The program was organized in 1977 by the national agricultural economics department. Strong leadership, particularly for the development of methodology, was provided by the regional office of CIMMYT's Economics Program. Adaptive on-farm research, including a strong social-science component, was designed as a 'third phase' of the national research strategy, to complement on-station experiments and regional variety trials. Financing from the Interamerican Development Bank and USAID provided vehicles and other support, and gave the program relative freedom from budgetary constraints in its first years.

Research on farms is implemented by ten small, semi-independent field teams, each of which is linked to a regional experiment station. Five of them operate independently and five work within the framework of regional integrated rural development programs of a national agency (PDRI). Following CIMMYT's restricted systems approach, their research has been focused on the food crops maize, wheat, barley, and potatoes. Although the PIP's staff constituted less than 10 percent of INIAP's scientists, they ran 30 percent of the total number of experiments on these commodities completed between 1980 and 1985.[2]

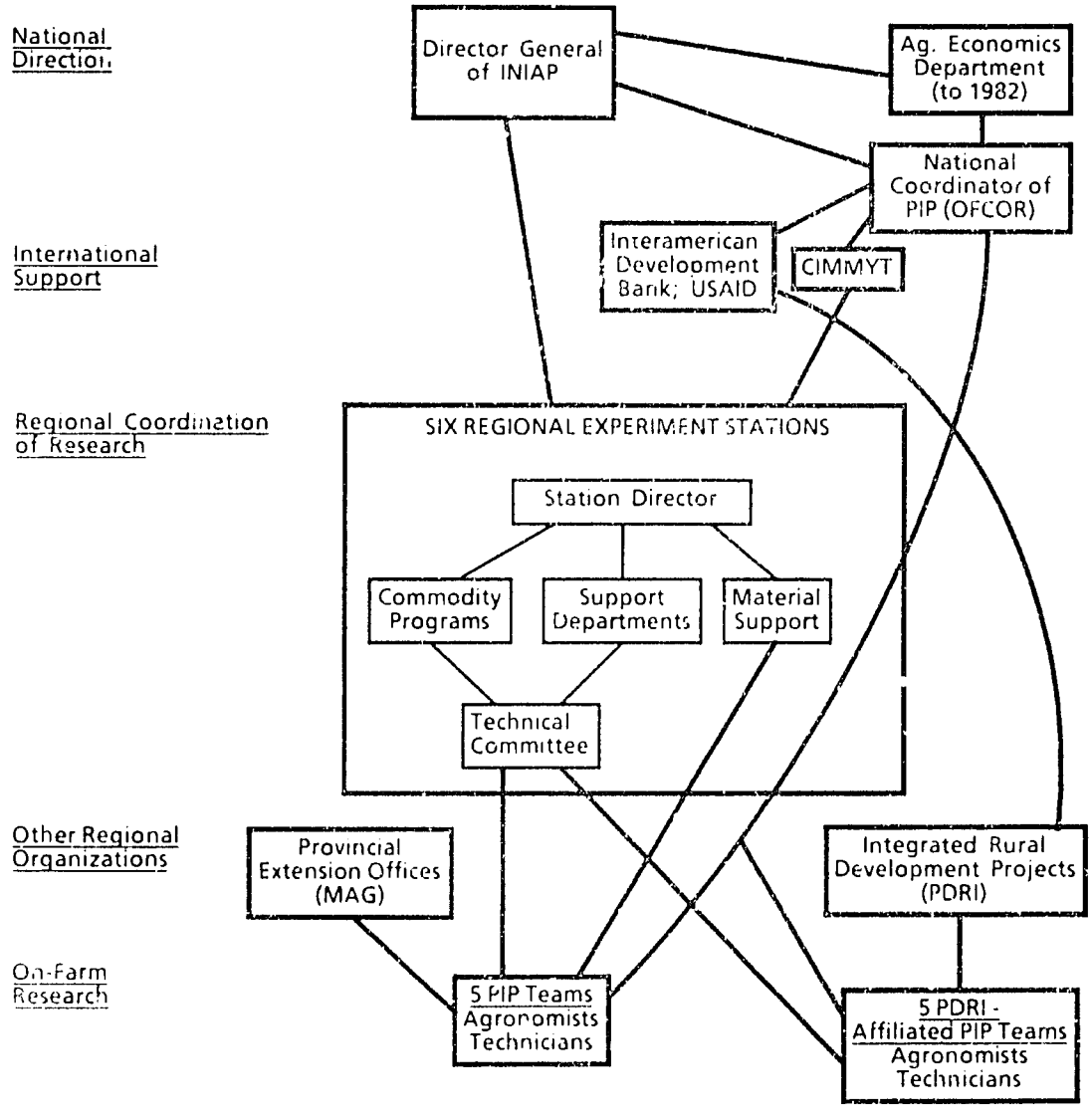
The 'normal' staffing pattern -- a team of one agronomist and one technician working directly with him as an assistant -- was found in only four out of the ten teams in 1985. In three zones an agronomist was working alone, and two were manned by teams of two agronomists. Social scientists from the central office, from CIMMYT and other international centers, and from North American universities, have participated in surveys and other aspects of on-farm research, but none has been assigned to the field teams.

Formal mechanisms for the transfer of technology have never been developed with the extension service of the Ministry of Agriculture, although there has been some informal coordination with the local offices. The teams that work within the development projects define their targets according to criteria laid down by the sponsoring agency, and cooperate closely with special extension agents working out of the same offices. Salaries, benefits, inputs for the trials, and other material support are channeled through the corresponding experiment station or integrated rural development office.

A central ambiguity in the organizational structure of the program has been that the field researchers are responsible both to the regional experiment stations and

[2] This is not meant to imply that the number of experiments is a good measure of research productivity. Experimental designs vary enormously in their scope and complexity. On-farm trials usually employ a simpler design with fewer replications than experiments on stations, and are often run in relatively large numbers.

Chart 1
Ecuador: Schematic Diagram of the Organization of OFCOR Operations



to the national PIP program. In the first years, senior social scientists from CIMMYT and the national PIP office organized *ad hoc* committees of scientists in the commodity programs and departments at the stations for the planning and support of on-farm research. This arrangement could not provide a stable alternative to the established pattern of the institution, where the regional experiment stations have substantial authority over their programs and budgets.

After 1982, when international funding ended and CIMMYT closed the regional office of its Economics Program, the PIP teams became regular programs of the stations, but with reduced status and funding. The Ecuadorian economists have moved to other posts, and the national coordinator has been too burdened with administrative details to provide effective scientific leadership. The relatively junior field agronomists in the PIP have had difficulty defending their farmer-oriented agenda in their meetings with the technical committees of the stations. The teams are too small to maintain a broad, interdisciplinary OFCOR agenda without constant support, and the methodology has stagnated. Located in a marginal position relative to the predominant structure of INIAP, the PIP program has been particularly vulnerable to shifts in policy and to reductions in the operating budget.

Guatemala (Chart 2). ICTA, the national agricultural research institute, was organized in 1973 around a philosophy in which on-farm research plays a central role in the development and transfer of technology appropriate to producers of basic food grains. Research is decentralized in six regions, in which both on-station and on-farm activities are organized around local crops and agro-climatic conditions. The OFCOR functions are divided between two separate departments, Technology Testing and Socioeconomics. International organizations, particularly the Rockefeller Foundation, played key roles in the early years, but have never dominated the organization.

The Technology Testing department consists of 12 teams which are integral parts of ICTA's regionalized structure under the coordination of the Regional Directors. Each is based in a sub-region defined according to the predominant farming system. Each is headed by a Regional Sub-Delegate and consists of an average of four young scientists, each with a research assistant. The locally hired research assistants play important roles: selecting collaborators, delivering inputs, taking data, and organizing the farmer-managed and farmer-implemented validation trials. The teams are responsible for running all new varieties and other technology developed by all of the commodity programs at the regional experiment stations through a programmed sequence of on-farm trials. In a few isolated cases they have coordinated their activities with the extension offices and official credit banks based in the same regions, but this is not the norm.

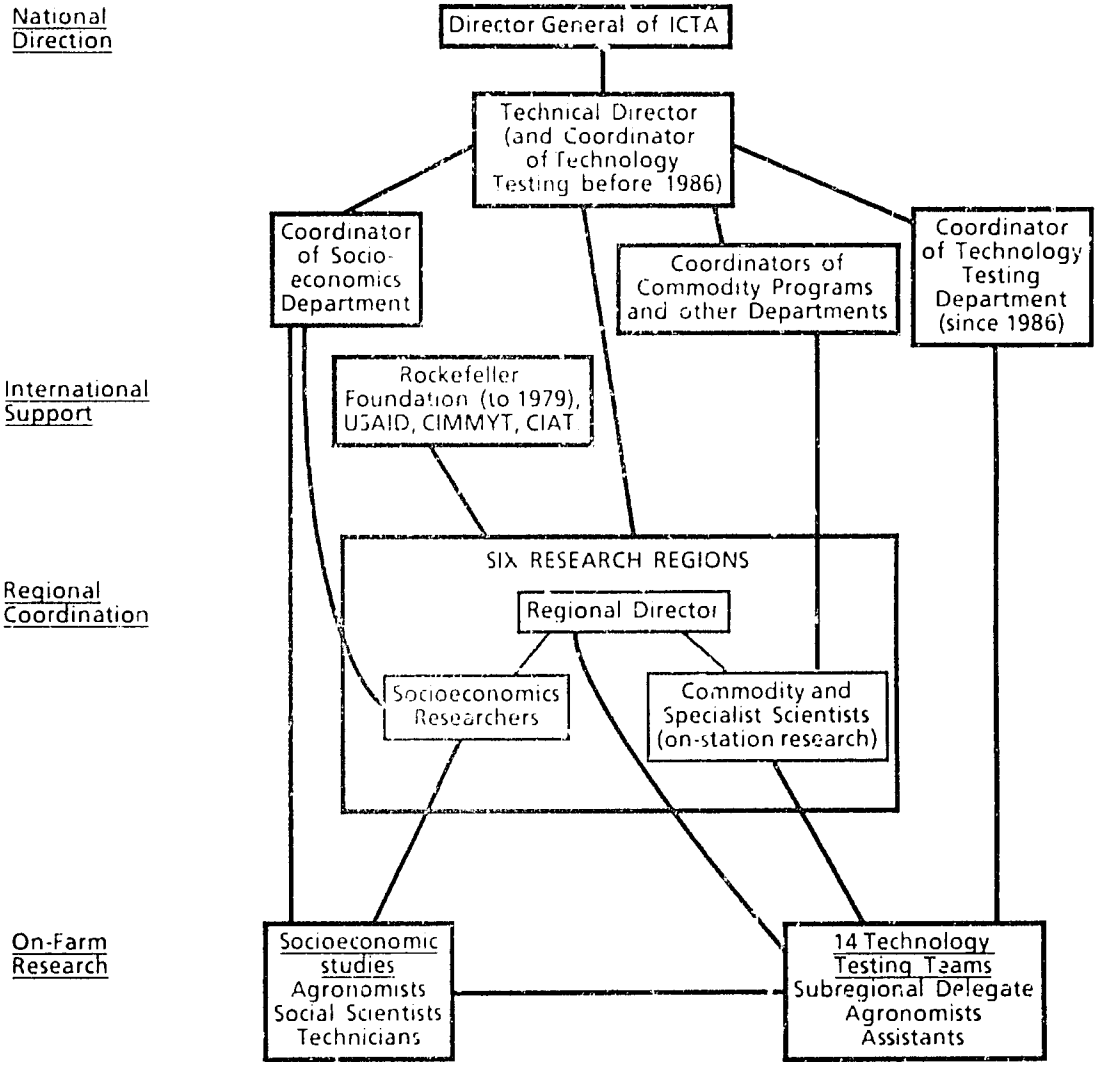
Operation of the teams is coordinated out of the regional experiment stations, where the scientists obtain resources such as their pay and benefits, travel allowances, and inputs for the experiments. They are assigned individual vehicles and enjoy some autonomy over routine expenses. The case study argues that Technology Testing is seen by many within ICTA as a relatively low-status service unit, rather than as a locus for original research. Until a coordinator was named in 1986, the department was only represented at the national level by the Technical Director, as just one of his many responsibilities.

The Socioeconomics Department is organized at the national level. Its history can be divided into two phases. Between 1974 and 1979 it operated as an interdisciplinary team of professionals under the leadership of a foreign economist from the Rockefeller Foundation. At its apogee it comprised two agricultural economists, an economist, two anthropologists, a sociologist, two agronomists, and two technicians. This was a period of methodological experimentation and discussion throughout the institution. The department ran both formal surveys and on-farm experiments before settling on a standardized methodological sequence.

First, informal diagnostic studies, or *sondeos*, would be carried out quickly by interdisciplinary teams which included senior social scientists, senior commodity scientists, and the regional director (Hildebrand and Russo, 1982). The field research program would be developed on the basis of group consensus. Detailed data would then be collected from small samples of farmers through multiple-visit farm records surveys. The department hired technicians to carry out this routine phase of the work. Social scientists were responsible for evaluating the acceptance of new technology, and also for assessing the progress of all of ICTA's programs towards the broad goal of meeting the needs of small farmers. They were assigned as individuals to work in the regions, but the department was never integrated into the predominant regional structure of the institution.

The department was left in a weak position after the foreign director left in 1979. The professionals drifted away from ICTA, methodological innovation ceased,

Chart 2
Guatemala: Schematic Diagram of the Organization of OFCOR Operations



and relatively few further socioeconomic studies were done to monitor changes after the initial sondeos. This left relatively low-level technicians isolated outside of the regional structure of Technology Testing, and did not have the status within the institution to provide feedback into the research process (Hildebrand, 1979; Gostyla and White, 1980). Since 1985, the department has been hiring more scientists to carry out socioeconomic research, although most of them are agronomists who have received some orientation in the goals and methods of economics and rural sociology.

Panama (Chart 3). Panama is a case in which many scientists are responsible for both on-station and on-farm research. The national research institute (IDIAP) was founded in 1975. Its facilities, including experiment stations, are modest. Most research is organized through national commodity programs. There is no formal on-farm research department, but a national plan including on-farm activities was developed in the late 1970s as part of a policy of orienting agricultural research to the needs of small farmers. A number of OFCOR projects have been developed in association with CIMMYT, IDRC, CATIE, and two North American universities.

On the basis of reviews of the secondary literature and multi-disciplinary *sondeos*, the national OFCOR plan selected 16 priority target areas where the agro-climatic and the socioeconomic conditions were representative of a larger set of areas to which it was assumed that technology could easily be transferred. In 1986, 33 percent of IDIAP's field experiments were run as part of OFCOR programs on farmers' fields in the target areas. The others were located on experiment stations or on land rented from farmers.

Three regional administrative offices were set up in 1982 as part of a process of decentralization. They handle the routine delivery of resources to the research areas in different parts of this small country, although many key planning decisions are still made in Panama City.

The case study highlights two special projects organized in some of the target areas in cooperation with international organizations. Caisán, was developed in association with CIMMYT, and the Dual-Purpose Livestock project was developed in association with CATIE and IDRC. Both were conceived as pilot projects to develop appropriate methodologies, and have worked with full-time research staffs.

In 1975, the average pro rata investment of research time in on-farm research in the target areas ranged from 0.5 to 3.6 person-years, with an average of 1.9. Technicians work directly with the scientists as assistants. The relative importance of on-farm experiments in IDIAP has been declining in recent years. Cooperation with extension has been poor, partly because the two institutions' respective responsibilities for technology adaptation and transfer have never been clearly delineated.

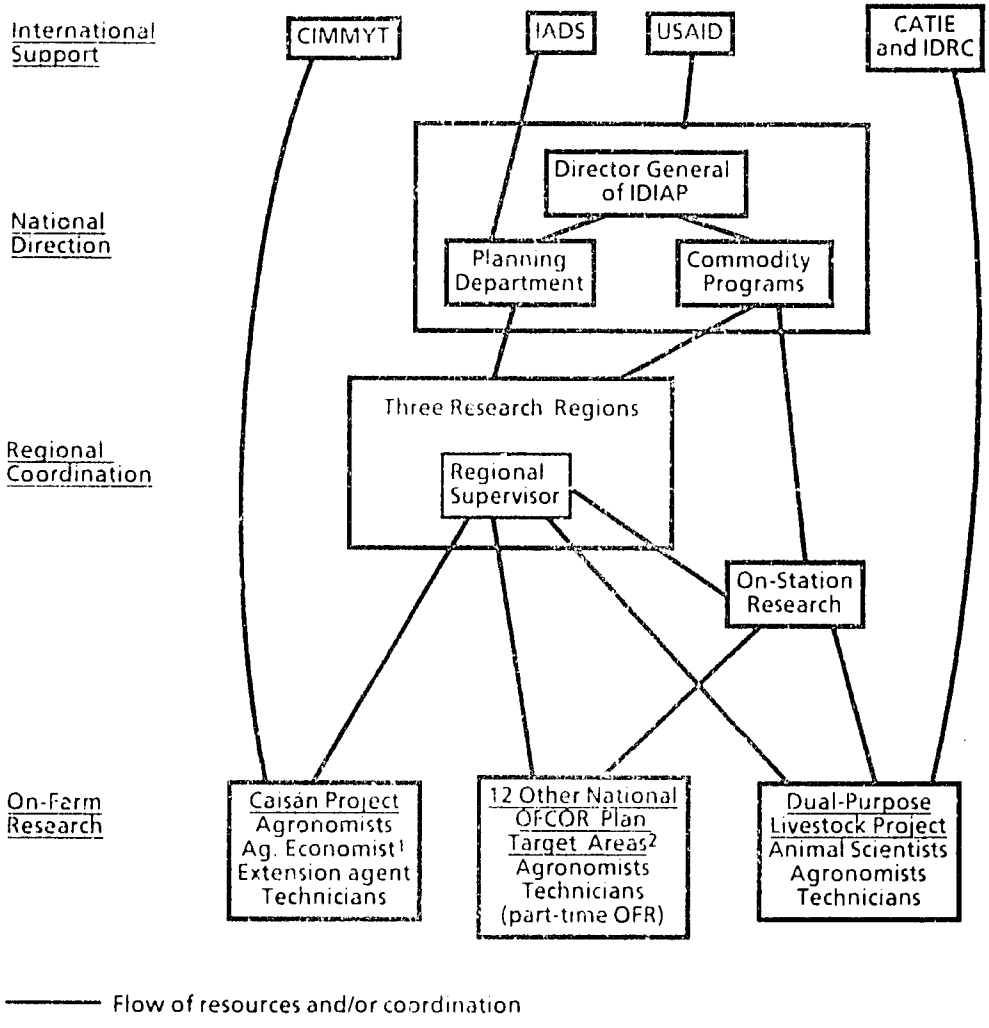
Currently, no social scientists are directly involved with on-farm research. Nevertheless, economists have played important roles, particularly for planning and methodological development. On the national level, IADS and USAID were involved in the process of selecting priority target areas. Social scientists from CIMMYT and CATIE assisted the development of methodology in the field. CIMMYT did an economic evaluation of the Caisán project as a tool for 'selling' OFCOR to natural scientists and policymakers as a rapid and efficient mechanism for the local adaptation and transfer of technology (Martinez and Saín, 1983). A sociologist hired to carry out a field study embarked on a very ambitious, broad survey of farmers' conditions but never completed it. This has given sociology a bad reputation in the institution (Tarté, 1983).

Senegal (Chart 4). OFCOR was initiated in Senegal more as a strategy to reform the research process in the parent institution (ISRA) than as a strategy to reach a previously neglected client group of farmers. Institutional conflicts, both with a pre-existing on-farm research paradigm and with scientists in the regular commodity programs, have weighed heavily in the short history of the program.

Agronomic and socioeconomic on-farm research have both been an important part of a number of programs from the days of the French colony. Research teams following a new paradigm of farming systems research were set up in three of the country's five agroecological zones in 1982, under a new Department of Production Systems and Technology Transfer. Senior scientists are assigned to regional experiment stations and design parallel on-station and on-farm experiments. The on-farm trials in the village research areas are attended by resident field technicians *(observateurs)*, responsible for the collection of field data from the trials.

Technicians with somewhat more training *(enquêteurs)* live in town and are responsible for socioeconomic surveys. The program has been broadly interdisciplinary and has investigated a range of issues, including improved varieties, improved cropping systems, animal traction systems, and marketing. The director was a

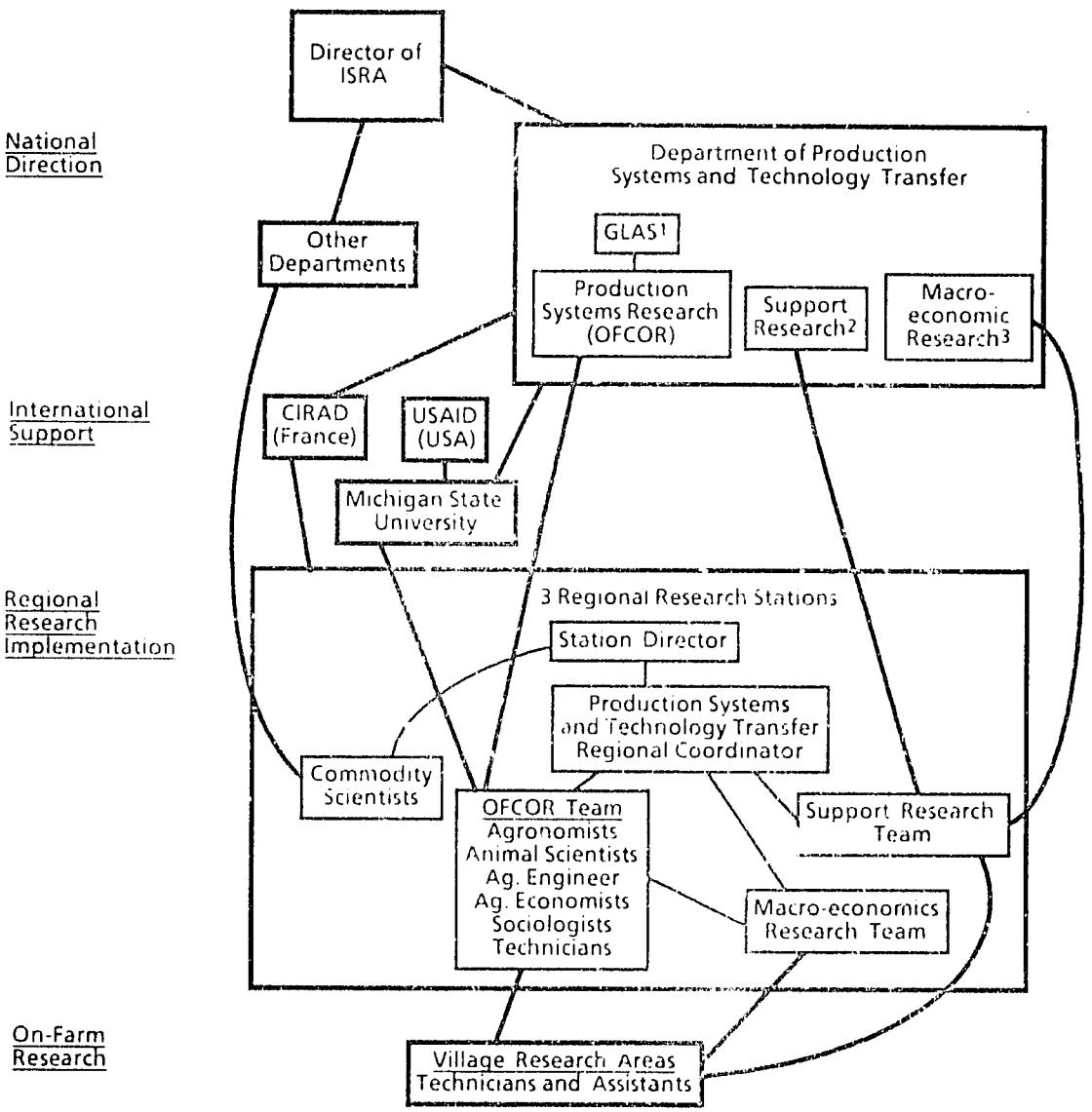
Chart 3
Panama: Schematic Diagram of the Organization of OFCOR Operations



[1] An agricultural economist from CIMMYT worked part-time on the project.

[2] As a matter of institutional policy, many scientists at IDIAP carry out a portion of their research in farmers' fields in target areas established under a national OFCOR plan. Caisán and the Dual-purpose Livestock project have been organized within this framework.

Chart 4
Senegal: Schematic Diagram of the Organization of OFCOR Operations



[1] The Central Systems Analysis group, a part-time committee responsible for the coordination and review of OFCOR.
[2] This section carries out research on technology with application on a supra-household level, such as community-level drainage projects.
[3] This section is dedicated to the collection and analysis of statistics.

sociologist for the period covered in the case study, and detailed socioeconomic evaluations have been an integral feature of the field research.

Resources have been provided by USAID through several projects, with additional funding from the World Bank. Technical assistance has been provided through a USAID contract with Michigan State University, and also from the French agency CIRAD. Until 1986, these funds were allocated by ISRA in blocks to its regional research centers, with no amounts specifically earmarked for OFCOR activities. The lack of explicit priorities and problems in delivery resulted in chronic shortages in operating funds, even though sufficient resources were available. The Production Systems Department set up a variety of special mechanisms to deal with the problem. The foreign scientists at the field level commonly had access to special funds from donors and contracts which allowed them to cover their needs for travel, purchases, and field personnel. Since 1986, ISRA has moved to set up a more efficient system.

Zambia (Chart 5). The Zambian on-farm research organization (ARPT) is an integrated national program organized within the Department of Agriculture. A national coordinator is located in the central research station. He is responsible for program leadership, coordinating field activities, and linking the work of ARPT with other research programs. Seven provincial teams of three to nine scientists are based at small regional experiment stations. On-farm experiments are located in three or four separate research areas per province, where technicians called trials assistants live.

Coordination with extension has been emphasized from the national level on down. A Research-Extension Liaison Officer (RELO) was a member of four of the ARPT teams in 1986, and all of the trials assistants are seconded from extension. The Provincial Agricultural Officers, the local leaders of extension, also provide housing in the field. They chair coordinating committees with nominal responsibility for all research and extension activities in their regions. In fact, these committees have not had much influence on the OFCOR programs after the initial decisions about where field research will be located. Each of the provincial teams has been funded by a separate donor, which has placed a premium on effective and flexible coordination at the national level. CIMMYT's regional economics program provided methodological support and training, particularly in the first years. The work in some of the research areas has been coordinated with integrated rural development projects.

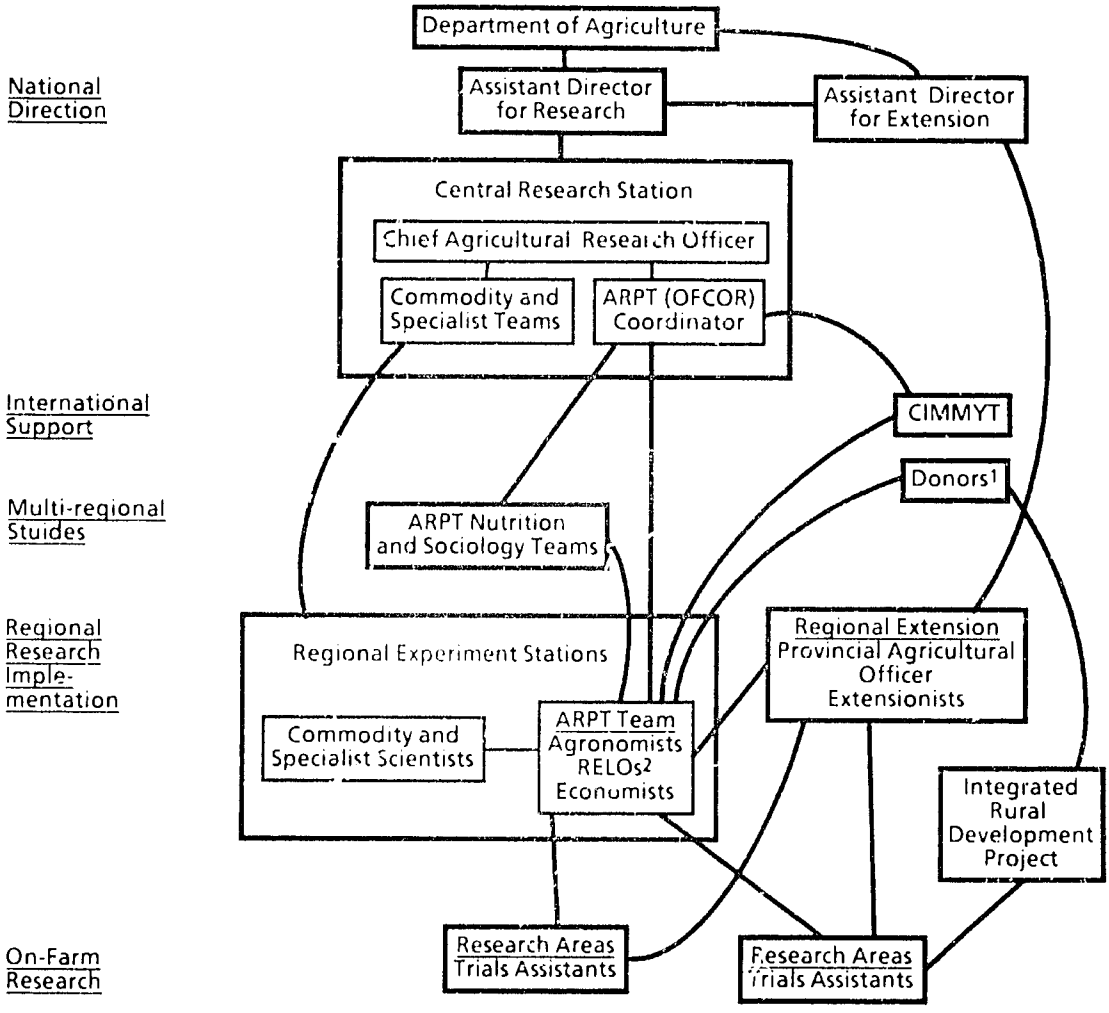
Zambia is the case with the highest proportion of social scientists — nearly 50 percent of the professional staff. Agricultural economists played important roles in the initiation of the program and in the development of the basic methodology. What is unusual is the flexibility with which new methods and approaches have been continuously introduced. Each team has at least one economist. Sociology and nutrition have been organized as separate support disciplines to carry out multi-regional studies and to back-stop the work of the teams.

Zimbabwe (Chart 6). The OFCOR activities of the national agricultural research organization (DR & SS) are divided between decentralized programs, called institutes. Since independence in 1980, most have developed some program of on-farm research as a strategy for developing improved technology appropriate for small farmers in the Communal Areas.[3] This new emphasis on small farmers is a radical shift for the institution. Before 1980 it worked almost exclusively with large-scale (primarily white) commercial farmers, who were concentrated in agro-climatically favored regions. Most scientists run experiments both on-station and on-farm. Field operations are carried out in cooperation with the extension agency (AGRITEX), which has gone through a parallel process of reorientation to the new priority clients. There have been problems developing effective collaboration. Various donors have provided support in key areas, but DR & SS is a well-established organization with high scientific standards and independent resources.

The case study reviews the experience of five of the institutes. Each develops it own program, although DR & SS has recently established a national committee to coordinate on-farm research and extension. The Crop Breeding Institute runs a conventional program of multilocational tests of their advanced materials. Lowveld Station has a regional mandate and is studying the yield stability of crops grown using experimental tillage methods designed to conserve soil moisture in rainfed systems. Neither of these institutes has posted teams in the field or has any staff dedicated full-time to on-farm research. The Cotton Institute has worked through specialized extension agents to improve cotton

[3] 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 then 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. Approximately 760,000 households farm and raise livestock on this land, much of which has very low productive capacity.

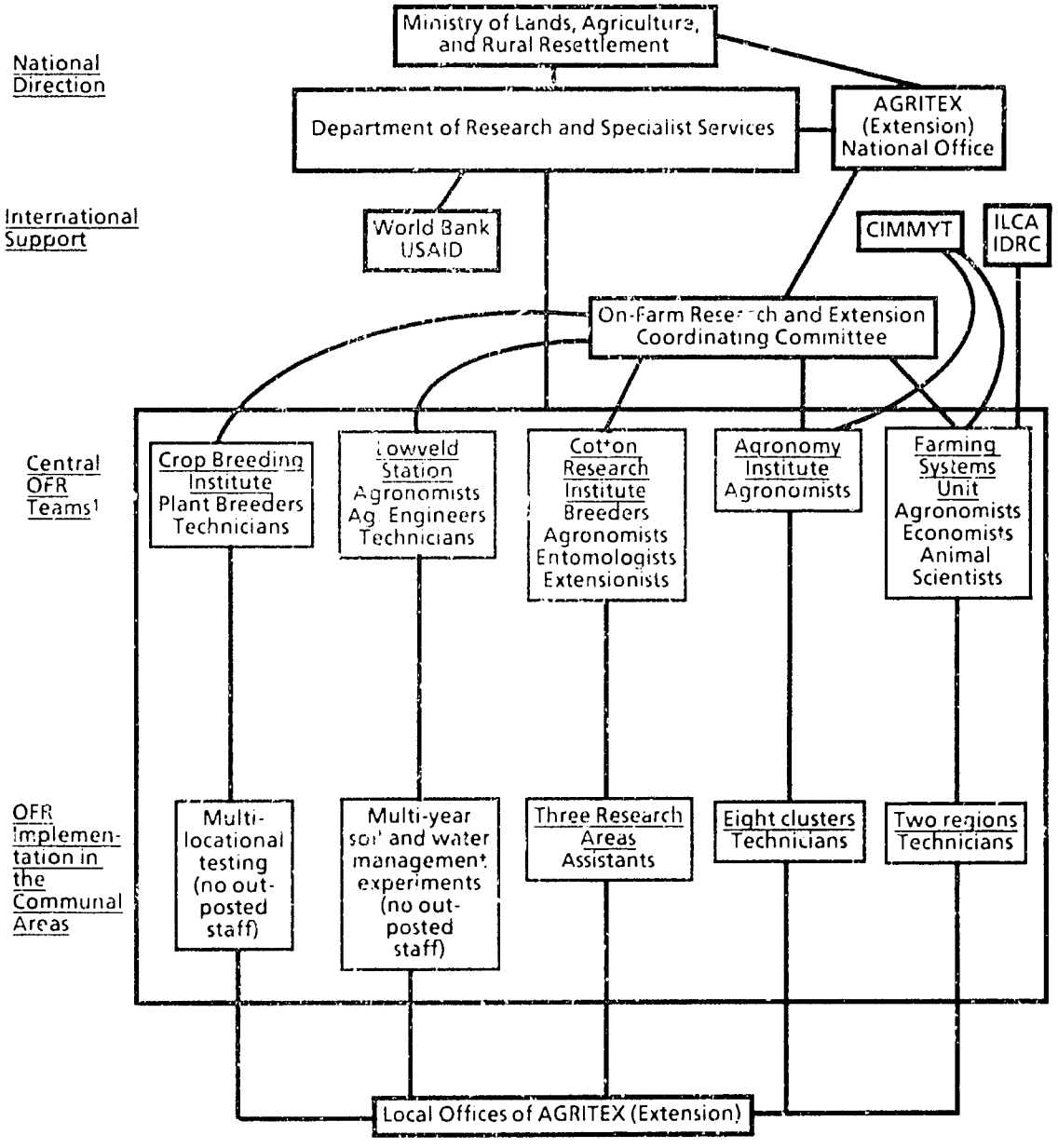
Zambia: Schematic Diagram of the Organization of OFCOR Operations



[1] Each provincial ARPT is supported by a different set of donors: The World Bank, IFAD, USAID (USA), SIDA (Sweden), ODA (Great Britain), GTZ (West Germany), NORAD (Norway), and The Netherlands.

[2] Research-Extension Liaison Officers

Chart 6
Zimbabwe: Schematic Diagram of the Organization of OFCOR Operations



[1] Three of the on-farm research teams are located in the capital city of Harare. The Cotton Research Institute is headquartered at its principal experiment station, and the Lowveld Station is a regional facility.

production in the communal areas, and has out-posted three teams of assistants to manage on-farm experiments.

OFCOR was initiated in the Agronomy Institute in two parallel programs, both of which have been run by scientists located at a central station near the capital. The first, called the Communal Area Trials (CART), was designed to test existing, 'off-the-shelf' technology. Many trial sites were scattered all over the country to cover the broadest range of conditions. Extension workers and farmers carried the burden of the work managing the plots and collecting data.

The institute organized an annual training workshop in research methods, but loss rates and coefficients of variation were extremely high. There was little progress towards the development of agronomic packages, and the program was reorganized in 1984. The number of research areas was cut to eight clusters of manageable size, each under the supervision of a single scientist at the central station who visits the site at regular intervals. Day-to-day management of the field trials was put under the responsibility of out-posted teams of technicians and assistants. No social scientists have been involved.

The Farming Systems Program was started in separate districts in the same institute in 1981, with advice, training, and some financial assistance from CIMMYT's regional economics program. Diagnostic surveys were designed to identify the principal constraints faced by farmers. On the basis of the results, on-farm experiments were run to adapt technology to local needs. ILCA expressed interest in assisting the development of an analogous program in the Livestock and Pasture Division. Rather than create two separate programs, the joint Farming Systems Unit was set up to investigate the interactions of crops and livestock within a unified systems perspective. A foreign scientist was funded by IDRC to be its head. A single interdisciplinary team of animal scientists, agronomists, and economists is based near Harare, where they also run a few on-station experiments. On-farm research is concentrated in two districts in the Communal Areas, one with high and the other with low agronomic potential. Senior technicians are responsible for supervising the trials. The program is closely coordinated with both on-station research and local extension workers.

Bangladesh (Chart 7). The Bangladesh case study is limited to the on-farm research activities of the Bangladesh Agricultural Research Institute (BARI), the largest of 11 institutes coordinated by the Bangladesh Agricultural Research Council (BARC). Nevertheless, with 90 natural scientists, 14 economists, and 449 technicians and assistants, its On-Farm Research Division is the largest OFCOR program in our study. It was established in 1984, with an exclusive mandate for on-farm research, as an amalgamation of the following independently funded programs:

1. **Soil Nutrient Status Monitoring Project,** funded by FAO/UNDP. This program is the successor of a program of on-farm fertilizer trials and soil testing which dates back to the early 1950s.
2. **Farming Systems Research Project,** funded on contract with BARC, the national research council, with resources which come primarily from USAID. This program is the successor of the Cropping Systems Program started in 1973 in cooperation with IRRI, and has also been influenced by CIMMYT and other organizations.
3. **Extension-Research Project,** funded by IDA. This program was established in 1978 to carry out adaptive research for the needs of a T & V extension system. 4. Various special projects.

These are not, however, *operated* as independent projects. Each researcher is hired under one or another of the programs, but works on one or more of the following subject-matter areas:

Type 1: **Farming Systems Research**
- a) Improvement of existing farming systems
  - rainfed cropping systems
  - irrigated cropping systems (much lower Priority)
- b) Homestead production and utilization
- c) Pre-production evaluation
- d) Socioeconomics

Type 2: **Field Trials of Advanced Technology**
- a) Testing of improved lines and varieties
- b) On-farm fertilizer trials and soil nutrient monitoring

Type 3: **Learning from Innovators**

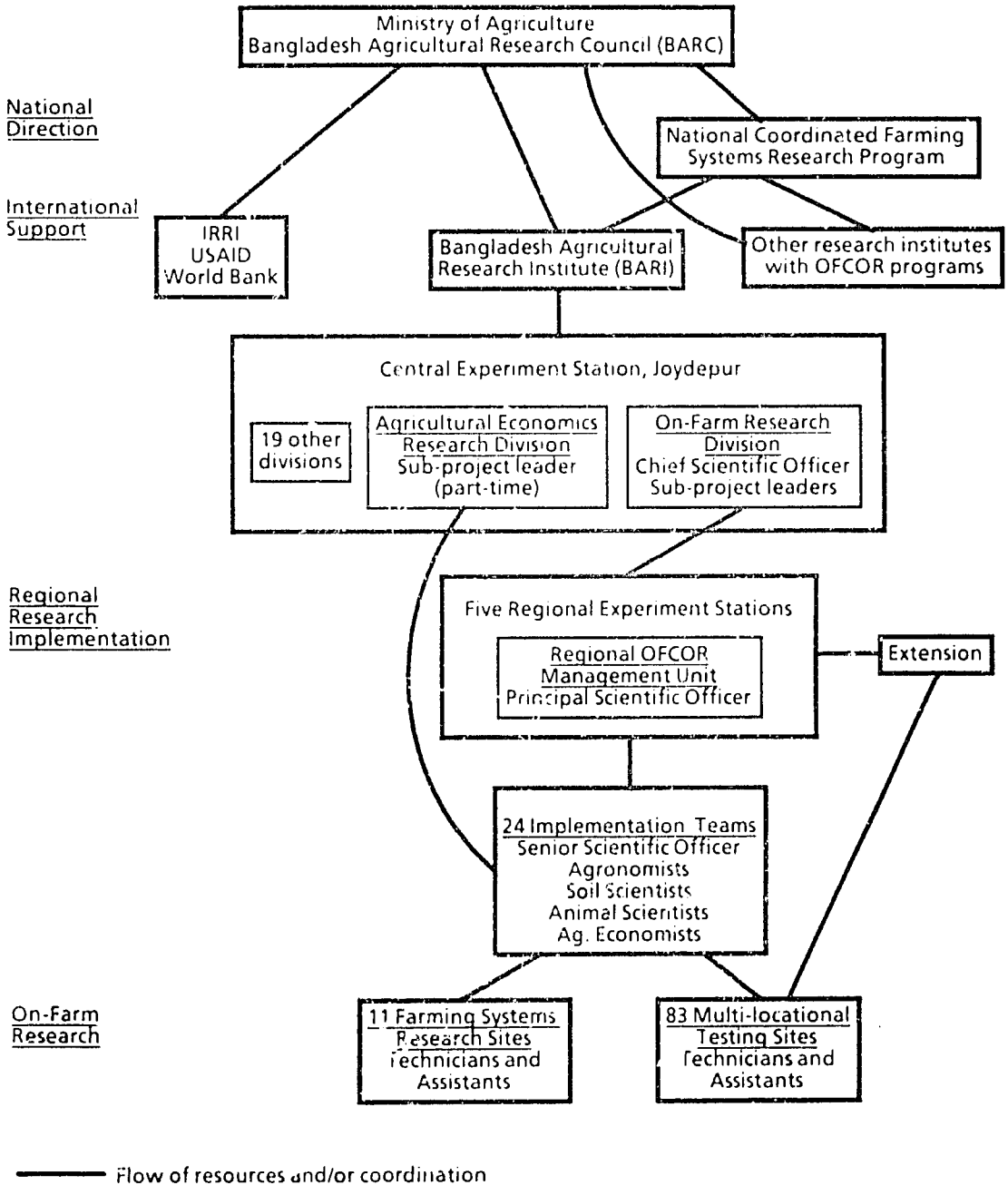
Type 4: **Household Fuel and Organic Matter Utilization**

Type 5: **On-station Back-up Research**

The On-farm Research Division is organized in a hierarchical system of five regional management units and 24 regional implementation teams. The scientists at the implementation level direct technicians in 11 FSR sites delineated by the National Farming Systems Research Program (for Type 1 research), and in 83 multilocational testing sites (for Type 2 research). Farmers in the FSR sites are selected by field assistants as part of the research process. Farmers in the

Chart 7

Bangladesh: Schematic Diagram of the Organization of OFCOR Operations in BARI



multilocational testing sites are selected by extension. USAID has been an important donor.

Although the On-farm Research Division is administered as a full-fledged unit of BARI, its staff is patched together. It consists of:

1) regular appointees, many of whom are agronomists and soil scientists of relatively low professional qualification inherited from the long-established soils and fertility programs;
2) temporary staff hired in a project mode;
3) staff deputed from other divisions of BARI.

In spite of the broad, farming systems research mandate, there are no livestock or fisheries specialists. Many of the personnel are of lower academic caliber than the previous standards of the institute for two reasons: the program inherited a number of career technicians from the soil fertility program and has expanded rapidly by hiring inexperienced recent graduates.

Indonesia (Chart 8). The Indonesian Agricultural Research Agency (AARD) coordinates the activities of a wide range of research institutes and specialized centers. It has operated as many as 50 separate on-farm research programs since the cropping systems methodology was first introduced by IRRI in the early 1970s. The case study focuses on four programs. Two of them, the Maize On-farm Research Project and the Small Ruminant CRSP Project, are special programs of single commodity institute. The other two, the Upland Agriculture and Conservation Project and the Crop-Livestock Systems Research Project, are cooperative projects of several research institutes.

The OFCOR teams of the single-institute programs are located at regional experiment stations, where they are involved in both onstation and on-farm research. Field work is implemented by technicians living in villages. The maize project is associated with CIMMYT and follows its methodology. Both full- and part-time staff are assigned to the program. Its research areas are located within 20 or 30 kilometers of the station, so there is close supervision. The Small Ruminant CRSP Program is funded by USAID through a group of U.S. universities. The scientists on the station dedicate an average of less than a third of their time to OFCOR and visit on-farm areas about once a month. Village research areas representative of important ecological zones are chosen to coordinate with extension.

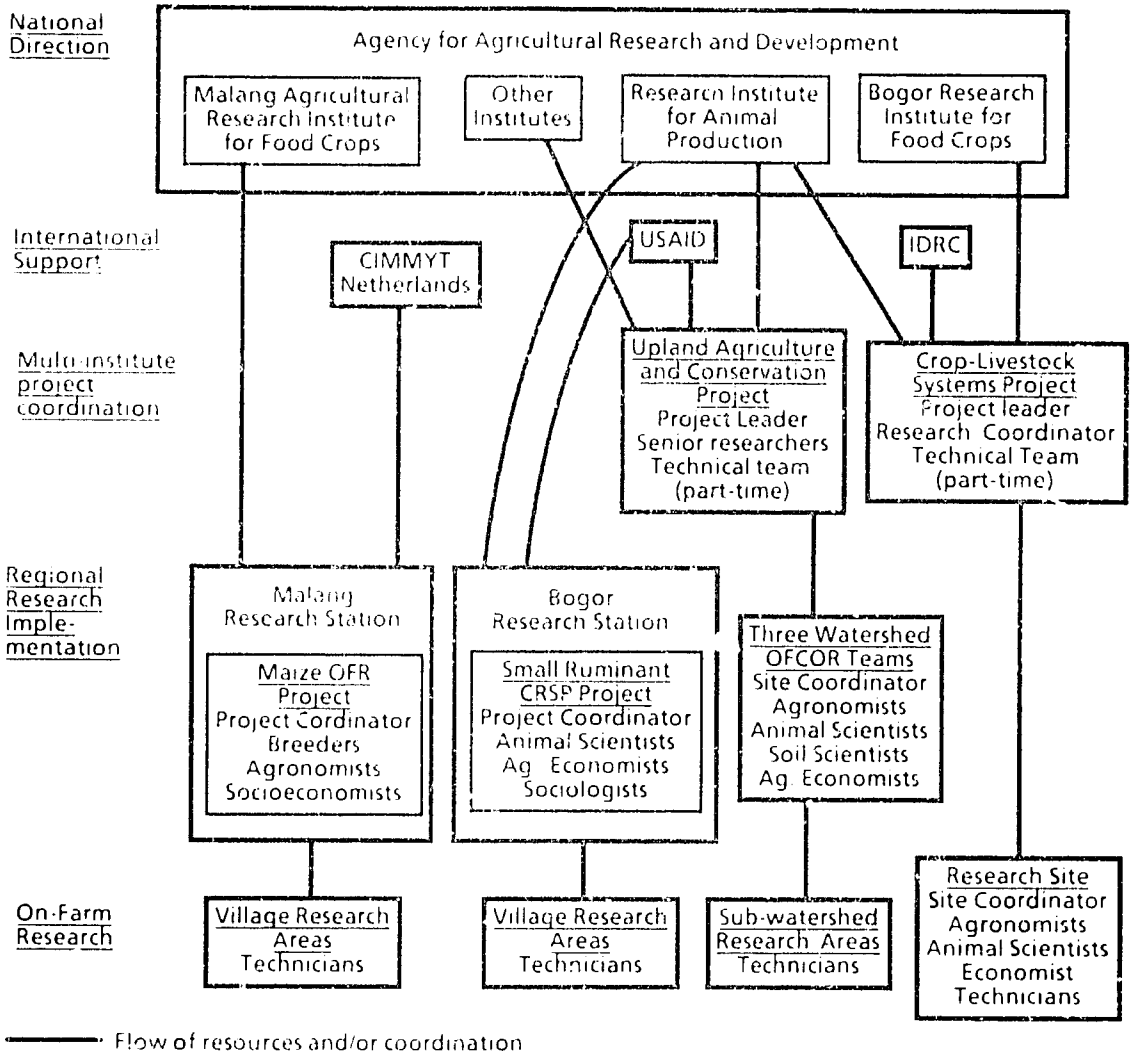
The Upland Agriculture and Conservation Project is a regional development project with a broad mandate to protect the upper basins of three watersheds in Java. It is funded by the World Bank and USAID. The agricultural research component is managed by a project leader located at the general headquarters. His immediate staff consists of three full-time researchers, and he draws upon the expertise of a technical team of ten specialists from the participating research institutes who serve on a part-time basis. Both on-station and on-farm research is planned and implemented by broad interdisciplinary teams in each of the watersheds, each of which is headed by a site coordinator. The on-farm experiments are attended on a day-to-day basis by technicians in a number of research areas, or 'subwatersheds'.

The Crop-Livestock Systems Project is a joint enterprise of two specialized institutes, with the support of IDRC. It is managed out of an office in Bogor by a a Project Leader and a Research Coordinator, with the support of a part-time technical team. A single autonomous research team is posted to a remote area in Sumatra. Three natural scientists, a social scientist, and six technicians who work directly with them as assistants live at a headquarters station. They carry out applied component research at that site. On-farm experiments are located in three villages within 12 kilometers, to which the research staff commutes regularly.

Nepal (Chart 9). On-farm research in Nepal has evolved in several different forms since the first programs were launched in the early 1970s. The oldest program highlighted in the case study is the National Rice Improvement Program (NRIP), founded in 1972. It has been funded by USAID through the Integrated Cereals Program, along with the maize and wheat programs. In addition to running routine multilocational variety tests on farms, the program also distributes 'minikits' through extension. These are packets of seed from the breeding program, sometimes accompanied with measured amounts of fertilizer and/or other inputs. Farmers are expected to return a card commenting on the performance of the package under their conditions. 106,100 kits were distributed between 1977 and 1985, but the feedback proved difficult to organize without direct contact between researchers and farmers. Like the other commodity programs, the NRIP also operates an outreach program in one area surrounding its principal research station in the lowland Tarai region. This provides the scientists with regular opportunities to assess farmers' conditions, and the results feed into an extension program organized according to the World Bank's Training and Visit system.

This single-commodity approach has had success in the high-potential Tarai. The Cropping Systems Program

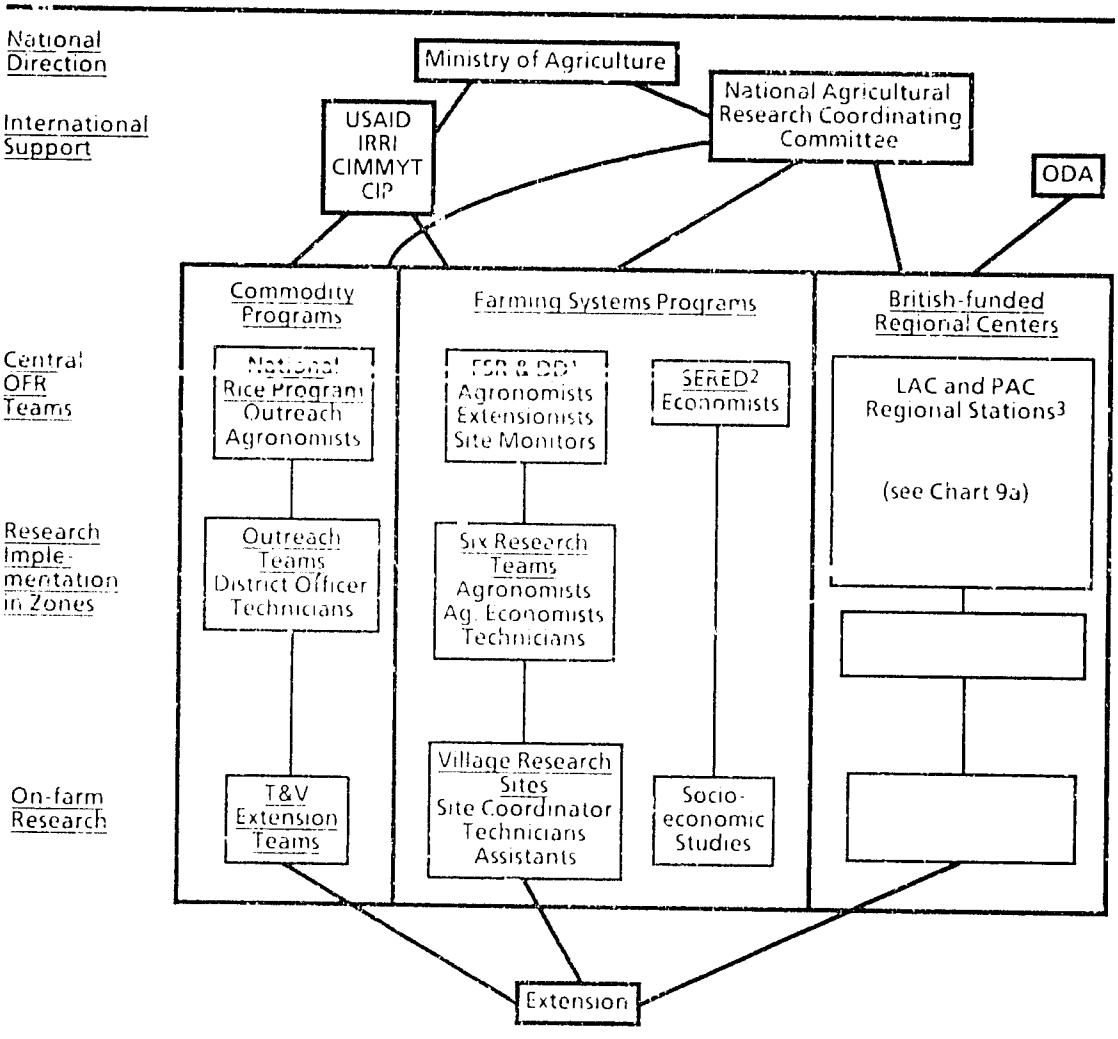
Chart 8
Indonesia: Schematic Diagram of the Organization of OFCOR Operations



was developed in 1979 as a special project, in close association with IRRI, to develop technology for the mixed systems of small, resource-poor farmers, particularly in the agro-ecologically marginal hill regions. Research was planned and coordinated by on-station agronomists, and a central team of socioeconomists administered several types of surveys. A standardized sequence of on-farm experiments and socioeconomic monitoring were carried out in six selected zones by inter-disciplinary teams of five to twelve technicians and assistants. The program was administered by the Agronomy Division of the Ministry.

In 1985, the program was reorganized and more fully institutionalized as the Farming Systems Research and Development Division (FSR & DD). The mandate was

Chart 9
Nepal: Schematic Diagram of the Organization of OFCOR Operations



[1] The Farming Systems Research and Development Division was formed in 1985 through the reorganization of the Cropping Systems Program of the Agronomy Division.

[2] The Socio-Economic Research and Extension Division was formed at the same time. Part of its mandate is to support the on-farm work of FSR&DD.

[3] The Lumle (LAC) and Pokhribas (PAC) Agricultural Centres have restricted national mandates and are programs of the British Government. Their work is increasingly coordinated with divisions of the Ministry of Agriculture.

broadened to include horticultural crops, livestock, and forestry. Research continued in most of the same zones, although there were some readjustments to carry out research exclusively in the hill regions. The methodology was made more flexible to encourage participation by farmers. Socioeconomic research was broken off into a separate division (SERED) with other responsibilities in addition to cooperating in on-farm research. This has strengthened the position of social scientists within the institution, at some risk of reducing day-to-day contact

with natural scientists in field. A Site Monitor was posted at headquarters to act as liaison between the scientific staff and the Site Coordinators.

The Lumle (LAC) and Pakhribas (PAC) Agricultural Centres were started as training and extension programs for Gurkha soldiers returning from the British army. They are funded by the British government through ODA. As they identified demand for a range of technologies suitable to the conditions of all the farmers in their mandate regions in the hills, they have expanded their programs to include both on-station and on-farm research. With their focused regional mandates and independent funding, they have taken a lead in the development of innovative methods and forms of organization. Although these two centers are separate from the Ministry of Agriculture, their work has been increasingly coordinated with The Ministry's divisions, particularly FSR & DD and SERED.

The Lumle Centre (LAC) was founded in 1968, and a farming systems research focus was adopted in 1983 (Chart 9a). All research of the disciplinary sections is organized into interdisciplinary, problem-oriented thrusts. Experiments are designed and analyzed by agronomists at headquarters, who are responsible for both on-station and on-farm research. LAC's socioeconomics section provides overall coordination of on-farm research in five sites.

Important mechanisms for orienting research around farmers' needs are Group Treks, regular events at which interdisciplinary groups of senior scientists travel out to the field sites to interview farmers and set priorities. Field experiments are supervised by site supervisors, senior technicians appointed by the socioeconomics section. They travel to attend regular technical meetings at the station, also attended by scientists from other sections. On-farm experiments in village research areas are overseen by assistants who are local farmers. In addition to this work within a farming systems perspective, the extension section runs Farmer Field Trials and other on-farm tests on an extensive basis, and both the Livestock and Forestry sections test component technology on farms through their own field staff.

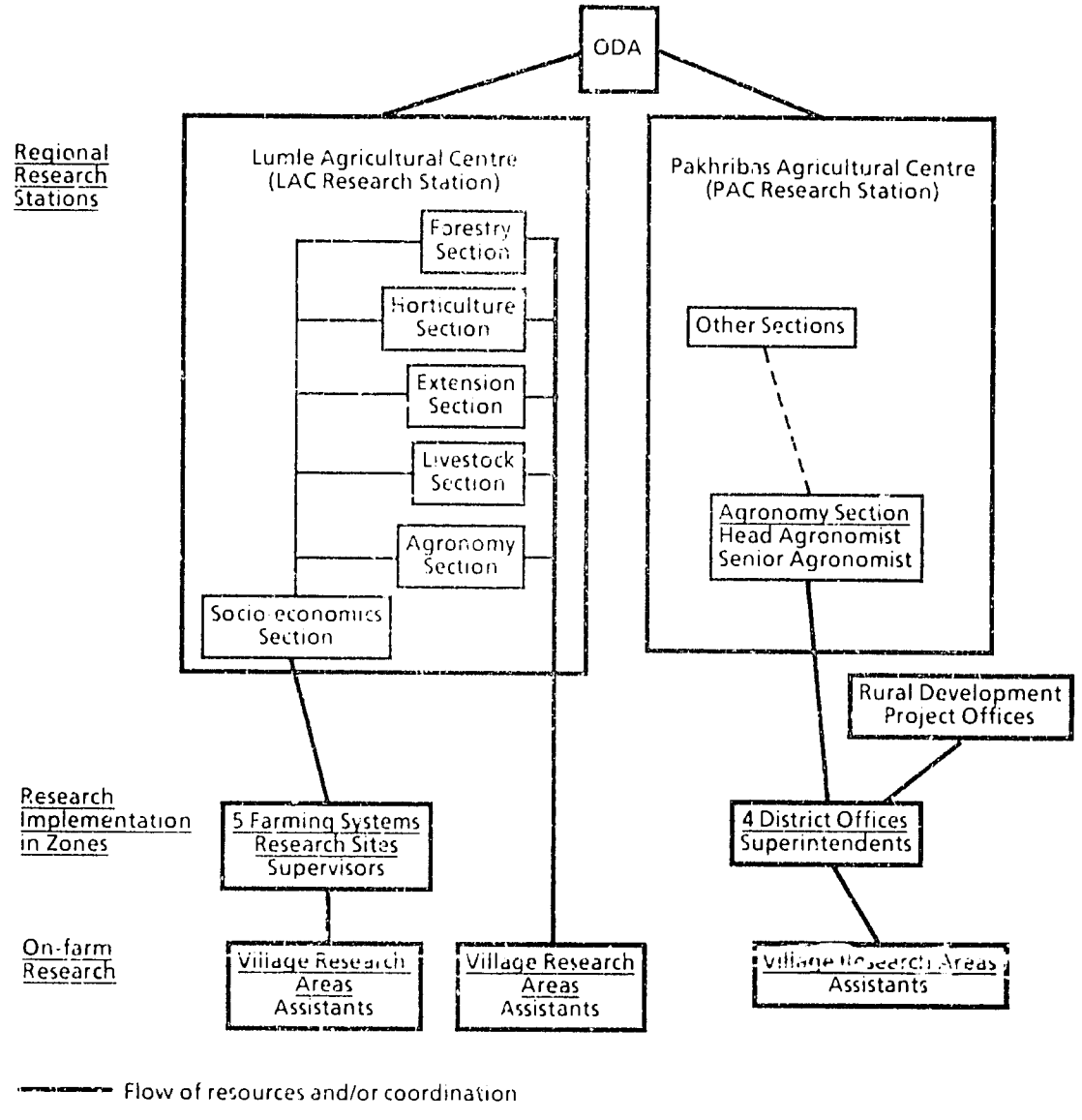
The Pakhribas Agricultural Centre (PAC) is a parallel organization based in another part of the highlands. Its on-farm research program is planned out of the Agronomy Section and is coordinated out of four regional centers of an integrated rural development agency (KHARDEP). In each of these zones, a District Agronomist and Site Superintendent supervise farming systems research in three areas.

General Comments

The broad range of organizational arrangements in the case studies demonstrates that there is no standard or optimal way to set up onfarm research. Semi-independent field teams, such as those in Ecuador and Guatemala, have a clear institutional identity. They are well situated to carry out the functions of diagnosing farmers' problems and carrying out adaptive experiments, but they often have trouble maintaining linkages with on-station researchers. Centralized OFCOR teams, such as the Farming Systems Research and Development Division in Nepal and the Farming Systems Research Unit in Nepal, require special mechanisms to maintain effective communication with the technicians in the field. Locating OFCOR scientists at regional research stations has proved an effective compromise in Zambia. On-farm research programs implemented by scientists who are also responsible for on-station research, such as those in Panama and Zimbabwe, need strong leadership to maintain their focus on farmers' conditions and needs. OFCOR programs tied to regional development projects such as those in Ecuador, Nepal, and Indonesia promote close interaction between research and technology transfer. Nevertheless, they are subject to shifts in policy, and it is often difficult to sustain long-term research programs.

Chart 9a

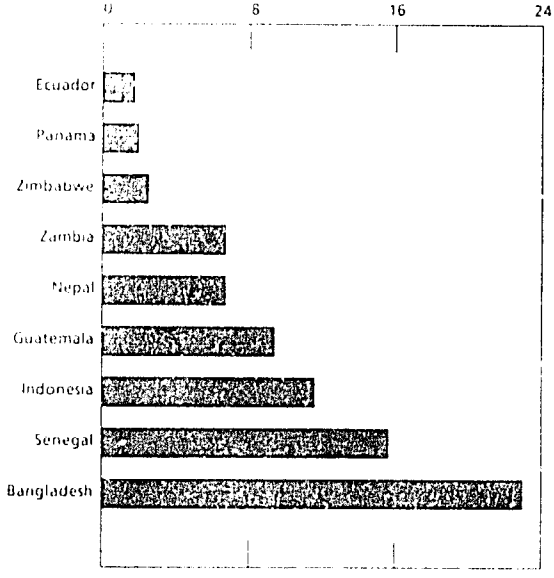
Nepal: Schematic Diagram of the Organization of OFCOR Operations in LAC and PAC



III. Organization and Management of Field Staff

One of the essential characteristics of OFCOR programs is that research is carried out in the field, away from the support services available on established experiment stations. The field staff is usually divided into teams, each responsible for a range of research tasks in a given area. The word 'team' is used in a broad descriptive sense; its use does not imply the endorsement of any particular 'team approach' to OFCOR. The mean size of individual field teams in the case studies varies from 1.7 in Ecuador to 23 in Bangladesh, as is shown in Chart 10.

Chart 10
Mean Size of OFCOR Field Teams



Source: Appendix Table 3

Types of Personnel

The management of OFCOR teams involves the coordination of the work of different types of personnel.[4] For this comparative study, ISNAR has developed the following uniform terminology:

1. **researcb scientists,** with university degrees
   a) natural scientists,
   b) social scientists -- agricultural economists, and less commonly anthropologists, sociologists, and nutritionists,
2. **extension specialists,**
3. **technicians,** with secondary training,
4. **field assistants,** with in-service training,
5. **laborers.**

Chart 11 shows a cross-section of the composition of the field staff of 19 OFCOR programs in the year of the case studies. A fuller summary of the data is provided in Appendix Table 1. Extension specialists are integral team members only in Zambia and Nepal, so in these countries they have been counted in with the natural scientists. The proportion of social scientists ranges from zero in Ecuador and Panama to 30 percent in Zambia. The proportion of technicians and assistants ranges from 24 percent in Ecuador to over 80 percent in Bangladesh. These wide differences will be discussed in terms of two major issues: cooperation between scientists of different disciplines, and the division of research tasks between scientists and technicians and/or assistants.

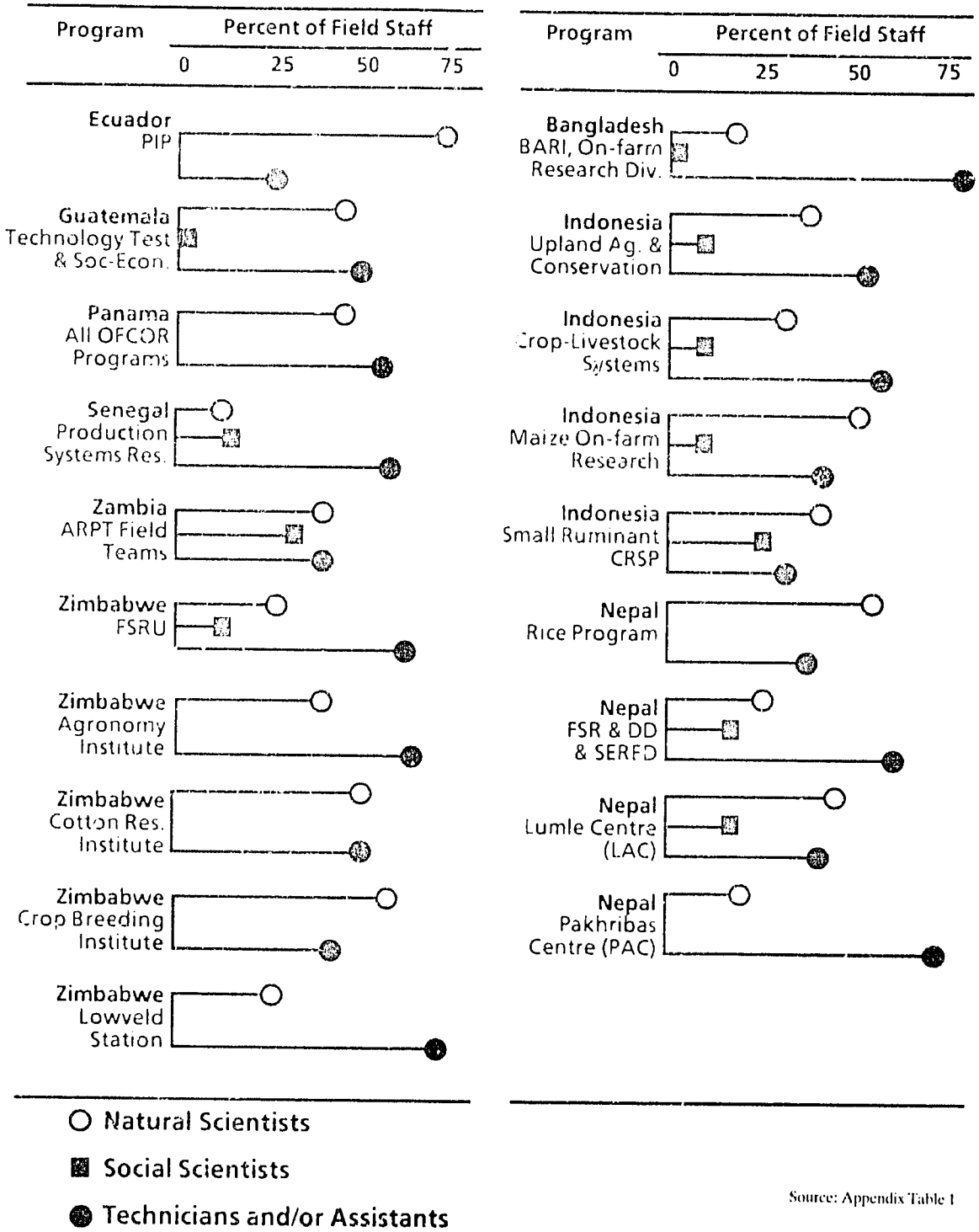
Interdisciplinary Cooperation between Scientists

The complex production systems of the clients of most on-farm research programs require interdisciplinary cooperation. Small, resource-poor farmers typically grow a range of crops and raise animals, both for sale and for home consumption. Their operations are diversified as a protection against risk, to provide food and income to the household throughout the year, and to build equity in the long-term stability of the family unit. Agriculture is often combined with wage labor and other sources of income. Within this context, achieving maximum yields and net returns to any one crop are not necessarily the over-riding concern that they are for many specialized research scientists.

The need for interdisciplinary cooperation in the first, diagnostic phases of on-farm research is widely recognized. Most of the OFCOR programs in the case studies have organized informal and/or formal surveys in which natural scientists from various commodity programs and disciplines cooperate with social scientists to set priorities and plan the methodology. It has proved much more difficult to manage or sustain joint activities on a regular basis (Byerlee and Tripp, 1988). Linkages between field staff and specialized researchers on experiment stations require active management (Merrill-Sands and McAllister, 1988). Large OFCOR teams of natural scientists, social scientists, technicians,

[4] This section concentrates on the field research staff. Another working paper in this series will analyze the staffing patterns of the OFCOR programs as a whole, and of the larger research institutes of which they form a part (Poats and Bingen, 1988).

Chart 11
Relative Weight of Natural Scientists, Social Scientists, and Technicians and/or Assistants on the Field Staff of 19 OFCOR Programs



Source: Appendix Table 1

and field assistants, as well as extension and other specialists, are not easy to manage effectively. Even if appropriate specialists and sufficient resources are available -- and they seldom are -- posting people from different disciplines to OFCOR teams does not guarantee that they will work together productively. Active, creative research management is required.

Strategies for Achieving Disciplinary Breadth

The programs reviewed in the study have developed different strategies for achieving disciplinary breadth. The data are summarized in Appendix Table 2. At one extreme, one or two agronomists with special training are responsible for on-farm research in an entire province. At the other, large interdisciplinary teams with as many as 15 or 20 members are responsible for a broad range of projects. The approaches can be categorized into three broad types.

Reliance on researchers from a single technical discipline. In nearly half of the 21 separate programs in the nine countries, most of the field research has been carried out by "generalists". They are usually agronomists, or animal scientists in livestock projects, who have received additional training in surveys and in simple techniques of economic evaluation such as partial budgeting. They have often been supported in various ways by specialists from experiment stations and national offices.

The 'minimal pair' of disciplines. Agronomists are teamed with agricultural economists in the field in approximately 15 percent of the programs studied. These arrangements have been organized to implement methodologies which carry out surveys and other diagnostic studies, and then systematically screen and adapt component technologies according to both agronomic and economic criteria.

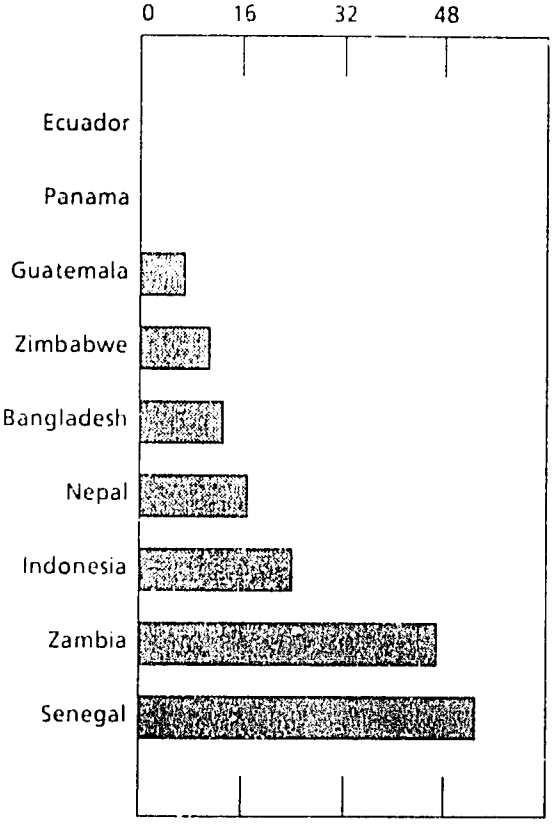
Farming systems teams with a broader range of disciplines. About a third of the programs have mounted broader farming systems teams which include specialists from such additional disciplines as animal science, forestry, nutrition, and anthropology.

Roles of Social Scientists

Agricultural economists and other social scientists have played very limited roles in most agricultural research institutes in the past. The orientation of OFCOR to farmers' needs has brought these disciplines into the research process, which has led to friction in some cases. Some natural scientists resent the reduction of their control over the research agenda, and see OFCOR as a 'social scientists' invention' (Chambers and Jiggens, 1986). Nevertheless, as Chart 12 illustrates, social scientists do not dominate the field staff of the OFCOR programs in the case studies. They constitute less than a third of the scientists in all but two cases, and never more than a half. Their contributions have been organized in various ways.

Social scientists restricted to diagnosis and evaluation. In the cases from Latin America in particular, social scientists have participated primarily in the early stages of the on-farm research process -- for planning, the design and analysis of diagnostic surveys, and the development of methodology. Their work is intended to focus subsequent experimental work on the solution of the most pressing problems facing farmers. They are intermittently called in later for follow-up studies or short-term monitoring and evaluation.

Chart 12
Social Scientists as Percent
of all Scientists on OFCOR Field Staff



Source: Appendix Table 1

The experience of ICTA in Guatemala provides a good example. The incorporation of the perspective of the social sciences into agricultural research was a major goal in the first years. The Socioeconomics department included agronomists on its own staff, and ran on-farm experiments directly for several years. This was strongly criticized by others in the institution, both because the trials mimicked the practices of marginal farmers so closely that they did not demonstrate 'what science could offer', and because the work duplicated that of the Technology Testing teams (Hildebrand, 1979). Because the department restricted itself to more specialized functions separate from the on-farm experiments which form the bulk of OFCOR operations, it became vulnerable to restrictions in operating budgets and to changes in leadership. The problems were compounded by the departure of all of the senior social scientists directly involved in developing the institution and its methodology. Fewer *sondeos*, farm records surveys, and acceptability studies were carried out, and new information on farmers' conditions was not systematically incorporated into the research programs. Since 1986, the new PROGETTAPS program, funded by IFAD and the Interamerican Development Bank, has been working to reverse this trend.

The PIP program in Ecuador has gone through a similar process of methodological entropy. In the first years, senior social scientists from CIMMYT and the national office of INIAP played critical roles in the development of methodology for OFCOR and its implementation in the field. When the foreign social scientists left, the Agricultural Economics Department was absorbed into the broader functions of the Planning Department. No members of the senior staff were particularly concerned with micro-economic issues at the field level, so the agronomists in PIP had significantly less incentive to collect and present data other than the results of their formal experiments. In Panama, social scientists have been involved almost exclusively in the initial phases of OFCOR research.

These cases strongly suggest that training agronomists in informal surveying, partial budgeting, and other techniques from the social sciences is a very imperfect substitute for having those disciplines participate directly in the programs. 'Generalists' become absorbed in their experimental work and have little opportunity or incentive to seek out and present perspectives based on other kinds of evidence. Social scientists tend to defend and expand their own kinds of contributions. This can be a difficult problem to solve when resources and trained social scientists are in short supply, but it should be recognized.

Social scientists in broader roles. Social scientists were active members of the field teams in at least some programs of all the cases in Africa and Asia. Their relative proportion in the field teams is highest in Zambia, Senegal, and Indonesia. The relative importance of experimental work may rise as the on-farm experimental programs become established, but all of them were committed to interdisciplinary approaches which combine social and natural scientists in the field teams. In addition, the Zambian program has developed separate multi-regional teams of sociologists to carry out studies in support of the work of the regional teams responsible for on-farm experiments.

In Bangladesh, economists have been delegated from a separate Socioeconomics department to the OFCOR teams, but they have tended to run routine surveys with little connection to the on-farm experiments. Since their career opportunities lie back with their own colleagues and distant supervisors, they have little incentive to adapt standard methodologies to the particular circumstances in which the OFCOR teams are working. SFERD in Nepal has also been set up as a separate social science department but has taken the lead in the development of innovative on-farm research methodologies.

In Zimbabwe, only the small Farming Systems Research Unit has any social scientists on the staff. They have carried out characterization studies in two regions chosen as representative of common conditions in the communal areas, but they have not functioned as a central support group. Very little micro-economic evaluation of field research is done within DR & SS. It has been argued that this is the responsibility of economists in AGRITEX, the extension department. The problem has been that a regular flow of information on farmers' conditions is not incorporated systematically into the routine programming of research.

Support from international centers and donors. The participation of social scientists in OFCOR has been actively promoted by international organizations including IRRI's Asian Cropping Systems Network, IDRC, CIMMYT, the Rockefeller Foundation, and USAID. IRRI's influence was very important in the genesis of the Asian programs. In all the cases in Africa and Latin America expatriates played fulltime administrative or advisory roles in the establishment of the social sciences as part of OFCOR. At the time of the study, 38 percent of the social scientists in Senegal, Zambia, Zimbabwe, and Nepal were foreign nationals.

The experience in Latin America suggests that as these

senior people leave, they may be replaced with young national scientists with little field experience. This can lead to two problems. First, the newcomers may not have the stature within their own programs to maintain creativity and methodological momentum, or the stature in their larger institutes to influence decisions. Second, as professionals with a scarce set of skills, they may be drawn away from active participation in field research into other functions such as national planning projects, creating computerized data bases, or negotiations with foreign donors.

Broad Research on Multiple Farm Enterprises

All of the countries studied in Africa and Asia except Zambia have at least some programs which have taken a comprehensive Farming Systems approach, as seen in the range of natural science disciplines represented on the teams. BARI's on-farm research program in Bangladesh covers a range of crops and production systems, including household gardens. The Crop-Livestock Systems Project in Indonesia, the FSR Unit in Zimbabwe, and several projects of the Production Systems Department in Senegal are specifically focused on the interactions between crops and livestock at the farm level. In spite of its name, the broad interdisciplinary mandate of the FSR Division in Nepal is not reflected in the team structure. None of the available positions for animal scientists and foresters was filled in 1986. In Senegal, the livestock component of the farming systems research has been more complete than the work on crops, largely because the foreign scientists have emphasized it. Their research approach, supported by a full-time animal scientist in the Central Systems Analysis Group in Dakar, has been better defined and there has been more interaction between the different field teams than among the agronomists.

Building Effective Cooperation

Effective interdisciplinary research depends upon joint dedication to common goals. It is not easy to break down habits and boundaries, jointly develop hypotheses and methods, and arrive at conclusions which reflect interaction. It is one thing to assign scientists of different disciplines to the same project; it is quite another to develop mechanisms which promote effective interaction. In some of the cases studied, the members of a team do entirely separate research, and then staple their results together into a 'joint report'. Nevertheless, experience has been accumulated which indicates how teamwork can be improved.

One lesson from the case studies is the importance of maintaining some level of participation from a range of natural and social science disciplines throughout the research process. OFCOR programs which have relied on 'generalists' after the diagnostic phase have not maintained their dynamism. At the same time, it is both impractical and inefficient to post large, interdisciplinary teams permanently in every region.

Several compromise solutions have been found. In Nepal, the Group Treks have provided a regular mechanism for senior scientists from a range of disciplines to interact with field researchers. In Zambia, multi-regional teams of sociologists have focused on particular issues in support of the provincial ARPT. In Senegal, a core interdisciplinary team in the capital has supported the regional teams in the development of appropriate methodology. The advisory committees to OFCOR projects in Indonesia play a similar role.

The solution of the inevitable problems of interdisciplinary coordination depends on strong leaders, both for the program as a whole and for individual field teams. They can stimulate constructive debate and find ways to resolve conflicts. Evidence from Guatemala, Ecuador, and Zimbabwe demonstrates that senior social scientists have important roles to play throughout the OFCOR research process, because they are trained to integrate data of various types from several sources. To have credibility with natural scientists, they must have a good working knowledge of agriculture and agricultural research. Senior natural scientists must also be directly involved if the results of field experiments are to have credibility in the broader research community. Joint programming and joint field work must be continuously supported.

Organization of Scientists and Technicians

Technicians with various levels of training less than a university degree fulfil critical roles in on-farm research. They are directly responsible for surveys and experiments. They are in constant personal contact with the collaborating farmers, as well as with local officials and other influential people at the village level. In some cases, local farmers are themselves hired as assistants. Technicians usually provide the principal contacts with extension agents, and in some programs are themselves seconded to the OFCOR program from extension. It is a major challenge to train and motivate these people, and to develop mechanisms to channel the results of their experience into the larger research process.

'Hierarchical' and 'autonomous' teams. In the case studies, the organization of scientists and technicians

within field teams can be described as a continuum between two basic types: 'hierarchical' and 'autonomous'. In hierarchical teams, the OFCOR scientists are located at some central location, either nationally or regionally. They design and analyze research which is implemented in a number of research areas by technicians whom they visit periodically. The clearest example is BARI's On-Farm Research Division in Bangladesh. Over 400 technicians are responsible for on-farm research at 11 Farming Systems sites and 83 Multi-Locational Testing (MLT) sites.

In autonomous teams, scientists live at the field sites and are directly engaged in all phases of the research, including surveys and on-farm experiments. All of the Latin American OFCOR programs are organized in this mode, as is the Crop and Livestock Systems Project in Indonesia. In almost all cases, it the younger and less experienced professionals in their institutes are who are available and willing to be assigned to these posts.

The African cases are intermediate types. The OFCOR teams of the various institutes in Zimbabwe are essentially hierarchical. The scientists travel out from their headquarters to visit the experiments in the research areas, which are implemented by technicians. The ARPT in Zambia and the Production Systems Department in Senegal combines aspects of both modes. OFCOR teams are posted regionally. Each is responsible for both on-station experiments and for on-farm research implemented by technicians. In Senegal, there are both senior and junior technicians. The former are based at regional experiment stations along with the scientists, with whom they travel to visit the experiments. Junior technicians are recruited locally to live in the villages and collect data, but their training and responsibilities are limited.

The major advantage of the autonomous mode is that a tightly knit group of people carry through all phases of the research process. Scientists are in constant contact with farmers and are able to continuously re-assess the applicability of technology to dynamic local conditions. A persistent problem has been that the scientists become isolated from other researchers in their institutes. Unless they receive special support, they do not have the stature to ensure the incorporation of their results and conclusions into the priorities of the larger research program.

A hierarchical structure facilitates coordination and linkages with scientists in other research programs. On the other hand, the OFCOR scientists who plan the surveys and experiments can become isolated from the technicians who actually carry out the research with farmers, and yet they are the ones expected to plead the needs of the farmers within the research system. In the cases from Africa, the senior scientists in the OFCOR programs travel frequently to maintain close contact with their field staff. The larger and more hierarchical programs in Nepal have developed various mechanisms for regular contact and consultation between junior and senior staff.

The outreach program of the National Rice Program uses a pair of liaison officers and an assistant to tie the experiment station to adaptive research run in association with extension in a single region. The Farming Systems Research Division has created the post of Site Monitor. He is posted at the central experiment station with the specific responsibility of keeping track of operations at several research sites. The Lumle Centre (LAC) has decentralized this function; the Site Superintendents in the on-farm research zones travel back to the station at regular monthly meetings. Group Treks – organized field visits in which senior and junior scientists participate – provide formal, if relatively infrequent, opportunities for close contact between the centrally located scientists and the field teams, and for feedback from both technicians and farmers to senior scientists.

Training of technicians and communication. As the many of the OFCOR programs in the case studies have depended heavily on technicians posted in the field, training and communication are critical issues. The Farming Systems Research unit in Zimbabwe, the ARPT in Zambia, and the PIP program in Ecuador have sent junior staff to some courses, but few of the OFCOR programs in the case studies have provided systematic training for technicians. Most have relied on in-service instruction and accumulated experience. For example, trials assistants in the ARPT program in Zambia are seconded from the extension branch. The original intention was to rotate them, to expose as many extensionists as possible to the research process and to the new technology. Nevertheless, the Research Branch soon moved to hold onto them, to retain the benefits of their experience and to avoid the costs and time involved in retraining.

Technicians acquire a broad range of information from their frequent and sustained interactions with farmers. The effective communication to scientists of observations other than formally collected data is a real challenge. In Ecuador, for example, CIMMYT collaborated in the design of a flexible field notebook in which to record informal observations systematically,

and the ARPT program in Zambia has experimented with similar procedures. The problem in both cases has been that the scientists have not developed mechanisms to use non-standard information systematically. There has been little incentive to maintain field notes carefully and consistently.

Administration of Field Operations

OFCOR teams require administrative flexibility. The dispersion of research sites on farms requires the maintenance of vehicles in good condition and adequate fuel allowances away from established workshops and depots. Field workers require housing, travel allowances, and other special forms of support. Operating budgets and disbursement procedures must be flexible enough to permit researchers to compensate for unforeseen emergencies in the field. In general, operating funds are the most vulnerable section of an institution's budget, and the day-to-day management of OFCOR is particularly dependent on them.[1] Practical issues of this kind occupy a lot of time, both for the scientists and for managers in the stations and central offices.

Vehicles and transportation. Vehicles are often financed by donors, but delays in delivery and maintenance, breakdowns, lack of spare parts, and the like, are constant preoccupations of any field worker. Fuel allowances are a favorite target of reductions in government spending in times of austerity. These are major constraints on the size of the area scientists can cover, and on the number and complexity of on-farm trials which they and/or their assistants can reliably attend.

In Zambia, all procurement procedures are slow and time-consuming. The ARPT program has tried to reduce the number of different kinds of vehicles imported, and to stockpile spare parts to avoid long periods off the road. Some provincial teams have bought gasoline in bulk and stockpiled it at the regional stations. Nevertheless, they have been forced to reduce the number of meetings in the capital to conserve fuel. The foreign scientists have more flexibility; the problems have weighed more heavily on the Zambian professionals and field assistants. Problems getting out to the field have been an incentive to concentrate field trials in smaller research areas and in clusters.

For most of the OFCOR programs in Zimbabwe, long delays in getting vehicles repaired at the government's garages has been a major problem. The Farming Systems Unit is the one exception: its vehicles have been donated by IDRC and the scientists have the authority to get them fixed at commercial garages. In Ecuador, the externally funded PIP program has had better vehicles than many of the scientists on the stations, and the field staff have been given the flexibility to buy gas and repairs locally. In Guatemala, ICTA's fleet of vehicles is aging and the institution cannot afford to insure them. Although the individual scientists are responsible for their own vehicles and receive fuel vouchers, restrictions on the use of gasoline have reduced the area they can cover. In the hills of Nepal, all transportation is on foot.

Travel allowances, per diems, and petty cash. The flexible release of funds for travel can be a critical factor in maintaining good communication between junior and senior staff, and between scientists and technicians. In Nepal, for example, the Lumle Center (LAC) has been able to involve scientists in systematic research programming in the field because it is funded by an outside donor with flexible procedures. In contrast, the Farming Systems Research Division of the Ministry of Agriculture cannot offer adequate per diems under civil service rules, and many of its scientists rely on second jobs which they cannot leave. The makes contact with technicians in the field more difficult to organize in sustain. In Zimbabwe the allowances are adequate, but the disbursement procedures are so cumbersome that most OFCOR scientists prefer to pay their travel costs out of their own pockets and wait for reimbursement. In many of the case studies, the lack of travel funds for the scientists in commodity and disciplinary programs on the research stations prevents them from visiting on-farm experiments regularly (Merrill-Sands and McAllister, 1988).

Most of the field programs depend on regional stations or other central supply points for inputs and supplies, and obtaining them can be a lengthy process. The flexible availability of relatively small amounts of cash for the local purchase of supplies can make a critical difference to a program's capacity to respond to short-term crises. The field staff in all of the Latin American projects have control over petty cash funds. In Senegal, the money the foreign scientists have been able to obtain from their donors to pay routine operating expenses, including the salaries of temporary staff, has allowed OFCOR field research to survive within a

[1] Because OFCOR programs draw more heavily on operating funds and less on fixed infrastructure and investments, they are often perceived as 'more expensive' than conventional on-station research. The management of financial resources will be discussed in detail in a separate paper in this series.

chaotic system. In Bangladesh, the constant need to divert funds from one project's budget to the immediate needs of another has greatly complicated orderly administration.

Housing. The research institutes provide housing to their field staff in several cases, including Zambia, the Caisán project in Panama, and several of the programs in Indonesia. In other cases, including Zimbabwe and Ecuador, the staff receive special allowances to compensate them for the hardships and extra costs involved in being away from their homes.

Decentralized responsibility with adequate back-stopping. By their nature, these kinds of administrative problems are very specific to the context of a particular institution, and each program must search for its own solutions. A major issue is to find an appropriate balance between flexible autonomy for each field team, efficient program-wide procedures, and adequate back-stopping from the national leadership. In Ecuador, administrative issues have taken up so much of time of the national coordinators of the PIP program that they have not been able to provide adequate scientific leadership. In Senegal, ISRA's central offices have been slow in organizing efficient administrative procedures, and relations between the OFCOR field teams and the directors of the stations on which they directly depend have been conflictive. In Zambia, although a very active national coordinator spent a lot of his time administering resources from eight different donors, the regional coordinators of some provincial teams have spent as much as 60 percent of their time on administration. Part of their administrative burden was later formally distributed among all members of the teams. This kind of decentralization should be encouraged.

IV. Choice of Research Sites and Selection of Collaborators

The choice of research sites and the selection of collaborators involve a series of decisions with far-reaching implications. Too often sites are widely scattered to achieve wide coverage for political reasons. At the other extreme, the process is sometimes regarded as a purely methodological problem of applying very broadly defined agro-climatic and socioeconomic criteria. Management goals — such as the solution of logistical problems, the improvement of linkages between scientists and technicians, and the development of continuous relations with farmers — are often given much less attention than they deserve. The selection of farmers is too often left to junior technicians, extension staff, or ad hoc procedures without the application of any consistent criteria.

Three Key Questions

In one way or another, the following issues must be addressed:

In which geographical regions will the program work? OFCOR must be organized within some administrative framework. Most of the programs in the study have worked within existing political units or other administrative districts. These often do not correspond to agroecological zones, types of farms, or other characteristics of agricultural regions. In most cases, too little attention has been paid to opportunities for collaboration between administrative districts. This trade-off, between the scientific logic of choosing regions according to their natural and socioeconomic characteristics on the one hand and the administrative logic of working within the existing structure on the other, is highlighted in almost all of the case studies.

What types of farmers will be targeted? Within a chosen region, researchers must decide what types of farmers will be chosen as targets. OFCOR programs state their goals in terms of various theoretical criteria. Most have focused on resource-poor farmers in marginal areas, who had not previously been adequately served by the research system. Other criteria include:

agro-ecological regions — e.g., hill rather than valley farmers;
types of crop — e.g., basic foods rather than export commodities;
recommendation domains[6] — e.g., where a short-season maize would meet a need;
production systems — e.g., hoe rather than animal or tillage;
farm types — e.g., farms under a certain size.

[6] The term 'recommendation domain' was coined by researchers at CIMMYT as they developed their on-farm research methodology (Byerlee et al., 1982; Harrington and Tripp, 1984; Tripp, 1986). Others have developed slightly different definitions for it. It refers both to a geographical area with roughly homogeneous agro-ecological conditions for a particular crop, and to a group of farmers whose socioeconomic conditions are homogeneous enough so that they might adopt a particular technological innovation. The term 'research domain' means about the same thing, although it implies less emphasis on the transfer of technology.

In practice, scientists and technicians in many of the programs, under heavy time pressure, have made critical decisions on unsystematic, *ad hoc* bases.

How will collaborators be selected? Within the target clientele, collaborators must be selected for surveys and trials. These choices involve three important issues. First, OFCOR researchers need to work with farmers who are representative of the target group. Second, the must find research-minded farmers who will be willing and effective collaborators. Third, they must work in accessible field sites where it is feasible to manage surveys and experiments efficiently.

Mechanisms for the Selection of Research Sites

Table 1 compares the mechanisms the OFCOR programs have used to locate their field teams in research sites into three roughly equivalent levels

Regions of responsibility. Regions of responsibility refer to the geographical districts where OFCOR teams are assigned to work, which in most cases follows the standard procedures of the parent institutions. They are political provinces in Zambia and for some programs in Ecuador, administrative regions in Guatemala, Panama, and Bangladesh, and agroecological regions in Senegal. Inflexibility on this level of organization has complicated coordination with extension services and development agencies in cases where their operational areas do not correspond.

The Lumle (LAC) and Pakhribas (PAC) centres in Nepal, the programs highlighted in the case study of Indonesia, the PIP teams which work with the integrated rural development agency in Ecuador, and the Farming Systems Research Unit in Zimbabwe all have specific regional mandates.

A few programs have national mandates which are not subdivided into regions of responsibility. These are the Socioeconomics Department in Guatemala, the Cotton, Agronomy, and Crop Breeding Institutes in Zimbabwe, and the Farming Systems Division in Nepal. OFCOR in Panama consists of separate projects on a sub-regional level. There is no single national program, and the three regional offices have purely administrative functions.

Zones. Within the regions, research is often concentrated in zones defined according to both methodological and practical concerns. In Zambia, for example, each of the seven provincial teams of ARPT divided its region of responsibility into recommendation domains defined according to agroclimatic conditions and the predominant production systems. They then selected three or four representative zones called 'target areas,' where they have posted technicians to carry out experiments in farmers' fields. These areas are approximately 15 to 20 kilometers across and include several villages. Conditions in these areas are meant to be representative of the recommendation domains. ICTA in Guatemala has followed a similar procedure. *Sondeos* were organized in each of the six regions to identify zones called 'sub-regions' in terms of the predominant farming systems. Their boundaries are set according to local conditions, and there is no standard size for them. Technology Testing teams have been posted to sub-regions for which promising technology has been under development. In Zimbabwe, on-farm research is targeted at small farmers in the communal areas.

Recommendation domains were identified in Ecuador according to agroclimatic criteria, primarily altitude and soil type. These have provided guidelines for PIP's research, but the one- or two-man teams have not been deployed at any level below that of the province, their regions of responsibility. In Senegal the regional teams have divided their regions of responsibility into zones defined according to the predominant production systems. These are important in planning the research, but are not operational zones. In the Fleuve region, research is organized within development zones called 'irrigated perimeters'.

In Panama, IDIAP has carried out all on-farm research in townships* designated as 'priority target areas', chosen according to three criteria:

1. predominance of small- and medium-size farmers;
2. predominance of crops and/or livestock with priority in a national five-year plan;
3. low technological level, on the theory that research should have a dramatic impact which would enhance the credibility of the new Institute.

Sixteen zones were chosen on the basis of census data and informal interviews with farmers. The planning exercise brought natural and social scientists together to discuss the priorities.

Bangladesh, Indonesia, and Nepal have all been influenced by the methodology developed in the Asian Cropping/Farming Systems Network in cooperation with IRRI. One of the key stages is the identification of

* *Corregimientos*, the smallest political units in Panama.

Table 1
Levels at Which OFCOR Programs Have Developed Explicit Mechanisms for the Selection of Research Sites

Country	Regions of Responsibility	Zones	Research Areas
Ecuador			
Independent PIP teams	Provinces	-	-
PDRI-linked[1] PIP teams	PDRI Zones	-	-
Guatemala			
Technology Testing	All-agency regions	Sub-regions	-
Socioeconomics	-	-	-
Panama			
National OFCOR plan	-	Target Areas	-
Caisán	-	Target Areas	Recommendation Domains
Dual-Purpose Livestock	-	Target Areas	-
Senegal			
Production Systems Department	Agro-ecological regions	-	Villages
Zambia	Provinces	Target areas	Clusters
Zimbabwe			
Farming Systems Research Unit		Target Regions	Research areas, divided into clusters
Cotton Research Institute	-	Communal areas	-
Agronomy Institute	-	Communal areas	Clusters
Crop Breding Institute	-	-	-
Lowveld Station	Mandate region	Communal areas	-
Bangladesh (BARI)	Implementation regions	FSR Sites[2] & MLT sites[3]	Villages
Indonesia			
Upland Agriculture and Conservation	Mandate regions	Watersheds	Sub-watersheds
Crop-Livestock Systems	Mandate regions	Sites	Villages
Maize On-Farm Research	Mandate regions	Sites	Villages
Small Ruminant CRSP	Mandate regions	Sites	Villages
Nepal			
Rice Program	Mandate regions[4]	-	-
Cropping Systems Program	-	CS sites	Villages
Farming Systems Program	-	FSR sites	Villages
Lumle Centre (LAC)	Mandate regions	FSR sites	Village panchayats
Pakhribas Centre (PAC)	Mandate regions	Ag. service centers[5]	Village panchayats, divided into wards

[1] PDRI is an integrated rural development program.
[2] Defined by the national Farming Systems Research Program
[3] Multi-locational testing sites
[4] In the Terai (lowland) regions, NRIP runs an outreach OFR program. Throughout Nepal they run multi-locational variety trials (Farmer Field Tests), both directly and through other agencies, and distribute mini-kits.
[5] Pre-established centers of the KHARDEP rural development agency.

zones called 'sites', chosen as representative of the sets of conditions under which the target crops are grown. In Bangladesh and Nepal, national research committees have designated the sites where on-farm research teams operate.

Research area Both to simplify their logistical problems and to sharpen their focus, many of the OFCOR programs have further concentrated their efforts in sub-zones which are called 'research areas' in Table 1. All of the programs in Asia concentrate their on-farm experiments in a limited number of selected villages. After experiencing serious logistical problems, the ARPT regional team in Lusaka Province in Zambia has selected sub-zones within each target area so that all experiments are within walking distance of each technician's house. These are further divided into compact 'clusters' of households with adjacent fields (Sutherland, 1986). In Zimbabwe, the Agronomy Institute has greatly reduced the dispersion of its on-farm experiments by confining them to 'clusters' of manageable size. The Farming Systems Research Unit has followed a similar strategy.

The PEP program in Ecuador has not developed any mechanisms at this level, and their trials are scattered widely within the teams' regions of responsibility. As the operating budget contracted, experiments run by the Technology Testing teams in Guatemala were *de facto* clustered closer to the bases of operations. Nevertheless, this was not an explicit management decision, and the authors of the case study point out that insufficient attention was paid to the selection of representative samples of farmers.

As Appendix Table 4 shows, OFCOR researchers in the case studies routinely travel hundreds of kilometers to visit on-farm experiments. The concentration of activities in research areas of manageable size has several advantages. It means that scientists spend less time in travel, and simplifies the logistical support of the field teams. It fosters improved supervision and management of trials. It facilitates systematic contact with farmers over extended periods. It provides a stable presence, from which linkages with extension and with on-station research can be built.

Selecting Farmers as Collaborators

Many of the OFCOR programs in the study have suffered from a basic ambiguity. On the one hand, good adaptive research depends on good collaborators: farmers who grasp the concept of the experiments, who protect them from damage, and who do not interfere with the treatments. On the other, an effective on-farm testing program requires farmers who are representative of a well-defined target group. Evidence from the case studies demonstrates the difficulty of meeting both goals simultaneously within a framework which can be managed and supported effectively.

Unlike scientists who may work on experiment stations with agronomic conditions radically different from those faced by small farmers, individual OFCOR researchers are held personally responsible for the representativeness of their research sites. They are often relatively young and inexperienced agronomists, who operate under many kinds of pressure. They and their assistants are often expected to plant large numbers of experiments over a broad geographic range, and yet are criticized if their loss rates and the coefficients of variation of their results do not meet standards established under controlled conditions on stations. Problems with vehicles, input supplies, and similar logistical issues are constant preoccupations.

The selection of collaborators has been a difficult area for many of the programs. Those which have developed formal procedures have not applied them consistently, or they leave these critical decisions to junior staff without adequate support. Self-criticism about these shortcomings is a persistent theme in many of the case studies. In general terms, individual farmers or households are chosen for surveys and on-farm experiments using one of three broad procedures.

Statistically representative samples. The issue is often presented as if it were simply a problem of statistical sampling — collaborating farmers should be representative of the agro-ecological and socioeconomic conditions in the zone. If this were so, it would be a daunting methodological problem, because the conditions face by small, resource-poor producers tend to be extremely heterogeneous — 'typical' farms are hard to find. The concept of statistical representativeness from sampling theory is often in direct conflict with strong pressures to find collaborators with whom it is possible to develop a successful experimental program. Whole classes of farmers dependent on off-farm work may not be home regularly enough to attend properly to trials on their land, and very small holders may not be able to afford the space. With the exception of small projects like Caisan in Panama, random sampling procedures are normally applied only for surveys, not for the selection of experimental sites.

Purposive selection of collaborators. Stratified sampling

and other techniques are used to select collaborators who are representative of the range of conditions toward which the development of technology is directed. Many programs look for farmers with specific criteria for different kinds of trials and surveys. These include technical factors such as size, cropping pattern, and type of labor use as well as the far less tangible question of what constitutes a 'good' collaborator.

In Panama, the dual-purpose cattle project selected ranches with technical characteristics which would justify a long-term commitment to working with them. The Upland Agriculture and Conservation Project in Indonesia developed a list of criteria for selecting collaborators. As part of the clustering procedure developed in Lusaka Province in Zambia outlined in the previous section, a survey method called the 'community perspective' was used to select farmers who met specific criteria, who were willing to work with the crop under study, and whose fields were in close proximity (Sutherland, 1986). The Guatemalan, Bangladeshi, and other programs include continuous monitoring of a few case study households, which are selected very carefully.

All of the programs have established informal procedures of some kind for choosing 'good collaborators' reliable and willing to participate. One of the few cases where farmers' skills are formal criteria is Zimbabwe, where both the Cotton Research Institute and Lowveld Station have worked with 'master farmers' who have received training in modern production methods from AGRITEX, the extension agency. In many programs including those in Ecuador, Guatemala, Senegal, and Nepal, these critical decisions are left to the field technicians, many of whom are from the local villages.

Ad hoc selection. Many researchers simply accept farmers recommended by local extension agents, or solicit volunteers at meetings. In Ecuador, the PIP teams who collaborated in Integrated Rural Development projects worked with self-selected households who met guidelines established by the administering agency. In Guatemala, the assistants of the Technology Testing teams are responsible for finding farmers willing to collaborate. Extension has been given the primary responsibility in most provinces in Zambia and in Zimbabwe. *Ad hoc* selection tends to mean that researchers work with relatively prosperous farmers who have local leadership positions in their communities and who are accustomed to outsiders. Surveys of collaborators in both Zambia and Ecuador demonstrated these kinds of biases, which are in conflict with the goals of the programs to reach the resource-poor.

A serious weakness of many of the programs in the case studies is that they cannot defend the procedures they have used to select farmers. If defensible criteria are applied systematically, purposive sampling can be a realistic and practical solution to this problem. The dual objective of finding good collaborators who are also representative of the target clients can be recognized explicitly. The results can be defended in discussions with scientists based on stations, who often criticize the results of on-farm experiments as 'unrepresentative'.

Need for Clear Goals and Flexible Procedures

One of the strengths of OFCOR is that it forces a research system to confront these issues. Given the heterogeneous conditions of resource-poor agriculture, no research program can develop precise recommendations and technical packages for all farmers. Technology must be targeted to clearly defined types of clients, and then developed with the understanding that it will inevitably be modified by the farmers themselves as they adapt it to their own conditions (Horton, 1984). The principal goals of OFCOR are to involve farmers in the research process and to provide a flexible, client-oriented perspective to the larger research system, not to tailor technology precisely to every geographic zone and type of farmer.

V. Field Research Activities

All of the OFCOR programs in the case studies are organized to carry out various types of surveys and on-farm experiments from the diagnosis of farmers' conditions and problems, to adaptive research on suitable technology, to the testing of alternatives. Key people in all of the programs have been influenced by several international models of Farming Systems Research through various mechanisms: literature, conferences, courses, tours, consultants, and the concerns of donors and international centers. It is not within the scope of this study to make any attempt to evaluate the effectiveness or the efficiency of the various research methods which have been applied. We are, however, very much concerned with the following questions:

1) What kinds of activities have formed the content of the programs? Which have become well-established, and which have proved difficult to sustain?
2) What kinds of human resources have been allocated to carry them out?
3) What kinds of logistical support have they required, and what kinds of effects have they had on operating budgets?
4) What kinds of special demands have they placed on the coordination and management of the research process?

Major Methodological Paradigms

All of the programs in the study have developed their own set of methods and adapted them to their specific conditions. Nevertheless, three broad paradigms have had a major impact: the Asian Cropping Systems Network developed by national rice programs in cooperation with IRRI, the restricted systems approach developed by CIMMYT, and more comprehensive systems approaches promoted by CATIE in Central America and by the French in West Africa. There are many similarities between them, but also several important differences. These include the degree of central control required to manage large networks, the frequency of interaction between research scientists and farmers, and the relative influence of social scientists on the agenda and procedures.

The Asian Cropping Systems Network. The OFCOR programs of the large hierarchical research systems in Asia, particularly those working with rice, have been heavily influenced by the methodology developed by the Asian Cropping Systems Network under the leadership of IRRI. All of the associated programs have followed essentially the same programmed sequence of steps (Zandstra et al., 1982):

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 alternatives;
6) Production programs — to diffuse the innovations in large areas, in cooperation with extension.

The implementation of this approach has been characterized by a tension between the centralized administration of a uniform methodology and the need to tailor the research agenda to each individual country and region. The OFCOR programs associated with the network have stressed the administration of the same types of surveys and trials in all areas where they do field work. This requires a high degree of centralized management: training people to carry out the various component tasks, developing manuals to ensure the consistent application of uniform methods, distributing seed and inputs, collecting and analyzing data, etc. Senior scientists are concentrated in national or regional centers to plan and supervise the research; the scientists and technicians in the field have been given very little flexibility to vary the details of the plan. Cooperation between disciplines and with other agencies, particularly extension, is emphasized.

The programs using this uniform approach have struggled to overcome its inherent inflexibility, to tailor their research to the priority problems of farmers in each region. The program in Nepal is an example of how the cropping systems model was used successfully to introduce adaptive research into a system dominated by specialized commodity programs. The introduction of the approach corresponded to a shift in the government's research policy to place more emphasis on small, diversified peasant farmers in the hill regions of the country. Agroecological conditions are marginal and heterogeneous and the farming systems are very complex, compared to the lowlands of the Tarai. The expansion of the program to include livestock and other locally important activities was a major battle, and all of the FSR sites are now located in the hills. In Bangladesh, BARI is fighting entrenched habits to make its research more responsive to local conditions and needs. As a result of processes like these, the network as a whole has broadened to a more comprehensive Farming Systems approach, and junior scientists at each site have been given more autonomy to plan their own research.

Restricted Systems Approach. The restricted systems approach developed and promoted by CIMMYT has had an important influence on programs in the case studies, particularly in Latin America and Africa. This methodology focuses on the development of improved technology for targ[illegible] crops under the specific conditions faced by farmers in a given region. It requires close contact between research teams posted in the field and relatively small samples of farmers, as they work through iterative sequences of the following research activities (Byerlee et al. 1982; Moscardi et al 1982):

1) exploratory surveys — unstructured interviews with farmers by the researchers themselves to delineate homogeneous recommendation domains and to

identify key problems for which solutions may be found;

2) verification surveys -- surveys of small samples focused on a few variables needed to get started on the design of improved technology;
3) multiple factor trials -- to identify key interactions;
4) levels trials -- to identify the most economical levels of inputs;
5) Verification or validation trials -- to test the acceptability to farmers of the proposed innovations.

This method is appropriate for the 'autonomous model' of organizing regional teams, where scientists in the field are responsible for the full range of research activities. It places heavy emphasis on diagnostic studies carried out by social scientists. Since it is seldom possible to post senior people to the field for extended periods, intensive training and good backstopping by senior advisors are necessary to maintain a broad perspective, as well as methodological creativity.

In the early years of the PIP program in Ecuador, this support was provided to the small field teams of one or two agronomists by researchers at the national headquarters in cooperation with CIMMYT. This central support team drifted apart after CIMMYT closed the regional office of its Economics program in 1982. The field teams became more fully dependent on the experiment stations, and methodological entropy set in. Rapid turnover meant that by 1986 only 20 percent of PIP's staff had participated in special training courses for on-farm research. The program was under constant pressure from the commodity scientists in the stations to carry out more routine on-farm screening of their technology. The Cañar Project in Panama followed a very similar methodology with direct support from CIMMYT.

ICTA in Guatemala has also followed a methodological sequence of this type, although not directly derived from CIMMYT's. The Technology Testing program is closely tied to the commodity scientists in each region and has been very successful at running an established sequence of adaptive agronomic research in farmers' fields. Again, however, the broader OFCOR agenda gradually eroded for lack of continuous collaboration with the Socioeconomics Department and active, creative leadership within Technology Testing. ICTA is currently attempting to reverse this trend through the implementation of PROGETAPS, a new externally funded program designed to coordinate research and technology transfer within a comprehensive framework. Other reforms include the appointment of a national coordinator for the Technology Testing Department and the revitalization of Socioeconomics.

The ARPT teams in Zambia have also focused on key technological components of the major production systems in their regions. The field teams are responsible for both on-farm and on-station research. Staffing patterns have been variable; teams which have included a full range of disciplines from the beginning have been most successful at adjusting their methods to local conditions. The first national coordinator invested time and energy in a systematic review of a number of methods, and balanced the demands of multiple donors. Frequent meetings among teams and close contact with commodity and specialist scientists have facilitated open dialogue about the best methods for particular problems and circumstances. ARPT was still a relatively young program at the time of the study -- the challenge will be to maintain this dynamism and flexibility as the institution becomes established and its activities become routine.

Comprehensive Systems Approach. Several projects have developed methods for the detailed, holistic analysis of farmers' production systems. They are not as focused on the transfer of individual technologies, but look simultaneously at a range of factors at different levels. For example, a team might research improved varieties, better use of fertilizer, better technology for tillage, better community management of irrigation resources, the effect of price policies, as well as other factors. The teams tend to be larger, cover a broader range of disciplines, and operate more independently of other research departments within their institutes.

The best example of this approach in the case studies is the Production Systems Department in Senegal. The French research tradition places great emphasis on the systematic evaluation of many factors affecting technology within the economy of rural communities (Fresco and Poats, 1986). This paradigm survived in uneasy coexistence with the more pragmatic, restricted systems approach focused on technology transfer introduced by USAID and Michigan State University. In each region, surveys and experiments covered a broad range of issues. The Central Systems Analysis Group in the office in Dakar is a multi-disciplinary committee designed to provide a conceptual framework and methodological guidance to the teams. It provided a useful forum for the discussion of differences, particularly among scientists of different schools.

CATIE has developed methods for analysis of small farms as systems which have been applied in the Dual-Purpose Livestock project in Panama, as well as in

other OFCOR projects throughout Central America which are not covered in this study (Hart, 1980; Jones, 1986). The Upland Agriculture and Conservation Project in Indonesia has broadened the Cropping Systems methodology to include soil conservation and a variety of other issues.

The Farming Systems Research Unit in Zimbabwe has followed an intermediate approach. It was developed specifically to take a systems approach because the existing, narrowly focused institutes could not deal effectively with the mixed crop and livestock systems of farmers in the Communal Areas. It does not focus on particular crops, but neither does it look at a comprehensive range of technical and socioeconomic factors. The small interdisciplinary team is based at headquarters, where its members interact closely with specialists from other departments. Field research is concentrated in two reasonably accessible zones, under the supervision of highly trained technicians.

The initial mandate of the Lumle Agricultural Centre (LAC) in Nepal was to provide extension and training to a specific client group of returning soldiers. The research component has expanded to develop technology to all of the farmers in their mandate zones. The complexity of local conditions and needs has led them to develop a systems approach to on-farm research which combines agronomy, animal science, horticulture, agro-forestry and extension under the coordination of a socioeconomics department. As a small, externally funded institution with few internal barriers to communication, they have had the flexibility to develop new methods such as the Group Treks which are gradually being adopted by other institutions. The sister center at Pakhribas (PAC) has followed a similar progression of methodological development. Its on-farm research has been managed by the Agronomy Department in close association with a regional development project and the government's research system.

Balancing the approaches of several donors. Many programs have faced the problem of balancing the different approaches of several donors. In Panama, both crop and livestock projects associated with CATIE's comprehensive systems approach dedicated several years to diagnostic studies of farmers' current practices before introducing innovations. Projects associated with CIMMYT have stressed immediate experimentation on major constraints to provide technological alternatives as soon as possible. Their managers were very concerned to have a positive demonstration effect — to prove that on-farm research was an effective strategy for increasing food production rapidly. This difference involves important administrative decisions about the size of the research staff, training, mechanisms for the analysis of data, etc. IDIAP did not develop effective institutional mechanisms for harmonizing conflicting methodologies, and each project has followed the paradigm of its international affiliate.

OFCOR in Indonesia is divided into autonomous projects, each of which follows a separate methodology influenced by its donors. The Maize On-farm Research Project has applied CIMMYT's restricted systems methodology; the Crop-Livestock Systems Project has followed guidelines established by the broadened Asian Farming Systems Network headed by IRRI. The Upland Agriculture and Conservation Project is an example of a comprehensive systems approach to research within the context of a broad development project.

Each provincial OFCOR team in Zambia is funded by separate donors, each with its own approach. In Eastern Province, for example, ARPT operated as one component of a broader agricultural development project tied to a T & V extension system. The agronomist in charge interpreted the donor's mandate to scatter verification trials at 'representative locations throughout the province' rather than concentrate them in selected Research Areas, the usual practice of ARPT. This decision required different arrangements for transport and for deploying the field technicians, and a different linkage with extension. This alternative was not successful. A series of discussions under the leadership of the national coordinator led to a compromise arrangement. Of all the OFCOR programs in the study, ARPT placed the most emphasis on a dynamic process of learning from the experience in its first five years. This process involved frequent meetings and evaluations of the experience of the various provincial teams.

A wealth of research methods, analytical methods, and training materials is available from a variety of sources, but these must be adapted to local circumstances and institutions. Rather than simply adopt an established methodological sequence, managers must develop mechanisms to flexibly adjust their programs in the light of their own experience.

The Array of Research Activities in the Cases

The research activities described in the case studies are listed in Appendix Table 5. Part I itemizes surveys and Part II on-farm experiments, classified according to

their principal purpose.[8] Some of the programs — as well as various studies of on-farm research (Lightfoot and Barker, 1988), have classified experiments according to who is responsible for their design and implementation:

> Researcher-managed/researcher-implemented;
> Researcher-managed/farmer-implemented;
> Researcher-managed/extension implemented;
> Farmer-managed/farmer-implemented.

Several of the case studies use these or similar terms, but the criteria were not applied consistently enough to categorize the broad range of research activities in all of the case studies in this way

Diagnostic surveys. The diagnosis of farmers' conditions is an essential step in all OFCOR programs — various 'baseline', 'exploratory', 'initial', 'descriptive', 'planning', and similar types of surveys are reported. Both natural and social scientists almost always participate in one way or another. Baseline and other formal statistical surveys require assembling a special team, training enumerators, coding the data, and analyzing the results. They require transport, travel allowances, computer facilities, and other resources. Long delays in getting useful information published and other problems have led several of the programs to develop informal methods for gathering critical data more quickly.

In most cases, informal surveys involve mobilizing groups of senior researchers from various disciplines and sending them out into the field for short, intensive periods. One of the most widely publicized has been the *sondeo* (informal survey) developed by ICTA in Guatemala. The group treks developed in Nepal are a more elaborate exercise along the same lines. Group tours have also been used effectively in Zimbabwe. The need for diagnostic studies at the beginning of a new OFCOR program is universally recognized, and donors often make resources available. It is more difficult for management to find clear reasons and resources to sustain the effort — to institutionalize these 'special events' as part of the routine research process. Only a few programs, including the ARPT team in Zambia's Central Province, have carried out further diagnostic studies once the experimental programs were established. A number of cases have already been cited in which programs have lost credibility and dynamism because the methodology has stagnated after an initial burst of creative enthusiasm.

Routine monitoring surveys. The same problem has had an even more serious impact on routine monitoring surveys. Data collected at regular intervals in farmers' fields, farm households, and other locations are among the most valuable contributions OFCOR programs can make. Many aspects of farmers' conditions, particularly seasonal patterns and the variance of key parameters, cannot be evaluated in any other way. Some subjects for monitoring, such as planting densities, pest populations, or yields in farmers' fields, are handled by natural scientists. Others, such as weeding practices, labor use, and selling prices, are normally in the domain of the social sciences. In either case, these are labor-intensive research activities, which require consistent routine effort. They are often delegated to technicians and other junior staff. As the residual claimants on resources, these people often face logistical problems, such as getting transport and other kinds of support.

The Farm Records Surveys in Guatemala are a good case in point. According to the ICTA's methodology they were to provide detailed data, both to back up the rapid assessments of the *sondeos* and to provide a baseline for the economic evaluation of new technology. In the early years of ICTA the surveys were used very effectively to focus experimental research on improved maize technology in the district of La Maquina, where the Technology Testing and Socioeconomics Departments worked closely together. This common focus was eroded during a leadership vacuum in the early 1980s. Data were collected only sporadically and were not routinely used in the planning and evaluation of experiments.

Special-purpose surveys. This catch-all category includes many kinds of surveys: studies of the acceptability and adoption of technology, nutrition surveys, land tenure surveys, etc. In Guatemala, ICTA's Socioeconomics Department has used informal *sondeos* very effectively to pull together the factors most relevant to specialized issues. In most cases, more formal surveys are used. The members of the OFCOR field teams have participated in special studies such as surveys of collaborators in Ecuador and Zambia. More specialized studies of nutritional status, market structures, and sociological factors are often delegated to special teams. These kinds of studies can become a specialized, rather isolated activity of social scientists, poorly integrated with other on-farm research. The ARPT program in Zambia has developed a standard format for proposals

[8] Meetings with farmers are included in the list of surveys when their principal purpose is to collect information. A full treatment of meetings of various types is given in another paper in this series (Biggs, 1988).

for both surveys and experiments in an attempt to maintain consistent standards.

Diagnostic experiments. Diagnostic experiments[9] are designed to analyze key factors of the production systems in a given environment – local soils and other environmental characteristics, interactions of farming practices, etc. They are usually planned, managed, and implemented by the researchers, with little direct participation by farmers. This kind of work is often most efficiently carried out under controlled conditions at experiment stations, as long as close contact with researchers in the field is maintained. Almost all of the programs in the case studies are organized so that the scientists dedicated to OFCOR also have access to experimental plots. Nevertheless, most report cases where complex experiments have been run on farms because no other suitable or convenient location was available.

Technology design and testing experiments. Design and testing are the heart of the adaptive research process. The largest number of experiments in Appendix Table 5, part II fall into this category. Most are planned and managed by the scientists; farmers participate in either a "consultative" or a "collaborative" mode, following the typology developed by Stephen Biggs[10] (Biggs, 1988).

Verification trials. All of the programs have developed mechanisms for testing promising technology under farmers' conditions. Trials are called "verification trials", "on-farm tests", "demonstration plots", and similar terms. The goal is usually to have farmers test a new variety, input, agronomic practice, cropping pattern, or other technique under their own conditions. On-farm verification is an important part of the OFCOR mandate in the case studies, but the relative importance of this type of trial varies considerably. Technology suitable for verification has not been available in many cases, which has required a greater emphasis on applied research. In Guatemala, 52 percent of the trials run by the Technology Testing Department in 1986 were farmer-managed verification trials. In Zambia, less than 30 percent of the trials run by ARPT in 1986 were managed and implemented by farmers. Less than 20 percent of the OFCOR researchers surveyed in Bangladesh said that farmers directly participate in the management of trials carried out on their land.

Data Analysis and Publications

On-farm research produces large quantities of different kinds of data – it is a real challenge to analyze them systematically and present them in forms useful to other researchers. In most cases, the first problem is how to muster and use diverse sources of secondary information, including the results of previous experimental work carried on both on stations and on farms. Few field agronomists have the skills or experience to search through libraries and archives systematically, even where these exist. In Guatemala, ICTA has very slowly developed a central information office. A CRSP project coordinated by Cornell University put together a methods guide on the analysis of secondary sources for the PIP program in Ecuador, but it is not clear how much it has actually been used. One of the provincial ARPT teams in Zambia developed a protocol whereby each researcher abstracted each article he or she read according to a standard format for the benefit of their colleagues.

A more serious general problem is the underutilization of data collected by the programs themselves. There is always strong short-term pressure at the end of each year to pull together summary reports for the annual meeting or as the basis for planning the next stage of the research. Summary data are extracted and analyzed by applying simple, familiar statistical tests. Particularly when an OFCOR team does not have its own capacity for analysis, a mass of raw data from surveys, experiments, and particularly on-farm monitoring is simply never utilized. The Soil Fertility and Testing Program in Bangladesh and several of the older programs in Indonesia mentioned this issue particularly, but it is universal.

Further delays in the editing and publication of results often add up to several years before the results are distributed. The programs in the case studies have taken two approaches to overcome these problems: the simplification of procedures to reduce the mass of data accumulated; and the acquisition of microcomputers and other facilities to speed up the analysis and distribution of what is collected.

In Guatemala, *sondeos* were used at ICTA as an alternative to formal surveys. It was felt that they

[9] Michael Collinson uses the term "exploratory experiments" for this type, and the term "determinative experiments" for what we are calling "design and testing experiments" (Collinson, 1987).

[10] Biggs' categories are: 1) *Contract mode* – scientists "contract" farmers to provide land or services; 2) *Consultative mode* – scientists consult farmers about their problems and then develop solutions, like a doctor and his patients; 3) *Collaborative mode* – scientists and farmers collaborate as partners in the research process; and 4) *Collegiate mode* – scientists strengthen farmers' existing capacity for informal research and development.

provided most of the necessary information more quickly and with less data. Reporting procedures in the Technology Testing Department have been reduced to standardized forms which each researcher completes himself, with the assistance of a central computing facility. In Ecuador and Panama, initial surveys were analyzed by CIMMYT in Mexico to get baseline profiles produced quickly. Both cases report significant problems maintaining their capacity for the timely analysis of the broad range of data which they have subsequently collected. Hierarchical systems often funnel more information to senior researchers than they have the capacity to analyze and use. In Bangladesh, cases are reported where scientists are reluctant to release to other researchers raw data of which they have administered the collection, even though they cannot use them.

The Dual-Purpose Livestock Program in Panama has its own microcomputer but still has not been able to keep pace with the data produced by continuous monitoring of a range of data on 34 ranches. Microcomputers in the regional stations have permitted the faster and more comprehensive analysis of survey data in Zambia. Computers have not yet had much impact in Bangladesh, however, for lack of appropriate software and trained operators.

The first and most immediate output of most of the OFCOR programs are annual summaries and reports. In addition, almost all publish working papers, survey reports, methodological guides, and other mimeographed materials. Several have developed mechanisms to get key information to other scientists quickly. The Farming Systems Research Unit in Zimbabwe has chosen to downplay the publication of comprehensive reports, in favor of the presentation of summarized information at interdisciplinary seminars and workshops. The danger of this tactic is that information is not registered permanently within the institution. In Ecuador, for example, the formal reports of the PIP teams do not include the full range of data on farmers' conditions collected in the field. Important insights are not brought to the attention of scientists on the stations and are lost to the institution when the field researchers move on.

In Bangladesh, scientists have felt that collaborative adaptive on-farm research provides fewer opportunities to publish articles in regular journals than on-station work. The case studies from Africa, on the other hand, do not report any discrimination of this kind. All of the Latin American cases argue that the institutional cultures of their institutes do not encourage individuals to write up their research for publication.

VI. Planning, Programming, and Review of OFCOR

The planning, programming, and review of research carried out at dispersed field sites are key challenges facing an OFCOR program. The following discussion focuses on issues of effective research management within the OFCOR programs.

Planning and Priority Setting

Most of the OFCOR programs in the study have been set up relatively recently as part of a broader policy or plan to reorient research to particular client groups. In Ecuador, Guatemala, and Zambia, a few senior individuals in the research systems played key roles in mobilizing and catalyzing the process. In Panama and Senegal, the development of adaptive research programs was one of the recommendations of comprehensive sectorial plans. In Zimbabwe and in the Asian cases, agricultural development policies encouraging OFCOR were implemented in different ways by a number of research institutes and programs.

In Ecuador, the Director General and a few of his associates became convinced that a new initiative for adaptive research should be given a high priority. An Interamerican Development Bank loan made funds available for a vaguely defined program of 'production research'. Concrete PIP programs were first developed on a pilot basis in cooperation with CIMMYT. They were then expanded through integrated rural development projects. There was never any comprehensive process to integrate on-farm research into the research priorities of the institution as a whole.

The Guatemala case provides a clear contrast. A core group of national professionals mobilized the support of a number of international institutions to formulate a tightly integrated program of on-station and on-farm research. After a series of workshops laid out the general goals, senior foreign experts worked in regular line positions within ICTA for several years to establish both priorities and specific planning and programming

mechanisms which have had a major influence on the organization of OFCOR programs elsewhere.

OFCOR was developed by ISRA in Senegal in part because of a recommendation in a comprehensive sectorial plan developed in cooperation with the World Bank. Nevertheless, partially because it was brought in by Americans funded by USAID, the process was marked by conflict with advocates of a French-sponsored approach. As discussed above, the Central Systems Analysis Group, created to develop a comprehensive set of programs and methods, was only a partial success. In Panama, OFCOR was developed as a national plan based on a systematic priority-setting exercise. Nevertheless, this work was not followed by the development of a coherent program, and each externally-funded project has followed its own procedures.

Although the ARPT in Zambia has been organized within a single institution, the development of a coherent program has been a challenge because each of the regional teams is funded by separate donors and operates semi-independently. A comprehensive plan was never developed. Instead, the program has expended a great deal of time and energy on process: organizing meetings to set priorities in each province, to develop comparable, if not identical, methods across teams, and to organize relations with the donors, with other sections of the Research Branch, and with extension.

After the independence of Zimbabwe in 1980 all of the branches of the decentralized national research institute (DR&SS) developed separate, uncoordinated plans to develop technology for peasant farmers working under marginal agro-ecological conditions in the Communal Areas. Only the Farming Systems Research Unit used a formal priority-setting procedure, a one-week workshop in each of their two research areas to launch their program in 1984. Senior researchers got out into the field to look at local conditions and discuss alternatives. There were no formal mechanisms for coordination throughout the institution until 1986, when the Committee for On-farm Research and Extension was formed.

The long-term continuity of OFCOR and the maintenance of a broad research agenda can be threatened unless the programs and their priorities are included explicitly in an established plan. This in itself is no guarantee — even in Guatemala, where OFCOR is central to the formal structure of ICTA, several of its functions were seriously weakened during a period when the operating budget was reduced and leadership flagged.

Annual Programming and Review

The annual review of the last year's work and design of a program of surveys and experiments for the next are normally closely linked. The principal forums the OFCOR programs have developed for these purposes are summarized in Table 2.

In six of the nine countries, formal programming and review meetings are held each season. They are organized by region in Guatemala, by project in Indonesia, and on a comprehensive national basis in Zambia, Bangladesh, and Nepal. The ARPT scientists in Zambia review their research and plans within each regional team and at quarterly and annual program meetings before discussing them with the commodity scientists at the annual Commodity Research Review meeting. This provides different forums for discussing various kinds of methodological and procedural issues, and gives the program a strong front in relation to commodity and specialist scientists. The regional teams in Bangladesh follow a similar two-tier procedure before presenting their results at BARI's general internal review. The centralized, hierarchical systems both there and in Nepal have led to cumbersome procedures and delays in decision making.
PIP researchers in Ecuador do not report to a national programming and review meeting. In the early years, research was programmed by an *ad hoc* group of field researchers, scientists from those commodity programs directly involved, and senior social scientists from INIAP and CIMMYT. A robust OFCOR agenda was vigorously promoted in this forum. Since the PIP was institutionalized as a regular program of INIAP in 1981, results have been reviewed by the Technical Committees of the corresponding experiment stations, while written reports are sent to the national PIP coordinator. This change was intended to provide better integration between on-farm and on-station research. In fact, it has meant that standard statistical criteria for the evaluation of trial results have come to dominate over the broader goals of OFCOR. The reviews are superficial, and the process is often delayed. Within this context, there is no incentive to report anything beyond the simple statistical results of the experiments. Potentially valuable information coming out of the interactions of farmers and junior staff is not incorporated into the research process. More recently, the PIP Coordinators have sat on the committees to prevent the research agenda from being taken over by routine testing functions promoted out of the stations.

Table 2
Forums for the programming and review of OFCOR

Program	Major Forums for Programming and Review	Other Forums
Ecuador PIP	Technical Committees of Regional Exp. Stas.	Quarterly and annual written reports
Guatemala Technology Testing Social Science	Annual Regional Reviews	
Panama National OFCOR Plan Caisán Dual-purpose lvsck.	Annual Research Plan Project staff Project staff	
Senegal Prod.Sys.Res.	Written reports by teams, Program review meetings Special workshps.	Ad hoc meetings at headquarters
Zambia ARPT	Regional team process, Quarterly and annual, ARPT reviews, Annual commodity research review.	Provincial ARPT Committees
Zimbabwe FSR Unit Agronomy I. Cotton Research I. Lowveld Sta. Crop Breed I.	Program review, Annual program meeting. Institute staff. Annual planning meeting. Annual planning meeting. Institute staff.	Expert consultation
Bangladesh BARI	Implementing teams' plans, BARI internal review	Task force Central review committee
Indonesia Upland Ag.&C. Crop-Lvsck S. Maize OFR Sml. Rum CRSP	Participating institutes, Annual planning meeting. Technical team, semi-annual planning meeting. Frequent on-station meetings. Annual review.	Technical team Project management unit Participating Institutes Monthly project meetings
Nepal All OFCOR Rice Program (NRIP) Crop.Sys.Res. FSR & DD Lumle (LAC) Pakribas (PAC)	Technical committee Semi-annual seminars Semi-annual seminars Project staff Group treks Monthly tech. meetings Group Treks	Working group meetings Group Treks, Semi-annual seminars. Semi-annual FSR review Annual program meeting FSR working committee

Participation of scientists on experiment stations. In theory, programming and review meetings provide opportunities for systematic communication between on-farm and on-station researchers. Nevertheless, there is a tendency for OFCOR researchers to be junior scientists, of lower status than their counterparts on stations and in commodity programs. A major challenge for management is to bridge that gap. In Guatemala, the Technology Testing Teams present their results and plans to the Annual Review of the regional stations. Their work is seen as mere 'testing' of the important scientific work, their presentations are poorly attended, and they feel that their conclusions and insights are not incorporated into plans for the next season. The newly appointed national coordinator of the department should have the status to redress this balance.

The Group Treks in Nepal are a very interesting mechanism to involve senior scientists in both the programming and the regular programming of research in a country where the lack of roads makes distance a real barrier. Interdisciplinary teams mount large expeditions to walk to a research area and stay there for several days. They break up into groups and carry out key informant surveys (to get general information about conditions in the area) and individual farm household surveys (to get information about the conditions in individual households). The group then holds discussions among its members, to arrive at a preliminary list of priorities, which they discuss with groups of farmers. Then the group meets again to arrive at a consensus about the ranking of problems to be addressed, and develops a preliminary plan on the spot of what surveys and experiments should be run.

Follow-up treks are organized a regular intervals to adjust the program in the light of experience. The sondeo in Guatemala serves a similar function as a planning device, but ICTA has never institutionalized it as a routine mechanism for programming and review.

Participation of technicians and assistants. Particularly in programs where field teams are organized hierarchically, it is often the technicians and assistants who have the most experience working directly with farmers. Nevertheless, only rarely do they participate in formal programming and review procedures, and many of their insights are never captured systematically by their institutions. There are some important exceptions in the case studies. The Farming Systems Research Unit in Zimbabwe has included one technician from each research area in formal discussions to review research proposals in detail. At the Lumle Center in Nepal, senior technicians called Field Superintendents report back to the research station for review meetings at regular intervals. BARI's on-farm research program in Bangladesh started to invite field technicians to its programming and review meetings in 1986, on the recommendation of a consultant who headed a review on the issue of responsiveness to farmers' needs (Gupta, 1987).

Participation of extension staff. The linkages between extension and the OFCOR programs are discussed in a separate paper in this series (Ewell, 1988). Only in Zambia and in some programs in Nepal are extensionists fully integrated into the OFCOR teams. Close cooperative arrangements, including participation in the routine programming of research, have been developed in Zimbabwe, Bangladesh, and some programs in Indonesia. This is a significantly weak point of all of the programs in Latin America.

Participation of farmers. Farmers participate only indirectly in the formal planning and programming procedures, although in a few cases they are asked to comment on research proposals or results. In Bangladesh they are consulted twice: once as the field teams are preparing their proposals for BARI's Annual Review, and again after projects are finally approved as part of getting them out into the field. The Farming Systems Research Unit in Zimbabwe also consults with farmers as one of the steps in formulating research proposals. One of the objectives of the Group Trek in Nepal is to involve farmers in the planning and programming processes.

VII. Lessons

The effective institutionalization of OFCOR within larger agricultural research institutions has been a major challenge to each of the programs studied. A close analogy can be drawn between this process and the development of technology appropriate to the conditions of small, resource-poor farmers.

On the basis of experience in many different environments, it is now widely accepted that no package of technology, no matter how high its yields or economic returns on an experiment station, will necessarily out-perform current varieties and practices under farmers' conditions. A technology which is heavily

dependent on inputs from outside of the immediate region, and which is very sensitive to hazards and variations in the environment, will not be sustainable on small farms. We cannot simply blame the farmers for being 'resistant to change'. The process of developing technology for the complex and heterogeneous natural and socioeconomic conditions of small farmers requires an ongoing process of adaptive research.

An OFCOR program which is heavily dependent on external funds, personnel, and methodologies, and which cannot withstand predictable fluctuations in the operating budget, will not be sustainable within a research system without adaptation. We cannot simply blame commodity scientists or administrators for being resistant to new approaches (Heinemann and Biggs, 1985). OFCOR must be developed in different ways for different institutional settings. At the same time, the effective institutionalization of OFCOR requires changes within the larger institutions to accommodate and support the new approach.

This paper has concentrated on a limited set of issues directly related to the organization and management of the field research personnel and their activities. General lessons drawn from the experience of the case studies can summarized as follows.

Improving Focus on the Targeted Clients

The principal goal of most OFCOR programs is to reach previously neglected groups of farmers and to give their demands for technology a voice within the research system. On methodological grounds, a field team should define its clients in terms of their agro-ecological and socioeconomic characteristics. For administrative reasons, however, most of the programs have been organized in existing political districts. Many have come under pressure to expand quickly, and have become over-extended. Wide dispersion of surveys and trials creates many logistical problems, and complicates collaboration with station-based researchers. A more serious danger is the loss of focus on the targeted clients and their specific needs. The clustering of research activities in carefully selected sites has proved an effective mechanism which improves the quality of the research results and facilitates continuous two-way communication with farmers and with extensionists.

Selecting Collaborators

The selection of farmers as collaborators is a chronically weak area in the nine cases studied, in spite of the attention this issue has received in the literature.

Although all of the OFCOR programs in the case studies are well established, most have relied primarily on ad hoc procedures which are biased in favor of large farmers who are influential in their communities.

There are good arguments for seeking out research-minded farmers who will be effective collaborators. Purposive selection is a valid procedure, but it must be based on explicit goals and clearly articulated criteria. If it is not, results are difficult to defend in discussion with other scientists or to extrapolate to the larger community of farmers. This is a key issue which has not received the attention it deserves.

Maintaining an Interdisciplinary Perspective

OFCOR takes research off the station out into farmers' fields in order to adapt technology to a broad range of both natural and socioeconomic factors. All of the programs in the case studies have, therefore, involved scientists from a number of disciplines, particularly in the early, diagnostic phases. It has proved much more difficult to maintain a broad perspective throughout the research process.

Only about a third of programs in the study have assigned natural scientists other than agronomists to their regular field staff; less than half have included social scientists at that level. Even when specialists from different disciplines are assigned to the same team, active management is needed to keep them working together effectively. Unless clear direction and effective mechanisms are provided, there is a tendency for each scientist to develop and follow his or her own agenda. In several programs, interdisciplinary cooperation has faded away after an initial burst of enthusiasm, and the methodology has stagnated into routine on-farm testing.

The collection and analysis of socioeconomic data are unfamiliar topics for most agricultural research institutes. In only a few of the OFCOR projects in the case studies have the professionals and funds been available for social scientists to play a prominent role. One alternative has been to train generalist agronomists in basic techniques of socioeconomic research, but this has not proved an effective substitute for full-time, trained professionals. Another has been to assign social scientists to work with several field teams, or to organize part-time support committees. At a minimum, a national OFCOR program needs at least some senior social scientists with a strong background in agriculture to provide direction and to maintain a broad, flexible research agenda.

Sustaining Feedback

One of the principal goals of OFCOR is to provide feedback -- a constant flow of information from the on-farm research process into the larger research system. Various mechanisms have helped to keep senior scientists continuously in touch with the process, if only on a part-time basis, after the initial priorities have been set. Regular programming and review meetings are common, but the procedures could be greatly improved. Joint field visits and research projects involving both on-station and on-farm scientists have been very successful, but are difficult to sustain without a special budget and explicit support from managers.

Technicians are a critical point of contact between OFCOR and farmers, and yet few of the programs have used them as effectively as they could. Their experience and insights are not recorded systematically. Improved training would allow them to play broader roles more effectively. They should be invited to participate in programming and review meetings.

Administering Field Operations

The administration of on-farm research, in dispersed sites far from research institutes' established centers of operation, requires flexibility and special support. Long lines of responsibility and communication are vulnerable to disruption. If field teams can be given decentralized authority over routine operations such as the servicing of vehicles, the purchase of spare parts and fuel, and the storage of inputs, they can be spared many frustrations.

Providing Leadership

Strong national coordinators of OFCOR programs have played a number of important roles in the case studies. They have defended operating budgets, vital to dispersed field operations, which are always subject to restrictions and reductions. They have promoted communication between different field teams, so that they can learn from each others' experience within a coherent overall research program. They have encouraged and rewarded methodological innovation, and have helped to maintain a multidisciplinary research agenda. They have defended and legitimated the analysis and presentation of many types of data in programming and review meetings. They have ensured that new entrants receive the training they need, and identified opportunities for the existing staff. Special efforts of this kind have been needed to compensate for the fact that in many institutions, OFCOR is accorded lower status than research on experiment stations.

On a broader scale, the senior managers of a national agricultural research system can promote the integration of OFCOR into medium and long-term priorities of the institution as a whole. They can make sure that mechanisms which encourage linkages of on-farm research with on-station research, with extension, and with farmers are explicitly included in all planning, programming, and review processes. Above all, they can maintain the focus on the client: on the resource-poor farm household.

References

A. The Case Studies

These documents are being published by ISNAR, and will be available upon request.

Avila, M., E.E. Whingwiri, and B.G. Mombeshora. *In press.* 'Zimbabwe: A case study of five on-farm research programs in the Department of Research and Special Services, Ministry of Agriculture.' The Hague: International Service for National Agricultural Research (ISNAR).

Budianto, J., I.G. Ismail Siridodo, P. Sitorus, D.D. Tarigans, and A. Mulyadi Suprat. *In press.* 'Indonesia: A case study of the organization and management of on-farm research in the Agency for Agricultural Research and Development, Ministry of Agriculture.' The Hague: International Service for National Agricultural Research (ISNAR).

Cuéllar, M. *In press.* 'Panama: Un estudio de caso de la organización y el manejo del programa de investigacion en finca de productores en el Instituto de Investigacion Agropecuaria de Panama.' The Hague: International Service for National Agricultural Research (ISNAR).

Faye, J., and J. Bingen. *In press.* 'Senegal: Organisation et gestion de la recherche sur les systemes de production, Institut Senegelais de Recherches Agricoles.' The Hague: International Service for National Agricultural Research (ISNAR).

Jabbar, M.A., and M.D. Zainul Abedin. *In press.* 'Bangladesh: A case study of the evolution and significance of on-farm and farming systems research in the Bangladesh Agricultural Research Institute.' The Hague: International Service for National Agricultural Research (ISNAR).

Kayastha, B.N., and S.B. Mathema. *In press.* 'Nepal: A case study of the organization and management of on-farm research in Nepal.' The Hague: International Service for National Agricultural Research (ISNAR).

Kean, S.A., and L.P. Singogo. 1988. *Zambia: Organization and management of the Adaptive Research Planning Team (ARPT), Ministry of Agriculture and Water Development.* OFCOR Case Study No. 1. The Hague: International Service for National Agricultural Research (ISNAR).

Ruano, S., and A. Fumagalli. 1988. *Guatemala: Organizacion y manejo de la investigación en finca en el Instituto de Ciencia y Tecnología Agrícolas (ICTA).* OFCOR Case Study No. 2. The Hague: International Service for National Agricultural Research (ISNAR).

Soliz, R., P. Espinosa, and V.H. Cardoso. *In press.* 'Ecuador: Un estudio de caso de la organización y manejo del programa de investigación en finca de productores en el Instituto Nacional de Investigaciones Agropecuarias (INIAP).' The Hague: International Service for National Agricultural Research (ISNAR).

B. Other References

Barker, R., and C. Lightfoot. 1985. 'Farm experiments on trial.' Paper presented at the Farming Systems Research and Extension, Management and Methodology Symposium, Kansas State University, Manhattan.

Biggs, S.D. *In press.* 'Organization and management of the participation of farmers in research: A synthesis of experience in nine case studies.' The Hague: International Service for National Agricultural Research (ISNAR).

Byerlee, D., M.P. Collinson, S. Biggs, L. Harrington, J.C. Martinez, E. Moscardi, and D. Winkelmann. 1980. *Planning technologies appropriate to farmers: Concepts and procedures.* Mexico City: Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT).

Byerlee, D., and R. Tripp. 1988. 'Strengthening linkages in agricultural research through a farming systems perspective: The role of social scientists.' *Experimental Agriculture* 24:137-151.

Chambers, R., and J. Jiggens. 1987. 'Agricultural research for resource-poor farmers: A parsimonious paradigm.' *Agricultural Administration and Extension* 27:109-128.

Collinson, M.P. 1982. *Farming systems research in eastern Africa: The experience of CIMMYT and some national agricultural research services, 1976-81.* International Development Paper No. 3. East Lansing: Michigan State University.

Collinson, M.P. 1987. 'Farming systems research: Procedures for technology development.' *Experimental Agriculture* 23:365-386.

Ewell, P.T. *In preparation.* 'Organization and management of linkages between on-farm, client-oriented research (OFCOR) and extension institutions in nine countries.' The Hague: International Service for National Agricultural Research (ISNAR).

Fresco, L.A., and S.V. Poats. 1986. 'Farming systems research and extension: An approach to solving food problems in Africa.' In *Food in sub-Saharan Africa*, ed. A. Hansen and D.E. McMillan, 308-331. Boulder: Lynne Rienner Publishers.

Gostyla, L., and W. Whyte. 1980. *ICTA in Guatemala: the evolution of a new model for agricultural research and extension.* Special series on agricultural research and extension No. 3. Ithaca: Cornell University Rural Development Committee.

Gupta, A.K. 1987. 'Organizing and managing poor-client-oriented research: Can the tail wag the dog?' Paper presented at the Workshop on the organization and management of on-farm, client-oriented research. The Hague, International Service for National Agricultural Research (ISNAR).

Harrington, L., and R. Tripp. 1984. *Recommendation domains: A framework for on-farm research.* CIMMYT Economics Working Paper 2/84. Mexico City: Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT).

Hart, R.D. 1980. *Agroecosistemas: Conceptos básicos.* Turrialba, Costa Rica: Centro Agronómico Tropical de Investigación y Enseñanza (CATIE).

Heinemann, E., and S.D. Biggs. 1985. 'Farming systems research: An evolutionary approach to implementation.' *Journal of Agricultural Economics* 36: 59-65.

Hildebrand, P. 1979. 'Incorporating the social sciences into agricultural research: The formation of a national farm systems research institute.' Instituto de Ciencia y Tecnología Agrícolas (ICTA), Guatemala City, and the Rockefeller Foundation, New York. Photocopy.

Hildebrand, P., and S. Ruano. 1982. *The 'sondeo,' a multidisciplinary methodology for farm description and analysis developed for ICTA.* Guatemala: Institute for Science and Agricultural Technology (ICTA).

Horton, D. 1984. *Social scientists in agricultural research: Lessons from the Montaro Valley project, Peru.* Ottawa: International Development Research Center (IDRC).

Jones, J.R. 1986. 'Evaluation of technological alternatives for small farmers in Central America.' In *Social sciences and farming systems research*, ed. J.R. Jones and B.J. Wallace, 171-193. Boulder: Westview Press.

Martínez, J.C., and G. Sain. 1983. 'The economic returns to institutional innovations in national agricultural research: On-farm research in IDIAP.' Economics Program Working Paper 04/83. Mexico City: Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT).

Merrill-Sands, D. 1986. 'Farming systems research: clarification of terms and concepts.' *Experimental Agriculture* 22: 87-104.

Merrill-Sands, D. *In preparation.* 'Organizational options for on-farm, client-oriented research (OFCOR).' The Hague: International Service for National Agricultural Research (ISNAR).

Merrill-Sands, D., and J. McAllister. *In press.* 'Integrating on-farm and on-station research: Lessons from nine case studies.' The Hague: International Service for National Agricultural Research (ISNAR).

Moscardi, E., and J.C. Martínez. 1984. 'Investigación en producción: Ideas principales, problemas, y oportunidades para su implementación.' In *Memoria sobre el fortalecimiento de la investigación agrícola en América Latina y el Caribe.* Mexico City: International Maize and Wheat Improvement Center (CIMMYT).

Poats, S., and J. Bingen. *In preparation.* 'Development and management of human resources for on-farm, client-oriented research (OFCOR).' The Hague:

International Service for National Agricultural Research (ISNAR).

Shaner, W., P. Philipp, and W. Schmehl. 1981. *Farming systems research and development: Guidelines for developing countries*. Boulder: Westview Press.

Sutherland, A.J. 1986. 'Managing bias: Farmer selection during on-farm research.' *Farming Systems Newsletter* (CIMMYT Eastern Africa Economics Programme, Nairobi) No. 26:11-28.

Tarté, R. 1983. 'Experience in organization and management of research with a farming system perspective in Panama.' In workshop proceedings: *Issues in organization and management of research with a farming systems perspective aimed at technology generation*. The Hague: International Maize and Wheat Improvement Center (CIMMYT) and International Service for National Agricultural Research (ISNAR).

Tripp, R. 1986. 'Some common sense about recommendation domains.' *FSSP Newsletter* 4:1-3.

Zandstra, H.G., E.C. Price, J.A. Litsinger, and R.A. Morris. 1981. *A methodology for on-farm cropping systems research. Los Baños: The International Rice Research Institute (IRRI).*

Appendix Table 1
Distribution of Personnel in OFCOR Teams by Discipline [1]

	Natural Scientists		Social Scientists		Technicians and Assistants		Total OFCOR Staff
	No.	%	No.	%	No.	%	No.
Ecuador (1985)							
PIP	13.0	74	0.0	0	4.0	24	17.0
Guatemala (1986)							
Tech. Testing	53.0	46	0.0	0	61.0[2]	54	114.0[3]
Socioeconomics	4.0	31	4.0	31	5.0	38	13.0
All OFCOR	57.0	45	4.0	3	65.0	51	127.0
Panama (1986)							
OFCOR[4]	14.5[5]	44	0.0	0	16.9	56	31.4
Senegal (1986)							
Production Sys. Res.	8.0	17	9.0	19	30.0	64	47.0
Zambia[6] (1986)							
Case study teams	7.0	33	5.0	24	9.0	43	21.0
Other teams	9.0	43	6.0	29	6.0	29	21.0
All ARPT	16.0	34	14.0[7]	30	17.0	36	47.0
Zimbabwe[4] (1987)							
FSR Unit	2.7	23	1.8	16	7.0	61	11.5
Agronomy Inst.	5.7	35	0.0	0	10.5	65	16.2
Cotton R.Inst.	2.4	49	0.0	0	2.5	51	4.9
Lowveld Station	1.0	25	0.0	0	3.0	75	4.0
Crop. Breed. Inst.	2.4	57	0.0	0	1.8	43	4.2
Sub-total[8]	14.2	35	1.8	4	24.8	61	40.8
Bangladesh (1986)							
BARI	90.0	16	14.0	3	449.0	81	553.0
Indonesia (1986)							
Upland Ag. & C.	14.0	35	3.0	8	23.0	58	40.0
Crop-Livestock S.	3.0	3	1.0	10	8.0	80	10.0
Maize OFR	9.0	50	2.0	11	7.0	39	18.0
Sml. Rum. CRSP	12.0	48	6.0	24	7.0	28	25.0
Sub-Total	38.0	41	12.0	13	43.0	46	93.0
Nepal (1986)							
Rice Prog. (NRIP)	2.0	66	0.0	0	1.0	33	3.0
Crop. Sys. Res.[9]	(10.0)	(20.)	(4.0)	(8.)	(35.0)	(7.)	(49.0)
FSR & DD + SERED	15.0	27	4.0	7	37.0	66	56.0
Lumle (LAC)	7.0	47	2.0	13	6.0	40	15.0
Pakhribas (PAC)	5.0	19	0.0	0	21.0	81	26.0
Sub-total	29.0	29	6.0	6	65.0	65	100.0

1/ Figures refer to field personnel only; administrators in central offices have been excluded. In some cases, technicians and assitants are seconded from separate extension department.

2/ Research technicians (peritos), plus paraprofessional assistants. The text states that each of the scientists works with a locally recruited research assistant. No figures on the number of assistants are provided, but 50 have been included here to provide comparability with the other cases.

3/ Including estimated number of research assistants

4/ Pro-rata of research workers' time on OFCOR

5/ A total of 24 scientists are involved to some degree in OFCOR

6/ Research-extension linkage officers (RELOs) are included as natural scientists in this table. Trials assistants (technicians) are seconded from the extension branch

7/ Includes three sociologists located in a separate department.

8/ These institutes only. In DR & SS as a whole, 24 natural and 2 social scientists are [illegible] farm research.

9/ The Cropping Systems Program was founded in 1977 and was reorganized as the Farming Sys[illegible]earch and Development Division in 1985. It is unclear to which year these figures apply, and they are not included in the totals.

Appendix Table 2
Disciplines Involved with OFCOR Programs

Program	Mode[1]	Disciplines Represented on OFCOR Field Teams	Social Sciences in Other Units or Departments with a Specific Mandate to Back-up the OFCOR Program
Ecuador			
PIP	A	Agronomy	Ag. Economics (to 1982)
Guatemala			
Technology Test	A	Agronomy	Social Science Dept.[2] Ag. Economics, Sociology, Anthropology.
Panama			
N. OFCOR Plan	A	Agronomy	Ag. Economics, Planning[3].
Caisán	A	Agronomy	Ag. Economics[4]
Dual-purpose L.	A	Animal Science, Agrostology.	
Senegal			
Prod. Sys. Res.	C	Agronomy, Animal Science, Ag. Economics, Sociology, Ag. Engineering.	Political Science Macro-Economics
Zambia			
ARPT	B	Agronomy, Extension, Ag. Economics.	Sociology, Nutrition[5]
Zimbabwe			
FSR Unit	C	Agronomy, Ag. Economics, Animal Science.	-
Agronomy I.	A	Agronomy.	-
Cotton R.I.	A	Agronomy, Entomology.	
Lowveld Sta.	A	Agronomy, Soil Science.	-
Crop Breed I.	A	Breeding.	-
Bangladesh			
BARI	C	Agronomy, Soil Science, Ag. Economics, Animal Science.	- -
Indonesia			
Upland Ag.& C.[6]	C	Agronomy, Animal Science, Soil Science, Ag. Economics.	-
Crop-Lvsck. S.[6]	C	Agronomy, Animal Science, Economics.	-
Maize OFR	B	Plant Breeding, Agronomy, Economics.	-
Sml. Rum. CRSP	C	Animal Science, Sociology, Ag. Economics.	-
Nepal			
Rice Program	A	Agronomy	-
Crop.Sys.Res.	B	Agronomy, Ag. Economics.	-
FSR & DD	C	Agronomy, Ag. Economics, Extension.	SERED[7]: Ag. Economics
LAC and PAC	C	Agronomy, Ag. Economics. Horticulture, Anthropology Agro-forestry, Animal Science, Extension.	- -

Appendix Table 2 (notes)

[a] We have divided the disciplinary composition of the teams into three modes:
A: Generalists from broad technical disciplines, usually Agronomy (or Animal Science for livestock projects), with part-time support from specialists.
B: The 'minimal pair': Agronomy and Agricultural Economics
C: Farming Systems teams which combine a broader range of natural and social science disciplines.

[b] In this study, were are considering the Technology Testing and Socioeconomics departments as ICTA's OFCOR program. The former is organized regionally into field teams, the latter is a national department in support of OFCOR which has on occasion delegated scientists to work on the Technology Testing teams.

[c] The central Planning and Ag. Economics departments provided back-up services to all the OFCOR projects.

[d] An agricultural economist from CIMMYT worked part-time on the project.

[e] These disciplines were organized into special multi-regional units within ARPT.

[f] These multi-institute OFCOR projects are advised on their programs by Technical Advisory Teams which include additional disciplines.

[g] When the Cropping Systems Research Program was reorganized into the Farming Systems Research Division in 1984, the Social Scientists hived off to form SERED. Part of the mandate of this independent department is to do socioeconomic research for FSR&DD.

Appendix Table 3
Number and Size of Field Teams

	Number of Field Personnel[1]	Number of Field Teams	Mean Team Size
Ecuador			
Independent PIP	9	5	1.8
PDRI-affiliated PIP	8	5	1.6
All PIP	17	10	1.7
Panama[2]			
Caisán	7.0	1	7.0
Dual-purpose	15.0	3	5.0
Total national OFCOR plan	31.4	16.0[3]	1.9
Zimbabwe[2]			
FSR Unit	11.5	2	5.8
Cotton R.I.	4.9	3	1.6
Agronomy I.	16.2	8	2.0
Crop Breed I.	4.2[4]	-	-
Lowveld Sta.	4.0[4]	-	-
Sub-total[5]	32.6	13	2.5
Zambia			
All ARPT	47	7	6.7
Nepal			
Rice Prog. (NRIP)	3	1	3.0
Crop Sys. Prog.	(49)	(6)	(3.8)
FSR& D. + SERED	56	5	11.2
Lumle (LAC)	15	5	3.0
Pakhribas (PAC)	26	4	6.5
Sub-total	100	15	6.7
Guatemala			
Technology testing	113	12	9.4
Indonesia			
Upland Ag.&C.	40	3	15.7
Crop-Lvstk.S.	10	1	10.0
Maiz OFR	18	1	18.0
Sml.Rum. CRSP[2]	25	3	8.3
Sub-total	93	8	11.6
Senegal			
Production Sys. Dept.	47	3	15.7
Bangladesh			
(BARI)	553	24	23.0

[1] Scientists, technicians, and assistants, from Appendix Table 1.
[2] Pro-rata of research workers' time on OFCOR.
[3] Number of priority target areas where IDIAP ran on-farm experiments in 1986. Many of them were only attended part-time.
[4] Number dedicated to OFCOR. These institutes do not operate field teams.
[5] Of the three programs with field teams.

Appendix Table 4
Distances from OFCOR Teams' Base of Operations to Research Areas

Country	Distances Scientists Travel (Kms.)	Travel Time (hours)
Guatemala[1]		
Maximum	50-70 (paved roads) 20-30 (dirt roads)	1.5
Ecuador[1]		
Maximum	100	-
Minimum	8	-
Mean	34	-
Panama		
Caisán project[1]	1-30	-
Dual-purpose livestock project[1]	5-200	-
Senegal[2]		
Maximum	200	
Minimum	30	
Mean	-	2.0
Zambia[2]		
Maximum	300	5.5
Minimum	10	.2
Mean	120	2.1
Zimbabwe[2]		
Crop Breeding Institute	190	2.1
Agronomy Institute	280	3.1
Cotton Research Institute	110	1.5
Lowveld Station	120	1.6
Farming Systems Research Unit	220	2.4
Mean of these programs	184	2.1
Nepal[2]		
Lumle Centre (LAC)	-	1 day
Bangladesh[2]	5 - 15	-
Indonesia		
Crop-livestock Systems[1]	5 - 10	-
Maize On-Farm Research[1]	10 - 20	-

[1] Travel to farms within research areas ('autonomous' OFCOR teams).
[2] Travel to research areas from central team locations ('hierarchical' OFCOR teams).

Appendix Table 5
Research Activities of OFCOR programs

I. Surveys and Meetings:

Country	Program	Type of Survey or meeting[1]	Purpose of Survey or meeting: Initial diagnosis	Routine monitoring	Special purpose
Ecuador					
	Independent PIP teams				
		Exploratory surveys	X		
		Focused surveys	X		
		Nutrition survey			X
		Regular market data collection		X	
		Special studies			X
	PDRI-affiliated PIP teams				
		Farmer selection meetings	X		
		Survey of collaborators			X
Guatemala					
	Socioeconomics Department				
		Sondeos	X		X
		Farm records surveys		X	
		Acceptibility surveys			X
		Special studies			X
	Technology Testing teams				
		Community meetings			X
Panama					
	National OFCOR plan				
		National planning survey	X		
		Site surveys	X		
		Special studies			X
	Caisán project				
		Diagnostic survey	X		
		Adoption survey			X
	Dual-purpose Cattle Project				
		Baseline surveys			
		Detailed monitoring of case-study farmers		X	

cont...

[1] Meetings with farmers are included in the list of surveys when their principal purpose is to collect information. A full treatment of meetings of various types is given in another paper (Biggs, 1988).

Appendix Table 5 (continued)

Surveys and meetings (cont.)

Country	Program	Type of Survey or meeting	Purpose of Survey or meeting: Initial diagnosis	Routine monitoring	Special purpose
Senegal					
		Informal surveys	X		
		Village demographic censuses	X		
		Farm baseline surveys	X		
		Multiple-visit surveys		X	
		Farm follow-up surveys		X	
		Agronomic monitoring		X	
		Economics of animal traction surveys			X
		Credit surveys for animal traction			X
		Off-farm activities surveys			X
		Sociological surveys:			
		Migration surveys			X
		Land tenure surveys			X
		Labor organization surveys			X
		Livestock surveys		X	
		Farm input-output analysis surveys		X	
		Farm equipment surveys			X
		Technology adoption surveys			X
		Market surveys		X	
		Evaluations of salt exclusion dikes			X
Zambia					
	ARPT				
		Initial diagnostic surveys	X		
		"Community prespective" surveys	X		
		Farm records surveys		X	
		Participant observation		X	
		Income surveys			X
		Labor surveys		X	
		Nutrition surveys			X
		Special studies			X
		Agronomic monitoring		X	
Zimbabwe					
	Farming Systems Unit				
		Diagnostic surveys	X		
		Household monitoring surveys		X	
		Livestock monitoring		X	
	Agronomy Institute				
		Diagnostic surveys	X		
	Cotton Research Institute				
		Pest management surveys		X	

cont...

Appendix Table 5 (continued)

Surveys and meetings (cont.)

Country	Program	Type of Survey or meeting	Purpose of Survey or meeting: Initial diagnosis	Routine monitoring	Special purpose
Bangladesh					
	BARI				
		Exploratory surveys	X		
		Site description surveys	X		
		Farming Systems Evaluations	X		
		Household studies		X	
Indonesia					
	Upland Agriculture & Conservation				
		Village meetings	X		
		Baseline surveys	X		
		Group interviews	X		
		Farm records surveys		X	
	Crop-Livestock Systems				
		Agro-economic profile surveys	X		
		Farm records surveys		X	
		Meetings with cooperating farmers		X	
	Maize OFR				
		Exploratory surveys	X		
		Production surveys	X		
		Special-purpose surveys			X
	Small Ruminant CRSP				
		Informal surveys	X		
		Baseline socioeconomic assessments	X		
		Intensive monitoring of participant farmers		X	
		Annual household survey		X	
		Monthly meetings with cooperators		X	
		Semi-annual evaluation meetings		X	
Nepal					
	Cropping Systems				
		Baseline surveys	X		
		Household monitoring surveys		X	
	Farming Systems				
		Baseline surveys	X		
		Group treks (Samuhik Bhraman)	X	X	
		Rapid rural appraisals	X		
		Key informant surveys	X		
		Household monitoring surveys		X	
		Special studies			X
	LAC and PAC				
		Group treks (Samuhik Bhraman)	X	X	
		Site description surveys	X		
		Narrowly focused surveys	X		
		Village case studies	X		
		Cattle and buffalo breeds monitoring		X	
		Agronomic monitoring		X	
		Special studies			X

Appendix Table 5 (continued)

II. On-farm Experiments

	Purpose of Experiment		
	Diagnosis	Design and Testing	Verification
Ecuador			
CIMMYT affiliated			
Variety trials	X	X	
Multiple-factor interaction trials		X	
Fertilizer levels trials		X	
Verification trials			X
PDRI affiliated			
		?	
Guatemala			
Technology Testing			
Agro-technical trials	X	X	
Agro-economic trials		X	
Farmers' test trials			X
Panama			
National OFCOR plan			
On-farm trials	X	X	X
Caisán project			
Exploratory trials	X	X	
Levels trials		X	
Verification trials		X	
Demonstration plots			X
Dual-purpose cattle project			
Monitoring of traditional systems	X	X	
Component technology trials		X	
Monitoring of improved technology		X	
Senegal			
On-station component technology trials		X	
Variety trials		X	X
Fertilizer trials		X	
Cultural practices and herbicide trials	X	X	
Cropping systems diversification trials		X	X
Marginal lands trials	X	X	
"Dialogue trials"	X	X	X
Zambia			
ARPT			
On-station trials	X	X	
Researcher managed trials		X	
Farmer-managed trials		X	
On-farm tests		X	X
Zimbabwe			
Researcher managed trials	X	X	
Farmer-managed trials		X	X

cont.

Appendix Table 5 (continued)

On-farm Experiments (cont.)

	Purpose of Experiment		
	Diagnosis	Design and Testing	Verification
Bangladesh			
BARI			
Cropping pattern trials		X	
Homestead production and utilization trials	X	X	
Component technology trials	X	X	
Pre-production evaluations		X	X
Multi-location testing trials		X	
Soil nutrient status monitoring trials	X	X	
Indonesia			
Upland Agriculture and Conservation			
On-farm trials	X	X	X
Experimental terrace construction		X	
Crop-Livestock Systems			
Component technology trials		X	
Integrated crop-livestock systems trials	X	X	
Maize On-Farm Research			
On-farm experiments	X	X	X
Small Ruminant CRSP			
Animal nutrition trials	X	X	
Intensive monitoring studies	X	X	
Nepal			
Rice Program			
Outreach trials			X
Farmer Field Trials (FFT)		X	
Mini-kits		X	X
Plant protection demonstrations			X
Cropping and Farming Systems			
Component technology trials	X	X	
Cropping pattern trials		X	
Farmer Field Trials (FFT)		X	
Mini-kits			X
Pilot production programs		X	
Pre-production verification trials		X	
Validation trials			X
LAC and PAC			
Component technology trials	X	X	
Cropping pattern trials		X	
Farmer Field Trials (FFT)		X	
Mini-kits			X
Diamond trials		X	X
Cattle feeding trials		X	
Fodder improvement trials		X	