OFCOR
Comparative Study
Paper No. 1

STRENGTHENING THE INTEGRATION OF ON-FARM CLIENT-ORIENTED RESEARCH AND EXPERIMENT STATION RESEARCH IN NATIONAL AGRICULTURAL RESEARCH SYSTEMS (NARS): MANAGEMENT LESSONS FROM NINE COUNTRY CASE STUDIES

By

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and

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International Service for National Agricultural Research

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

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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

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Study Leader

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

Latin America

Ecuador

OFCOR is conducted by the Production Research Program (PIP, Programa de Investigacion en Produccion), 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 Tecnologia Agricolas (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 Investigacion Agropecuaria de Panama (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, Département 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 Systèmes), three multidisciplinary OFCOR teams located at regional stations, a Bureau of Macro-economic Analysis (BAME, Bureau d'Analyses Macro-Economiques), and a division of thematic research. The case focuses on the OFCOR part of the DRSP, namely the GCAS and the three regional teams.

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

Zambia

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

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

Zimbabwe

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

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

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

Asia

Bangladesh

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

The OFRD subsumed four distinct older programs: multi-locational testing of the Soil Fertility and Soil Testing Institute (later renamed the On-Farm Trials Division), cropping system research on

the IRRI model; varietal testing and verification of the wheat program; and the adaptive research of the T & V

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 -- Lumle Agricultural Research Centre and Pakhribas Agricultural Centre.

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

Table 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)[b]: 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 [c]	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)[d], 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[h]
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	6	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[i]
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[i]

Table 1 (notes)

1. The case study is limited to the Bangladesh Agricultural Research Institute (BARI), the largest of the five institutes coordinated by the Bangladesh Agricultural Research Council (BARC).
2. The data refer only to the subcase studies unless otherwise indicated; NARS-wide data are not available.
3. Base year for all statistical data is 1986.

a. Lumle Agricultural Centre and Pakhribas Agricultural Centre.
b. Programa de Investigación en Producción.
c. The Spanish names for these departments are Prueba de Tecnología and Socioeconomica.
d. Département 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, F.L. Whingwiri, and B.C. Mombeshora)

Senegal: Organisation et Gestion de la Recherche sur les Systèmes 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: Organizacion y Manejo de la Investigacion 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 Panama (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 Siridedo, P. Sitorus, D.D. Tarigans, A. Mulyadi Suprat)

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

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Preface

This paper is the first in a series of comparative study papers on the central issues involved in integrating on-farm client-oriented research (OFCOR) effectively as a stable and productive component of national agricultural research systems. To break this complex topic down into discrete analytic segments means that there will inevitably be some duplication across papers as well as some rather artificial divisions in the content and scope of each paper. The advantages lie in greater clarity resulting from more focussed analyses of specific issues and more rapid dissemination of the findings of the study.

Specifically, this paper focuses on the policy and management issues involved in strengthening the integration of OFCOR and on-station research (OSR). Organizational factors are included in the analysis, but not emphasized. The theme of relative strengths and weaknesses for OFCOR-OSR integration of distinct options for organizing OFCOR will be examined in depth in a separate, forthcoming, paper 'Alternative Arrangements for Organizing OFCOR: Comparative Strengths and Weaknesses' (Merrill-Sands et al., in preparation).

Acknowledgements

This paper is based largely on the nine case studies produced as part of ISNAR's study on the organization and management on on-farm client-oriented research (OFCOR) in national agricultural research systems. We are indebted to the authors of these case studies for their hard work, the high quality of their research, and insightfulness of their analyses, all of which have contributed directly to our analysis. Many of our ideas, in various stages of development, were discussed in depth with S. Biggs, P. Ewell, and S. Poats, the regional coordinators of the OFCOR study, whose generous comments through several successive revisions of this paper helped us to refine and develop our ideas considerably. Early discussions with M. Avila and S. Kean in the field also enabled us to understand essential issues more clearly and to develop a preliminary framework for analysis.

The paper also owes a great deal to reviewers' comments on earlier drafts. Thanks are due especially to M. Avila, M. Collinson, M. Dagg, H. Elliott, E. Javier, D. Kaimowitz, R. Kirkby, S. Kean, S. Ruano, W. Stoop, and L. Zuidema, as well as to the participants in the September 1987 OFCOR Workshop. As always, however, the authors remain fully responsible for any omissions or misinterpretations. Finally, we acknowledge the important contribution of D. Bloch who edited the final draft of the paper and the dedication of L. Spenceley in preparing the manuscript for publication.

Deborah Merrill-Sands, a Research Officer at ISNAR since 1987, is the leader of the ISNAR study on the organization and management of on-farm client-oriented research in NARS. She joined ISNAR to carry out the study in 1986 as a Research Fellow sponsored by the Rockefeller Foundation's Social Science Research Fellowship Program. Jean McAllister, who joined ISNAR in 1987, is the Research Assistant for the study.

Glossary of Acronyms

AARD	The Agency for Agricultural Research and Development of the Ministry of Agriculture of Indonesia.
AI	Agronomy Institute, Zimbabwe.
ARPT	Adaptive Research Planning Team, Zambia's on-farm research program.
BAME	Bureau d'Analyses Macro-Economiques (Bureau of Macro-Economic Analysis), a department of the DRSP in Senegal.
BARI	Bangladesh Agricultural Research Institute
CLSR	Crop Livestock Systems Research, one of Indonesia's multi-institute OFCOR projects.
COFRE	Committee on On-Farm Research and Extension in Zimbabwe.
CSP	Cropping Systems Program, Nepal.
CSRT	Commodity Specialist Research Team, Zambia's OSR
DR&SS	Department of Research and Development Division of the Ministry of Lands, Agriculture and Rural Resettlement of Zimbabwe
DRSP	Departement des Recherches sur les Systemes de Production et le Transfert de Technologies en Milieu Rural (Department of Production Systems and Technology Transfer) in Senegal.
FSR&DD	Farming Systems Research and Development Division of the Ministry of Agriculture of Nepal.
FSR	Farming systems research.
FSRU	Farming Systems Research Unit of DR&SS, in Zimbabwe.
ICTA	Instituto de Ciencia y Tecnología Agrícolas (Agricultural Science and Technology Institute), the national agricultural research institute of Guatemala.
IDIAP	Instituto de Investigación Agropecuaria de Panamá (Panamanian Agricultural Research Institute), the national agricultural research institute of Panama.
INIAP	Instituto Nacional de Investigaciones Agropecuarias (National Agricultural Research Institute), the national agricultural research institute of Ecuador.
ISRA	Institut Sénégalais de Recherches Agricoles, the national agricultural research institute of Senegal.
LAC	Lumle Agricultural Center in Nepal.
MARIF	Malang Research Institute for Food Crops in Indonesia
NARI	National agricultural research institute.
NARS	National agricultural research system.
NRIP	National Rice Improvement Program of the Ministry of Agriculture in Nepal.
OFCOR	On-farm client oriented research.
OFR	On-farm research.
OFRD	On-Farm Research Division, a division of BARI in Bangladesh.
OSR	On-station research.
PAC	Pakhribas Agricultural Center in Nepal.
PIP	Programa de Investigación en Producción (Production Research Program), OFCOR in Ecuador.
RIAP	Research Institute for Animal Production, Indonesia.

SED	Socioeconomics Department of ICTA, Guatemala.
SERED	Socioeconomic Research and Extension Division of the Ministry of Agriculture of Nepal.
TTD	Technology Testing Department, the OFCOR program in ICTA in Guatemala.
UACP	Upland Agriculture and Conservation Project, one of Indonesia's multi-institute OFCOR projects.

SUMMARY

I. Introduction

On-farm client-oriented research (OFCOR) and experiment station research share as their common goal the generation and transfer of productive and relevant technology. The agricultural research system's efficiency and effectiveness in meeting the needs of its clients depends largely on their strong integration.

OFCOR and on-station research (OSR) represent distinct sets of research activities designed to perform complementary and interdependent functions within the research process. The work done on stations is largely applied research, commodity-, discipline-, or factor-based, aimed at generating new technical components. Experiment stations are especially suitable for this type of research because here scientists can manipulate the variables in which they are interested under controlled conditions. OFCOR, in turn, is designed to increase a research system's ability to respond to the demands and needs of specific client groups, most importantly resource-poor farmers. OFCOR employs specific methods to define relevant client groups and to identify their priority research needs. It emphasizes adaptive research, seeking suitable niches for available technology and tailoring technology to the real conditions, both agroecological and socioeconomic, which obtain for target groups of farmers. Such research is usually best conducted on farms in order to capture the full range and variability of conditions confronting farmers.

Designed to complement -- and reliant upon -- on-station research (OSR), OFCOR's contribution to the agricultural research process depends largely upon its effective integration with station-based, applied, commodity and disciplinary research programs. Analysis of the experiences of nine case study NARS reveals, however, how difficult strong integration is to achieve and sustain over time. This is hardly surprising. The very factors which make OSR and OFCOR complementary research activities also create the potential for conflict. Differences among scientists working in OFCOR and OSR typically arose with respect to research objectives, perceptions of constraints, clients and products, as well as research methods and modes of analysis. To resolve such conflict and to develop productive collaboration, active, often intensive, management and explicit institutional support for OFCOR-OSR integration are required.

This paper presents the principal management lessons for OFCOR-OSR integration deriving from a comparative analysis of the experiences of research managers in nine agricultural research systems having well-established OFCOR efforts. It examines how the institutional conditions of a research system, fixed as well as flexible, can affect OFCOR-OSR integration; how certain conditions particularly favor integration; and how managers have implemented specific mechanisms in an effort to create these desired conditions.

II. The Nature of OFCOR-OSR Integration: Complementary Functions

The potential benefits of strong OFCOR-OSR integration can best be appreciated by considering the five complementary research functions which they ideally perform for each other within the research process: a service function, an adaptive research function, a feedback function, an applied research function, and a support function. Whereas OFCOR has a comparative advantage in performing the service, adaptive research, and feedback functions, OSR has a comparative advantage in carrying out the applied and support functions. These five research functions constitute the link between OFCOR and OSR.

The service function involves broad-scale on-farm screening, testing and evaluation of technologies developed on station. A demonstration role is often an important secondary objective of such on-farm trials. The adaptive research function involves field diagnosis of problems and the adjustment, or adaptation, of existing technology to a particular set of environmental conditions, agroecological or socioeconomic, through on-farm research. The feedback function involves the channeling of relevant information from farming system descriptions, farm-level diagnosis, or adaptive research to the priority-setting, planning, and annual

programming processes of station-based research. The feedback function thus enables research to better address the identified needs of designated client groups.

The applied research function, complementing OFCOR's adaptive research function, is technology generation. Station-based programs generate technological alternatives for OFCOR to screen and adapt on-farm to meet the specific needs and conditions of particular client groups. The support function involves the provision of specialized knowledge and expertise to OFCOR. This function implies that station-based researchers have both the opportunity and ability to keep abreast of relevant scientific advances in their areas of expertise. The support function is complementary to OFCOR's feedback function; together they involve scientists in a reciprocal exchange of expertise.

In any given research system, how these five basic linkage research functions are performed and the relative balance among them will determine the nature of OFCOR-OSR integration and its relative strength. The emphasis which research managers choose to give to specific functions, moreover, will determine the most appropriate organizational arrangements and managerial mechanisms for strengthening integration.

III. Review of the Experiences of the Case Studies

Comparative analysis of the nine case study NARS revealed that, in most instances, when assessed in terms of the performance of all five linkage research functions, only moderate progress had been made towards attaining full integration. There were three key findings concerning the relative performance of the five functions:

1) the adaptive and applied research functions have been the most successfully implemented;
2) the service function has varied markedly across the cases in its relative importance and degree of implementation;
3) the feedback and support functions have been the least successfully implemented.

The case studies help identify several reasons why the feedback and support functions appear particularly difficult to implement. Both depend heavily on collaboration and interaction. Both also lead to changes in researchers' work programs, responsibilities and decision-making autonomy. In the minds of many researchers, moreover, the benefits from collaboration accrue more frequently to the research institution than to the individual. Such benefits may also be somewhat intangible and long-term in nature. In contrast, the additional demands which collaborative effort makes on researchers' time and other scarce resources are often perceived as personal costs which are concrete and immediate. The case studies show that researchers will seldom shoulder the extra costs of collaboration entirely on their own volition.

IV. Designing a Management Strategy: Guidelines for Strengthening Integration of OFCOR and Experiment Station Research

The experiences of the cases studied indicate clearly that achieving OFCOR-OSR integration is one of management's most challenging tasks in incorporating OFCOR as a stable component of the research process. Comparative analysis also shows that to realize the full potential benefits of OFCOR-OSR integration, research managers need a management strategy based on clearly defined institutional policy and appropriate organizational and managerial mechanisms for effective collaboration.

The objective of this analysis is to provide a set of guidelines, derived from the synthesis of the experiences documented in the nine case studies, to assist research managers to design such a management strategy for strengthening OFCOR-OSR integration tailored to the specific conditions and needs of their own research systems. Three processes were involved in developing the guidelines:

1) analysis of institutional conditions affecting OFCOR-OSR integration in the case study NARS;
2) identification of policy, organizational, and managerial factors determining these conditions;

3) review of management mechanisms which research managers have used effectively to foster integration.

Two kinds of institutional conditions were identified as affecting OFCOR-OSR integration in case study NARS:

1) *environmental conditions*: research managers have little control over these conditions, at least in the short term; environmental conditions define the basic constraints and opportunities which a research manager has to take into account when designing his/her management strategy;

2) *facilitating conditions*: research managers can develop these conditions in order to strengthen OFCOR-OSR integration. It is in these areas that research managers have room to maneuver.

Environmental Conditions

Of the 13 relatively fixed environmental conditions identified as influencing OFCOR-OSR integration, four figured most prominently in the cases reviewed: the human resource base of the NARS, the financial resource base of the NARS, OSR's capacity to supply component technologies for adaptive research, and the degree to which national development policy is oriented towards assisting resource poor farmers.

Facilitating Conditions

Comparative analysis of the cases studied also identified six conditions which facilitate strong integration and which are amenable to management intervention. Optimal realization of these conditions should be the principal objective of any management strategy for promoting full OFCOR-OSR integration. Research managers should strive to create an institutional environment in which:

1) scientists share an applied, farmer-oriented perspective to agricultural research;
2) scientists agree on the respective research functions OFCOR and OSR should perform and on their relative importance;
3) scientists share a common understanding of OFCOR as a complementary, not competing, research activity;
4) scientists view OFCOR as scientifically credible;
5) scientists perceive the benefits of collaboration to outweigh personal costs;
6) scientists have adequate opportunities for formal and informal interaction.

The degree to which these facilitating conditions had been successfully developed in the case study NARS varied considerably. An applied, farmer-oriented perspective held jointly by researchers working in OFCOR and OSR -- a shared sense of 'mission' -- appeared to be the most difficult of the conditions to realize. This is to be expected. The inculcation of attitudes is a long-term management goal which may require nothing less than the forging of a new institutional culture.

A working consensus on the explicit division of labor and responsibilities for linkage research functions had also been achieved fully in only a few cases. In approximately two thirds of the situations reviewed, on-station researchers perceived OFCOR as competitive and not complementary; in only a third did they report a shared consensus concerning what mutually supportive roles should be. Conflicts typically arose when station-based researchers saw OFCOR as a strategy instituted to 'correct' their research priorities and agenda; the feedback or support functions were executed in a supervisory, rather than consultative, spirit; assignment of responsibility for issuing recommendations was ambiguous; and OFCOR and OSR were perceived as competing for scarce human and financial resources.

Establishing OFCOR's scientific credibility also emerged as a critical area for management initiative to bolster integration. Experiment station scientists' low esteem for OFCOR was cited as a major factor hindering integration in five of the cases reviewed. Conversely, OFCOR's strong scientific capacity was credited with facilitating integration in the four others. The primary issues involved in OFCOR's scientific credibility included: the relative seniority of OFCOR researchers (degree level and experience); the quality of their research; the perceived legitimacy of OFCOR methods, modes of analysis, and criteria for evaluation; and the ability of OFCOR staff to demonstrate convincingly their complementary expertise in generating a better understanding of actual farming conditions and farmers' priority needs and problems.

Researchers' notions that the costs of collaboration outweighed the benefits to them prevailed in almost all the institutions studied. Researchers' principal concern was that whatever time they allocated to collaborative activities would effectively undermine their status within their own institutes or among their larger scientific peer group. In other situations, more tangible personal costs, such as arduous field trips with inadequate per diems, cast collaboration in a negative light.

Opportunities for collegial interaction not only facilitate the exchange of information, but also help researchers to develop personal relationships which enhance their motivation to work together professionally. Despite the commonsense advantages of facilitating contacts between OFCOR and OSR staff, opportunities for such interaction were unfortunately lacking or underdeveloped in a clear majority of situations studied. Analysis of case study experiences indicates that having scientists reside together on station, or posting them to the same organizational unit -- department, research program, or development project -- increases the frequency and depth of both their formal and informal interaction, and consequently promotes stronger OFCOR-OSR integration. In addition, reliable communication facilities are a distinct advantage in realizing this sixth facilitating condition.

V. Management Mechanisms for Strengthening Integration of OFCOR and Experiment Station Research

Research managers in the case study institutions promoted OFCOR OSR integration by using management mechanisms which created incentives, mobilized resources, and provided opportunities for collegial interaction. Comparative analysis of the cases identified nine key management mechanisms which helped research managers both to develop the institutional conditions conducive to strong integration and to improve the performance of the two linkage research functions. These mechanisms relate to four management areas: research management processes; scientific activities; resource allocation; and coordination of collaboration.

Research Management Processes

The experiences of the OFCOR situations studied demonstrate that joint diagnosis of farm-level constraints and joint identification of priorities for research by OFCOR and station-based scientists not only is a powerful integrating mechanism, but can establish a solid foundation for on-going collaboration. The most common application of this frequently employed linkage mechanism was to involve OFCOR and OSR scientists in an informal diagnostic survey leading up to a joint priority-setting and planning exercise. Collaborative priority-setting and planning exercises were considered particularly effective when implemented periodically, rather than incidentally, and when conducted in the field rather than in the conference room.

Analysis of the case studies distinguished several other managerial factors which can increase the effectiveness of this mechanism: the explicit support of senior management; a well-defined procedure for carrying out problem diagnosis and priority-setting; identification of the activity as a means for defining research agendas for *both* on-farm and station-based research; and allocation of sufficient funds to cover researchers' costs to reach field sites and do their work there.

Joint programming and review meetings, used in all OFCOR situations studied, were found to facilitate the rapid dissemination of new research results as well as to provide an arena for immediate and direct feedback from colleagues. Such meetings appear in the different cases in various forms depending on the specific institutional setting and the nature of previously established programming and review processes.

The experiences of the cases studied indicate, however, that the spirit of equal and active participation in joint programming and review by both OFCOR and OSR staff is difficult to sustain over the long term. In the OFCOR situations studied it was far more common for station-based researchers to review the proposed programs and results of OFCOR than for OFCOR researchers to do the same for OSR. Analysis suggests, furthermore, that this linkage mechanism works more effectively to strengthen integration when review is consultative, with researchers drawing on each others' respective areas of expertise, rather than supervisory. The cases reveal, moreover, how this mechanism, like joint priority-setting exercises, can stir up controversies over power and control that require prompt attention from research managers. A number of other management factors identified as adding to the effectiveness of joint programming and review meetings as a linkage mechanism promoting integration include: the support of senior research management and mandatory attendance; smaller meetings with a narrow mandate; and authorization of participants to take programming decisions and implement proposals.

Participation in joint field visits such as annual monitoring tours or regular field days, as well as periodic planning exercises, has been used extensively in case

study OFCOR situations to develop stronger integration between OFCOR and OSR scientists. Review of the case studies reveals how periodic joint field visits to reassess priorities, adjust research agendas and develop joint work plans help to sustain active OFCOR-OSR collaboration. The complementary roles of OFCOR and OSR become clarified in the field, where scientists based at experiment stations see their technology applied on-farm, observe the work of OFCOR scientists in practice, and can develop a clearer understanding of clients' needs and the opportunities for research intervention. Although joint field visits may be logistically more difficult to arrange and, sometimes, more costly than meetings and seminars, the benefits they yield were considered to easily warrant the additional investment.

Despite chronic disputes over the prerogative to draw up recommendations, in the case studies reviewed there was little experimentation with procedures to involve both OFCOR and OSR scientists in decisions on recommendation release. Evidence from the case studies indicates that ultimate responsibility for formulating recommendations has been a problem especially where distinct groups of researchers carry out OFCOR and OSR and where the former have only a regional, but the latter a national, mandate. Managers need to be alert to this potential area for conflict and establish unambiguous procedures for recommendation release which incorporate input from both OFCOR and OSR.

Collaborative Scientific Activities

The experiences of the case studies reveal that collaboration in the design, implementation and analysis of results from trials and formal surveys served to foster OFCOR-OSR integration by promoting shared research interests and objectives, by helping OFCOR and OSR researchers to orient their research to meet each other's priority needs and interests, by forcing resolution of disagreements over the validity of different research methods and modes of analysis, and by providing an excellent opportunity for focussed professional interaction. Managers did not frequently employ this mechanism in the cases reviewed, however, and collaboration in trials was more common than in surveys.

Informal consultation among scientists was seen in the case studies to be important for developing trust, interest, personal commitment and professional incentives for collaboration between OFCOR and OSR colleagues. It is also a low cost, expedient means of communication. Research managers can intensify such contacts in their systems by identifying and promoting formal, as well as informal, opportunities for interaction. In addition to joint planning, programming, and review meetings, joint trips, seminars, social gatherings and recreational activities all were perceived as useful for strengthening OFCOR-OSR integration.

Resource Allocation Procedures

The case studies indicate that formal guidelines for the allocation of funds and time to collaborative activities greatly facilitate the successful implementation of those activities. The reservation of specific funds for collaborative OFCOR-OSR activities, although not used frequently in the situations reviewed, can keep basic financial constraints from inhibiting the collaborative activities upon which successful OFCOR-OSR integration depends.

The specific allocation of researcher time, used more frequently in the cases, helped to 'protect' collaboration from competing responsibilities. The experiences of the case studies show that professional responsibilities for which researchers are held directly accountable, as well as the pursuit of personal interests, tend to take precedence over joint OFCOR-OSR ventures. Guidelines for the allocation of researchers' time, seen to be more effective as they become more specific, contributed the most to OFCOR-OSR integration when backed up by a well-argued rationale together with incentives and rewards for collaboration.

Coordination

Successful implementation of all the management mechanisms discussed depends largely on the effective coordination of collaboration between relevant partners. The organization and scheduling of OFCOR-OSR joint activities, and the allocation of researchers' time, funds and other resources for collaborative efforts are in themselves challenging and time-consuming tasks. Case study experiences indicate the need for the formal assignment of coordination responsibilities, if they are to be effectively discharged. Research managers in the situations studied appointed as coordinator of OFCOR-OSR collaboration either a representative from OFCOR or OSR, but usually from OFCOR, or a joint OFCOR-OSR supervisor, or, in a few cases, a committee with both OFCOR-OSR representation.

Each of these alternative choices involves distinct opportunities and problems. In any event efficient coordination was more the exception than the rule.

Comparative analysis of the experiences of the cases studied indicates that the individual or group assigned responsibility for coordination of OFCOR-OSR collaboration will have a greater chance to succeed if he, she, or they have available enough time and resources to attend to their tasks; enough authority, status and respect from colleagues to translate ideas into action; enough skill and tact to resolve conflict peaceably; and enough professional motivation to persevere despite setbacks.

VI. Applying the Guidelines

Predictably, comparative analysis of the case study experiences shows that there is no single foolproof formula for effective OFCOR-OSR integration. Specific mechanisms for strengthening collaboration have variable results; their utility fluctuates under different institutional conditions.

This paper, therefore, synthesizes the experiences of research managers in the case study NARS in order to provide other managers with a set of guidelines for developing an effective, institution-specific management strategy for building strong OFCOR-OSR integration. While the proposed guidelines are specific enough to provide concrete advice on the practical steps to be taken to reach the identified objectives, they remain sufficiently general to oblige managers to design a strategy appropriate to their own particular institutions.

Research managers can apply the guidelines presented in this paper to all five stages in the development of their management strategy:

1) setting objectives;
2) diagnosing the constraints and opportunities of the research system;
3) designing a plan of action;
4) implementing the plan; and
5) monitoring progress towards defined objectives.

VII. Lessons Learned

Analysis of the case study experiences yielded several crucial lessons for research managers striving to strengthen OFCOR-OSR integration:

1) A balanced build-up of OFCOR and OSR is essential for strong integration;
2) Each organizational option for OFCOR entails distinct opportunities and constraints for integration;
3) An effective division of labor and responsibility for research functions must be built on consensus;
4) Strong scientific leadership for OFCOR is essential for developing and sustaining effective integration;
5) Someone must be responsible for coordinating OFCOR-OSR collaboration;
6) Successful performance of the feedback and support functions requires intensive management;
7) There is no such thing as a free lunch: Resources required for OFCOR-OSR integration must come from somewhere;
8) Research management processes are effective and efficient points of intervention for building OFCOR-OSR integration;
9) A return to common sense: Managers need to create opportunities for scientists to interact.

CHAPTER 1
THE ISSUE

I. Introduction

On-farm client-oriented research (OFCOR) is designed to increase the capacity of technology generation and transfer systems to respond effectively to the needs of specific client groups, most commonly resource-poor farmers. OFCOR, which complements and depends upon research carried out on experiment stations, involves a client-oriented philosophy, a specific approach to research, a set of methods integrating trials and formal and informal surveys, and a variety of farm-level activities which range from the diagnosis and ranking of problems, through the design, development, adaptation, and evaluation of appropriate technologies to solve them. As the principal clients of research, farmers are actively involved at various stages in the research process.[1]

The success of OFCOR — in terms of realizing its potential to improve the effectiveness and efficiency of the agricultural research process as a whole — is contingent upon its integration with commodity and disciplinary research carried out on experiment stations. Without such integration, OFCOR cannot survive as a stable and productive component of the research system (Baker and Norman, 1988; Biggs and Gibbon, 1984; Collinson, 1987; Fresco, 1984; Gilbert et al., 1980; Norman, 1983).

Experience has shown, however, that although most strategies for incorporating or strengthening OFCOR within national agricultural research systems recognize the importance of integrating OFCOR and on-station research (OSR), this has only rarely been achieved. Research managers have run into significant institutional and logistical problems when trying to develop this link. Full and systematic collaboration among researchers working in OFCOR and OSR seldom occurs spontaneously. Indeed, differences in research objectives, approaches, methods, and evaluation criteria have often led to conflict. Active management is needed to develop effective and productive interaction.

Achieving and sustaining successful integration over time is a challenge to good management. Research managers need to define respective OFCOR and OSR research objectives and functions explicitly. They must then organize channels for frequent and timely communication, promote incentives for collaboration, support the development of new research skills among their staff, and allocate resources for collaborative activities and projects. This requires a clear and focussed management strategy which develops research policy support as well as organizational arrangements and managerial mechanisms for collaboration.

This paper provides research managers with guidelines and practical advice for designing such a management strategy to promote effective OFCOR and OSR integration. The guidelines derive from a detailed comparative analysis of the experiences of research managers in nine national agricultural research systems with well-established OFCOR efforts.[2] The paper examines the problems they have encountered in strengthening integration and the solutions they developed to overcome these problems. General management guidelines and lessons are extracted from the analysis of these diverse experiences. Targeted at research managers entrusted with direct responsibility for effectively integrating OFCOR and OSR, the paper strives to strike a useful balance between providing broad recommendations for developing an effective management strategy (Chapter 3), and offering concrete practical advice and management tools for implementing such a strategy (Chapter 4).

Predictably, the analysis does not come up with any single formula for success. Research institutions and the specific objectives of their research managers are simply too disparate. Nevertheless, through this synthesis of experience there is now a considerable body of

[1] We have used the term OFCOR rather than Farming Systems Research (FSR) because the latter has come to have very different meanings for different people or schools of thought (Merrill-Sands, 1986). OFCOR corresponds to the type of FSR which has also been called on-farm adaptive research or farming systems adaptive research (Byerlee et al., 1982; Collinson, 1982; Gilbert et al., 1980; Norman 1980, 1982); it is not equivalent to longer-term, more applied systems research or thematic research.

[2] See prefatory material: 'Introduction to the ISNAR Study on Organization and Management of On-Farm Client-Oriented Research (OFCOR)' and 'Overview of the Nine Case Studies' by D. Merrill-Sands.

instructive material which research managers can use in their own efforts to strengthen the integration of OFCOR and experiment station research within their research systems.

II. Complementary Activities: OFCOR and Experiment Station Research

OFCOR and experiment station research involve complementary sets of activities which perform discrete, but interdependent, functions within the research process (Baker and Norman, 1988; Biggs, 1983; Byerlee et al., 1982; Collinson, 1982; Denning, 1988; Monteith et al., 1988; Morris, 1984; Norman and Collinson, 1985). They share a common goal: the generation and transfer of relevant technology, and the efficiency and effectiveness of the research process as a whole depends on their strong integration.

Research on station emphasizes applied research, either commodity-, discipline-, or factor-based, aimed at generating new technological components (e.g. the breeding of a new variety). Experiment stations are more suitable for such work because scientists require an environment where they can manipulate the variables under study under controlled conditions. Scientists concentrating in OSR, owing to their disciplinary specialization, also generally have a comparative advantage in keeping up with and exploiting advances in world knowledge in their fields of expertise.

OFCOR emphasizes adaptive research aimed both at seeking suitable niches for available technology and at tailoring such technology to suit actual conditions — both agroecological and socioeconomic — faced by target groups of farmers. Such research is usually best conducted on farms in order to capture the full range and variability of conditions which farmers confront. Adaptive research is particularly important in comparatively marginal environments where factors limiting productivity are variable and complex. Here the findings of OSR may not be *directly* applicable; adjustments and fine-tuning are likely to be required.

OFCOR also systematically collects information for the research system concerning the priority problems and needs of particular client groups. While OFCOR and applied research on experiment stations are both client-oriented, OFCOR employs specific methods to define relevant client groups and to identify their priority research needs (Byerlee and Tripp, 1988). In this way, the function of OFCOR is analogous to the marketing research department in technology companies in the private sector.

This resume of OFCOR functions suggests why OFCOR is of such potential importance to developing country research systems in particular, systems striving to produce technologies for resource-poor farmers. In developed countries, comparable activities are carried out expeditiously by agents outside of government research institutions: by private agricultural input and services companies, by extension services, and, above all, by farmers who have access to necessary information, inputs, credit, and services, who can afford to assume the risks inherent in experimentation, and who are organized to demand the products and information they need from research. Such conditions, however, do not obtain for resource-poor farmers in developing countries: their access to information generated through formal science is restricted; they have only a limited capacity to tolerate risk; and they are rarely well-organized or powerful enough to bring pressure to bear so that their demands are adequately met by public sector research systems. Under these circumstances, OFCOR can ensure that these clients have a voice in the agricultural research process.

At the outset, it is important to emphasize that this analysis focuses on OFCOR and OSR as research approaches performing complementary and interdependent functions in the research process, not necessarily as distinct types of researchers or research units. The analysis is aimed, therefore, at generating guidelines for developing effective integration and performance of these complementary research *functions*. It is not limited to building linkages between discrete research units or programs. In some of the cases studied, separate staffs carried out OSR and OFCOR, and in others, a single researcher conducted both sets of activities. The manner in which responsibility for the respective research functions is divided — i.e. assigned to a single researcher or to a group of specialists — is an organizational issue, and only one of several factors affecting integration. This paper focuses on policy and managerial factors, as well as organizational factors, involved in strengthening OFCOR-OSR integration. In what follows, the term 'generalized model' is used to denote an organizational arrangement in which the same researcher performs both OSR and OFCOR in an integrated program. The term 'specialized model' refers

to arrangements in which OFCOR is implemented instead by a separate individual or team. The term 'composite model' refers to organizational arrangements where OFCOR is carried out both by specialists and generalists. The paper gives more attention to the specialized model since it was the dominant organizational arrangement in the cases studied.

III. Problems in Achieving Effective Integration: The Potential for Conflict

The experiences of the research institutions included in this study show that in practice effective integration between OFCOR and experiment station research is difficult to achieve. Conflicts and misunderstandings among researchers working in OSR and OFCOR occurred in a majority of cases. This is hardly surprising, for the very factors which make these activities complementary also create potential for conflict.

The case studies revealed that basic disagreements about what constitutes good science and credible research can divide researchers working in OFCOR and OSR, especially when OFCOR is carried out in relative isolation. Conflicts typically stemmed from divergent perceptions of the priority constraints to be addressed by research and of the clients and products of research. Differences in research objectives, methods and modes of analysis further complicated cooperation.

Perceptions of Constraints

In general, station-based research aims to overcome technical constraints by developing the *best* possible technology, usually defined as that which gives the highest yield under broadly specified conditions. The assumption is that once scientists make good technology available, policy-makers will do their job as well, reducing socioeconomic constraints by providing the necessary infrastructure, services, credit, inputs, and marketing facilities. In other words, the station-based research perspective is rather long term and assumes that the environment can be changed to fit technology, as, indeed, occurred in the Green Revolution, so successful in the more productive and uniform environments throughout Asia.

In contrast, OFCOR, working on the adaptive end of the research spectrum, takes a shorter-term perspective. It strives to provide farmers with technology which they can feasibly adopt under existing, or only moderately changed, political and socioeconomic conditions. This means that the technological alternatives which OFCOR offers may only be *better* than farmers' current technologies, rather than the *best* technology possible. It also means that a broader range of criteria, reflecting farmers' needs and priorities, are used to evaluate the relevance and utility of possible technologies.

Clients and Products

Many scientists concentrating in OSR are trained to develop the kind of high-yield technology most appropriate for commercial farmers who, operating in favorable environments and with facilities for high input use, are able to take advantage of this increased production potential. In contrast, OFCOR researchers are by and large directing their efforts towards generating technologies for small-scale, resource-poor farmers who are often situated in marginal environments. The complex farming systems and multiple objectives of such farmers result in OFCOR's commitment to a broader research agenda including the study of ways to increase the total output of the farming system through more productive interactions among components, ways to minimize risk and enhance the system's stability, ways to improve consumption or feed quality characteristics of crops, or ways to maximize returns to scarce labor or cash rather than just to land.

Objectives

Whereas OSR, focussing on technological components, strives to optimize the productive potential of a given crop or animal by reducing constraints in the biological and physical environment, OFCOR, in its turn, strives to optimize the potential of a targeted farming system in keeping with farmers' own objectives and priorities by reducing socioeconomic, as well as biological and physical constraints.

A second difference between the two is that while station-based research, which often has a national mandate, strives to produce varieties and production technologies with wide adaptability across a broad range of environmental conditions, OFCOR is more location-specific and strives to adapt varieties and technologies to a particular environment or farming system. These differences in objectives give rise to quite

distinct research agendas. Unless the fundamental complementarity of the two sets of research objectives is properly appreciated in terms of their ultimate goal of generating technologies appropriate for farmers with limited resources, conflicts among the scientists involved will all too easily erupt.

Research Methods and Modes of Analysis

OSR applies experimental designs, measurements, and analytic methods which are statistically robust, precise, and well tested in terms of procedures and assumptions. OSR criteria for evaluating 'good research' are well defined and commonly accepted by the academic and scientific community. OSR methods, however, cannot be applied directly under the more variable conditions encountered in on-farm research. Such conditions mean higher coefficients of variation (CVs) and higher rates of trial loss, and they require different types of experimental design. The broader research agenda of OFCOR, moreover, entails alternative criteria for evaluating technologies which may not seem relevant or sufficiently rigorous according to OSR standards. OFCOR also generally incorporates socioeconomic analysis both while identifying priority constraints within farming systems and while assessing the performance of technologies. OSR scientists are sometimes unsure how to interpret and evaluate results from such socioeconomic research. Other kinds of data generated through farm-level research may also be unfamiliar and, therefore, confusing. These differences in methods, modes of analysis, and evaluation criteria can result in fundamental conflicts over what constitutes 'good science,' and about the legitimacy of the respective approaches to research.

Managing Conflict

The experiences documented in the nine case studies indicate that these differences between OSR and OFCOR in general orientation, in conjunction with differences in the more specific issues of methods, modes of analysis, and evaluation criteria, often create conflict. Divergent goals and attitudes lead, in turn, to disputes over more concrete issues such as resource allocation, priorities in the planning and programming of research, or the validity and interpretation of results. Conflict can be still further exacerbated when OFCOR is introduced, or perceived to be introduced, as a corrective measure, an attempt to compensate for the failure of conventional on-station research to generate technologies relevant for resource-poor farmers in more marginal environments.

Both OFCOR and OSR are necessary to realize the production gains that developing countries badly need. For OFCOR to have a chance to successfully complement OSR and to achieve long-term institutional stability, the resolution of internal tension between OFCOR and OSR is critical. The challenge for research managers is, therefore, to turn the potential for conflict into constructive debate by uniting the two approaches under a common goal with complementary objectives and ensuring that OFCOR and OSR provide products and services which are mutually supportive. The experiences of the case studies argue that active, innovative, management can curtail wasteful disagreement while consolidating effective, productive integration. Specific guidelines to help managers achieve such integration are developed in Chapters 3 and 4.

IV. The Nature of Integration

What is strong and effective integration of OFCOR and experiment station research? This ideal can best be understood by looking at the functions which these two research approaches perform, or can potentially perform, in relation to each other within the research process. For the purposes of this analysis, five complementary research functions have been identified as constituting the link between OFCOR and OSR (Table 1).

Out of this cluster of five functions, OFCOR is generally used to carry out the service, adaptive research, and feedback functions, while OSR is responsible for the applied research and support functions. It should be noted, however, that in some cases, depending on the research problem, adaptive research is carried out on stations and applied research on farms, but under strictly controlled conditions.

OFCOR Linkage Functions

OFCOR can potentially perform three research functions in relation to experiment station research:

1) a service function
2) an adaptive research function
3) a feedback function

Table 1:

Five OFCOR-OSR Linkage Research Functions

Research Function	Description
The Service Function:	Broad-scale on-farm screening, testing, and evaluation of technologies developed on-station. A demonstration effect is often an important secondary objective of these trials.
The Adaptive Research Function:	The diagnosis of farm-level constraints and the adjustment, or adaptation, of existing technology to a particular set of environmental conditions, either agroecological or socioeconomic, through on-farm research.
The Feedback Function:	The identification and provision of relevant information from farm-level description, diagnosis, or adaptive research to the priority-setting, planning, and annual programming processes of station-based research. It is the aim of the feedback function to focus research on identified needs of designated client groups.
The Applied Research Function:	The generation of technological components.
The Support Function:	The professional input of OSR specialists at different stages of the OFCOR research process. The support function implies the opportunity and ability to keep up with research developments worldwide in specific fields. This specialized knowledge complements the specialized farm-level information generated by OFCOR.

These functions are considered to constitute the OFCOR side of the link. At its most robust, OFCOR will perform all three functions with particular emphasis on the adaptive research and feedback functions.

Service function. The service function, the validation or verification of technology through on-farm screening and testing, is the final stage of research before recommendations are formalized and attempts to transfer technology begin. On-farm trials are relatively simple in design with emphasis on broad-scale coverage, and multi-locational testing. The demonstration role of these trials is also considered important for they expose both farmers and extension agents to new technologies.

The service function has been the traditional function of on-farm research. It is a passive research role in which OSR is extended to the farm with station-based programs usually 'pushing out' selected new technology for testing. In some cases, on-station researchers even design the on-farm trials. For the purposes of this analysis, on-farm research which performs a passive service function only is not regarded as OFCOR.

Adaptive research function.[3] This function involves the modification of known technology to suit a particular set of agroecological and socioeconomic conditions or, in other words, to meet the requirements of specific client groups. On-farm research, usually involving both surveys and trials, is used to identify opportunities for improving the performance of an existing production system. Potential technologies or knowledge from experimental station research are then 'pulled down' as a basis for designing solutions.[4]

In adaptive research, OFCOR has an active role to play: diagnosing problems in the field, setting priorities, and designing potential solutions. OFCOR draws on experiment station expertise and knowledge in a

[2] we use the CGIAR (1981) definitions of applied and adaptive research:
applied research is that designed to create new technology;
adaptive research is that designed to adjust technology to the specific needs of a particular set of environmental conditions.

[3] This is based on Collinson's (1985) definition of adaptive research in which he introduced the idea of selectively 'pulling down' technologies based on farm-level diagnosis.

consultative or support role, but retains control of its research agenda.

A good example of the adaptive research function, reported in the Guatemalan case study, is the development of recommendations for improved maize varieties and associated management practices in the agricultural development zone of La Maquina. Conducting both formal and informal surveys, the OFCOR team characterized the predominant farming system of La Maquina and pinpointed two key production constraints: the low-yield potential of local maize varieties and insect pest infestation from *Spodoptera frugiperda*. Working closely with the maize commodity program, researchers identified hybrid materials for testing and designed a more cost-effective system for pest control. Experiments were also conducted on herbicide use, planting schedules and plant spacing.

After three seasons of research, including both agronomic and economic validation studies, the team issued recommendations. Four years later, a follow-up evaluation revealed that for the significant majority of farmers in the area who had indeed adopted the recommendations, average yields and economic returns had approximately doubled.

The Zambian case study also offers an example of the OFCOR adaptive research function; on this occasion, however, researchers responded to a socioeconomic problem which was limiting the overall productivity of a farming system in Central Province.

A diagnostic survey identified shortages of labor at the peak period in the cropping cycle as a primary constraint limiting maize production. Lack of manpower meant that planting was harmfully delayed, while weeding was both late and inadequate. The team designed a trial program to enable farmers to make the best use of the scarce labor on hand. The underlying strategy of the program was to try to save labor without a significant loss in yield by combining certain operations.

The results of two trial seasons showed that basal fertilizer application could be delayed without loss in yield and that combined early weeding and top dressing actually resulted in a 20% increase in productivity. The OFCOR team concluded that to apply fertilizer and to weed, farmers need only make a single pass through their fields. This would save them approximately 6 person-days during the period of peak labor demand and, with the increased yield, give a marginal rate of return on investment in labor of approximately 75%.

Farmers participating in the on-farm trials responded positively to the innovation, leading researchers to prepare a formal set of recommendations.

The feedback function. The feedback function involves channeling relevant information from on-farm characterization, diagnosis, or adaptive research into the priority-setting, planning, and annual programming processes of station-based research. Indeed, Baker and Norman (1988) have usefully distinguished two kinds of feedback:

1) feedback to OSR priority setting; and
2) feedback to OSR annual programming.

The first, and more ambitious, feedback has to do with information about farmers' technical and managerial problems — information essential for the establishment of sound priorities within applied station-based research programs. Here feedback can assist programs to respond to the identified needs of their client groups, rather than to their own specific discipline- or commodity-determined interests.

The case studies provide many illustrations of the value of OFCOR feedback to OSR priority-setting. Information from farm-level research on constraints to livestock production in the communal areas organized by the Farming Systems Research Unit (FSRU) in Zimbabwe, for example, resulted in three new research thrusts in station-based livestock programs: the screening of forage legumes, the upgrading of crop residues, and improved goat production.

Similarly in Panama, on-farm research in the Dual-Purpose Cattle Project identified the key problem in dual-purpose production systems as low productivity per hectare resulting from a large percentage of nonproductive animals. Feedback to scientists at the Gualaca research station led to their pursuing a new line of research on improved management practices for calves. Their work focused on control of internal parasites and on improved nutrition through forages grown specifically for calves (Sands 1987).

In Nepal, to cite a third example of the link between feedback and adjusting OSR priorities, on-farm research conducted by the Cropping Systems Program (CSP) to identify maize varieties suitable for rice/wheat/maize cropping patterns revealed that, contrary to expectation, there was no suitable 'technology on the shelf'. The growing seasons of available high-yielding maize varieties were too long to fit the desired new cropping pattern. Accordingly, in response to this

feedback, the maize breeding program spared no effort to develop an early-maturing composite 'Arun' variety. The new variety is suitable to a wide range of growing conditions and is being rapidly adopted by farmers (Biggs and Rood, 1987).

Lastly, returning to ICTA in Guatemala, feedback from OFCOR eventually convinced the sorghum program to broaden its research agenda to work on varieties appropriate for the farming systems of resource-poor farmers in the hills of the southeastern region of the country. Although the crop is grown primarily by small farmers in association with maize and beans, the breeders had focussed on early maturing, high yielding, varieties designed to be grown in monoculture. The new varieties they developed did allow a limited group of medium- and large-scale farmers in the more favorable valley environments to expand sorghum production for sale as animal feed. These new varieties, which had tannin levels too high for human consumption, were completely unsuitable however, for the majority of small farmers who grew sorghum as an 'insurance crop' to substitute for maize — the principal staple food when supplies ran short.

After several years of acrimonious debate, OFCOR scientists, armed with data from surveys, aerial photography, and on-farm agronomic research, finally convinced the sorghum program to broaden their research agenda in order to address more effectively the needs of resource-poor farmers. The program introduced a new line of research aimed at genetic improvement of local varieties, which are suitable for human consumption, and development of improved management practices for sorghum intercropping.

Feedback to OSR programming - the annual planning and design of experiments, is more modest in its objective and easier to implement. It involves encouraging station-based researchers to take into account systematically in their experiments the characteristics of farmers' environment. OFCOR provides information about the farming conditions and management practices of defined groups of farmers so that on-station experiments can be designed to conform more closely to the actual conditions under which farmers operate, significantly increasing the relevance of applied research and accelerating the process of developing appropriate technologies.

This kind of feedback allows station-based scientists first of all to compare the degree to which conditions on their station (e.g. rainfall, soil type, fertility levels, cultivation practices) resemble those encountered by farmers. In this way they can interpret their experimental results more realistically. Such feedback can also stimulate station-based scientists to adjust the level of both experimental and non-experimental variables to more closely approximate conditions which farmers themselves can hope to replicate. Such adjustment may apply to the use of external inputs - e.g. fertilizers and insecticides, or to simulation of prevailing production techniques, e.g. seedbed preparation or water control. This feedback also encourages researchers to evaluate technology by those criteria farmers themselves use. This may mean, in addition to yield per unit area, taking into consideration returns to scarce inputs such as cash or labor; or it may mean evaluating technologies on the basis of consumption, rather than production, criteria.

Again the case-studies amply illustrate this more modest type of feedback. In the Upland Agriculture and Conservation Project in Indonesia, for example, on-farm screening of an improved rice variety, Ranau, revealed that, contrary to the results from on-station testing, Ranau was susceptible to blast. Feedback spurred OSR scientists to reevaluate the resistance status of the improved variety while continuing their efforts to identify other cultivars with stronger resistance. In Zambia, to cite a further example of OFCOR's second feedback function, information on small farmers' management conditions led the Sunflower Commodity Program to reduce fertilizer levels by fully one-half in some of their experiment station trials for screening varieties.

OSR Linkage Functions

Station-based research performs two principal research functions which complement those of OFCOR in the research process:

1) an applied research function;
2) a support function.

Applied research function. Applied research is essentially technology generation, the direct complement of OFCOR's adaptive research function. OFCOR depends on strong, applied on-station research programs for technological alternatives to screen, select, and adapt to the specific needs and conditions of designated client groups (Fresco, 1984; Harwood, 1985; Norman, 1982; Norman and Collinson 1985).

Support function. The support function involves the provision of advice and knowledge to OFCOR by commodity and disciplinary specialists at all stages of the research process (CIMMYT, 1986; Collinson, 1988).

Specialists can assist with the diagnosis of constraints such as soil nutrients, water availability, diseases and pests; the identification or generation of potential technological solutions such as early maturing varieties, water conservation methods, or feeding regimes for livestock; the design of experiments and the analysis of results; and the interpretation of the performance of experimental technologies under farmers' conditions. OSR's support function implies its ability to keep abreast of world-wide research developments. Such specialized disciplinary knowledge complements the farm-level information which OFCOR is in a position to provide to OSR, i.e. the OFCOR feedback function.

A number of good examples of the OSR support function emerged from the review of the nine case studies. In Zimbabwe specialized researchers have supported the work of the FSRU by providing reviews of previous research on problem areas identified as high priority through on-farm research, such as water harvesting techniques or crop fertilization with cattle manure. They have also assisted in identifying productive opportunities for research by participating in informal diagnostic surveys and have collaborated in designing and monitoring on-farm trials. In the Small Ruminant Collaborative Research Support Program in Indonesia, station-based research has supported OFCOR by assessing the nutritional potential of industrial by-products and alternative local grasses.

In summary, the relative performance of these five research linkage functions and the weight assigned to them in the research process determine the strength of OFCOR-OSR integration. The relative emphasis research managers wish to give to the respective linkage functions, moreover, will determine the specific types of organizational arrangements and management mechanisms that are most suitable for achieving effective integration.

CHAPTER 2
REVIEW OF THE EXPERIENCES OF THE CASE STUDIES

Short profiles of the specific OFCOR situations whose analysis served as the basis for the development of management guidelines on OFCOR-OSR integration are presented in Section I. These profiles give an overview of the organization of OFCOR and OSR in each case, and describe OFCOR-OSR integration in terms of the balance and relative strength of the five linkage functions outlined in the preceding chapter.

Table 2 summarizes the assessment made of the performance of the five linkage functions and their relative importance in the OFCOR situations studied. In four case studies, Senegal, Zimbabwe, Indonesia and Nepal, where distinct institutional arrangements have created different types of OFCOR-OSR integration, these have been analyzed separately. In total 13 specific linkage situations were reviewed for this comparative analysis.

The assessment of the performance of the functions, while clearly somewhat subjective, is based on the systematic, in-depth, functional analyses developed in all of the case study reports. Each case study analysis used a common methodology based on a specific set of indicators to assess the level of performance of the functions.[6] While the assessment presented in Table 2 relies heavily on conclusions of individual case study reports, it also reflects a systematic comparative analysis across case study situations, as well as a careful evaluation of evidence presented to support the assessment of functional performance in the case studies.

Organization of OFCOR-OSR links and the quality of overall integration vary considerably across the cases reviewed. The wide range of situations covered by the cases provides a rich body of experiences from which to draw management lessons and guidelines. Key observations based on comparative analysis of the experiences of these NARS in building integration are presented in Section II.

I. Profiles of the Integration of OFCOR and Experiment Station Research in the Case Studies

Latin American Cases

Ecuador. The Production Research Program (PIP), responsible for OFCOR within the Instituto Nacional de Investigaciones Agropecuarias (INIAP), is decentralized, consisting of 10 small teams comprised of an agronomist and technician. The teams are based in provinces and the researchers reside in the field, but they are under the administrative auspices of regional experiment stations. Most of the interaction between researchers in the PIP and researchers in the disciplinary and commodity programs occurs informally at the stations and is usually initiated by PIP scientists. Formal mechanisms for integration are not well developed and those that do exist are not fully exploited. Integration has been weakest for the PIP teams which are part of Integrated Rural Development Projects. The most important linkage mechanism is the Technical Committee at each station. These committees, comprised of senior OSR scientists, are responsible for reviewing the research plans and results of all station programs, including the PIP.

In the PIP the service and adaptive research functions predominate; there is a wide range of technology available from the stations for on-farm testing and adaptation. The feedback function, never strong, has been especially weak in recent years, as scientific leadership has declined and the OFCOR agenda has narrowed to fairly routine on-farm agronomic testing. The junior status of OFCOR researchers, their posting in the field rather than at a station, the lack of sustained and systematic training in OFCOR methods, and the entrenched power of the commodity programs all contribute to the weak performance of the feedback function. In the early years of the program, foreign

More general descriptions of the NARS studied are provided in "Overview of the Nine Case Studies," p. vi; for a list of case study reports, see p. xi.

[6] "Methodology Module 1: Indicators for Functional Analysis of the Organization and Management of On-Farm Client-Oriented Research," ISNAR (1986).

expert advisors were able to give the program a strong methodological base and to defend the OFCOR approach within the system. More recently, however, the PIP's two national coordinators have had difficulties sustaining the dynamism and capacity of the OFCOR program owing to frequent staff turnover and the excessive burden of their own administrative responsibilities.

Guatemala. The Technology Testing Department and the Socioeconomics Department, which together perform the OFCOR functions in the Instituto de Ciencias y Tecnología Agrícolas (ICTA), are disciplinary support programs for national commodity research programs.

The Technology Testing Department, decentralized and integrated into ICTA's regional structure, has 14 teams comprised of agronomists and technicians. These teams are assigned to regional experiment stations along with commodity scientists, but are deployed at the sub-regional level. Interaction between researchers in the Technology Testing Department and commodity programs occurs primarily at the stations where the annual regional programming and review process has proven to be an important mechanism for developing integration.

On the whole, the level of integration of the research of the Technology Testing Department and commodity scientists is moderate. Service and applied research functions have been strong because the Technology Testing Department was explicitly designed to run all technology developed by the commodity programs through on-farm trials for verification. Support and feedback functions, however, have been quite limited. Factors shaping the nature of the link include the low institutional status of the Technology Testing Department relative to the commodity programs, the relative youth and inexperience of its staff, and the lack of scientific leadership within the department. The Technology Testing Department did not have a department head until 1986.

Organizational barriers have impeded the integration of the Socioeconomics Department with other research programs, including the Technology Testing Department. As a separate department with a centralized national program, the Socioeconomics Department contrasts with the decentralized, regional organization of other departments and programs in ICTA. Never strong at best, integration has weakened over time. The research of this initially innovative and dynamic department has stagnated owing largely to attrition in the ranks of its scientific leadership, staffing by predominantly junior researchers and technicians with little formal training in social science research methods, and changes in research policy within ICTA. Since ICTA has renewed its commitment to produce technology for resource-poor farmers in the Highlands, however, the revitalization of the Socioeconomics Department is currently being attempted.

Panama. In the late 1970s the Instituto de Investigación Agropecuaria de Panamá (IDIAP) developed a research plan on the basis of field-level problem diagnosis which defined target areas for on-farm research and identified priority research themes for each area. Subsequently, OFCOR has been initiated in several target areas either through semi-independent projects with full-time staff, or by scientists from IDIAP's commodity programs as part of their regular research program. OFCOR is viewed as a specific research approach and there is no formal, coordinated, OFCOR program within IDIAP. The nature of OFCOR-OSR integration varies considerably among these independent efforts.

No formal mechanisms for integration of OFCOR and OSR exist and overall integration has been limited. Commodity programs do their own on-farm testing and OFCOR projects, emphasizing adaptive research, have worked quite independently. Feedback and support functions have been weak since there are no institutional planning, programming or review processes through which information can be channeled. Integration has been stronger where OFCOR researchers have been based on stations as with the Dual-Purpose Cattle Project. The Caisan Project, on the other hand, isolated from station-based research, even had its own experimental field for more controlled trial work.

African Cases

Senegal. OFCOR, which falls within the mandate of the Department of Production Systems and Technology Transfer (DRSP), is carried out by three semi-autonomous, multidisciplinary teams based at regional stations and backstopped by a Central Systems Analysis Group at the headquarters of the Institut Sénégalais de Recherches Agricoles (ISRA). Two types of links with station-based research were studied: links with OSR within the DRSP, which includes a Bureau of Macro-economic Analysis (BAME) and a thematic research division; and links with OSR in other departments and regional research centers.

Integration between OFCOR and OSR within the

DRSP has been rather strong, facilitated by a common supervisor, joint planning and programming procedures, deployment of personnel at the same regional stations, and a shared systems research orientation.

On the other hand, OFCOR integration with station-based research in other departments and regional research centers has been limited. Where integration has occurred, as in the case of rice research, it has been the result of individual initiatives by scientists based together at a regional station. No formal linkage mechanisms exist. The Head of the DRSP has had little time for developing links across departments owing to heavy administrative responsibilities. The DRSP teams do not provide a service function, for commodity programs carry out their own on-farm testing. The performance of feedback and support functions has been limited and erratic. Acceptance of a broader OFCOR agenda by other scientists has been complicated by Senegal's long history of agronomic and socioeconomic on-farm research, as well as by conflicts arising from the institutional reorganization in 1982. The lower professional level of regionally deployed commodity researchers relative to DRSP researchers has also discouraged collaborative activities.

Zambia. The Adaptive Research Planning Team (ARPT), responsible for OFCOR in the Research Branch of the Ministry of Agriculture and Water Development, is a coordinated national program equal in status to commodity and specialist programs (CSRTs). ARPT's National Coordinator has his headquarters at the main research station, as do the directors of many of the CSRTs. All 7 ARPT provincial teams are based at small regional stations.

Integration, now moderate, has improved significantly after an initial period of marked conflict. ARPT, while emphasizing the adaptive research function, also provides a service function for CSRTs when it is within the scope of their research agenda. The feedback function has grown stronger as ARPT has developed its research capacity, gained credibility with CSRTs, and established specific linkage mechanisms, such as joint programming and review meetings.

The CSRTs have made moderate contributions to ARPT in terms of technologies and specialist advice. These programs, like the ARPT, are quite young. The performance of their applied research and support functions has improved as they have matured. CSRT scientists' interest in collaboration has increased, moreover, as they have begun to generate technologies ready for on-farm testing. Organizational divisions and geographical distance between scientists on ARPT teams and those working for CSRTs remain obstacles to integration. In recent years, nevertheless, the active efforts of management have strengthened integration considerably.

Zimbabwe. OFCOR is conducted through several independent efforts within the Department of Research and Specialist Services. A specialized Farming Systems Research Unit (FSRU), which has its headquarters at the central research station, and consists of a multidisciplinary core team and two regionally deployed field teams, conducts a full OFCOR program. In other institutes and stations, scientists carry out station-based research and narrower applications of OFCOR as part of their regular research programs. OFCOR-OSR integration, therefore, is a matter not only of links between the FSRU and the on-station research of various institutes, but also of OFCOR and OSR links within the institutes themselves.

The integration of research in the FSRU with OSR has been moderate to strong. The FSRU is considered to have the primary responsibility for characterization of farming systems in the communal areas[1] and for adaptive research. FSRU's performance of these functions has been strong. Station-based scientists have also been forthcoming in providing specialist advice and technologies, although technology for livestock in marginal areas is limited.

The FSRU has given high priority to collaboration with OSR. Links have developed primarily through informal consultation. The formation in 1986 of the institute-wide Committee for On-farm Research and Extension, however, has forged more formal links between FSRU and OSR in the other institutes. Several factors have contributed to effective integration: the distinctly technical orientation of the FSRU team, the location of the core team at central headquarters, and the solid commitment of senior research managers to fostering integration.

Within the institutes, integration between OFCOR and OSR has been at the best moderate, even though scientists carry out both on-farm and on-station research. In general the range of linkage functions

[1] The Communal Areas are a legacy of colonial land policy which authorized the private ownership of commercial farm land 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 comprise 42% of the land area of Zimbabwe.

performed has been narrow, with emphasis placed on the applied research function and, to a lesser extent, on-farm testing. While the support function has been strong within disciplinary institutes and stations, it has proven weaker across disciplines and commodities. The feedback function has been limited, with little farm-level characterization or diagnosis being carried out.

Asian Cases

Bangladesh/BARI. The On-Farm Research Division (OFRD), with the mandate for all on-farm research within the Bangladesh Agricultural Research Institute (BARI), consists of five regional management units and 24 implementation teams dispersed throughout BARI's extensive network of stations and sub-stations. The fact that OSR scientists from other departments and programs are also deployed at the BARI stations has facilitated some informal consultation. Yet the annual OFRD programming and review meeting at headquarters remains the principle linkage mechanism between OFRD and the rest of BARI.

Integration of the OFRD and on-station research in other departments and research centers has been quite limited. A top-down technology transfer model prevails, with OSR passing technologies on to OFRD for testing. Few formal mechanisms for other types of interaction exist. The adaptive research and feedback functions have been slight; neither is given particularly high priority by OSR scientists. OSR has also performed a limited support role. Principal constraints to integration include: the newness of OFRD, organizational separation, the lower academic status and experience level of OFRD researchers, the decentralization of OFRD activities at distant field sites, and the lack of formal integrating mechanisms.

Indonesia. In the Agency for Agricultural Research and Development (AARD), OFCOR is conducted both within individual commodity institutes and within multi-institute projects. In the two regional commodity institutes studied, the Malang Institute for Food Crops (MARIF) and the Research Institute for Animal Production (RIAP), OFCOR programs are carried out on a part time basis by scientists as sub-programs of larger station-based research programs. The principal tasks of OFCOR are to test and adapt technologies developed on experimental stations.

In the multi-institute projects, the Upland Agriculture and Conservation Project (UACP) and the Crop-Livestock Systems Research Project (CLSR), OFCOR is conducted by multidisciplinary teams of full-time researchers seconded from several institutes. Linkages between project staff and scientists of the home institutes is quite strong. A technical team of senior scientists from these institutes works part time for the projects, advising and supporting OFCOR researchers, and feeding information from the project back to relevant on-station research programs. OFCOR researchers, encouraged to maintain connections with their home institutes, participate in annual programming and review meetings.

In both organizational set-ups, strong integration has been facilitated by the high caliber of researchers assigned to OFCOR activities, the strong development orientation of AARD, and the long tradition of OFCOR in Indonesia.

Nepal. In Nepal OFCOR is carried out either by commodity improvement programs as an outreach of their regular research program, or by the Farming Systems Research and Development Division (FSR&DD). Where OFCOR is part of a commodity program, its service function is prominent. FSR&DD research, supported by a separate Socioeconomic Research and Extension Division (SRED), is designed to complement commodity program research through application of a systems perspective and adaptation of technologies to site-specific conditions. The FSR&DD, established in 1985, is a descendant of the former Cropping Systems Program based in the Agronomy Division. While this independence has elevated the status of the newly created division, it has at the same time rendered integration with OSR in other divisions and research stations more difficult to manage. OFCOR-OSR integration has been weak to moderate. Their principal linkage mechanism has proven to be the 'combined trek': field trips during which FSR&DD and OSR scientists travel together to FSR sites for joint priority-setting, planning and programming exercises. An FSR Technical Panel, including scientists from other divisions, has also been established to review FSR&DD activities.

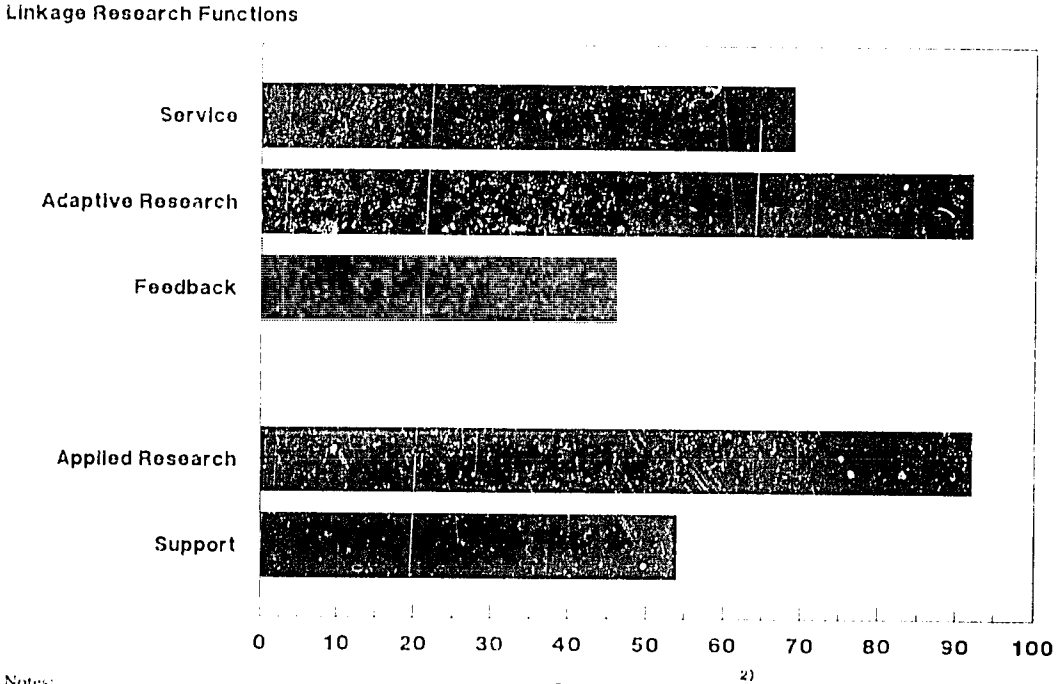
OFCOR also plays a major role in the programs of two externally funded, regional research institutes in the Hills, the Lumle Agricultural Center (LAC) and the Pakhribas Agricultural Center (PAC). In PAC, OFCOR and OSR are conducted within the Agronomy Division by separate groups under a common supervisor. In LAC, OFCOR is coordinated by the Socioeconomics Department but carried out by scientists who also do on-station research. The performance of the linkage functions in both centers is strong. The applied research function, however, is

somewhat less well developed, since for technology generation the centers rely on national commodity programs. Integration is abetted by the small size of the centers and their narrowly defined regional mandate, by regular joint treks to FSR sites, by joint planning, programming, and review exercises, by adequate funding, and by a shared client-oriented philosophy. PAC and LAC also have strong links with the national commodity programs. These links are maintained primarily through national, semi-annual crop review meetings and through informal consultations among scientists who are friends.

II. Observations on the Degree of OFCOR-OSR Integration in the Case Study NARS

Comparative review of the research institutions in the case studies shows that, in general, good progress has been made towards building effective integration of OFCOR and experiment station research. This progress is evident from Chart 1 which summarizes in graphic form assessments of the performance of the five linkage functions in the 13 OFCOR-OSR linkage situations studied. In the majority of cases, the performance of most linkage functions was judged moderate or strong. Research managers in the case study NARS, moreover, while actively pursuing strong links, have developed innovative, useful management approaches and tools (see Chapter 4).

Chart 1: Relative Strength of OFCOR-OSR Linkage Research Functions
(Percent of cases where performance of function was moderate to strong[1])



Notes:

1) Assessment is based on conclusions of case study reports and on systematic comparative analysis across cases.

2) N = 13. In four of the cases — Indonesia, Nepal, Senegal, Zimbabwe — different organizational arrangements for OFCOR-OSR links within the national agricultural system were sufficiently varied to warrant separate analysis.

Nevertheless, the case studies also suggest that a great deal remains to be accomplished before the full potential of OFCOR and OSR collaboration can be realized in terms of the research system's increased responsiveness to the demands of its clients. Even for the relatively mature OFCOR programs reviewed, the level of integration achieved, in most cases, was considered to be only moderate when assessed by the aggregate performance of the five linkage functions (Table 2). In only a few instances was strong integration with effective performance on all functions considered to have been fully institutionalized.

Comparative review also discloses that the relative ease and degree to which the five linkage functions have been implemented vary significantly across the case study situations (Chart 1, Table 2). Three general observations can be made concerning the relative performance of the linkage functions.

1) The adaptive and applied research functions have been the most successfully implemented;
2) The service function, despite its being the traditional role of on-farm research, has varied markedly across the cases in relative importance and degree of implementation;
3) The feedback and support functions have been the least fully implemented.

These observations indicate which aspects of integration appear to be the most difficult to achieve and therefore require the most attention from research managers. The case study analyses shed light on factors influencing the relative performance of the functions. They also reveal predictable problems which arise in the course of carrying out the functions. Lastly, they provide practical guidelines for strengthening the performance of the respective linkage functions as reviewed in the following chapters.

The Adaptive and Applied Research Functions

In the case studies these functions were judged to be the most successfully implemented. The adaptive research function was considered strong in 50% of the OFCOR situations, moderate in 40% (Table 2). The agronomic component of adaptive research has been the most vital; the social scientific component has been neither as widely implemented, nor as successfully integrated (Ewell, 1988).

The applied research function, in terms of the degree to which station-based research is providing suitable technologies for on-farm adaptation, was considered strong in 40% of the situations and moderate in 50% (Table 2). This pattern reflects the lack in some cases of technologies appropriate for the comparatively marginal environments typical of OFCOR's resource-poor clients and for the non-crop components of farming systems, such as livestock or agroforestry.

Indeed, the relatively strong performance of the adaptive and applied research functions, both of which relate to the flow of technologies through the research system, is to be expected. The division of responsibilities between OFCOR and OSR can be made quite clear. Institutional changes to implement these functions are likely to be more modest than those required on behalf of the feedback and support functions. Mechanisms to encourage timely information exchange between OFCOR and OSR are needed, but major alterations either in the planning and programming of research or in scientists' priorities and responsibilities usually are not.

The case studies indicate that when OFCOR demonstrates a strong adaptive research capacity, it acquires credibility within the research system, thus opening the door to developing the feedback and support functions. The management implication of this finding is that OFCOR should concentrate on developing and demonstrating its adaptive research capacity in the early stages of institutionalization, thereby laying the foundation for fuller collaboration and stronger integration with OSR as the OFCOR effects develop. This may mean initiating OFCOR in higher potential areas and choosing to tackle comparatively easy problems to begin with.

Here the main source of potential institutional conflict appears to be the frequent wish of researchers in OFCOR to control their own research agendas based on priorities determined through farm-level diagnosis, e.g. their wanting to 'pull down' technologies, rather than simply to serve as on-farm testers of technologies which OSR scientists want to 'push out'. Conflicts can also arise when applied research programs are weak in particular areas identified as high priority by OFCOR, e.g. farm machinery, food processing technology, or varieties suitable for intercropping. In certain case studies when OFCOR researchers addressed these problems on their own, moving 'upstream' into applied research, OSR scientists accused them of duplicating research, or overstepping the agreed-upon division of responsibilities. These are, however, the kinds of predictable problems which alert research managers should be able to anticipate and to handle carefully in the interest of harmonious integration.

The Service Function

In 70% of the OFCOR situations studied the performance of the service function was considered moderate to strong (Chart 1). This function was generally viewed as the responsibility of OFCOR. Its relative importance and degree of implementation, however, varied considerably across the cases reviewed (Table 2). In ICTA and BARI, for example, where specific departments have an exclusive mandate for on-farm research, the service function is dominant. Yet elsewhere, as in Senegal and Panama, where station-based research programs carry out their own multi-locational testing, OFCOR's service function was of slight importance.

As noted previously, the service function is the traditional role of on-farm research. It is, therefore, usually the easiest to establish, demanding minimal changes in organization and resource allocation. It can be arranged as an extension of existing research programs and conducted by technicians or junior-level agronomists.

Nevertheless, the experiences recounted in our cases suggest that even such an essentially conservative division of responsibilities between OFCOR and OSR can result in conflict. In several instances, OFCOR researchers found that as long as their evaluation of technologies was favorable, OSR commodity and disciplinary programs were supportive of their research. In the event that testing results were negative, however, OSR scientists challenged the scientific validity of OFCOR methods, the representativeness of farmers participating in trials, and the reliability of their results.

Conflicts can also originate because of the different relative importance assigned to the service function by OFCOR and station-based researchers. In general service is the OFCOR linkage function which station-based scientists most desire. Tension can mount when OSR scientists expect OFCOR staff to respond unreservedly to their testing needs, while OFCOR researchers, predisposed to the adaptive research function, prefer to test technologies *selectively* on a basis of priorities established through farm-level research.

The experiences of the case studies indicate that managers must carefully monitor the relative weight assigned to OFCOR's service function. The danger inherent in overemphasizing this function, especially in the early stages of building up OFCOR, is that OFCOR comes to be viewed as a mere extension, or handmaiden, of station-based research programs. If this occurs OFCOR may lose the power to determine its own research agenda, to define its mandate more broadly, or even to have any impact on station-based research through the feedback of information from farm-level diagnosis and research. In short, where the service function, testing and demonstration, outstrips the rest, the total research contribution of OFCOR tends to diminish.

A related concern for research managers is that without strong scientific leadership and management, OFCOR tends to lose vitality and breadth, to decline into routine technology testing. Indeed, case histories portray how just such a deterioration of OFCOR efforts has taken place in both ICTA and INIAP — two of the longest standing programs included in this study. In both the service function now predominates. Their OFCOR programs have become subordinate to commodity programs, jeopardizing the performance of the feedback function. Field-level diagnosis and adaptive research, as well as socioeconomic analysis, strong elements of the programs in their early years, have waned considerably. The overall effect has been the decline of integration.

Research managers designing a strategy for strengthening integration would do well to consider this evidence carefully. The central lesson to be drawn is clear: although the service function may be useful as an initial basis for building collaboration, in most cases, OFCOR should not be given the exclusive mandate for performing this function. Exaggeration or exclusive emphasis on the service function soon overburdens the OFCOR effort; diverts resources and attention from other, more robust, OFCOR functions; and places OFCOR in a supplementary, rather than complementary, relation to station-based research. Moreover, it removes a primary incentive for commodity and disciplinary specialists to leave their stations and laboratories to interact with farmers. This has a high cost: experiment station scientists' exposure to clients and their farming conditions was found in the cases studied to be important for facilitating integration with respect to the performance of the other linkage functions.

The Feedback and Support Functions

Of the five research functions, feedback and support were considered the least fully implemented in the case situations reviewed (Chart 1), both moderate in 30% of the situations studied, strong in only 15% and 23% of the situations respectively (Table 2). These findings, especially in relation to relatively mature OFCOR efforts, are disturbing, for these two functions are

Table 2:

Annotated Overview of OFCOR-OSR Integration in the Case Studies[1]

Case Study	Assessment of Performance of Five Research Linkage Functions[2]				
	SERVICE FUNCTION	ADAPTIVE FUNCTION	FEEDBACK FUNCTION	APPLIED FUNCTION	SUPPORT FUNCTION
ECUADOR	Moderate. Tendency is for OSR to expect PIP to supervise regional trials.	Moderate. PIP has emphasized role but research has stagnated in recent years. PIP teams staffed by agronomists, no socioeconomists.	Limited. Isolated examples based on ad hoc linkages. No strong mechanisms to stimulate feedback. PIP does not give this high priority.	Strong. Technology available, but not all is appropriate for small-scale farmers.	Limited. Informal. Technical committees review PIP research programs and results, but give little guidance.
GUATEMALA	Strong. Principal function of TTD. Theoretically all technology passes through on-farm validation stage.	Moderate. Validation emphasized more than adaptation. Technologies more "pushed out" than "pulled down."	Limited. Feedback to OSR often not incorporated into research plans. Characterization and diagnosis now superficial.	Strong. Commodity programs effectively funnel technology to the TTD for testing.	Limited. Little consistent input from senior scientists. Joint diagnosis and monitoring tours are now infrequent
PANAMA	Non-existent. Commodity programs run own trials.	Strong. Emphasis of OFCOR activities. Farm-level diagnosis appears strong.	Limited. Variable among individual projects. No institutional mechanisms for feedback.	Moderate.	Limited. No formal mechanisms for interaction or collaborative support.
SENEGAL a. Between OFCOR and the rest of DRSP.	Limited.	Strong. Programs articulated through joint annual planning.	Moderate. Variable among teams. Better where deployed at the same station.	Moderate.	Moderate. Variable among teams. Better where deployed at the same station.
b. Between OFCOR and other departments of ISRA.	Non-existent. Commodity teams run own multi-locational testing.	Moderate. Variable among teams. Good integration with commodity team at Djibelor station.	Limited. Variable among teams depending on individual initiatives. Better where deployed at same station.	Limited. Research programs of departments operate very independently. Has improved as OSR scientists gain more interest.	Limited. No formal mechanisms. Deployed at a distance from one another. OFCOR researchers generally have more training and experience than regionally deployed OSR.
ZAMBIA	Moderate. ARPT does testing when it conforms to its research agenda.	Strong. Identifies problems at farm-level & designs solutions. ARPT "pulls down" technologies from CSRTs.	Moderate. Has improved in recent years as ARPT has gained credibility and formal mechanisms have been established.	Moderate. Many CSRTs have not had appropriate technologies to give ARPT. Young programs with limited resources.	Moderate. Mostly on informal basis. Hindered by physical distance. Few formal mechanisms.

ZIMBABWE	a.Within institutes.	Moderate. Testing done under optimal management conditions.	Moderate. Emphasis more on applied research. No socioeconomic analysis	Limited Limited systematic characterizations or farm-level diagnosis	Strong. OFCOR supported by developed knowledge base for high potential areas; technologies available for testing.	Moderate. Strong within each department, but weaker across departments.
	b.Between FSRU and institutes.	Limited. FSRU carries out some testing but it is not perceived as primary function.	Strong FSRU viewed as having primary responsibility for adaptive research within DR&SS.	Moderate. FSRU has lead responsibility for characterization of farming systems in communal areas.	Moderate-Strong. Limited technology available for livestock in marginal areas	Strong. FSRU consults frequently with specialists.
BANGLADESH		Strong. Principal role assigned to OFRD. Strong antecedents for OFR as testing service for advanced technologies.	Limited. A stated objective, but not fully implemented. Strengthened as FSR concepts gradually permeate OFRD	Limited Not widely perceived by OSR or OFRD scientists to be a priority function of OFRD. No mechanisms for feedback.	Strong. Technologies available for adaptive research	Limited. Few opportunities for input. Many OFRD field researchers isolated at sub-regional or multi-locational testing sites.
INDONESIA	a.Within institutes.	Strong. Principal role of OFR program is testing and adaptation of institutes' technologies	Strong	Moderate. OFCOR most often conducted through composite model.	Strong. Technologies available for adaptive research.	Strong. OFCOR most often conducted through composite model.
	b.Between multi-institute projects and home institutes.	Moderate. Projects test technologies when it conforms to their research agenda.	Strong Adaptation of technologies to marginal or transmigration areas is principal role of projects.	Moderate. Evidence of changes in OSR agenda. Technical Teams are the main conduit of feedback	Moderate. Participating institutes provide technology.	Moderate. Technical committees give support. OFR scientists supported to an extent by home institutes.
NEPAL	a.Within LAC and PAC.	Strong. Originally established as testing and extension centers for hill farmers.	Strong. Principal mandate of regional centers. Have produced technologies appropriate to hill region.	Strong. Numerous mechanisms facilitating integration. Some scientists do both OFR and OSR. Feedback to national commodity programs moderate.	Moderate. Reliance on national programs for technology generation..	Strong. Numerous mechanisms established. Close integration within and across departments.
	b.Between FSR&DD and other divisions of the NARS.	Strong. Major role of testing advanced technologies from OSR.	Moderate Technologies not available for some components, e.g. livestock and agroforestry.	Limited. Linkages with other departments weak; few formal mechanisms. Improving with combined trek..	Moderate. Emphasis has been on the Tarai; less technologies available for the hills.	Limited. Difficult to get collaboration from scientists in other departments.

Notes:

[1] Assessment is based on detailed functional analysis and evidence provided in case studies, as well as on a comparative analysis across cases.

[2] Scale = non-existant, limited, moderate, strong.

essential to realizing the full potential that strong integration of OFCOR and OSR has to offer for improving the capacity of research to respond to the needs of designated client groups.

At the same time, the fact that the feedback and support functions have been the most difficult to implement is not surprising. Three principal sources of friction impeding their acceptance and development were evident from the case study situations. First, because these functions involve influencing the research agenda of other scientists and scientific programs, they can provoke conflicts of interest, power, and scientific judgment. In some cases, for example, although OFCOR researchers were strong proponents of the importance of the feedback function, i.e. of their own role in influencing the research agenda of experiment station research, they had significant difficulties in accepting OSR's support function when the specialist advice of OSR researchers challenged their own perceptions of priority problems or possible solutions. The same reluctance was observed among disciplinary and commodity researchers with respect to the feedback function when farm-level information challenged their own priorities for research.[8]

Second, since both feedback and support functions depend on interaction among researchers and joint planning, they involve shifts in researchers' work programs, areas of responsibility, and decision-making autonomy. The resentment which may result is discussed in detail in the following chapter.

And, third, the kind of benefits accruing from the collaboration entailed in the feedback and support functions, which are somewhat intangible and realized in the long term, are often perceived as greater for the institution than for the individual researcher. In contrast the additional demands made on researchers' time and scarce resources, often perceived as personal costs, are concrete and immediate in nature. Research managers need to recognize that the additional costs for individuals which integration of efforts may entail will often not be cheerfully or voluntarily accepted.

An important lesson to be drawn from the cases studied is that feedback and support functions usually prove more effective when implemented in a consultative, rather than a supervisory manner. Neither OSR nor OFCOR should serve as a 'watchdog' for the other. When the feedback function is consultative, for example, information from farm-level research constitutes an important and credible input for the priority-setting in a commodity program, but the program itself, together with senior research management, retains ultimate responsibility for setting its own priorities. Similarly, with the support function, researchers conducting OFCOR need to be able to draw on specialist advice systematically, but in the end they themselves must define their research problems, set priorities, and develop an appropriate trial and survey program. Allowing the last word to those responsible for taking a decision is the essence of strong and productive collaboration. Once a supervisory posture is assumed, however, power struggles which can only obstruct successful integration are all too likely to be provoked.

Although informal interaction among colleagues may permit partial implementation of the feedback and support functions, it is clear from the case histories reviewed that for these functions to be fully implemented and sustained over time they require staunch and creative backing from senior research managers. Such backing, discussed in the following chapter, involves:

- fostering mutual respect among scientists working in OFCOR and experiment station research;
- generating incentives and resources for collaboration; providing opportunities for interaction and communication;
  integrating the planning and programming of OFCOR and OSR;
- cultivating an institutional culture which promotes and rewards a strong client orientation in research.

[8] For two instructive examples of this type of conflict and its resolution, see the Zambia and Guatemala case studies: in the former, the technology vignette on a maize variety and management trial in Luapula Province (Kean and Singogo, 1988); and in the latter, the account of developing a sorghum variety for Region VI (Ruano and Fumagalli, 1988).

CHAPTER 3

DESIGNING A MANAGEMENT STRATEGY: GUIDELINES FOR STRENGTHENING INTEGRATION OF OFCOR AND EXPERIMENT STATION RESEARCH

I. Introduction

Analysis of the experiences of the case study research institutions reveals clearly that successful integration of OFCOR and experiment station research requires intensive and sustained management. Collaboration needs more than wishful thinking; it must be nurtured and supported. Integration of OFCOR and experiment station research, moreover, is not static, carved in stone. It is malleable and can be successfully developed through good management.

Achieving the full potential of integration is one of the most significant challenges facing research managers who wish to incorporate OFCOR effectively into their institutions in order to improve the efficiency and effectiveness of the research process. To attain integration, research managers need a management strategy which defines a clear institutional policy and specifies appropriate organizational and managerial mechanisms for effective collaboration. The systematic comparative analysis of the OFCOR situations presented in this paper offers a rich body of experience upon which research managers can draw when designing a management strategy for integration that is suitable to the needs and conditions of their own institutions.

It must be emphasized that forces and factors affecting integration of OFCOR and experiment station research, so numerous and complex, are apt to differ in their relative importance under different institutional settings. Given the diversity of institutional environments and the varying dispositions and capacities of research managers, it is impossible to develop a fixed recipe — a single blueprint of prescriptive procedures and inputs for achieving effective integration. At best we can propose a set of management guidelines derived from a synthesis of the experiences documented in the case studies.

Three processes were involved in preparing the following guidelines for research managers:

1) analysis of institutional conditions affecting integration;
2) identification of policy, organizational, and managerial factors determining these conditions;
3) review of management mechanisms which research managers have effectively employed to foster integration.

The results of the first two processes are reported in this chapter. Successful management mechanisms for achieving integration are described in Chapter 4.

The comparative analysis of case study situations was aimed at determining the kinds of institutional environments in which integration has been most successful: in other words, on what kinds of conditions does the effectiveness of integration depend? The analysis revealed two basic types of conditions which shape the institutional environments in which research managers operate: those which are largely inflexible, and those that fall, at least to some degree, under their control. Accordingly, two kinds of conditions need to be addressed when developing a management strategy:

1) *conditions which define* the decision-making environment of the senior research manager;

2) *conditions which can be created* by the senior research manager in order to strengthen integration of OFCOR and experiment station research.

The common property of the first type of conditions which determine the institutional environment of the research manager is that he or she has no, or only limited, ability to change them. They must be recognized as the basic constraints and opportunities under which realistic objectives must be set and a practical strategy for strengthening integration devised. These parameters will affect both the nature of the integration and the degree of institutionalization of various linkage research functions that proves ultimately feasible.

In contrast the second set of conditions are those over which the research manager *can* exercise control. Here, as far as the limitations imposed by the environmental conditions described above allow, he/she has room to maneuver in developing a favorable environment for strong integration. The realization of such facilitating

conditions is the goal of a management strategy for building effective collaboration.

This chapter focuses on the second set of facilitating conditions -- those which research managers can develop. Relevant lessons and insights are drawn from case study experience on the factors influencing the feasibility of cultivating these conditions and on various organizational and managerial arrangements which research managers and scientists have used to develop them.

II. Conditions Which Define the Decision-Making Environment of the Research Manager

Table 3 presents environmental conditions identified in the case studies as affecting the nature of the integration of OFCOR and experiment station research. The conditions are briefly reviewed below drawing selectively on experiences from the cases to illustrate their implications for integration. Chart 2, summarizing in graphic form the information presented in Annex Table 1, shows the percent of OFCOR situations where these factors were considered to have had a significant effect on the quality of integration achieved. Annex Table 1 shows specific cases in which the factor, in either its positive or negative aspects, was judged to be important. This assessment is based primarily on the conclusions of the individual case study analyses.

It is important to clarify that certain of these environmental conditions do actually have a measure of inherent flexibility. Senior managers could potentially alter some of these conditions over the long term or through major structural change (Table 3). The degree of flexibility of these conditions, moreover, will vary considerably across research systems. What may be a rigid parameter in one system in another may be a tool for manipulation by senior research managers. As a first step in designing a management strategy, research managers need to analyze their own systems to determine the comparative rigidity of these environmental conditions and what it would take to change them. This systematic appraisal of environmental conditions will allow managers to identify the principal constraints to, as well as opportunities for, strengthening OFCOR-OSR integration in their research systems.

Table 3:
Environmental Conditions Affecting OFCOR-OSR Integration

- Development policy
- Research policy commitment to OFCOR*
- Organizational flexibility of the NARS
- Existing organization of research*
- Degree of centralization of research infrastructure*
- Institutional stability of the NARS
- Human resource base of the NARI*
- Financial resource base of the NARI*
- Research management processes within the NARS*
- Maturity and capacity of station-based research
- On-farm research antecedents
- Extension capacity
- Agroecological complexity

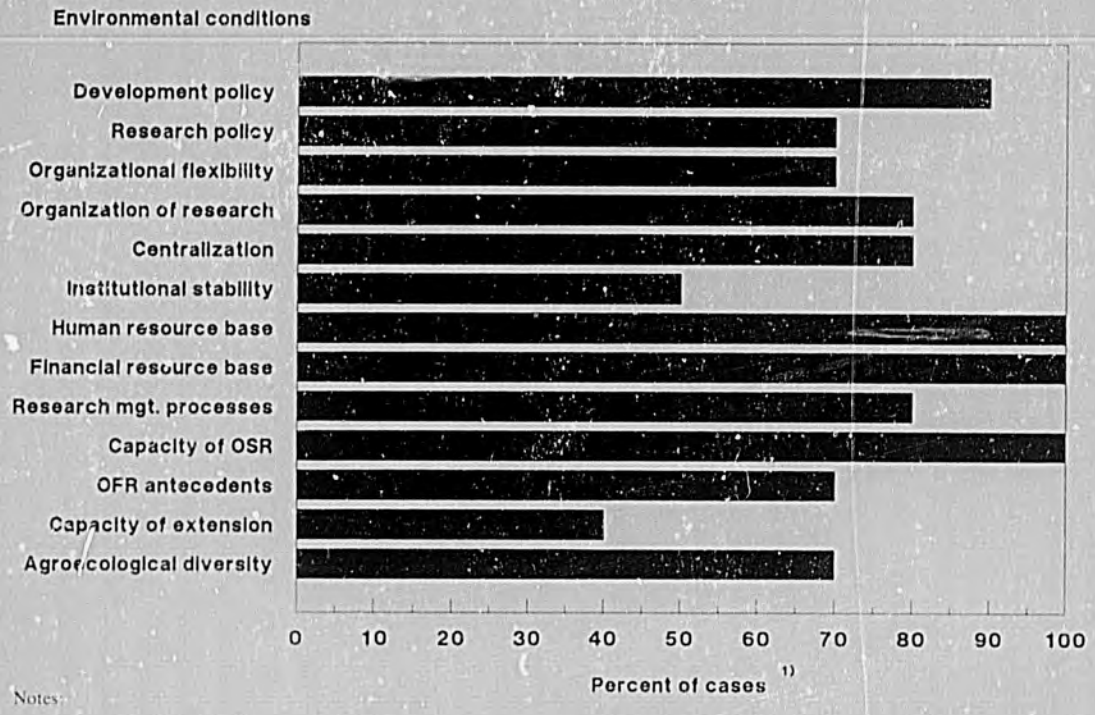
* Conditions which could potentially be altered by senior management over the long term.

Development Policy

OFCOR is generally implemented as a research strategy to address the needs of resource-poor farmers more effectively. Consequently, the degree to which national development policy is committed to assisting this client group has an important bearing on the priority given to OFCOR within a NARS. Indeed, such commitment proved to be an important condition in determining the strength of integration of OFCOR and experiment station research in 90% of the cases reviewed (Chart 2). A strong commitment to resource-poor farmers, when translated into research policy provides a common goal, strong incentives for collaboration, and bolsters the scientific credibility of OFCOR within the research institute. In all case study countries OFCOR in fact was either launched or strengthened in response to national initiatives to stimulate development of small-farm agriculture. The level and longevity of such policy commitment, however, have varied significantly.

In Zimbabwe, to cite a positive example, the original OFCOR initiative was a direct response to the post-Independence government policy of stimulating agricultural development within the communal areas. Within six years of the adoption of this new policy, nine of 17 DR&SS research institutes/stations had expanded their research agenda to include OFCOR and on-farm research activities in these areas. Communal area

Chart 2: Percent of Cases Where Environmental Conditions Affected OFCOR-OSR Integration



Notes:

1) N = 10. In Nepal the semi-autonomous LAC and PAC were analyzed separately from the national research system.

farmers are now viewed as an important client group and most station scientists see on-farm research as an effective complementary means for addressing these clients' needs.

Research Policy Commitment to OFCOR

A development policy supporting OFCOR can only facilitate collaboration if senior research managers use it to set compatible research policy objectives. The degree of commitment of senior research managers to addressing the needs of resource-poor farmers through OFCOR was a key factor found to influence the intensity of integration in 70% of the cases reviewed (Chart 2).[9]

Again, what took place when the FSRU was founded in Zimbabwe illustrates the importance of senior management support for collaboration. The Director of DR&SS issued a directive to all heads of institutes and programs calling on them to collaborate closely with the new FSRU and to play a strong support role in providing technical expertise and advice. With this clear policy statement from management, the FSR Unit was able to secure collaboration efficiently from senior scientists, who provided reviews of past research on selected topics, participated in field diagnosis activities, and reviewed FSRU research proposals and results. These activities have laid a solid foundation for on-going collaboration.

Organizational Flexibility

Capacity for productive change within a research organization was an important condition affecting integration in 70% of the cases (Chart 2). In most of these, organizational flexibility had a positive impact because it allowed research managers to bring about efficient changes in deployment of resources, division of research responsibilities, or managerial processes supporting collaboration. The positive impact of

[9] The commitment of research managers was also cited by Collinson (1988) as a key factor influencing the incorporation of OFCOR within the Institute of Agricultural Research in Ethiopia.

organizational flexibility was probably greatest in Guatemala and, to a lesser extent, in Panama where OFCOR was established within new institutions. In Zambia, the flexibility resulting from the recent reorganization of the Research Branch was cited as an instrumental factor permitting the rapid establishment of ARPT and the clear division of responsibilities between ARPT and the commodity and specialist teams.

Flexibility when it reaches the extreme of disorganization can, however, jeopardize integration. This occurred in Senegal where OFCOR was introduced during a period of massive reorganization under the auspices of a World Bank project. The conflicts which arose among researchers over appropriate division of responsibilities and control over resources have since had a negative impact on building integration.

At the other extreme, organizational rigidity can make it difficult to bring about changes required for developing effective integration. This is evident from experiences in Ecuador. Although the PIP, which began life as a special project, was eventually established formally as a program, room to maneuver while organizing the program was limited, and therefore, effective development of the program constrained. Modest changes introduced in the research planning, programming, and review processes in order to integrate the PIP with commodity programs have not been sufficient to support the full implementation of all the linkage functions.

Existing Organization of Research

In 80% of the cases reviewed, the way in which station-based research was organized — i.e. by commodities, disciplines, or resource management factors — had an important bearing on the nature of its link with OFCOR, as well as on the organizational and managerial arrangements required for strengthening integration (Chart 2).[1]

The organizational arrangement most conducive to developing integration between OFCOR and station-based research appears, for example, to be a regional system where both OFCOR and station-based research are carried out by scientists posted at regional centers or stations. The regional mandate is more focussed in terms of clients and agroecological conditions and facilitates the application of a system's perspective and a strong problem-solving approach. Furthermore, the interaction of scientists under such circumstances is more frequent, and planning and logistics for joint activities are easier to arrange.

A regional system emerged clearly as a facilitating condition in Guatemala, in EAC and PAC in Nepal, and in the Dual Purpose Cattle Project in Panama. In contrast, organization based on discipline appears to be the least compatible with strong integration: if a systems perspective in OFCOR is to be applied effectively, links have to be built across disciplines as well as across commodities. In both Ecuador and Guatemala, building effective links between the OFCOR program and discipline-based research departments has proven more problematic than collaboration with the commodity programs.

Degree of Centralization of Research Infrastructure

An institutional condition related to the organization of research is the degree of centralization of research infrastructure in terms of stations and laboratories. Because a highly centralized system is more dependent on OFCOR to achieve necessary agroecological coverage, centralization tends not only to increase the relative weight given to OFCOR, but also to add emphasis to developing a rational division of responsibilities between OFCOR and station-based research. On the other hand, where centralization is extreme, especially in larger research systems, communications and the organization of collaborative field activities often prove comparatively difficult and costly. These problems are most severe when OFCOR is carried out by a separate group of researchers, but also arise when, as in Zimbabwe, the same researchers carry out both on-station and on-farm research. Centralization of research infrastructure increases the distance and time scientists have to travel for OFCOR tasks, thus working as a disincentive to carrying out on-farm research in addition to experiment station research.

Degree of centralization of infrastructure influenced OFCOR-OSR integration in the majority of cases reviewed, although the relationship was not always straightforward (Chart 2, Annex Table 1). In Zimbabwe, for example, centralization was cited as supporting integration between the FSRU and station-based research because it facilitated informal communication and planning of joint activities among scientists. Yet, in Zambia, where 50% of commodity and specialist researchers are based at the large Central

[1] Detailed analysis of the strengths and weaknesses of various arrangements for organizing OFCOR will be treated in a forthcoming comparative study paper by D. Merrill Sands, S. Biggs, P. Ewell, and S. Poats.

Research Station but 80% of ARPT scientists at small regional stations, centralization of OSR in relation to ARPT inhibited integration. Formal management mechanisms had to be instituted to overcome limited informal interaction, weak communication owing to long distances and poor facilities, and difficult and costly logistical arrangements for joint field activities. In BARI, a large research institute with over 800 researchers and 23 stations, similarly extreme decentralization of OFCOR staff at regional stations and research sites in relation to station-based researchers was cited as one of the principal conditions inhibiting successful integration.

Institutional Stability

In half the cases reviewed, the degree of stability of both senior research managers and research staff was seen to influence significantly the strength of integration between OFCOR and experiment station research (Chart 2).

Systematic collaboration between OFCOR and station-based research requires ongoing support and encouragement from senior research managers. The link is thus vulnerable to frequent turnovers at the upper level of management. Because OFCOR is seldom a long-established research effort, management instability can prove particularly disruptive. Leaders of OFCOR efforts usually have to devote considerable energy to explaining and defending OFCOR objectives and functions to senior managers in order to gain their support. Frequent changes in top personnel mean that OFCOR leaders must spend still more time building and rebuilding support among management, to the detriment of fulfilling other important tasks such as providing actual research leadership and promoting collaboration with station-based research.

Similarly, frequent changes among the heads of programs or departments result in collaborative relations having to be reestablished continually, especially when OFCOR is organized as a separate program. This problem was cited in Ecuador, Panama, Guatemala, and Senegal. Indeed, the Senegal case vividly illustrates the potential severity of institutional instability as a negative condition for integration: between 1982 and 1986 a succession of 34 different managers occupied the 17 senior research management posts available.

High turnover of research staff was also cited as an impediment to strong integration in half the cases reviewed. Lack of continuity inhibited scientists from building effective collegial relationships and collaborative research programs. Staff instability was a particular problem in programs, such as the ARPT in Zambia, which rely heavily on foreign experts with short-term contracts.

Human Resource Base of NARI

The number and kind of staff available within the National Agricultural Research Institute (NARI) affected the nature and strength of OFCOR and OSR integration in all cases reviewed (Chart 2).

Problems arising from scarcity of scientific staff were cited in Senegal, FSR&DD in Nepal, and in some programs in Zambia. In these cases, there were barely enough scientists to carry out core research, much less collaborative activities. In other cases competition among programs for limited human resources undermined building integration.

The composition of staff available for OFCOR appeared even more frequently to affect integration. This determines what disciplines can be represented in OFCOR, what level of scientific research experience can be counted upon, what ratio between scientists and technical personnel is feasible, and how heavily OFCOR needs to rely on foreign experts. Such staffing characteristics invariably have an impact on the nature of the link between OFCOR and station-based research, especially in terms of the relative weight assigned to the five linkage research functions. In Ecuador, Guatemala, and Zambia, for example, where OFCOR has been relegated to more junior national researchers, establishing the scientific credibility of OFCOR with more senior station-based researchers has been difficult. Consequently, this has weakened the performance of feedback and adaptive research functions.

The type of staff assigned to OFCOR is a function of three factors: the profile of total staff available, the feasibility of recruiting staff with different skills, and the allocation decisions of senior research managers. The first two factors are parameters which define the managers' options. Allocation decisions reflect a manager's commitment to OFCOR, the philosophy and methodology for OFCOR adopted, the demands of other scientific research in the institution. They also reflect the feasibility of assigning more senior scientists to OFCOR. In some cases, Nepal and Ecuador, for example, where scientists depend on supplementary income from teaching or consulting in the capital city, the posting of senior scientists to remote areas targeted for OFCOR work is simply unrealistic. Another

solution, such as the outposting of junior researchers with arrangements for support from senior scientists, has to be found.[11]

Financial Resource Base of the NARI

Funding patterns had a major influence on the nature of research integration in all cases reviewed (Chart 2). Its impact is registered in two principal ways:

1) Scarcity of funds can aggravate the potential for conflict between OFCOR and station-based research.
2) Insufficient or erratic operating funds jeopardize implementation of collaborative activities, especially field visits.

Internal struggles over funds were most intense in BARI and in Senegal where OFCOR was institutionalized in large new departments with significant donor support. OFCOR's 'privileged' position fostered resentment among other departments which has inhibited building effective integration.

Scarcity of operating funds to support collaborative activities was cited as a constraint inhibiting integration in half the cases reviewed. This problem has been particularly severe for the FSR&DD in Nepal and, recently, for ICTA in Guatemala which has had to face budgetary cuts.

Research Management Processes

This condition reflects the degree to which research policies within the national research institute are formulated clearly, and priority-setting, planning, programming, and review processes operate effectively and efficiently. This condition, cited in 80% of the cases reviewed as affecting integration of OFCOR and OSR, has important implications for the ease with which the adaptive research, feedback and support functions, as well as some of the FnFage mechanisms, reviewed in Chapter 4, can be implemented.

Lack of an institute-wide planning and programming process, for example, means that no established mechanism exists for channeling information between farm-level and station-based research. In Panama, the absence of any such processes was cited as the most important factor inhibiting successful integration. In contrast, in Guatemala well-developed programming and review processes at the regional level have been the principal mechanisms for integrating the research of the Technology Testing Department with that of the commodity programs. In Ecuador, a different situation has emerged. Here, managers tried to adapt existing programming and review processes -- the Technical Committees of the Regional Stations -- to serve as integrating mechanisms. This resulted, however, in overburdening the Committees with too many separate objectives, in the application of inappropriate criteria for evaluating PIP's work, and in a weakening of PIP's research functions.

Clearly, the presence of effective research management processes is not an immutable parameter. New, improved mechanisms can be introduced, as in the case of the Coordinating Committee on On-Farm Research and Extension (COFRE) in Zimbabwe. Such change is, however, likely to take time and can complicate management's task of building strong OFCOR-OSR collaboration.

Maturity and Capacity of Experiment Station Research

The capacity of OSR, relevant in all cases reviewed, affects integration in terms of the performance of the applied research and support functions. It also influences the degree to which OSR scientists see the need for OFCOR and are receptive to feedback of information from farm-level research (Chart 2). Concretely, the maturity and capacity of experiment station research is likely to correlate with the inventory of 'technology on the shelf' for OFCOR to draw on in fulfilling the adaptive research function.[12]

In Zambia, the relative youth of the commodity programs and their paucity of technological options seriously restricted possibilities for collaboration with OFCOR in the early years of ARPT. Indeed, the situation actually sparked conflict because in certain instances ARPT felt itself obliged to undertake applied on-station research to try to fill technology gaps. Such initiatives, by obscuring the division of labor and responsibilities between the two groups, elicited strong complaints that ARPT was duplicating research and overstepping its mandate. Integration has improved markedly, however, as the commodity programs have over time developed technologies which they need to have tested. Consequently, ARPT has come to respect the commodity programs as a source of technological

[11] Human resource issues in the organization and management of OFCOR will be treated in depth in a forthcoming comparative study paper by S. Poats and R.J. Bingen.

[12] Lack of technologies is also cited by D. Norman (1983) as impeding the integration of OFCOR and experiment station research in Botswana.

innovation. This experience underscores the need for a balanced build-up of OSR and OFCOR capacities in young research institutions.

The experience of ICTA in Guatemala has been very different. Here emphasis was initially placed on the development of strong commodity teams while OFCOR was assigned a subordinate role. The applied research function has been strong, for everything was done to see to it that the commodity programs would rapidly acquire the capacity to feed technologies into the Technology Testing Department. Since this went hand in hand with a narrower research mandate for OFCOR, however, OFCOR's service function has come to predominate, while its feedback function has proven difficult to implement. Now that priorities are shifting to production in more marginal regions where ICTA has fewer appropriate technological alternatives to offer, the nature of OSR-OFCOR collaboration is necessarily changing. Integration is becoming stronger, as the adaptive research and feedback functions are being revitalized.

Similar trends of collaboration increasing as scientists confront the challenge of generating technologies for more marginal environments have occurred in Nepal and Zimbabwe as well. Scientists in station-based research programs which had successfully generated technologies for more favorable environments actively sought to strengthen integration with OFCOR once they began to work in places where existing technologies proved unsuitable. The need for the full complement of OFCOR linkage functions appears greatest in comparatively marginal environments where the complex farming systems are relatively unfamiliar to station-based researchers.

On-Farm Research Antecedents

The tradition of on-farm research within a NARS was seen to affect how experiment station scientists perceived OFCOR, both in terms of OFCOR's validity as a research strategy and the nature of OFCOR's role within the total research endeavor. These perceptions, in turn, colored views about appropriate links between OFCOR and experiment station research.

On-farm research antecedents have influenced the course of integration in 70% of the cases reviewed (Chart 2). BARI provides the most pronounced example of how OFR antecedents have impeded integration. In BARI's past a large-scale on-farm soil testing and fertilizer trial program was carried out which struck many scientists as scientifically unreliable, and of little relevance to their research. This antecedent has continued to make it difficult for the recently formed OFRD to broaden its mandate beyond the service function to include adaptive research and feedback functions. In Guatemala, on the other hand, the positive experiences of wheat breeders who had done on-farm work over considerable time was decisive in the foundation of ICTA as an institution with a pervasive OFCOR approach.

Extension Capacity

Important to integration of OFCOR and OSR in 40% of the cases reviewed (Chart 2), the size and competence of extension services can significantly influence the degree to which OFCOR emphasizes, or is expected to emphasize, the service function, i.e. the testing and demonstration of technology. In Zimbabwe, for example, where the extension service is thought to be quite strong, researchers expect extension to test advanced technologies, to develop recommendations for specific client groups, and to demonstrate and transfer technologies to farmers. Consequently, many consider the service and even the adaptive research function to be extension's domain. This has meant that OFCOR efforts have been more applied in nature.

Conversely, in Guatemala, where the extension service is weak and its linkages with ICTA have never been very successful, ICTA emphasizes the service and adaptive research functions of OFCOR, and considers its large on-farm research program as the primary vehicle for disseminating technologies to farmers.

Agroecological Complexity

The degree of agroecological complexity encountered in a region will in large measure determine the relative importance accorded to the adaptive research and feedback functions of OFCOR, within the overall research process. Generally, the greater the diversity, the greater is the need for location-specific diagnosis and adaptation of technologies. The cases reviewed showed that scientists and research managers working to generate technology appropriate for marginal or complex agroecological zones felt the greatest need for OFCOR. The importance assigned to OFCOR in the Department of Research in Zimbabwe, for example, increased once scientists began to address the research needs of the more marginal areas typical of the communal areas. Agroecological complexity affected integration of OFCOR and OSR in 70% of the cases analyzed (Chart 2).

III. Room to Maneuver: Facilitating Conditions Which the Senior Research Manager Can Develop

As sketched above, in any given situation, a number of fundamental environmental conditions will define the possibilities for strengthening the integration of OFCOR and OSR. Nevertheless, within any institutional environment there will always remain room to maneuver (Clay and Schaffer, 1984; Hemenmann and Biggs, 1985). The challenge for the research manager is to analyze his/her specific institutional setting in order to develop a management strategy which, given the institutional environment of constraints and opportunities, is realistic but which at the same time goes as far as possible towards developing those conditions which will support the strong integration of OFCOR and station based research (Biggs, 1984).

From comparative analysis of the cases studied, six basic institutional conditions have been identified which promote strong and effective integration of OFCOR and experiment station research and which resourceful research managers can develop (Table 4).

Optimal realization of these conditions may, thus, be viewed as the central objectives of a sound management strategy to achieve strong integration.

Table 4: Conditions Which Facilitate Effective OFCOR-OSR Integration

1. Scientists share an applied, farmer oriented perspective to agricultural research.
2. Scientists agree on the respective research functions OFCOR and OSR should perform and on their relative importance.
3. Scientists share a common understanding of OFCOR as a complementary, not a competing, research activity.
4. Scientists view OFCOR as scientifically credible.
5. Scientists perceive the benefits of collaboration to outweigh the personal costs.
6. Scientists have adequate opportunities for formal and informal interaction.

These six conditions, the essential policy, organizational, and managerial issues which must be considered in devising a strategy to attain them, and a number of relevant management lessons from the case studies are considered below. The following chapter reviews the specific linkage mechanisms used by research managers to develop these six basic conditions favorable for research integration.

Condition 1. Scientists Share an Applied, Farmer-Oriented, Perspective to Agricultural Research

When this condition prevails, researchers carrying out OFCOR and experiment station research have a common 'mission' of generating knowledge for the purpose of developing technologies for designated client groups. This perspective involves researchers agreeing about their objectives, sharing common perceptions concerning primary constraints to agricultural development, and reaching a clear understanding regarding the priority needs of their clients.

Realizing this condition is a long-term objective, a goal which requires the sustained commitment of senior research management. It entails nothing less than forging a client-based institutional culture and motivating researchers to adopt such a culture. The challenge is that such a consensus generally requires modifying professional values and concepts of 'good science' taught to researchers during their specialized training.[13]

Issues. A shared, applied, farmer-oriented perspective to agricultural research is probably the most difficult of all conditions for research managers to develop. Differences in orientation between OFCOR and more applied station-based research typically affect scientists' perception of objectives, constraints, and target clients (see Chapter 1). Such differences may well prompt conflict. The challenge for senior research managers is to convert conflict into constructive debate, culminating in the broad unification of OFCOR and experiment station research under a set of common goals.

Experiences from the case studies. Research managers appear to have been quite successful at developing a

[13] See also Byerlee and Tripp (1988) and Chambers and Jiggins (1987).

sense of common 'mission' in ICTA in Guatemala, in some research institutes in Indonesia, and in LAC and PAC in Nepal. Clear progress towards the attainment of this condition was also evident in Zimbabwe. In Zambia the Director of Agriculture even stated that ARPT had had a major impact on commodity and disciplinary scientists making them more sensitive to the specific problems and needs of resource poor farmers.

In Guatemala, in response to national policy designed to attain food self-sufficiency by increasing production among small farmers, ICTA developed a unifying, applied, farmer-oriented research strategy. Strong commodity programs have been linked with the systematic testing of technology on farms. This approach has very successfully generated technologies for medium-scale peasant farmers with relatively good resources. As ICTA has shifted its priorities in more recent years, however, gravitating towards the needs of farmers with fewer resources under the diverse agroecological conditions prevailing in the highlands, the technological challenges to research have become more daunting and it has proven difficult to sustain a shared client-oriented philosophy. Organizational and managerial changes, such as fortification of the Socioeconomics Department and strengthening of scientific leadership in the Technology Testing Department, have had to be introduced to bolster the institute's capacity to deal with these new challenges. A key instrument ICTA has used throughout to ensure that scientists, both in OFCOR and in commodity and discipline programs, share a strong client orientation, is a ten-month training course for all recruits, during which students live in peasant communities and farm under local conditions.

In Indonesia, AARD has a strong development mandate, and much of its research is carried out as a component of large development projects. This development orientation has facilitated the integration of OFCOR and station-based research. Similarly, LAC and PAC, founded as extension services for the hill regions of Nepal, have sustained a strong client-oriented philosophy. As national policy has shifted to place more emphasis on agricultural development in the hill regions, these stations have become more integrated into the national research system, with stronger links to national commodity and disciplinary programs. In Zimbabwe, the government's shift in priorities to the communal areas, where farmers are relatively poor and conditions more marginal, stimulated DR&SS to undertake a major research effort, uniting both on-farm and station-based research, in order to meet the needs of this new client group more effectively.

Management lessons. These examples illustrate how national development policy, translated into an agricultural research policy which sets clear priorities and defines client groups for research, can provide a favorable setting for the attainment of a common OFCOR-OSR sense of 'mission'.

Analysis of the case studies discloses several other ways managers can promote the institutional culture desired:

1) strong and sustained commitment from senior research management to a client-oriented research philosophy;

2) research management mechanisms which encourage scientists to define research problems in terms of end users. In both Zambia and Zimbabwe, for example, managers have experimented with trial proposals in annual research programming, proposals which require a justification of research in terms of its relevance to small farmers' identified needs and problems;

3) a reward system which encourages client orientation in research. Placing emphasis on contributions to developing recommendations, rather than number of publications, for example, could be incorporated as a criterion for evaluating staff performance;

4) organization of research by regions, bringing scientists into closer contact with clients, and each other, and providing a more restricted mandate useful for defining and prioritizing common objectives;

5) exposure of scientists to client groups and their farming conditions through mechanisms such as field visits, and indirect mechanisms such as seminars and focus studies of specific farming systems outlining the prevailing constraints and opportunities for research;

6) opportunities for debate and consensus-building among scientists working in OFCOR and station-based research.

Methods 5) and 6) may be facilitated by the direct linkage mechanisms described in the following chapter.

Condition 2. Scientists Agree on the Respective Research Functions OFCOR and OSR Should Perform and on Their Relative Importance

Successful OFCOR-OSR integration depends on a clear

division of labor and responsibilities for research functions acceptable to both partners. OFCOR and station-based research should be perceived as having the potential to enhance the productivity and effectiveness of the other (Biggs, 1982; Eicher, 1982; Norman, 1982; Norman and Collinson, 1985).

Issues. Defining a clear division of labor and responsibilities entails delineating appropriate linkage research functions for OFCOR and OSR and establishing their relative importance explicitly, as well as specifying the services and products which each should provide to the other. To achieve this end, careful planning is required in the early stages of an OFCOR effort, followed up by subsequent monitoring to see if the proposed plan is working as expected or requires readjustment. Because researchers see eye to eye today, does not mean their agreement will always hold firm tomorrow. Adjustments and reaffirmation of consensus may be necessary. The experiences of the case studies indicate that continuous management attention is required for sustaining effective operational division of responsibilities. A single policy statement is not enough.

Experiences from the case studies. In the majority of cases studied, no full consensus on an explicit division of labor and responsibilities for the linkage functions had been achieved. Two recurrent problems were documented. In some instances, station-based researchers were simply unclear about OFCOR's objectives and the functions which OFCOR was supposed to perform within the research process. This was particularly true in Senegal and for BARI, where the OFRD was relatively new and had consolidated several distinct on-farm research projects. Such lack of awareness of OFCOR's role among station-based scientists was also observed, although more individually, in Zambia, Zimbabwe, Guatemala, and Nepal in the FSR&DD.

In Senegal confusion over roles has been a serious obstacle to effective integration between the DRSP and other departments and research centers. Most commodity and disciplinary scientists are content to have the DRSP provide them with information on farmers' practices and problems, thus carrying on the role of the former Rural Sociology Department. They are not comfortable, however, with DRSP's new role as both generator and adapter of technology. On-station scientists, who routinely conduct multi-locational trials in farmers' fields, view DSRP's research as redundant. Many fail to appreciate the differences between their own on-farm research and that of the DRSP, in which socioeconomic factors and farmer management practices are explicitly included as variables. This problem of station-based researchers seeing OFCOR as duplicating their previous research but in farmers' fields was also documented in Zambia, Nepal, and BARI.

A more common problem, documented in a majority of the cases reviewed, has been that researchers concentrating in station-based research and those working in OFCOR have had different expectations about the functions that they are to perform — and about their relative importance.[11] Station-based scientists, for example, often assert that they are generating component technologies, and OFCOR should give its highest priority to testing their results on farms and providing feedback. Scientists in OFCOR, on the other hand, believe that OFCOR should define and prioritize problems on the basis of on-farm research. These problems should then be tackled both on experiment stations, as well as in the field. In other words there is potential for significant conflict over who initiates research programs and sets the agenda. Problems of this type were documented in Zambia, Guatemala, Bangladesh and Ecuador.

Management lessons. It is clear from the case studies reviewed that lack of understanding and differences of opinion among researchers in OFCOR and OSR on the appropriateness and relative importance of the five linkage research functions represent potential sources of conflict which can seriously undermine building stronger integration. It is also clear that maintaining a working consensus among OFCOR and station-based researchers on their respective areas of independence and interdependence is certainly one of the most challenging aspects of achieving successful integration. Yet, definition of responsibility has also been one of management's most neglected tasks. For building a working consensus on the complementary relationship between OFCOR and OSR several lessons can be drawn from comparative analysis of the case study experiences. First and foremost, it is important to have:

1) a policy framework defining assigned functions and the expected division of labor;

2) incentives to motivate researchers to implement this policy.

Policy framework. A policy framework suitable for achieving a working consensus among research staff must minimally include three elements:

[11] In a Nigerian case, Okali and Sumberg (1986) also cite ambiguity of roles as a problem.

1) a clear mandate for OFCOR defining its objectives and functions;
2) a policy statement defining the complementary roles and responsibilities of OFCOR and station-based research, and explaining the need for research integration;
3) mechanisms for dissemination of the policy to all researchers and administrators.

These basic elements were implemented to varying degrees in the cases studied. In all case study situations, except the institutes in Zimbabwe, an initial plan outlining OFCOR's objectives and expected functions had been developed.

A clear policy statement about division of labor and responsibilities for research functions between OFCOR and FOSR was less common. The most robust implementation was in Guatemala where OFCOR was defined as a specific phase in the research process with specific functions, and the complementary relationship between OFCOR and station-based research was made explicit in the research strategy of the institute. This policy framework led to a clear operational division of labor. Elsewhere, senior research management used internal papers, directives, or meetings to spell out intended policy. Nonetheless, in many places ambiguity persists about OFCOR's intended role, a clear indication that if the intended division of labor is to become fully operational policy statements need to be followed up and reinforced as they were in IAC and Indonesia.

Communication of policy to staff was only sporadically implemented among the cases reviewed. Inclusion of policy considerations in strategy statements within the institutes, as in Guatemala, has proven helpful. Also, because they are more widely disseminated and read, short memos or directives summarizing key points of policy appear to be more effective as guidelines for implementation than internal papers. In Zimbabwe, for example, when the FSRU was established, the Director circulated a concise directive which defined its objectives and clearly delineated the complementary roles and areas of research collaboration expected. Four years later, this directive still remained fresh in institutional memory. In most other cases communication of policy to researchers and research managers was virtually neglected.

Incentives. However important a policy framework embodying a clear division of labor and responsibilities is, researchers' active adherence to and implementation of policy is likely to depend largely on motivational factors. It is crucial for researchers to perceive:

1) their assigned roles to be legitimate and productive;
2) the specified division of labor to be feasible;
3) the services and products of each type of research to be necessary to the success of the other.

Unfortunately, an effective incentive structure along these lines has been achieved in only a few of the OFCOR situations studied. Creating incentives to collaborate requires senior research managers' active and sustained leadership to develop a working consensus among scientists on the areas of mutual dependence and to foster their commitment to this agreed-upon division of responsibilities.

Indeed, management experiences indicate that commitment to collaboration is strongest when the assigned division of labor and responsibilities is reached through a consensus -- or is at least open to discussion -- of the participants, rather than unilaterally imposed on them from above. This implies a joint planning process involving researchers working in OFCOR and experiment station research. In almost all OFCOR situations reviewed, collaborative functions designated for OFCOR and OSR were essentially laid down by senior research management or by donors with varying degrees of follow-up to track levels of staff acceptance.

The Senegal case provides a dramatic example of how conflict can arise from imposed collaboration. Plans for setting up the DRSP and definition of its responsibilities within ISRA were developed by a World Bank funded project. Negotiations took place at Ministerial level; ISRA researchers were not involved. When the newly appointed Head of DRSP issued a memo to the Director General of ISRA defining his Department's role and specifying what DSRP expected from other departments, ISRA researchers, believing they faced a 'fait accompli', reacted with hostility. At a meeting run much like a tribunal, DRSP representatives were called on to 'explain themselves.' Diverging standpoints about DRSP within ISRA emerged. Some saw DRSP as redundant, others accused it of trying either to minimize the importance of on-station research or else to exercise control over its priorities. The highly confrontational environment which resulted has made it extremely difficult for DRSP to build effective collaborative relations with station-based research in the other departments.

Periodic appraisal of the effectiveness and feasibility of policy-defined division of labor so that adjustments in assigned roles and responsibilities can be made as

required is a second useful way to foster staff commitment. Again, such monitoring was rare in the cases studied. Guatemala and Ecuador have recently undertaken such an appraisal, but only after more than 10 years of operation. Significantly, in both cases, it emerged that division of labor and responsibilities between OFCOR and OSR was not actually being carried out as planned. Important organizational and managerial changes had to be introduced to try to correct the weaknesses identified.

OFCOR researchers can also assume responsibility for stimulating active interest in their products and services and, in this way, can raise station-based colleagues' incentives to collaborate. They can do this by:

1) demonstrating the capacity to perform their assigned research functions;
2) tailoring the results of their research to the needs of OSR.

Because demonstrating a capacity to perform assigned research functions builds confidence in integration and its potential benefits, it becomes important to deliver expected services or products in the early stages of collaboration. Emphasis in the beginning on good trial management, for example, or the distribution of concise reports of field diagnoses and results helps to establish the validity of OFCOR. In some cases, indeed, it may be best to take on easier research problems first to demonstrate the feasibility of agreed-upon division of labor (Anderson and Hardaker, 1986). With this demonstrated objective in mind, for example, the FSRU in Zimbabwe included a relatively high-potential zone as one of its initial two regions of responsibility.

The Caisan Project in Panama also adopted this strategy. OFCOR undertook adaptive research in a high-potential area in order to show as soon as possible the benefits it had to offer. Its success in quickly developing appropriate technology for the region led IDIAP to adopt the OFCOR approach more broadly. The danger of this demonstration strategy, however, is that it can set up false expectations, suggesting a promise of short-term impact from adaptive research in more marginal zones as well. Progress here, however, is more difficult so that impatience arising from unfulfilled hopes can undermine OFCOR's credibility.

The delivery of data and information tailored to meet the needs of station-based scientists is another important mechanism for ensuring that OFCOR will be viewed as useful. This means OFCOR's considering its partner in collaboration as a research client. OFCOR data which fail to pass from site to stations will not aid integration. As commonsensical as this may seem, problems with timely data availability were cited in 70% of the cases reviewed.[15] Either bottlenecks arose in data analysis owing to unwieldy methods and/or lack of appropriate equipment or else delays in the writing, printing, or distribution of reports disrupted internal information flow (Ewell, 1988). Similar obstacles to OFCOR's drawing on data from commodity and disciplinary scientists interfered with effective integration as well. In Zambia lack of access to results from station-based research led to OFCOR's duplicating some previous research. This not only meant wasted effort, but also sparked conflict with experiment station scientists.

Even when OFCOR results are made available, they are too infrequently presented in a way which highlights their relevance to the work of other scientists. This is especially true for the presentation of social science findings.[16] OFCOR researchers need to present their research results in a way which responds to the priority needs of technical scientists. Three useful tactics for research presentation emerged from analysis of the case studies:

1) preparation of a concise report for commodity scientists of relevant agronomic data on their crops and information on farmers' practices (Edwards and Muwamba, 1986);
2) inclusion in OFCOR reports of a special section on the implications of on-farm experimental results and field observations for OSR;
3) discussion of results in seminars and workshops for commodity and disciplinary specialists.

The case study experiences show that several institutional conditions facilitate research managers' ability to achieve a clear division of labor and consensus among researchers on the respective research functions of OFCOR and OSR. This is easier in situations where there is sufficient flexibility to institute organizational changes to accommodate new divisions of responsibilities; where institutes are small and have focussed mandates; where staff continuity helps to sustain collaborative relationships and agreed-upon principles of operation; where OSR has technology 'on the shelf' appropriate for adaptive research; and where agroecological complexity and diversity in the mandate region clearly justifies the need for location-specific OFCOR research.

[15] See also Bernsten (1986).

[16] See also Box (1984) and Gostyla and Whyte (1980).

Condition 3. Scientists Share a Common Understanding of OFCOR as a Complementary, not Competing, Research Activity

A clear understanding and recognition among researchers of the complementary relationship between OFCOR and station-based research depends not only on a clear division of labor and responsibilities within the research process (condition 2) but also on minimizing disruptive competition and conflicts over power whenever they may arise.

Issues. When scientists fail to appreciate the complementary roles of OFCOR and OSR two kinds of conflict typically occur: struggles for influence over the research program; and clashes concerning control over resources.

Experiences from the case studies. Well over one-half of the case studies reported conflicts arising from disputes over research agenda and competition for resources.

Influence over the research program. Conflicts are likely to emerge when:

1) scientists feel OFCOR is being introduced as a corrective strategy;
2) either the feedback or support function becomes supervisory;
3) responsibility for formulating recommendations is ambiguous.[17]

In many of the cases reviewed, OFCOR was seen, at least initially, as a research approach instituted to 'correct' or redirect station-based research. It was, thus, perceived as competitive, threatening the domain of influence and decision-making prerogatives within station based research programs. In Senegal, as described above, such a situation sparked conflicts over power, prestige, and professional influence. Indeed, conflicts of this type, also recorded in Ecuador, Panama, Zambia, Bangladesh, and in the early years of OFCOR in Guatemala, tend to be severe and therefore pose serious and enduring obstacles to building strong integration between OFCOR and station-based research.

Conflicts over power and research autonomy also arise when either the feedback function of OFCOR or the support function of station-based research turns supervisory rather than consultative. If OFCOR is perceived as a 'new boss' with authority to dictate priorities, integration will be jeopardized as indeed occurred in Senegal and to a lesser extent in Zambia. The consequences for integration are similarly negative in situations where station-based researchers overstep their advisory role and assume instead a supervisory or technical monitoring role towards OFCOR, as happened in the case of PIP and the Technical Committees of regional stations in Ecuador.

The third major area of potential conflict related to domains of influence concerns the formulation of recommendations. Should recommendations be developed by station-based programs with specialized expertise in a particular commodity or resource management factor, or should they be made by OFCOR with superior knowledge of a particular region or client group? This proved to be a major point of tension in Ecuador, for example, when the PIP advocated retracting a recommendation for an improved variety for the Highlands because of the variety's poor performance in on-farm trials. The prerogative to make recommendations has also been a topic of heated debate in Zambia and Guatemala. To be sure conflict on this issue remains more likely where policy is at all ambiguous about appropriate procedures for formulating recommendations.

Control over resources. Perceived OFCOR-OSR competition for resources also can give rise to power conflicts.[18] A sense that OFCOR was capturing resources, either human or financial, which would otherwise have flowed to station-based research inhibited collaboration in Senegal, BARI, Zambia, and Panama, and also in Ecuador while the PIP enjoyed special project status. Resource allocation has been a particular problem in NARS where donors have expressed a strong interest in promoting OFCOR efforts sometimes even at the expense of a balanced build-up of commodity and disciplinary research capacities. The visible benefits of the initial influx of donor money — new vehicles, micro-computers, travel and housing allowances, overseas conferences, and graduate training scholarships — were reported to have provoked jealousy among scientists in less favored, more traditional, station-based programs in Senegal and Zambia.

Management lessons. The manner in which an OFCOR effort is introduced and established within a research

[17] These areas of conflict have also been cited by Moscardi et al. (1983) writing about OFCOR in Ecuador; Norman (1983); and Nyirenda et al. (1985) writing about OFCOR in Malawi.

[18] For a discussion of this problem in Panama, see Sands et al. (1985).

institute will have a strong influence on how it is perceived. Power conflicts were more common in situations with: a rapid build-up of OFCOR (Ecuador, Zambia); a large OFCOR effort relative to other research programs or projects (Senegal, Bangladesh, Zambia); and special and visible donor attention to OFCOR (Senegal, Ecuador, Zambia, Panama, Bangladesh). In such situations, managers will have to give special attention to minimizing power conflicts.

Perception of OFCOR as a competing strategy with 'special status' disrupted integration mainly where OFCOR was organized as a separate program or department. In Ecuador and Zambia the problem was further exacerbated because the Head of OFCOR had a direct reporting relationship to the senior research manager. This situation threatened the professional and institutional status of other programs and bred resentment.

Power conflicts are obviously not inevitable simply because OFCOR is organized as a separate program. They did not erupt with the introduction of FSRU, for example, in Zimbabwe. The danger of discord arising from apparently preferential treatment for OFCOR, however, is one to which research managers should remain alert. In both Zambia and Ecuador senior research managers made adjustments when they recognized the costs of such a 'special status' OFCOR arrangement. They moved the OFCOR leader's office from the administrative headquarters of the Ministry to the main research station. This helped improve integration. Reporting relationships were made equal, and opportunities increased for informal interaction with heads of station-based programs.

The case experiences indicate that managers can minimize conflicts over power and control of resources most successfully in institutional settings where there is a strong research policy commitment to OFCOR, where the availability of staff and operating funds are not severely constrained, and where the established power base of OSR programs does not preclude the incorporation of OFCOR as a fully complementary research endeavor.

Certain concrete management mechanisms, used in the case study institutions, can also contribute to minimizing tension: assignment of responsibility for coordination of joint OFCOR-OSR activities to a specific individual or group; and formal allocation of researcher time and specific allocation of funds to collaborative activities (see Chapter 4).

Condition 4. Scientists View OFCOR as Scientifically Credible

If strong OFCOR-OSR integration is to be developed and the linkage research functions successfully performed, it is essential for OFCOR to enjoy scientific credibility within the research institution.[19] This is particularly true with respect to the performance of the adaptive research and feedback functions, both of which depend heavily on effective collegial interaction.

Issues. The cases reviewed clearly indicate that establishing OFCOR's scientific credibility is a priority management issue for strengthening integration between OFCOR and station-based research. It is a condition, moreover, which has repercussions for the other conditions identified as conducive to successful collaboration.

A number of key factors are involved in whether or not OFCOR will be able to attain scientific credibility:

1) the capabilities of OFCOR researchers, in absolute and relative terms;
2) the scientific quality of OFCOR efforts;
3) the degree to which station-based researchers view OFCOR methodology — both modes of analysis and criteria for evaluation — as valid;
4) the degree to which OFCOR scientists can demonstrate expertise in understanding real farming conditions and farmers' priority problems and needs.

Experiences from the case studies. Scientific credibility as a prerequisite for effective collaboration makes common sense. What is important to emphasize, however, is that OFCOR's poor scientific credibility was cited as hindering successful research integration in half of the cases reviewed — Ecuador, Guatemala, BARI, FSR&DD in Nepal, and Zambia in the early years of ARPT. Conversely, OFCOR's strong scientific credibility was specifically accredited with facilitating integration in Zimbabwe, the Crop-Livestock Project and Small Ruminant CRSP in Indonesia, the CSP and LAC and PAC in Nepal, and the Djibelor team in Senegal.

The capabilities of OFCOR researchers.[20] Junior staff with relatively little research experience and advanced

[19] See, for example: Cummings (1981), Morris (1984), Moscardi et al. (1983), Norman and Collinson (1985).

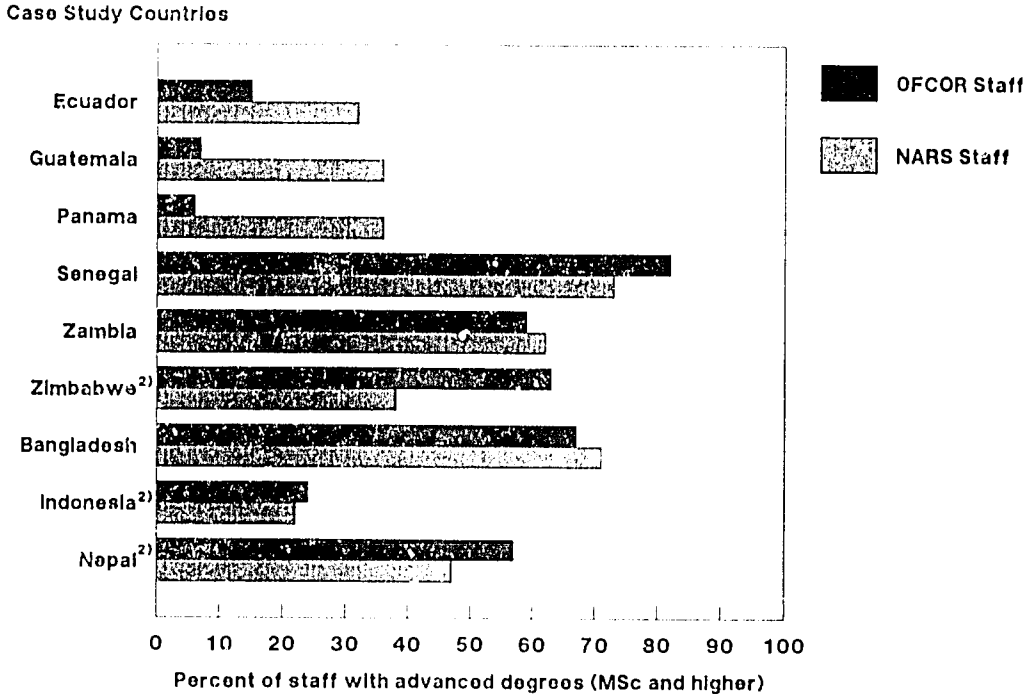
[20] This issue is treated comprehensively in a forthcoming comparative study paper on human resource management in OFCOR by S. Poats and R.J. Bingen.

training are often assigned to OFCOR, especially when OFCOR is established as a separate program. Chart 3 shows that in five of the nine case studies fewer OFCOR researchers had advanced degrees than staff in the NARS as a whole. OFCOR staff also had on the average fewer years of research experience. The differential is even more extreme if we look exclusively at the degree levels of national staff. Chart 4 shows that in the OFCOR situations which rely heavily on foreign experts, these experts hold the major share of advanced degrees, a situation which raises concern about the national research capacity in these programs and the sustainability of the OFCOR effort.

The deployment of junior researchers in OFCOR has important implications for the success of OFCOR-OSR integration: it limits OFCOR's ability to perform the feedback function effectively and, to a lesser degree, also adversely affects the performance of the adaptive research function. In addition this staffing pattern renders OFCOR more reliant on the support function of station-based researchers. If this situation is not managed carefully, OFCOR can lose its distinguishing features, and end up in the narrow role of a regional testing program, as has already occurred, to a certain extent, in Ecuador, Guatemala, and BARI. In reviewing early OFCOR experiences in Kenya, Collinson (1982) reached a similar conclusion: he observed how the strategy of placing young, inexperienced social scientists in commodity programs with no support from senior scientists left them vulnerable to criticism, and led to the marginalization of OFCOR within the research system. In contrast, when the FSRU in Zimbabwe was established this danger was explicitly recognized; a central objective therefore was to make sure from its inception that the FSRU would be as strong technically as the other research programs.

The scientific quality of OFCOR research.[21] OFCOR quality depends not only on the general research

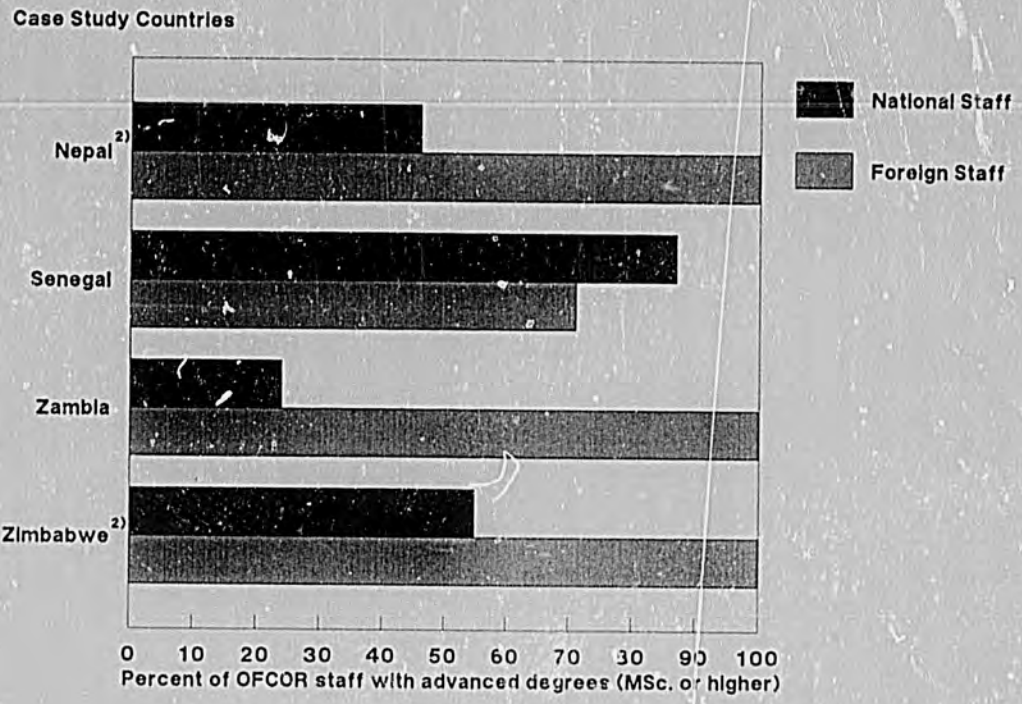
Chart 3: Comparison of Degree Levels of OFCOR and NARS Scientific Staff[1]
(percent with advanced degrees)



Notes:
1) OFCOR staff profile is a sub-set of NARS staff profile. All data is for 1986 except for Bangladesh (Jan. 1988) and Ecuador (1985) OFCOR.
2) Comparison made for sub-case studies only -- Zimbabwe (5), Indonesia (4), Nepal (4) -- not for NARS as a whole.

[21] See note 20

Chart 4: Comparison of Degree Levels of National and Foreign OFCOR Scientific Staff[1]



Notes:
1) Comparison limited to four cases where there was significant involvement of foreign scientists in OFCOR.
2) Comparison made for sub-cases only – Nepal (4), Zimbabwe (5).

capacity and experience of the researchers involved, but also on their mastery of special OFCOR skills. This will reflect the level of their experience in on-farm research, their knowledge of specific OFCOR research methods, and their ability to manage on-farm trials and surveys.

When careful attention is given to building up specialized skills in OFCOR as a complementary set of research activities, collaboration with on-station research is enhanced. Evidence in support of this claim can be drawn from the experiences of various of the case studies: the FSRU in Zimbabwe, Zambia, Indonesia, the Dual-Purpose Cattle Project in Panama, and the CSP in Nepal. In Guatemala and Ecuador, however, where early emphasis on developing OFCOR skills gradually dissipated, the scientific credibility of the programs, as well as their capacity to interact productively with experiment station research programs, declined markedly. In Ecuador only 20% of the researchers currently working in PIP have had any specialized training in OFCOR research methods. The research has become quite routine and methodological innovation has stagnated. In Guatemala, the lack of OFCOR training opportunities abroad, whether degree programs or short courses, was cited as a major constraint to program development and strong integration. ICTA management was able to solve this problem partially by establishing an internal training course for all new recruits which emphasized the OFCOR approach and research methods.

OFCOR methodology, modes of analysis, and criteria for evaluation are viewed as valid. Differences in both how research is designed and how results are interpreted are a common source of misunderstanding between on-farm and on-station researchers.[22] On-station research is conducted under relatively controlled conditions. Collection of precise technical and biological data is the primary objective. The objective of most OFCOR trials is different: the testing of technologies under the environmental, management, and socioeconomic conditions faced by specific groups of farmers. Many trials are designed to expose

[22] See also Lev (1988), Morris (1984), and Moscardi et al. (1983).

experimental treatments to the sources of variation that target groups of farmers have to manage in order to evaluate the viability of treatments across the range of conditions experienced.

Differences in objectives lead logically enough to different types of trials, analytic methods, and results. For a variety of methodological reasons, on-farm experiments usually have larger plots and fewer on-site replications than equivalent on-station designs, but the number of sites is usually large, with each site used as a replicate in the analysis. On-farm experiments also generally have higher coefficients of variation (CV), because non-experimental variables cannot be held constant. A number of hazards push up the proportion of treatments and entire experiments which are lost. These differences in standard quantitative measures for evaluation of agricultural research make OFCOR an easy target for criticism.

A more subtle issue related to whether on-station researchers view OFCOR's methods as legitimate concerns techniques of data analysis. OFCOR data are often interpreted according to criteria developed by social scientists with which on-station researchers are unfamiliar. Economic analysis is just one additional measure; a whole range of factors may apply. A lower-yielding technology may be deemed preferable to a "more productive" alternative, if the crop is ready for harvesting at a time when prices are high, or when food in the farm household is in short supply. OFCOR evaluations of farming results also take into consideration such factors as storage quality, nutritional quality, taste, and the timely availability of straw or other by-products for feeding livestock. In the lives of resource-poor farmers these criteria may indeed be more important than mere physical yield per unit area. Yet OSR scientists may have to be convinced to share the client's perspective. Questions about the legitimacy of the OFCOR approach retarded integration in Ecuador, Senegal, Zambia, and Guatemala.

Demonstration of complementary expertise in understanding real farming conditions and farmers' priority problems and needs. For OFCOR to win OSR support, its claim to provide a complementary area of expertise needs to be substantiated with tangible proof. Clearly, OFCOR researchers' comparative advantage should lie in their understanding of farming systems and farm-level constraints and opportunities for research. In situations where OFCOR researchers remain aloof from farmers and farms, relying on technicians to implement on-farm research, they may well lose credibility among station-based scientists for seeming to lack expertise in the very area where their contribution should be the greatest.

Management lessons. Several important management lessons for ensuring the scientific credibility of OFCOR can be drawn from the cases.

Experienced researchers. Evidence from the cases reviewed strongly suggests that for OFCOR to achieve full scientific credibility as part of an integrated research process it should be carried out by solid and experienced researchers who can interact as equals with their colleagues concentrating in experiment station research. When human resource constraints preclude this from happening, then junior OFCOR scientists must at the very least be actively supported by strong OFCOR scientific leadership and other senior staff.[7] In multi-institute projects in Indonesia, for example, a Technical Committee of senior scientists was set up specifically to backstop more junior OFCOR researchers outposted to field sites.

Scientific leadership. A related lesson is that strong scientific leadership is essential to the development and maintenance of OFCOR's scientific credibility. The OFCOR leader must be able to defend the validity of the OFCOR approach and justify the kinds of data and analyses performed. This implies that he/she should have recognized credentials and experience in both conventional agricultural research and social scientific research. Strong leadership is also required to ensure quality and dynamism in the research program which is essential to gaining credibility. Inadequate OFCOR leadership was cited as deterring integration in Ecuador, Guatemala, and BARI. Conversely, in Zimbabwe, the FSRU leader's strong research capacity and technical expertise in systems research greatly facilitated establishing credibility for the program and developing collaborative links with senior researchers in other departments. The experience of the cases also shows how important it is for the leader of OFCOR not to be overwhelmed with administrative responsibilities to the detriment of their scientific leadership responsibilities. This emerged as a major problem in Ecuador and Senegal.

Realistic objectives. The cases reviewed disclose a tendency among senior research managers, as well as among donors, to set unrealistic objectives for developing OFCOR efforts. Their inevitable failure to live up to these excessive expectations has led to

[7] See also Hildebrand et al. (1985).

disappointment in the contribution of OFCOR and undermined its scientific credibility. An important lesson to be drawn is that OFCOR should be built up incrementally, with respect to both the size and the scope of the effort, so that researchers enjoy sufficient time to experiment with methods and approaches and can consolidate their experience. Rapid build up of OFCOR programs was cited as having a negative impact on the quality of research and, consequently, on OFCOR's scientific credibility in Ecuador, Zambia, and BARI.

Specialized training. For ensuring the quality of OFCOR research and its scientific credibility, specialized training for staff in OFCOR research methods has proven valuable. Such training may well need to be periodically repeated or extended, especially in programs with high turnover of staff.

Introducing OSR staff to alternative types of analysis. Exposing station-based researchers to the OFCOR approach and to OFCOR research methods is likely to increase their acceptance of the validity of unfamiliar types of analysis and evaluation criteria. A robust mechanism for this is found in Guatemala where all researchers entering ICTA were obliged to attend a 10 month training course in research methods with an emphasis on OFCOR. These recruits, many of whom go on to work in commodity programs, subsequently prove supportive of the complementary research roles of the Technology Testing Unit and the Socioeconomic Department. On a more modest scale, in Zimbabwe and Senegal, seminars or workshops on OFCOR were found to be useful in building its credibility.

Sound trial management. In several cases reviewed, poor trial management undermined OFCOR's credibility. Usually this was a question of too many trials too widely dispersed to permit adequate supervision. A common solution found was the clustering of trials which facilitates more frequent supervision and monitoring, more reliable timing of operations and delivery of inputs, and more systematic data collection (Biggs, 1982; Ewell, 1988).

Having OFCOR scientists run trials on station may also pay dividends in terms of their acceptance as legitimate research partners. Such trials provide them with an opportunity to demonstrate their research skills under a more controlled environment. In Zambia some ARPT agronomists initiated on-station experiments after they were criticized by OSR scientists for high CVs and for the messy appearance of their on-farm trials. These experiments demonstrated the expertise of the ARPT scientists and showed that the high CVs and disorderly appearance of their OFR trials could not be attributed to their inexperience or incompetence.

Sustained contact with field research. In the more hierarchically organized OFCOR programs or in the generalized model for organizing OFCOR in which scientists do both OSR and OFCOR, demonstrating complementary expertise in understanding farmers' problems is more likely to be a problem. In these situations, OFCOR scientists, because they spend less time in the field interacting with farmers, can become removed from farm-level information and realities. In these cases, concerted effort is needed to maintain effective communication channels between senior scientists and the more junior staff based in the field (Fw. II, 1988; Harwood, 1985). In LAC, for example, where the rugged terrain of the Hills cuts down the frequency of senior scientists' visits to the field, outposted field technicians responsible for FSR sites return to the station regularly to participate in monthly research planning meetings. The FSRU in Zimbabwe also recently began to involve outposted field technicians in programming and review meetings in order to profit from the detailed farm-level information only they can provide.

The case study experiences indicate that several institutional conditions facilitate research managers' ability to develop OFCOR's scientific credibility. Where a strong policy commitment to resource-poor farmers and OFCOR prevails, senior managers are often more willing to assign experienced researchers to OFCOR, to provide incentives for field research, and to ensure strong scientific leadership. Furthermore, where scientific personnel are not severely lacking, it is easier for managers to assign experienced scientists to OFCOR, rather than resorting to the recruitment of young, inexperienced, university graduates as occurred in Zambia. Lastly, low rates of staff turnover facilitate managers' ability to invest in training in order to systematically develop a cadre of scientists with OFCOR expertise.

Condition 5. Scientists Perceive the Benefits of Collaboration to Outweigh Personal Costs

Integration depends on the *motivation* of the scientists involved to collaborate. Indeed, because participation in joint activities is likely to entail an adjustment of objectives and activities in scientists' research agenda, it is usually not without costs. Cases reviewed -- and literature -- indicate that collaborative activities require time and money, and so cannot be simply added to

previous responsibilities, and also will rarely be voluntarily assumed by scientists to the determent of their professional and personal interests.[24]

Issues. Research managers can motivate scientists to become involved in collaborative research by:

1) ensuring that a researcher's *institutional* status does not decline owing to collaborative activities;
2) ensuring that a researcher's *professional* status does not decline owing to collaborative activities;
3) ensuring that researchers are compensated for any *personal* costs incurred from collaborative activities.

Again, although the need for such incentives makes good common sense, they are all too frequently neglected by research managers. Low motivation persists as a chronic problem in many collaborative situations.

Experiences from the case studies. The case study experiences indicate that when designing a management strategy to strengthen OFCOR-OSR integration research managers need to take into account the reality of scientists' personal ambitions, and motivations. In approximately 60% of the cases, clearly perceived benefits encouraged OFCOR researchers to collaborate with station-based colleagues. This was also true in some instances for OSR scientists, but 70% of the cases reported that perceived costs of collaboration deterred OSR scientists and worked against integration.

Institutional status. Scientists' concern for completing their work, for maintaining their institutional status, often functions as a disincentive to participate in collaborative activities. These, usually, take time away from what they consider their primary responsibilities. Consequently, scientists often perceive collaboration as impairing their ability to perform well in areas traditionally recognized by the institutional reward system. In Ecuador, for example, where OSR scientists saw joint activities as an additional burden, work which supported PIP but did not benefit their own research, they had little desire to invest time or effort in working closely with PIP colleagues.

Conversely, when scientists believe that collaborative activities will improve their own job performance, their motivation to participate increases. This is why the scientific credibility of OFCOR as noted above is so important. In Zambia, for example, after commodity scientists came up with promising technologies that needed to be tested on farms, they became much more eager to work with ARPT. A similar shift of interest can occur even where the same scientists perform both OFCOR and OSR. In research institutes in Zimbabwe, scientists began to allocate more of their time to on-farm research once it became clear to them that future research funding and performance evaluations were going to reflect the new policy priority of serving communal areas.

The availability of staff also determines the cost of joint activities for researchers' institutional status. Where person-hours are scarce, scientists simply have less leeway to take on activities for which they are not held directly accountable. Shortages in personnel in Nepal's FSR&DD has made working with other units and building effective linkages very difficult. A similar problem was also cited in Senegal and Zambia.

Professional status. Concern for their professional status, as reflected in the career expectations and rewards of a scientist's peer group, represents a source of incentives or disincentives to joint efforts as well. Time for collaborative research entails an opportunity cost in terms of completing disciplinary research which can often be published more easily in academic journals and for which scientists may sooner be rewarded by professional recognition. The benefits of peer group recognition, whether abstract — pride in being respected — or concrete — advancement within the field and future job opportunities — can become more difficult for scientists to attain when they are 'diverted' from more specialized work into collaborative research. This problem, however, seldom emerged explicitly in the case studies reviewed. Problems with publishing OFCOR results appear to occur only where OFCOR gets bogged down in narrow, routine, testing activities. Yet, lack of opportunity for publishing research results has been cited repeatedly in the literature as a major constraint to institutionalizing OFCOR. (See, for example, Anderson and Hardaker, 1986; Biggs, 1985; Chambers, 1980; Gibbon, 1985.)

However obvious it may seem, it remains important enough to justify pointing out that the institutional culture prevailing within a research system affects the professional status of scientists who participate in collaborative activities. Should the reward system, for example, favor the development of appropriate technologies over basic research, ventures integrating

[24] Biggs (1984) points out the importance of designing policy which compensates for predictable aspects of human nature and the constraints they impose. For more on the significance of a behavioral perspective in management and the importance of a rational incentive policy see Honadle and Klauss (1979), chapters 1, 5, and 6.

on-farm and station-based research could enhance the professional status of the scientists involved.

Personal costs. Collaborative research often entails travel and field work under difficult conditions, not to mention long separations from home. Such personal hardships seem all the more severe when per diems are inadequate, expenses have to be paid out of pocket and reimbursement is delayed, or travelling eats up time scheduled for family or other professional activities. The case studies and relevant literature show that managers would do well not to underestimate how powerfully disuasive feelings of deprivation and inconvenience can be (Biggs, 1984)

The FSR&DD in Nepal, for example, has had great difficulty getting scientists from other departments to participate in collaborative planning activities in the field because authorized per diems do not cover expenses incurred. Similar problems were cited in Guatemala, Ecuador, NRIP in Nepal, and Zambia. Conversely, the generous per diems paid to members of Technical Committees in the multi-institute projects in Indonesia have provided a strong incentive for senior researchers to travel out to the field to work with the outposted OFCOR staff.

Intellectual incentives. Finally, it is important to note that if scientists perceive joint research activities as intellectually rewarding and helpful to their own ongoing research, then their motivation to collaborate will be strong, despite possible reservations related to institutional or professional status or personal discomfort. The incentive is only slightly different where OFCOR and OSR are conducted by the same individual, commitment to integration may still depend in large measure on how rewarding it promises to be to the scientists' intellectual curiosity, or how likely it seems that farm level research will turn up something of value for further on-station research.

Management lessons. Comparative analysis of the cases generated useful management lessons for making collaborative activities attractive to scientists.

Institutional support for collaborative activities. The case studies reviewed suggest that research managers attempting to integrate OFCOR and OSR need to lend explicit and active institutional support to collaborative activities. Such support should involve, first, systematic guidelines for allocating research time between individual and joint activities and, second, formal recognition in evaluation and reward procedures of collaborative research activities and contributions to technology development.[25] In this way, managers can confirm the policy priority assigned to integration, strongly encouraging scientists to initiate and participate in collaborative activities.

Managers can also demonstrate their commitment to OFCOR-OSR integration by participating in joint activities themselves. At LAC, for example, the Director takes part in the semi-annual group treks during which scientists spend 5-10 days at field sites reviewing on-farm research and interacting with farmers. His example has been very important in stimulating other scientists' involvement.

Promotion of professional opportunities. Research managers can alleviate fears about the possible costs to one's professional status by facilitating opportunities for publication or attendance at international meetings for scientists who collaborate in joint research activities. This has been done to good effect in Zambia and Indonesia. As an inducement to joint undertakings the managers can also provide guarantees that credit for successful research will be apportioned fairly among all who collaborated, whether through the joint authorship of publications or some other form of recognition visible within the research system and, where relevant, to funding agencies.

Steps can also be taken to minimize the opportunity costs of collaborative activities in relation to other research. By clustering OFCOR trials and locating sites near stations, for example, managers can make field visits easier and faster. Well organized and efficiently run meetings can also cut down on the time scientists feel they lose as a consequence of collaboration and integration efforts.

Intellectual incentives. Managers will only be able to cultivate intellectual incentives for participating in collaborative research if scientists view both OSR and OFCOR as scientifically credible. Should OSR and OFCOR be organized separately, then managers must first of all find ways to allow scientists to interact and become familiar with each other's research as is discussed in the following chapter.

Comparative analysis of the cases studied indicates several insitutional conditions which influence research managers' ability to motivate scientists to participate in collaborative activities. Station-based researchers' interest in effectively integrating OFCOR as a complementary research effort tends to increase when

[25] See also Dillon and Anderson (1983).

more marginal, and less well understood, environments are given priority as occurred in Zimbabwe, Nepal, and Indonesia. Staff stability within the research system helps because scientists have the time and repeated contact to build solid collegial relationships. More centralized systems where larger groups of scientists are based together are also beneficial for increasing informal and formal interaction among scientists and for reducing the financial and personal costs to scientists of long journeys to participate in joint activities. Lastly, availability of operating funds as well as staff time for collaborative activities is obviously crucial.

Condition 6. Scientists Have Adequate Opportunities for Formal and Informal Interaction

Integration of OFCOR and experiment station research is unthinkable without the interaction of researchers to 1) exchange information, and 2) develop collegial familiarity and respect. The first point requires little explanation; it is perhaps axiomatic that the exchange of information and specialized advice requires contact. The second is born out by the case study experiences which indicate that collegial familiarity and respect, and not simply material incentives, are generally necessary before researchers initiate collaborative activities.

Issues. Research managers can create opportunities for contact between OFCOR and OSR scientists. Proximity, both organizational and physical, promotes interaction. In addition to making formal interaction easier to arrange, organizational and physical proximity increase the likelihood of informal exchanges. Where opportunities are limited by distance, the gap has to be bridged by communication facilities and active management.

Obviously, too, the size of the NARS is also a factor which strongly influences both a manager's ability to create opportunities for interaction and the means available. Informal interaction is clearly easier in smaller institutes. The task of a manager hoping to multiply opportunities for informal interaction among researchers of different departments in BARI with more than 800 scientists and 18 divisions and research centers is completely different from that of a manager in Nepal's LAC with only 16 scientists located in 7 departments at a single station.

Experiences from the case studies. Despite the necessity of contact between OFCOR and OSR scientists, as a precondition for integration of the research process, opportunities for interaction were considered as inadequate in 60% of the cases reviewed.

Organizational proximity. Organizational proximity refers to the degree to which scientists in OFCOR and OSR come into regular contact with each other because they are assigned to the same unit within the research system — e.g. a commodity or regional program, a disciplinary department, or a division uniting various commodities or disciplines. Close organizational proximity was seen as stimulating formal and informal interaction between scientists working in OFCOR and OSR in approximately half of the cases studied: Senegal, Zambia, Indonesia, LAC and PAC in Nepal, and the Zimbabwe institutes.

OFCOR researchers in Senegal's DRSP, for example, had more frequent contact with station-based scientists in their department than with commodity scientists from other departments. In Zambia OFCOR and station-based scientists in the same donor-funded projects found that because this arrangement afforded them more than the usual opportunities for interaction, it stimulated collaborative research. In Indonesia's multi-institute projects, because scientists temporarily seconded to OFCOR projects maintained organizational affiliation with their home institutes, sustained interaction with their colleagues in those institutes was possible. Conversely in Nepal removal of the CSP from the Agronomy Division to become the FSR&DD conferred a higher institutional status on OFCOR; at the same time, however, the innovation set up organizational barriers which have impeded FSR&DD from developing links with station-based research programs in other division. In Ecuador and Guatemala, where OFCOR is a separate program and staff live and work out in the field, managers have tried to promote greater integration with OSR by affiliating each OFCOR team with a specific regional station.

It is important to bear in mind that even in situations where one and the same scientist conducts both OFCOR and OSR and some functional integration is therefore implicit, interdisciplinary or intercommodity interaction may not occur. In Zimbabwe the Committee for On-Farm Research and Extension was introduced partially to provide linkages and stronger integration between OFR and station-based *research* across institutes and disciplines. Similarly, in Nepal, LAC instituted the Farming Systems Research Thrust to integrate the on-farm and station-based work of various disciplinary departments.

Physical proximity. When scientists work daily in each other's immediate vicinity, analysis of the case studies suggests, joint activities are easier to arrange, require less effort to carry out, and, consequently, occur more

frequently. The less travel involved before interaction can take place, the lower the expense including opportunity costs. In both Zambia and Senegal, where OFCOR is organized as a separate program, links have proven considerably stronger between OFCOR and commodity scientists when they are based together at regional stations. Similarly in Panama, where OFCOR-OSR integration has generally been weak, strong collaboration nevertheless developed between livestock researchers and OFCOR scientists from the Dual-Purpose Cattle Project who were based together at the Gualaca Research Station.

The proximity of OFCOR trial sites to research stations also appears to affect integration between OFCOR and OSR. In the Indonesia case study accessibility of OFCOR sites was credited with facilitating integration; conversely, in BARI, the distance between OFCOR sites and experiment stations was alleged to impede joint OFCOR-OSR activities.

Communication facilities. Bridging organizational and physical distances, however slight, requires communication facilities and other resources. Joint activities demand access to some minimal combination of phones, radios, vehicles, fuel, per diems and housing. The case studies show how lack of attention to providing these commonplace necessities can make the interaction among scientists awkward and stumbling. In Zambia, for example, poor communication facilities and long distances make even the planning of joint activities, much less their implementation, difficult. Similarly, in Panama, tensions arose because OSR scientists, who had no means to communicate rapidly with OFCOR field teams, often simply did not show up for scheduled meetings, disrupting the work schedules of OFCOR scientists and wasting their time (Sands et al., 1985).

Management lessons. The case studies show that to strengthen OFCOR and OSR integration research managers should foster staff proximity, either through organizational arrangements or by basing scientists together so that they come in frequent contact, or both. When OFCOR and OSR scientists are obliged to work at a physical or organizational distance from each other, managers must find ways to bring them together and to facilitate communications. Indeed, the costs of maintaining proximity, funds for travel and communication, cannot be ignored. Currently operating funds are often limited and particularly vulnerable to budget cuts. Consequently, in the interest of building integration managers should anticipate these potential constraints and earmark a safe portion of their budgets specifically to support the logistics of collaborative activities.

Clearly, the way research is organized, e.g. by departments, programs, regional stations, will be an important institutional condition influencing a research managers' ability to create productive opportunities for interaction, as will the degree of centralization of research infrastructure. The availability of operating funds also emerged in the case studies as a key factor determining managers' ability to successfully organize joint OFCOR-OSR meetings and collaborative activities.

CHAPTER 4
MANAGEMENT MECHANISMS FOR STRENGTHENING INTEGRATION OF ON-FARM AND EXPERIMENT STATION RESEARCH

I. Introduction

Research managers in the institutions studied have experimented with and developed numerous management mechanisms which have proven successful in strengthening integration of OFCOR and OSR and, thus, in improving the effectiveness of the research system as a whole. These mechanisms help to:

1) *create incentives* to stimulate and reward collaboration;
2) *mobilize resources* to support communication, cooperation, and joint activities;
3) *provide opportunities* for formal and informal interaction.

Nine key linkage mechanisms were identified in the comparative analysis of case study OFCOR situations (Table 5). These were found to contribute to the attainment of all six strategic conditions identified in Chapter 3 as promoting integration and to facilitate performance of most, if not all, of the research linkage functions described in Chapters 1 and 2.

Obviously there is no single recipe for good research management. The utility and feasibility of specific mechanisms will vary with the institutional setting in which they are applied, as will the most effective form of their implementation. Nevertheless, analysis of managers' experiences in using mechanisms to promote integration in diverse OFCOR situations has yielded valuable insights, ideas, and management lessons upon which research managers can draw when formulating strategies appropriate for strengthening integration in their own institutions.

The mechanisms reviewed below fall under four distinct management areas: research management processes, collaborative scientific activities, resource allocation procedures, and coordination (Table 5). The following discussion highlights each mechanism's specific contribution to developing stronger integration, managers' experience in using the mechanisms in the diverse OFCOR situations studied, and the relevant management lessons to draw from these experiences.

Chart 5 shows the frequency with which these mechanisms were used across the institutional settings reviewed and the percentage of case studies in which they were specifically cited as important to strengthening integration. Chart 5 summarizes in graphic form the data presented in Annex Table 2. This table indicates the number of OFCOR situations for which information on each mechanism was available, the number of situations in which the mechanism was used, and the number of situations where case study researchers singled the mechanism out as contributing to stronger integration.

Table 5:
Key Management Mechanisms for Strengthening OFCOR-OSR Integration

Research Management Processes

- Joint problem diagnosis and collaborative priority-setting and planning exercises.
- Joint programming and review meetings.
- Periodic joint visits to the field.
- Joint decisions on release of recommendations.

Collaborative Scientific Activities

- Formal collaboration in trials and surveys.
- Stimulation of informal consultation.

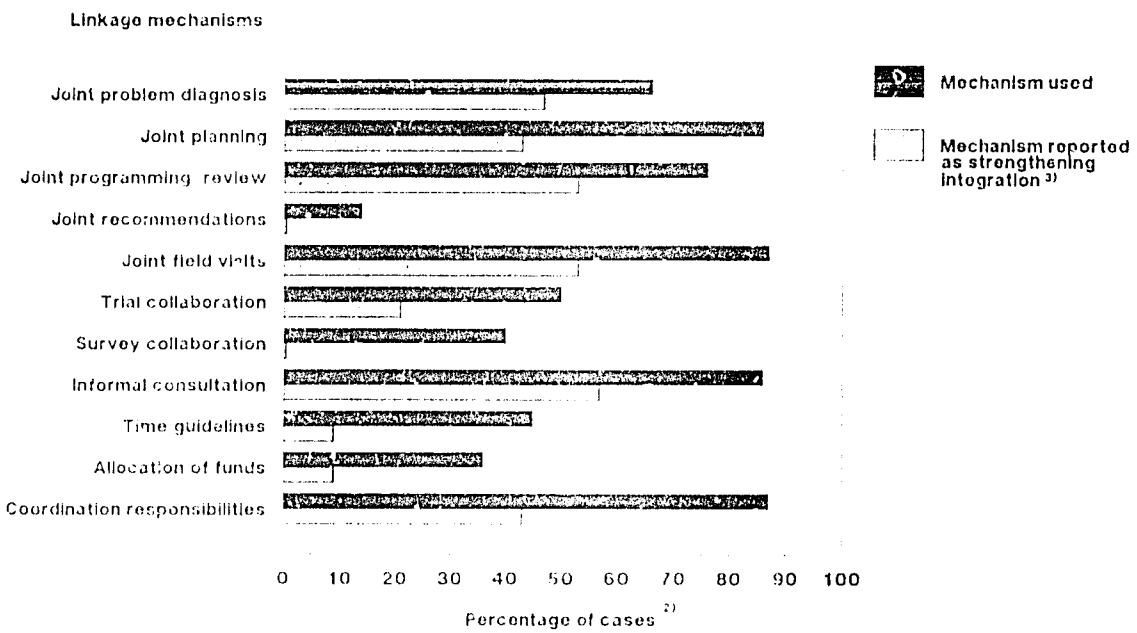
Resource Allocation Procedures

- Formal guidelines for allocating time to collaborative activities.
- Specific allocation of funds for collaborative activities.

Coordination

- Assignment of responsibility for coordination to a specific individual or group.

Chart 5: Percent of Cases in which Management Mechanisms for Strengthening OFCOR-OSR Integration Were Used[1]



Notes:

1) N = 17. Management mechanisms analyzed for discrete projects or programs within case study institutions.

2) Percentage based on number of situations for which information was available. Refer to Annex Table 2.

3) Refers to percent of OFCOR situations in which case study researchers specifically credited the mechanism with strengthening OFCOR-OSR integration.

II. Research Management Processes

Joint Problem Diagnosis and Collaborative Priority-Setting and Planning Exercises

The experiences of the OFCOR situations studied demonstrate that the joint diagnosis of farm-level constraints and collaborative definition of research priorities by OFCOR and station-based scientists is a powerful integrating mechanism. When effectively managed, it strongly improves the performance of all OFCOR-OSR linkage functions, especially the support and feedback functions, and it facilitates the attainment of all six strategic conditions identified as desirable for strengthening integration.

This mechanism can establish a solid foundation for on-going collaboration. By providing opportunities for discussion of farm-level problems and for debate and exchange of specialist knowledge, it helps to build a shared commitment to identified priorities and research problems and facilitates a complementary division of labor within a common problem-solving thrust. By promoting 'bottom-up' priority-setting based on systematic field-level analysis of the key constraints which specific target groups of farmers face, this mechanism also enhances the quality and relevance of both OFCOR and experiment station research. Case studies revealed, moreover, that the benefits of this mechanism increase when joint decision-making efforts also involve joint field visits (see below).

Research managers had used this linkage mechanism in the majority of OFCOR situations studied (Chart 5). In 65% of the situations for which information was available, station-based researchers had participated in diagnostic and priority-setting activities for OFCOR. And in 50% this mechanism was explicitly cited as contributing to effective integration.[1] It is important to note, however, that involvement of OFCOR scientists in

[1] See also Byerlee and Ali (1984) on Pakistan.

formal priority-setting exercises for experiment station research was less common and in only two cases was it specifically credited with strengthening integration.

The most common application of this mechanism has been to involve scientists working in OFCOR and station-based research in an informal field-level diagnostic survey leading to a joint priority-setting and planning exercise. The precise organizational and managerial arrangements adopted for carrying out this activity have varied considerably across the case study situations, however, reflecting differences in institutional contexts. In Guatemala, for example, the *sondeo* (Hildebrand and Ruano, 1982), a multidisciplinary, informal, diagnostic survey, was developed specifically to involve station-based researchers in initial field-level problem diagnosis and priority setting. In the early days of ICTA, the multidisciplinary OFCOR team based in the social science department found that when they carried out field diagnoses and defined research priorities independently, they could not get station-based researchers to support their conclusions. After initial conflicts, they changed their strategy to involve senior, station-based scientists and research managers actively. This approach proved successful in promoting strong collaboration for a number of years, but subsequently lost momentum. Today participation by station based scientists is erratic. The case study researchers cite lack of support from senior management and financial constraints to explain the declining effectiveness of this mechanism.

The FSRU in Zimbabwe implemented what was basically the same mechanism, but in a somewhat different way. Owing to the high level of specialist expertise available in DR&SS, the FSRU team gave priority to involving senior scientists in the development of their research plan. Early collaboration in problem diagnosis and priority-setting was seen as essential for building a strong OFCOR program which would effectively complement existing research programs.

To define their research agenda, the FSRU, with strong support from senior management, organized a week-long workshop in both of their research areas. These workshops, involving 20 senior scientists from DR&SS, included discussions with farmers and field diagnosis of key constraints to production. Joint efforts generated a tentative list of potential innovations for each area. The FSRU team subsequently evaluated the proposals for technical and economic feasibility, and developed a formal research plan. After the first year of research, the FSRU team organized a second round of workshops and invited station-based scientists to review their research results and to advise on the future direction of the research program. This thoughtful attention to involving senior scientists in the definition of research priorities for FSRU's on-farm research program has provided a solid basis for subsequent collaboration.

Among the OFCOR situations studied in Nepal, a number of interesting variations on the common model of 'the group trek' were registered which reflect the distinct institutional settings in which the mechanism has been implemented. The group trek involves scientists of different disciplines travelling together to field sites where they meet with farmers to diagnose key constraints and to identify opportunities for research. Through discussions in the field, scientists reach agreement on research priorities and develop a research plan with a clearly defined on-farm and station-based research division of labor (Mathema and Galt, 1987).

The implementation of group treks has been comparatively easy for LAC and EAC whose small size and more narrowly defined regional mandate facilitate collaboration. Their scientists reside together on-station, see themselves as working together in an integrated program, and report to a common director who actively promotes joint exercises. The field sites visited are within a single day's walk. External donor funding covers the expenses of scientists in the field. Thanks to these facilitating conditions, 10- to 12-day group treks can be carried out at LAC twice a year.

In contrast, when attempting to implement a group trek the FSR&DD has faced more daunting organizational and managerial problems (Mathema and Galt, 1987). The research institution has a national, rather than regional, mandate. Its scientists are so dispersed that to bring them together for a joint activity is logistically difficult and costly. Resource constraints, moreover, have resulted in per diems for scientists so low that they do not even cover the actual costs of staying in the field. Furthermore, since FSR&DD is only one department in a large institution, it is more difficult to get the attention of senior management and their explicit support for collaboration. These factors reduce incentives for station-based scientists to participate in group treks. Yet, despite these constraints, and although FSR&DD has in fact had to cut back time spent in the field to two to five days, the group trek is still viewed as a key mechanism for linking FSR&DD with other divisions and commodity programs. It also remains the principal means for integrating the research of FSR&DD and the Socioeconomic Research and Extension Department.

Collaborative priority-setting and planning exercises are particularly effective when implemented periodically, which, unfortunately, is not prevailing practice. The experiences of the cases indicate that regular joint field visits to reassess priorities and research agenda and to develop plans for joint work help to sustain active collaboration between OFCOR and station-based research. In both Guatemala and Ecuador, where initial joint field exercises in problem diagnosis stimulated intense collaboration, lack of repetition led to a decline of interest and participation in collaborative OFCOR-OSR activities over time. In contrast, in Nepal, group treks have been institutionalized at regular intervals. This helps maintain dynamism in collaborative research efforts and enables scientists to monitor the progress and direction of their research systematically.

The case studies reviewed disclose several additional managerial factors important for increasing the effectiveness of joint problem diagnosis and planning:

1) explicit support from senior management for joint participation in priority-setting and planning exercises;
2) involvement of senior scientists who have the power to make decisions on research plans and programs;
3) implementation of joint planning activities in the field with interaction with farmers;
4) identification of joint planning as a means for defining research agenda for both on-farm and station-based research;
5) clear definition of the objectives and expected output/product of joint exercises (Pandey et al., 1986);
6) a well-defined methodology or procedures for problem diagnosis and priority-setting;
7) unambiguous assignment of responsibility for coordination and leadership to a specific research manager;
8) allocation of sufficient funds to cover costs in the field and to minimize hardships for scientists;
9) periodic monitoring of progress in the execution of assigned research tasks.

It is clear from the case studies that research managers have primarily emphasized involving station-based researchers in developing research plans for OFCOR. More attention needs to be paid to ensuring that OFCOR scientists participate in formal priority-setting exercises for station-based research. Although this occurred incidentally in several research institutions studied, it still needs to be arranged more systematically if OFCOR is to perform its feedback function effectively.

Joint Programming and Review Meetings

Because joint review of proposed programs and research results facilitates the performance of all linkage research functions, it is potentially a very effective mechanism for integrating OFCOR and station-based research. For research institutes with well-established programming and review processes, this mechanism may be easier to implement than joint priority-setting and planning. The experiences of the cases indicate, however, that equal and active participation in programming and review by both partners on a regular basis and in a truly collaborative spirit is difficult to sustain.

Joint programming and review meetings can provide an effective and efficient means for improving communication among researchers. They make rapid dissemination of new research results possible as well as creating a setting for immediate feedback from colleagues. This clearly helps assure the relevance and quality of both on-farm and on-station research. Such meetings can also provide a convenient arena for efficiently organizing coordinated or collaborative research efforts.

When managers attempt to institute this linkage mechanism, they will inevitably confront scientists worried about issues of power and control. They will have to proceed carefully and ensure a balance of power. The experiences of the case studies indicate how important it is for joint programming and review processes to be perceived by all as consultative, and not supervisory, with researchers drawing on each others' respective areas of expertise.

Joint programming and review meetings were used in various forms in almost all the OFCOR situations studied (Chart 5). In more than half the cases such meetings were said to promote integration. In Panama, the lack of such a mechanism was identified as an obstruction to effective OFCOR-OSR linkages. Once again, however, it should be noted that joint review is not usually reciprocal; it is more common for station-based researchers to examine critically OFCOR's proposed programs and research results than vice versa.

Depending on the specific institutional setting and on established programming and review procedures, research managers in the cases studied implemented this linkage mechanism in different ways. Needless to say, its application is much more straightforward in situations where the same scientists carry out both OFCOR and station-based research, as in LAC in Nepal and the various research institutes in Zimbabwe. The case study

experiences reviewed below indicate some of the main issues for research managers to consider when attempting to institute joint programming and review meetings in settings where separate staffs carry out OFCOR and experiment-station research.

In Zambia, such meetings have probably emerged as the single most important mechanism for overcoming conflicts between ARPT and CSRT scientists and, thus, for building stronger, more effective, collaboration. Small meetings are organized to review research results and programs proposed for specific commodities. These are attended by commodity researchers and ARPT scientists who are working on the crops involved. The small meetings, it should be pointed out, were designed to complement large, public, highly formal, annual review meetings which had proven unsuitable for detailed program analysis, critical discussion, and joint planning. Significantly, both ARPT and CSRT scientists regard the small gatherings as a valuable linkage mechanism. Because the meetings are restricted to staff within the relevant research programs, and are narrowly focussed, they expedite the productive and efficient exchange of information, advice, and preliminary research results. This has led to the improved performance of all basic linkage research functions and to significantly stronger integration. ARPT researchers regard the meetings as their principal forum for communicating farmers' problems and needs to station-based researchers.

That regional organization of research facilitates implementation of joint programming and review meetings is evident from the experiences of ICTA in Guatemala, LAC and PAC in Nepal, and the Lowveld research station in Zimbabwe. At ICTA, annual meetings are held at the stations to review the results and proposed research agenda of each commodity program and discipline operating in the region. These meetings provide the principal opportunity for influencing the work plans of other programs and for organizing collaborative activities. The end result is an integrated research plan for the region. Owing to their relatively small size and their clear focus on regional research, the meetings have worked rather effectively to integrate the research of Technology Testing teams and commodity programs, and to promote a strong client orientation in research.

Some problems have arisen, however, in the regional planning process in Guatemala. First, because there is no formal monitoring mechanism, adjustments in proposed programs or arrangements for collaborative work agreed upon during joint meetings are not always incorporated into the final regional plan, much less actually carried out. Secondly, the meetings have mostly facilitated the flow of information in only one direction, from the commodity programs to the Technology Testing teams. Case study experiences in Guatemala indicate that favorable research policy and regularly held joint programming meetings in no way guarantee effective two-way communication. Even where OFCOR's feedback function is an explicit part of the research system's design and has the unambiguous formal support of the institution, as is true for ICTA, such feedback can prove difficult to implement. Two explanations for the disappointing situation recounted in ICTA's case study are that 1) Technology Testing teams present their findings last at programming and review meetings when interest and attendance has already largely waned and most programming decisions have been taken, and 2) until recently, the Technology Testing teams had no national coordinator to defend their interests and inputs into regional plans.

While in Guatemala and Zambia, OFCOR and station-based researchers have interacted at joint programming and review meetings on relatively equal footing, in other OFCOR situations senior scientists from experiment stations have rather one-sidedly been called upon to assess OFCOR research results and programs. Such review committees have operated in Ecuador, in multi-institute OFCOR projects in Indonesia, and at NRIP in Nepal.

While the use of such a review committee of senior scientists may improve communication and facilitate the performance of the service, support, and applied research linkage functions, it is less conducive to improving the feedback and adaptive research functions. Power here is invested solely in station-based scientists. They have a mandate to guide the direction of the OFCOR program, while OFCOR's possible influence on station-based research remains informal. This may not provoke major problems where there is a senior OFCOR scientist who can defend the OFCOR research agenda. When OFCOR scientists are all junior, however, the danger exists that the OSR review committee will assume a supervisory, rather than an advisory role so that complementary aspects of OFCOR are all too easily slighted. Case study experiences in Ecuador, where the research results and proposed programs of PIP teams are reviewed by the Technical Committee of the research station, illustrate such a development. Until recently the Technical Committee was made up exclusively of senior station-based researchers, with no PIP representation. Although this arrangement fostered communication among programs,

it also appears to have had a negative impact on the nature of PIP's research. Because the Technical Committee evaluated PIP's work according to the same criteria used for station-based research, PIP researchers, conscious of their need to be judged positively, limited reports to conventional statistical analyses of agronomic results, coefficients of variation, and justifications of trials lost – criteria by which 'good' scientific research is judged. They neglected the OFCOR perspective, in effect suppressing alternative types of information and analysis germane to meaningful farm-level research. Now that the problem has been recognized in a recent evaluation of the PIP program, however, the reorganization of joint programming and review to center on individual commodities, similar to the approach adhered to in Zambia, is expected to improve the situation presently.

These types of problems with review committees can be overcome by including a senior OFCOR scientist on a committee used to review both OFCOR and station-based research. This approach was used on the Samaru Research Station in Nigeria to help ensure the relevance of station-based research to the priority needs of small farmers in the region (Dagg, personal communication). Similarly, in the multi-institute OFCOR projects of Indonesia, where a Technical Committee of senior scientists advises the OFCOR program, the OFCOR project leader is also invited to attend the programming and review meetings of the collaborating institutes.

Senior managers must exert pressure continuously to defend the role of OFCOR researchers in the programming process. If they do not, experience in the case studies indicates that OSR scientists will almost inevitably come to dominate the agenda, feedback will be stifled, and the effectiveness of both program as well the overall research effort will suffer.

Comparative analysis of the experiences of the case study NARS identifies a number of managerial practices to strengthen the effectiveness of joint programming and review meetings as an integrating mechanism.

1) Such meetings should have the full support of senior research management and the attendance of researchers should be mandatory. (Erratic attendance undermined the effectiveness of meetings in Guatemala and Zambia.)
2) When OFCOR and station-based research are conducted by separate groups, both should participate equally in the review of each others' programs.
3) For the productive exchange of information and planning of collaborative activities, smaller meetings with a focussed mandate (e.g. commodity or region based) and with only the relevant scientists in attendance are the most suitable. Public presentation of research results should be confined to a different type of meeting. One meeting cannot successfully meet both these disparate objectives.
4) Participants in meetings should have the power to make programming decisions and implement proposals. Otherwise, the meetings can only serve for information exchange.
5) After joint programming and review meetings a written summary of agreements reached on division of labor and responsibilities will facilitate follow-up and monitoring of implementation.
6) When OFCOR and OSR have a common supervisor, it is easier to organize joint programming and review meetings and to ensure that any decisions reached are subsequently implemented.

Periodic Joint Field Visits

Participation in regular joint field visits, such as annual monitoring tours or regular field days, in addition to the periodic planning and programming exercises discussed above, emerged from the case studies as a crucial mechanism for developing stronger integration between OSR and OFCOR scientists. The point to be emphasized with respect to this linkage mechanism is that such joint field visits should occur on a regular basis instead of occasionally or as a one-off priority-setting exercise. Joint field visits are particularly important for the adaptive research, support, and feedback functions. Case study experiences indicate during joint field visits the complementary roles of OFCOR and station-based research become vivified, paving the way for stronger collaboration. The value of OFCOR becomes more visible in the field and through direct interaction with farmer-clients. Station-based scientists, seeing their technologies being applied under actual farm conditions, can develop a clearer understanding of their clients' needs and of the opportunities for and constraints against intervention.[27] This in turn helps them identify potentially relevant technologies more expeditiously and motivates them to provide a stronger support role for OFCOR. Joint field visits also allow OFCOR researchers to demonstrate their technical skills and complementary expertise, thereby increasing their scientific credibility in the eyes of station-based scientists and enhancing the attractiveness of professional collaboration.

[27] See also Baker and Norman (1988); Chambers (1980), Horton and Sawyer (1988), and Lev (1988).

Although joint field visits may be logistically more problematic and, sometimes, more expensive to arrange than meetings or seminars held at stations, case study experiences indicate that the benefits they yield warrant the additional trouble and investment. Being in the field together on a regular basis, jointly diagnosing and analyzing technical problems or successes, stimulates a sharply focused, lively exchange of ideas and provides a basis for building future cooperation. When scientists, removed from their normal work environments, are thrown together in the field, moreover, anxieties about status, power, and ego which typically color their more formal meetings, are apt to fade into the background.

In 85% of the OFCOR situations for which information was available regular joint field visits were scheduled. In 60% this mechanism was explicitly credited with strengthening integration of on-farm and station-based research (Chart 5). In Nepal periodic joint field visits have formed an important linkage mechanism in all OFCOR situations studied. In the Cropping Systems Research Program, for example, the maize breeder's frequent visits to research sites was cited as establishing a basis for strong and effective collaboration. In Zambia joint field visits have resulted in the 'conversions' of several CSRT scientists who were previously highly critical of ARPT and the quality of its research. In Zimbabwe the FSRU has held separate field days solely for station-based scientists as a means for fostering stronger and more productive collaboration.

Field visits are equally important when OFCOR is carried out by scientists who also conduct station-based research (Biggs 1982, 1983, 1985). In these situations, it is beneficial, when possible, to have trial sites clustered relatively near to the stations, for this allows OFCOR researchers to travel frequently to the field and to take other specialists along for consultation. In both MARIF in Indonesia and LAC in Nepal, the proximity of field sites was credited with improving the effectiveness and efficiency with which OFCOR was integrated into the institutional research program.

To be sure evidence from the case studies also indicates that implementation of regular joint field visits can constitute a real challenge to management. To begin with they require significant forward planning; in addition logistics can be complicated, especially where communications are difficult; funds must be secured; when travel will involve some hardship and discomfort, researchers must be persuaded that their gains will be worth the trouble; and, finally, someone has to assume responsibility for arranging the events.

In Zambia the ARPT National Coordinator reported having to invest considerable energy in organizing such field visits. What is more, even though ARPT covered the costs and handled the logistical arrangements, a specific directive from senior management was still necessary to secure collaboration. Furthermore, joint field visits, like many collaborative activities, are particularly vulnerable to cuts in operating funds. This was the principal reason for their curtailment in Guatemala and Ecuador. Funding constraints also frustrated managers who wanted to arrange joint field trips in Zambia and Zimbabwe.

Managers should not overlook the possibility that joint field visits might have a negative impact on OFCOR-OSR integration, if OSR scientists see what they believe to be messy or poorly implemented trials, which happened in Zambia. Also, to maintain the scientific credibility of OFCOR researchers, it is important for OSR scientists to be apprised of the various ways in which research on farms differs from that on stations. A clear explanation should be provided of the rationale behind the design and implementation of the OFR trials which they observe.

Analysis of the case study experiences suggests a number of additional management considerations for assuring the success of joint field trips:

1) Effective cooperation is easiest to secure when a common supervisor of OFCOR and station-based research organizes joint field visits. Responsibility for specific arrangements, however, can best be delegated to an individual who is committed to the usefulness of the mechanism.
2) Funds should be allocated specifically for field visits so that researchers are not confronted with making difficult choices among competing priorities.
3) Joint field visits should be well planned and organized so that researchers do not feel they are wasting time or undergoing hardships that could have been avoided.
4) A written summary of the principal conclusions reached during field visits can help guide ensuing discussion and facilitates follow-up.

Joint Decisions on the Release of Recommendations

Little experimentation with this mechanism was documented in the case studies. Yet, quite severe conflicts between OFCOR and station-based researchers over power and responsibilities for formulating recommendations arose to test managers' skills in Ecuador, Zambia, and Guatemala. Evidence

from the cases studied suggests that less potential for such conflict exists in situations where the same researchers carry out both on-farm and station-based research. When OFCOR and OSR are carried out by different groups, conflict is most likely in situations where experiment station researchers have a national mandate, as in most commodity programs, but OFCOR researchers are deployed regionally.

In most of the cases reviewed, such conflicts arose largely because procedures and responsibilities for recommendation release were ambiguously defined. Research managers have chosen to address the problem in different ways. In Guatemala, for example, after intermittent conflicts, the Technology Testing Unit was eventually given final responsibility for issuing recommendations based on the validation of technologies in on-farm tests. In Zambia, after much debate, a representative of ARPT was appointed to the national-level Variety Release Committee.

Research managers should be aware of this potential area for conflict, and as soon as an OFCOR effort is instituted, should establish unambiguous procedures for recommendation release.

III. Collaborative Scientific Activities

Formal Collaboration in Trials and Surveys

Formal collaboration in the design, implementation, and analysis of results from trials and surveys refers to shared responsibility, not merely to consultation. An important mechanism for strengthening integration when distinct groups of researchers carry out OFCOR and station-based research, formal collaboration supports integration in four principal ways.

1) It helps to build shared interests and objectives, reducing the tendency of OSR and OFCOR scientists to develop separate group identities and loyalties (i.e. counters the 'us-them' syndrome).
2) It helps both OSR and OFCOR scientists to orient their research to meet each other's priority needs and interests, i.e. to treat one another specifically as the clients of each other's research.
3) It helps to overcome common conflicts between OFCOR and OSR staff over the validity of their respective methods, results, and evaluation criteria.
4) It provides an excellent opportunity for focussed professional interaction.

Collaboration in trials and surveys can contribute to the performance of all five basic linkage research functions, although it is less important for the service function. It can also enhance the scientific credibility of OFCOR research, thereby fostering professional incentives for interaction.

Despite its obvious advantages for strengthening integration, formal collaboration in trials and surveys was not frequent in the case studies reviewed (Chart 5). Formal collaboration in trials occurred in only half the situations for which information was available, and in only three cases was it cited explicitly as promoting stronger integration. Collaboration in formal surveys, even less common, was reported only in Zambia and Zimbabwe.

In the case studies OFCOR-OSR, collaboration in trials generally sprang from informal arrangements among scientists. It was facilitated not only by organizational and geographic proximity, but by other more formal opportunities for interaction as well, such as joint programming meetings. One of the principal advantages of this linkage mechanism is that through collaborative fieldwork station-based researchers generally become more appreciative of the difficulties of working in less controlled on-farm environments, and more flexible in their criteria for evaluating on-farm research results.

Collaboration in the design of formal surveys and in the interpretation of data is more difficult to manage, but it has the potential to be very beneficial for integration.

Typically, information generated through OFCOR social science research is the most difficult of all to communicate successfully to station-based scientists. Unfamiliar with the research methods employed, they are often less than confident in the reliability and utility of the information produced. Involving OSR scientists directly in the design and implementation of surveys has several advantages. This approach helps ensure that the data which OSR scientists need are adequately collected, that OSR scientists' reservations about the quality of information can be dealt with before the survey is implemented, and that station scientists' prevailing assumptions about farmers' problems based on ad hoc observations can be tested adequately during the survey. Also, since many survey questions are usually of a technical nature, the quality and utility of the survey can be markedly improved by involving specialists in the formulation of questions, and interpretation of results.

By encouraging OSR collaboration in formal surveys, research managers can help to improve the relevance to station-based scientists of a major OFCOR research activity, enhancing the scientific credibility of OFCOR significantly and providing a stronger basis for OFCOR-OSR integration within the research institution.

Stimulation of Informal Consultation

Although less tangible than the previous linkage mechanisms, informal consultation entails benefits for research integration which research managers should not overlook. Informal consultation builds trust, arouses interest and personal commitment, and motivates colleagues to undertake formal collaboration.

A low-cost and expedient means of communication, it can be especially important for the support and feedback functions. Research managers can stimulate informal consultation by ensuring opportunities for scientists working in OFCOR-OSR to interact.

In 85% of the OFCOR situations for which we have information, informal consultations took place regularly between scientists working in OFCOR and those on experiment stations (Chart 5). In approximately 50%, such contacts were explicitly recognized as having a strong positive impact on integration. In the Caisan project in Panama and FSR&DD in Nepal, geographic and organizational isolation were blamed for inhibiting the informal exchange of information and, thus, forming an obstacle to effective integration.

In Ecuador informal consultation was even cited as the most important means for integrating PIP's work with that of experiment station researchers. The exchanges were usually initiated by PIP researchers during their regular visits to the stations. Since PIP researchers are generally hired from within INIAP, rather than from outside, they know the scientists at the stations and it has been comparatively easy for them to build collegial relations with them.

In Nepal the strong bond between researchers at LAC and PAC and scientists in the commodity programs of the national research institution has been based mainly on informal exchanges among friends. The same holds true for the CSP, where the fact that CSP researchers were part of the same externally funded donor project as many of the commodity scientists made forming close collegial relationships all the easier.

It is important to realize that within a research system the level of informal consultations among scientists need not depend wholly on individual personalities. A research manager can identify and promote various kinds of informal exchanges in his/her system.

For starters, as mentioned above during discussion of a manager's possible strategies for providing opportunities for staff interaction, proximity, both organizational and physical, considerably enhances the likelihood of informal consultation. Casual meetings entering a building, in a hallway, or in a recreational area lead to greater familiarity, and to useful exchanges of information. In Zimbabwe, for example, the tea room of the main Research Station has emerged as a key locale for informal consultation among leaders from the institutes and the FSRU.

Case study experiences indicate that research managers should take proximity seriously into account when deciding on appropriate means for organizing OFCOR in their systems. Although outposting OFCOR scientists to field sites may improve their interaction with farmers, for example, it clearly impedes their ability to intensify collegial relations with experiment station scientists. A manager's organizational model of choice must, indeed, depend on his/her specific objectives for OFCOR within the research process.[28]

Managers can also create opportunities for researchers to become better acquainted, professionally and socially, by scheduling opportunities for them to meet collectively, such as seminars, social gatherings, recreational activities, or joint trips. Although such events may seem trivial compared to other linkage mechanisms and research conditions we have discussed earlier, in the end successful scientific collaboration requires researchers being personally and professionally motivated to interact.

Research managers should be cautious, however, not to rely too heavily on informal consultations as a linkage mechanism. A common problem is that such collaborative relationships do not last, especially where there is instability in staffing owing to reliance on foreign scientists or to high rates of turnover or internal transfers.

[28] Detailed analysis of the strengths and weaknesses of various arrangements for organizing OFCOR will be treated in a forthcoming comparative study paper by D. Merrill-Sands, S. Biggs, P. Ewell, and S. Poats.

IV. Resource Allocation Procedures

Formal Guidelines for Allocation of Time to Collaborative Activities

Collaborative activities require researchers' time, a scarce resource in many institutes. The experiences documented in the case studies indicate that if collaborative activities are to be effective, managers cannot rely solely on researchers' own informal choices of how to use their time. Personal interests and those professional responsibilities for which researchers are held directly accountable will inevitably take precedence over joint activities. Where OFCOR and station-based research are carried out by the same individuals, the issue is somewhat different, but no less crucial. Scientists may not voluntarily concede time to OFCOR that could be spent on other more familiar, more institutionally favored, or better rewarded station work. It is therefore incumbent upon a research manager to provide clear and realistic guidelines about the amount of time to be devoted to OFCOR-OSR joint activities, and to back these guidelines up with well-argued justifications, as well as with incentives and rewards for productive collaboration. Guidelines express a management's commitment to collaborative activities and recognize formally the corresponding adjustments that have to be made in time allocated to other responsibilities when joint activities are programmed. They also help significantly in forward planning.

Guidelines for the allocation of researcher time were documented in less than half of the OFCOR situations reviewed (Chart 5). Lack of guidelines and formal time allocation procedures were identified as hindering integration in Guatemala, Panama, Ecuador, Bangladesh and Zambia. Where they were used, they varied markedly in clarity and with respect to the organizational level at which they were applied.

In Nepal's NARS, a policy notice was circulated to researchers which stipulated that they spend 40% of their time out on farms. Yet, because the on-farm activities intended were not specified, scientists passed the prescribed hours doing extension training, attending farmers' fairs, and carrying out other activities but not conducting OFCOR. In contrast, when Zimbabwe's Agronomy Institute and the LAC in Nepal set guidelines allocating time to OFCOR activities specifically (25% and 45% respectively), the mechanism proved successful.

Staff compliance has been all the greater, moreover, because at both institutes, which are comparatively small, management can easily oversee implementation of the policy. What's more, at both the Agronomy Institute and LAC, the generalized model of OFCOR obtains, so that researchers were already participating to some extent in on-farm research — an adjustment of time, not perspective, was required of them.

Very specific time guidelines are used in Indonesia's multi-institute projects. Membership on the Technical Committee of a multi-institute OFCOR project is officially recognized as a part-time responsibility for participating station-based scientists. Researcher time for collaborative meetings and visits to project sites is allocated formally. OFCOR researchers also have time reserved to return periodically to the home institutes from which they have been seconded. The Indonesian guidelines, which clarify and, to some extent, facilitate procedures for interaction between OFCOR and institute scientists, are perceived as an important mechanism for strengthening integration.

Case study experiences establish that guidelines for the allocation of researcher time become more effective as a spur to interaction as they become more specific. A guideline that spells out in a concrete workplan how much of a researcher's time is to be spent on collaborative activities may in fact be particularly effective. The introduction of such a mechanism, repeatedly recommended in the literature (Collinson, 1984; Norman and Collinson, 1985), was proposed by case study researchers in Ecuador, Guatemala, and Zambia.

Case study experiences also reveal that incentives for staff to follow guidelines increase the probability of compliance.

Research managers can, indeed, create incentives, employing such various tactics as rewarding scientists in staff review procedures for their collaborative activities, emphasizing collaboration in job descriptions (Zambia), promoting publication policies which favor collaborative work, or participating in collaborative activities themselves (LAC).

The third and crucial management consideration in setting time allocation guidelines is that more time for one thing means less time for another. It is vital never to assign so much research time for collaborative efforts that other core activities come into jeopardy. Guidelines should embody a realistic appraisal of the actual person-hours available. In situations where human

resources are scarce, such as a commodity program with a staff of only two, emphasis on collaborative activities may well be ill-considered. Even where researchers are not in such short supply, a manager needs to assess the relative promise of individual and collaborative activities carefully. OFCOR-OSR collaboration is always appealing, but it can have high opportunity costs in terms of researchers' finding themselves unable to fulfill other essential responsibilities.

Specific Allocation of Funds for Collaborative Activities

Our case studies demonstrate that lack of money to meet such operating costs as transportation, fuel, or researchers' per diems in the field commonly constitutes a barrier to OFCOR and OSR integration. Funding constraints can endanger the feedback and support functions in particular for these rely on the unbroken, iterative exchange of information between OFCOR and station-based researchers. Here, surely, managerial foresight should be able to forestall disruptions. Nevertheless, in only four case studies reviewed were there funds specifically budgeted to support collaborative activities. The resources upon which OFCOR-OSR cooperation and coordination depend appear to be assumed more often than managed.

Lack of funds were said to thwart collaborative activities — joint field visits in particular — in Ecuador, Guatemala, Panama, Zambia, and FSR&DD in Nepal. In some cases the unavailability of adequate financing made field trips arduous for scientists, and therefore unattractive. In Nepal the official FSR&DD per diem does not even cover the actual costs researchers incur in the field. In other cases, funds have not been available for vehicles and fuel — effectively curtailing collaborative field activities before they can begin.

By way of contrast, in Indonesia's multi-institute OFCOR projects, a travel budget is officially allocated to enable members of the Technical Committee to visit project sites regularly. These funds, including generous per diems, provide strong incentives for scientists to serve on the committees and to make collaborative field trips.

Where sufficient, if not ample, financial resources are available, the allocation of operational funds for collaborative activities, like the management of person-hours, reflects the priority which managers ascribe to these activities. A major lesson from the case studies is that if collaboration and stronger OFCOR-OSR integration are truly desired, then funds have to be allocated formally to support linkage mechanisms. One way to ensure this is to make coordination of collaborative activities a line item in a program budget. Another is to place funds for operational activities under the control of the individual(s) responsible for such coordination. In institutional settings where OFCOR and station research are by and large separate, specific allocation of funds from both partners in projected collaboration is important in order to avoid complacence arising from situations in which one side always initiates and the other merely follows along.

V. Coordination

Assignment of Responsibility for Coordination of OFCOR-OSR Collaboration to a Specific Individual or Group

Successful implementation of the various linkage mechanisms discussed above depends largely on effective coordination of the inputs of both partners. Coordination, a challenging and time consuming management task, entails such responsibilities as arranging joint programming and review meetings or joint field visits, as well as drafting guidelines for allocating researcher time, or other resources. It also involves a considerable amount of time spent in meetings and talking, what some would call 'networking.' Coordination of collaboration is especially necessary where OFCOR and station-based research are carried out by two separate staffs. To be effective, coordination should be the clear-cut responsibility of a specific individual or group.

This necessity appears to be recognized clearly by research managers: in 85% of the OFCOR situations reviewed, responsibility for coordinating on-farm and station-based research had been officially assigned to a person or a committee (Chart 5). Nevertheless, those designated did not always discharge their responsibilities effectively. In only half of the cases did it appear that coordination was contributing actively to successful integration.

In the cases studied, research managers assigned responsibility for coordination of collaboration to:

1) a representative of either OFCOR or OSR, but usually OFCOR;
2) a common supervisor;
3) a coordinating committee.

Each of these three alternatives has proven to involve distinct advantages and disadvantages.

Representative of OFCOR. Assignment of coordination responsibilities to OFCOR leadership was managements' most common choice, preferred in Ecuador, Zambia, Senegal, the multi-institute projects of Indonesia, and the Cropping Systems Research program in Nepal. It also occurred, informally, in the FSRU in Zimbabwe. Comparative analysis of these situations has identified five factors which influence an OFCOR leader's ability to carry out coordination responsibilities effectively.

First, coordinators with considerable research experience and a sound technical background in agricultural sciences will more readily secure the respect and cooperation of station-based scientists. Such credentials are particularly important when the OFCOR leader designated to be coordinator is a social scientist. He/she needs enough training and experience in the agricultural sciences to be able to interact professionally with senior natural scientists and to understand the work of station-based researchers.

Second, motivation is important: does the individual appointed recognize the need for coordination and has he/she a personal and professional interest in assuming the responsibility? Scientists who 'just want to get on with their work' will not excel in a coordinator role. Often, an OFCOR leader will have greater professional interest in coordinating collaborative research than a station-based program leader because OFCOR's success depends so largely on the output of applied research programs.

Third, an individual with many other responsibilities competing for his/her time and attention will have trouble fulfilling a coordinator's duties. In Ecuador and Senegal, administrative procedures and donor relations consumed so much of OFCOR leaders' time, that they could not devote adequate attention to coordination responsibilities. This jeopardized building effective links with station-based researchers. Time for coordination must be protected.

Fourth, a rapid turnover of coordinators undermines research integration. When the person responsible for coordination of collaboration changes frequently, as in Ecuador, relationships with station-based scientists need to be rebuilt continually before further positive action is possible. In Zambia, on the other hand, the national coordinator for ARPT served for six uninterrupted years, and he was able to experiment with and develop numerous coordinating mechanisms which led to significant improvements in OFCOR-OSR collaboration.

Fifth, when the OFCOR leader-coordinator has no authority to ensure that station-based researchers participate in collaborative activities senior management needs to lend explicit support to his/her efforts to execute coordinating responsibilities. It should be made clear that OFCOR is not soliciting OSR support independently, but that coordination of collaboration is a high-level institutional priority intended to improve the quality, relevance and complementarity of both on-farm and station-based research.

LAC in Nepal uses a variation of the OFCOR leader-coordinator model. Researchers in all LAC departments are involved part-time in OFCOR through their participation in the multidisciplinary Farming Systems Research Thrust. Overall responsibility for coordination of collaboration, however, is assigned to the Socioeconomics Department. The rationale behind this choice is that because the Socioeconomics Department does not generate technology of its own, it is relatively neutral. Coordination has worked well. In this case coordination of collaborative activities has been greatly facilitated by the small size of the institute and the active support and participation of the Director.

Common supervisor. In five other case study situations, Guatemala, Zimbabwe, single-institute projects in Indonesia, and the PAC and NRIP in Nepal, coordination of collaboration was assigned to a joint OFCOR-OSR supervisor. The principal advantage of this option is that because the joint supervisor has authority over both groups, he/she can more easily promote and monitor the implementation of collaborative activities. An additional advantage is that he/she can be instrumental in ensuring that on-farm and on-station research are integrated into a coherent program addressing designated priorities and identified problems. As soon as ongoing results indicate a need for a reorientation of research, a joint supervisor is well placed to move quickly to bring about the desired changes in the research agenda of both on-farm and on-station programs (Biggs, 1985).

In Guatemala and Zimbabwe a senior research manager from the national research institute (Deputy Director or

Technical Director level) was the joint supervisor assigned to coordinate collaboration. These experiences show, however, that although individuals at this level may have the power to execute decisions efficiently, they are also likely to have many competing responsibilities which limit the time they have available for attending to coordination.

Other case studies indicate that a joint OFCOR-OSR supervisor can discharge responsibilities for coordination more effectively when he/she occupies a somewhat lower management level position which involves fewer competing management responsibilities, e.g. such as program or station director. In Guatemala, some of ICTA's regional directors assumed this role and effectively coordinated the research activities of the Technology Testing teams with that of the commodity programs. In PAC in Nepal the Head of the Agronomy Department oversees both on-farm and on-station research which form part of an integrated program. He is also responsible for coordinating the work of his Department with the other departments in the institute, including the Socioeconomics Department. Similarly, in the Small Ruminant Collaborative Research Support Project at Indonesia's RIAP, the program coordinator is responsible for coordinating on-farm and on-station research within the project.

A joint supervisor's effectiveness in coordinating OFCOR and OSR will reflect the time he/she has available, the priority he/she assigns to coordination activities, the degree of respect and authority he/she commands within the research institute, and his/her understanding of the objectives and role of OFCOR within the research system.

From analysis of the case studies it appears that the arrangement of choice for effective coordination is a two-tiered distribution of responsibility with a high-level research manager bearing general responsibility, but explicitly delegating the organization, implementation, and monitoring of collaborative activities to a lower-level manager. This lower-level individual is better able to do the footwork involved in developing and instituting coordinating mechanisms, while the senior administrator has the authority to provide the incentives to ensure that scientists participate, and to see to it that linkage mechanisms are faithfully implemented.

Coordinating committee. In Nepal and Zimbabwe committees have been assigned responsibility for coordination of collaboration within the national research organizations. Both committees have only recently been formed so it is difficult to judge their effectiveness yet. In Nepal the committee faces the same difficulties which high-level administrators confront. It is responsible for coordinating research within the entire national research institute and therefore the coordination of FSR&DD with research in other divisions is only one small duty out of many. As a result the committee has still to set OFCOR-OSR linkage mechanisms fully in motion.

In DR&SS in Zimbabwe where there are many independent on-farm research efforts, the Director instituted in 1986 a coordinating committee (COFRE) comprised of the Heads of those units considered to be essential participants in OFR for the communal areas. In its first year and a half, the committee made considerable progress in rationalizing the diverse OFR efforts, coordinating station-based and on-farm research, and developing links with extension. Two key management factors have contributed to its success: 1) the committee has explicit support from the Director of DR&SS who frequently participates in meetings; and 2) it is comprised of managers with the authority to act decisively in committing resources to collaborative activities and to initiate new directions of research when required.

In any research situation coordination of the collaboration on which OFCOR-OSR integration depends has to be managed actively.
To have a chance to succeed individual(s) or group(s) assigned responsibility for coordination require:

1) enough time and resources to attend to the demanding tasks of coordination;
2) sufficient authority, status, and respect from colleagues to implement their ideas;
3) well-developed interpersonal skills for resolving conflict; and
4) strong professional motivation for strengthening integration (Handy, 1985).

CHAPTER 5
CONCLUSIONS

I. Using the Guidelines

The experiences of the case studies reviewed show that, however desirable, strong OFCOR-OSR integration is not an easy objective to achieve or to sustain over the long term. Active management and explicit institutional support are essential preconditions for productive collaboration, yet no single formula exists guaranteeing success in strengthening integration. There is no generic model, no blueprint for integration appropriate to all research systems; nor can a management strategy for OFCOR-OSR integration successfully implemented in one NARS be transferred directly to another. Research institutions, in terms of their culture, size, mandate, policies, organization, and existing management processes, are simply too heterogeneous — not to mention the diverse objectives and priorities of individual research managers. Under different institutional conditions, specific measures for strengthening integration, such as instituting particular linkage mechanisms or allocating certain kinds of human or financial resources, demonstrate variable results and utility. In some of the cases, for example, the hiring of experienced foreign scientists in the early stages of developing OFCOR contributed to building integration because their expertise helped establish OFCOR's scientific credibility. Elsewhere, however, where institutional conditions were different, their presence bred conflict and resentment against OFCOR.

The clearest implication of the case study experiences as a whole is that to achieve effective OFCOR-OSR integration research managers must design a strategy tailored in all respects to the specific objectives and conditions of their own systems. This in no way means, however, that research managers cannot learn from each other's experiences. To the contrary, our comparative analysis of nine research systems with relatively mature OFCOR efforts shows:

1) certain predictable problems arise when managers try to forge stronger OFCOR-OSR integration;
2) certain institutional conditions which either impede or facilitate integration frequently recur;
3) certain basic management principles and tools to strengthen integration are applicable, with adaptation, across a wide range of institutional settings.

We have consolidated the large body of management experience embodied in the case studies to generate practical guidelines to assist research managers in deriving and institutionalizing their own management strategies. The guidelines apply to all five essential steps of strategy design and implementation:

1) setting objectives;
2) diagnosing the research system to identify opportunities and constraints for building integration;
3) designing a plan of action;
4) implementing the plan of action;
5) monitoring progress.

Setting Objectives for OFCOR-OSR Integration

In designing a management strategy the first step is to define the nature and degree of OSR-OFCOR integration required to attain the goals of the research system. After all, integration is not an end in itself, but a means to improve the research system's capacity to respond efficiently and effectively to the priority needs of its client groups, resource-poor farmers in particular. Despite the overriding importance of setting clear, feasible objectives, the case studies show execution of this first step has consistently been a weak management area.

Setting objectives for a management strategy to achieve OFCOR-OSR integration necessitates reaching decisions about the emphasis to be given to each of the five linkage research functions — the service, adaptive research, feedback, applied research, and support functions — and defining the nature and capacity of OFCOR and OSR required to perform these functions as planned. The case studies show that the requisite balance among linkage functions will vary with the types of research problems which a NARS confronts. No hard and fast rule obtains for all situations.

Recognizing that, given the resource constraints endemic in many NARS, ideal OFCOR-OSR integration can rarely be achieved, managers must make sure that their management objectives are realistic. They need to base their aspirations on an accurate assessment of current OFCOR and OSR capacity, and on the likelihood that sufficient institutional flexibility exists for them to improve on present levels of

integration. Our review of the strengths and weaknesses of various organizational options and management processes instituted to facilitate the performance of OFCOR-OSR linkage functions is offered to help managers define feasible objectives for OFCOR-OSR integration within their own systems.

Diagnosing Constraints and Opportunities

Following the basic rule that diagnosis should precede prescription, once managers have decided upon realistic objectives for OFCOR-OSR integration, they then need to analyze the specific conditions of their research systems in order to determine the best possible means for achieving their objectives. How should they design their management strategy given the constraints and opportunities present in their institutions?

In the case studies reviewed 13 environmental conditions were identified which significantly affected the quality and degree of OFCOR-OSR integration. These environmental conditions can serve as a checklist to help research managers gauge how favorably or unfavorably oriented to OFCOR-OSR integration their own systems are. They can also assist in identifying where significant, longer-term effort may prove useful in developing an institutional setting where integration has a better chance to succeed.

Designing a Plan of Action

Once major constraints and opportunities for management intervention have been diagnosed, managers can proceed to design a specific plan of action for strengthening OFCOR-OSR integration. Such a plan should contain a succinct description of operational measures, their relative priorities, and the sequence in which they are to be implemented.

In developing their workplans managers should take into account the six conditions identified through our case study analysis as facilitating OFCOR-OSR integration. Indeed, these are the institutional conditions they must cultivate if they are to realize the full benefits of OFCOR-OSR integration for enhancing the effectiveness and efficiency of the research process. Study of the facilitating conditions and the policy, organizational and human factors influencing a manager's ability to create them can help research managers determine where in their own systems they need to take action and what kinds of operational measures promise to be most useful. Our analysis of case study experiences can also help them anticipate and design solutions to the more common problems likely to beset managers who are striving to develop these conditions.

The synthesis of diverse institutional experiences presented in the text also provides managers with a body of basic management principles and a wide range of management tools to draw upon when designing specific measures of their own to strengthen OFCOR-OSR integration in their systems.

Implementing the Plan of Action and Monitoring Progress

Even a cursory reading of the experiences of the case study research institutions is sufficient to discover that the effectiveness of individual management strategies and mechanisms to foster OFCOR-OSR integration has varied considerably across institutional settings. Our account of factors adding to or detracting from the performance of the various linkage mechanisms can be of assistance to managers trying to appraise the utility of various integration-strengthening mechanisms for use in their own particular institutions. Learning from others' experiences may enable them to adapt promising mechanisms to the specific conditions of their research institution while avoiding the problems which typically arise when managers attempt to use the mechanism.

The degree to which the six basic facilitating conditions have been realized can serve as an indication for managers of their progress towards creating a setting conducive to successful integration.

II. Lessons Learned

Comparative analysis of the experiences of the research institutions in the case studies has disclosed the basic issues involved in successfully integrating OFCOR and experiment station research. Important lessons, highlighted throughout the paper, have emerged for those responsible for designing and implementing management strategies to build stronger integration. Several of the most important lessons merit reemphasis.

A Balanced Build-Up of OFCOR and OSR is Essential for Strong Integration

The case study experiences show that the way in which OFCOR is introduced into a NARS is likely to influence

significantly a research managers' ability to develop effective integration. Overly ambitious initial attempts to develop OFCOR capacities may jeopardize the eventual stable incorporation of OFCOR activities within the research process.

Analyses of the cases supports the proposition that effective integration of OFCOR and OSR is best served by a balanced build-up of both. OFCOR and OSR are complementary and mutually dependent; the success of each is a function of the effectiveness and productivity of the other. To carry out adaptive research effectively, OFCOR relies upon station-based research to provide 1) a range of technological options which can be adjusted to specific agroecological and socioeconomic conditions, and 2) specialized expertise to assist in the diagnosis of farm-level problems and the design of their solutions. In the same vein, OSR needs OFCOR to give 1) feedback on the performance of technologies under a wide range of realistic management conditions, and 2) sound information on the priority needs and problems of specific client groups of farmers. Such information flow is particularly important for research in marginal environments where agricultural constraints are particularly daunting, where clients' needs are generally not well understood, and their links with the research system are often weak at best.

The rapid build-up of OFCOR efforts is a problem not only when it outstrips the development of OSR programs, but also when it exceeds OFCOR expertise. We have learned from some of our cases that too much too soon — in terms of the size and scope of OFCOR efforts — undermines the quality of research and, thus, damages OFCOR's scientific credibility. The development of strong OFCOR capacity takes time. Incremental build-up of OFCOR, in terms of number of agroecological zones covered, and number of components and interactions in the farming system addressed, permits the consolidation of experience and the growth of expertise, both of which are essential if OFCOR and OSR are to contribute to the research process as equal partners.

Integration may also be endangered by institutional tension if OFCOR is perceived as a major corrective strategy introduced to compensate for past failures of OSR. To ensure mutual cooperation, research managers must leave no room for doubt that OFCOR is intended to complement, not compete with, OSR. Similarly, any perception of OFCOR as enjoying special status or advantages in acquiring resources will usually work against successful OFCOR–OSR integration. Case study experiences demonstrate that strong donor attention to OFCOR at the expense of more traditional OSR can cause friction, damaging the prospects of the successful long-term integration of OFCOR within the research process.

As a general rule, research managers introducing OFCOR into a NARS or significantly building up existing OFCOR capacity should not be overambitious, carefully planning OFCOR's incremental development over time in step with the complementary development of OSR capacities. Any significant imbalance in the capacities of OSR and OFCOR will prohibit successful performance of the full complement of the five research linkage functions, diminishing the effectiveness and efficiency of the research process as a whole.

Each Organizational Option for OFCOR Entails Distinct Opportunities and Constraints for Integration

Managers developing OFCOR capacity in their research systems have to choose among various ways to organize OFCOR. They must decide whether scientists currently involved in experiment-station research should extend their programs to include on-farm research activities — what we have called the generalized model; whether a separate group of researchers should be assigned responsibility for OFCOR functions — what we have called the specialized model; or whether OFCOR should be conducted by both specialists and generalists — what we have called the composite model. The choice of model has important implications for the nature and quality of OFCOR's links with other components of the research system, with clients, and with extension, as well as for the further management of research processes and field operations.[7] Several consequences of different organizational options for OFCOR-OSR integration deserve emphasis here.

Research managers need to determine whether, in their particular system, the generalized, specialized, or composite OFCOR model will bring about the most rational and workable division of labor and responsibility for carrying out the complementary research functions of OFCOR and OSR. The case studies indicate that this decision should reflect the dominant kinds of research problems being addressed, the degree to which farm-level problems are currently understood by scientists on-station, the relative emphasis to be given to respective linkage functions, and the overall size of the research system and availability of

[7] These implications will be fully analysed in a forthcoming comparative study paper by D. Merrill-Sands, S. Biggs, P. Ewell, and S. Poats.

resources — both human and financial. The cases show, too, that none of the three models would be preferable in all NARS; each option has positive and negative implications for OFCOR-OSR integration, depending on the environment in which it is used.

The generalized model has one particularly obvious benefit for integration: when the same scientist conducts both OFCOR and OSR he/she passes information quickly and efficiently back and forth between the field and the station. Case study experiences suggest, however, that this arrangement has disadvantages with respect to both the scope of integration across disciplinary and commodity lines and the range of linkage functions that can be adequately performed. The generalized model, for example, facilitates information flow in the technology generation and testing processes, but is weaker in areas requiring a systems perspective such as definition of client groups, diagnosis of field-level problems, and the design and evaluation of potential solutions within the context of specific farming systems.

The specialized OFCOR model, on the other hand, because it facilitates the development of expertise in OFCOR in terms of methods and modes of analysis in both agronomic and socioeconomic research, offers clear benefits in terms of the quality and quantity of on-farm research conducted. Disciplinary biases, professional ambition, time constraints, or any combination of these may inhibit station-based scientists from fully developing the specialized skills that make OFCOR a valuable complement to OSR. One argument against adopting this model, however, is that it embodies intrinsic organizational barriers to effective integration. Where the specialized OFCOR model obtains, research managers have to find mechanisms to bridge the distances created by physical separation, organizational isolation, and the development of groups of researchers with separate and possibly conflicting identities.

While the composite OFCOR model has the potential to reinforce the strengths of both the generalized and specialized models and to mitigate their weaknesses, it requires intensive management and coordination skills if it is to be successfully implemented.

Team structure is a second organizational issue related to OFCOR-OSR integration. Ewell (1988) has defined the polar opposites of team organization as hierarchical versus autonomous. In hierarchical teams scientists are centrally located; they design and analyze research implemented in a number of research areas by field staff — technicians or junior scientists — whom they may or may not visit periodically. In contrast, in autonomous teams, scientists actually live at field sites and are directly engaged in all phases of research.

Again, these different team structures entail a trade-off of benefits for OFCOR-OSR integration. The principle advantage of the autonomous team structure is that scientists, kept in constant contact with farmers and field level problems, can develop and inject this vital area of expertise into the research system. The disadvantage for integration of the autonomous team, however, is that the outposting of OFCOR scientists limits their interaction with OSR scientists. Also, in many systems, only junior scientists can feasibly be assigned to remote areas; unless these scientists are supported by senior staff, doubts may arise about the quality and creativity of their on-farm research which, as we have seen from the cases, undermine OFCOR's scientific credibility.

In hierarchical teams interaction between scientists working in OFCOR and OSR is easier because at least the senior scientists are based together at the experiment stations or administrative headquarters of the NARS. Yet, the disadvantage is that senior OFCOR scientists may well remain rather isolated from the field research itself. This distancing can also lead to problems of scientific credibility, if OFCOR scientists prove unable to demonstrate complementary expertise in the in-depth understanding of farm-level problems and clients' needs.

An Effective Division of Labor and Responsibility for Research Functions Must Be Built on Consensus

Successful integration of OFCOR and OSR depends on researchers' agreement with and commitment to planned divisions of labor and responsibility for research functions. Experience shows that motivation to participate in collaboration is stronger when decisions on the assignment of research roles and responsibilities are reached after discussions among the managers and scientists involved than when such decisions are imposed by directive. Joint planning helps to ensure that OFCOR and OSR scientists perceive their allotted tasks to be realistic and feasible, their assigned roles legitimate, and the services and products expected of them necessary to their mutual success.

Strong Scientific Leadership for OFCOR is Essential for Developing and Sustaining Effective Integration

Strong scientific leadership for OFCOR contributes to building effective integration in two important ways. First, such leadership means that an OFCOR advocate

in the research system can defend the validity and utility of OFCOR methods and modes of analysis as well as the diverse kinds of data and information generated through on-farm research. Such a spokesperson is invaluable for building OFCOR's scientific credibility and for the effective performance of the feedback function. Second, strong OFCOR leadership is needed to inspire vigorous scientific effort, both nurturing systematic development of OFCOR capacity through encouraging methodological experimentation and innovation, and overseeing consolidation of on-farm research experience.

The experiences of the case studies reviewed indicate that OFCOR's leadership should have sufficient institutional and professional status to be able to interact with senior OSR scientists as their equal. This implies not only that they should have recognized credentials in both conventional agricultural research and social science research methods, but that their institutional position should be equivalent to those held by program leaders or department heads. It is also very important that the ability of OFCOR's leader(s) to provide research support and guidance does not get buried under overwhelming administrative or coordination duties.

Someone Must Be Responsible for Coordinating OFCOR-OSR Collaboration

The case studies suggest how necessary coordination is to initiate and sustain collaborative efforts among researchers successfully, to bring people together, to facilitate joint planning, to ensure that agreements are translated into action. OFCOR-OSR coordination entails a wide spectrum of responsibilities ranging from allocating resources for joint activities, to arranging joint field visits, to monitoring joint research programs. Such responsibilities are just as important for the specialized as for the generalized model of OFCOR — where it is necessary to coordinate activities across disciplines and commodities.

The experiences of the case studies lead us to believe that for coordination responsibilities to be effectively discharged, they must be entrusted to a particular individual or group. In choosing how to coordinate collaboration, research managers must take as their point of departure the specific needs of their particular NARS. Each of the three most common options which managers have used when assigning coordination responsibilities — an OFCOR or OSR representative, a joint OFCOR-OSR supervisor or a coordinating committee — entails distinct opportunities and problems. In any event, however, the individual or group acting as coordinator will succeed more readily if endowed with: enough time and resources to attend without hesitation or diversion to the actual tasks of coordination; enough authority, status and respect from colleagues to make ideas work; enough interpersonal skills to resolve conflicts smoothly; and enough professional motivation to work unreservedly to strengthen OFCOR-OSR integration.

Successful Performance of the Feedback and Support Functions Requires Intensive Management

The case studies show that implementation of the feedback and support functions has proven particularly challenging to research managers. Because these functions depend so heavily on periodic and intensive interaction among researchers, attempts to improve their performance may well involve changes in organization, work programs and the allocation of financial resources. In addition, the feedback and support functions entail revising the research agenda of other scientists or programs. Consequently performance of these functions can almost be expected to arouse conflicts of interest and scientific judgment.

For the feedback and support functions to be implemented and sustained meaningfully, they require strong support from senior research managers and energetic management directed towards fostering mutual respect among scientists, generating incentives and resources for collaboration, providing opportunities for interaction — formal and informal, integrating OFCOR-OSR planning and programming, and establishing an institutional culture which promotes and rewards a strong client orientation in research. When assigning priority to these functions, research managers need to recognize the real commitment to active management which their performance requires.

There Is No Such Thing as a Free Lunch: Resources Required for OFCOR-OSR Integration Must Come from Somewhere

Collaborative activities, which require both operational funds and researcher time, cannot just be tacked as additions onto researchers' existing programs. We have to accept that the law of conservation of energy will apply here as well as in the natural world; if researchers' resources are to be used in collaborative activities, they will have to be drawn from other enterprises. The case studies leave no doubt that researchers will rarely spontaneously assume an extra burden; personal interests and professional responsibilities for which

researchers are held directly accountable will take precedence over joint efforts.

Research managers, recognizing that the researcher-hours and financial resources which collaborative activities consume must be reallocated from other program activities, need to provide allocation guidelines to help researchers make rational choices among alternative activities. Guidelines not only assure the availability of necessary resources but demonstrate to researchers the value managers attach to collaborative research. If the priority assigned to OFCOR-OSR integration is ever to be more than rhetorical, managers must demonstrate institutional support of collaborative activities concretely in their programming decisions, including the allocation of rewards, funds and time.

Research Management Processes are Effective and Efficient Points of Intervention for Building OFCOR-OSR Integration

In most cases reviewed managers demonstrated considerable creative talent, even entrepreneurship at times, in their efforts to integrate OFCOR and OSR. One management area where mechanisms were frequently introduced to stimulate collaboration was research management processes, i.e. priority-setting, planning, and annual programming and review processes. Joint planning and programming meetings proved to be especially valuable arenas for OFCOR-OSR interaction. Comparative analysis of the case studies identified several managerial factors which significantly increase the effectiveness of joint research planning and programming exercises introduced to strengthen OFCOR-OSR integration: *explicit* support from and participation of senior management; clear definition of the objectives and output of the joint exercise; involvement of senior scientists with decision-making power; small, focused meetings; meetings in the field featuring direct interaction with farmers.

Finally, and very importantly, the cases indicate that scientists working in OFCOR and OSR should ideally participate as equals in joint planning, programming and review activities. These activities, carried out in a consultative, not supervisory spirit, can lend themselves to fortifying the research programs of *both* OFCOR and OSR. The cases reviewed disclose, however, that balanced collaboration is more the exception than the rule; it is more common for OSR scientists to be involved in the planning and programming of OFCOR than vice versa. This bias has jeopardized performance of the adaptive research and feedback functions and impaired development of effective integration.

A Return to Common Sense: Managers Need to Create Opportunities for Scientists to Interact

Interaction is essential to OFCOR-OSR integration, not only because it affords opportunities for the exchange of information among researchers, but also because it enables colleagues to get to know and respect each other. Such personal and professional familiarity increases researchers' motivation to participate in collaborative activities, especially in the kind of on-going informal consultation vital to the feedback and support functions. To appreciate the value of collegial interaction, whether between separate OFCOR and OSR units or across commodity and disciplinary boundaries, is commonsensical, and yet in almost two-thirds of the cases studied, opportunities for interaction were characterized as inadequate.

Research managers should promote opportunities — both formal and informal — for interaction between scientists. Such interaction is naturally easier to arrange when researchers can be based together, yet physical and organizational distances can also be bridged by managers sensitive to the importance of communications and eager to identify and develop mechanisms to bring scientists together. Managers also need to recognize, however, that where there is a structure of rewards and incentives for collaboration scientists are more likely to seize available opportunities for interaction.

Finally, to state the obvious in order not to overlook it: the movement of either information or researchers takes time, money and effort. The case study experiences reviewed suggest that without the explicit attention of management, stoppages are likely, creating bottlenecks detrimental to the development of OFCOR-OSR integration. The alert research manager will ensure that a lack of these basic necessities does not sabotage well-intentioned plans and that their provision, rather than an afterthought, is always the first step taken.

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Annex Table 1:
Appearance of Environmental Conditions Affecting OFCOR-OSR Integration in the Case Studies[1]

Environmental Conditions	Cases in Which the Condition Affected OFCOR-OSR Integration[2]
1. Orientation of development policy towards small farmers:	
-- strong	8: E, G, P, ZA, ZI, I, Na, Nb.
-- weak	1: B.
2. Research policy commitment to OFCOR:	
-- strong	5: G, ZA, ZI, I, Nb.
-- weak	2: E, P.
3. Organizational flexibility of the NARS:	
-- inflexible	1: E.
-- flexibile	6: G, P, S, ZA, ZI, Nb.
4. Stability of the NARI staff:	
a. Senior research managers:	
-- stable	1: ZA.
-- unstable	3: E, G, S.
b. Research staff:	
-- stable	0
-- unstable	5: E, G, S, ZA, Na.
5. Human resource base of the NARI:	
-- adequate	3: ZI, I, Nb.
-- scarce	7: E, G, P, S, ZA, B, Na.
6. Financial Resource Base of the NARI:	
-- adequate	3: ZI, I, Nb.
-- scarce	7: E, G, P, S, ZA, B, Na.
7. Development of research management processes:	
-- strong	4: E, G, Na, Nb.
-- weak	4: P, S, ZA, ZI.
8. Compatibility of OFCOR organization with organization of research in NARI:	
-- compatible	6: G, ZA, ZI, B, I, Nb.
-- incompatible	2: E, P.
9. Centralization of research infrastructure:	
-- centralized	4: P, S, ZA, ZI.
-- decentralized	4: E, G, B, I.
10. Capacity of OSR:	
-- technologies available	8: E, G, P, S, ZI, B, I, Nb. (Na)
-- lack of technologies	2: ZA, Na. (ZI, Nb)
11. OFR antecedents:	
-- long history	5: G, S, B, Na, Nb.
-- short history	2: E, ZA.
12. Capacity of extension:	
-- strong	2: ZI, Nb.
-- weak	2: E, G.
13. Agroecological complexity and diversity:	
-- high	7: E, G, ZA, ZI, I, Na, Nb.
-- low	0

Notes:

[1] N = 10. In Nepal, the NARS and LAC/PAC are considered separately.

[2] Key: Ecuador (E); Guatemala (G); Panama (P); Senegal (S); Zambia (ZA); Zimbabwe (ZI); Bangladesh (B); FSR&DD in Nepal (Na); LAC/PAC in Nepal (Nb).

Annex Table 2:
Frequency of Use of Management Mechanisms for Integration in the OFCOR Situations Studied[1]

Linkage mechanisms	Situations for which information was available. [2]	Situations where mechanism had been implemented. [3]	Situations where mechanism was cited as strengthening integration. [4]
1. a. Joint problem diagnosis and collaborative priority-setting exercises.	15	10: E, G, P, Sa, ZIb, Ia, Nb, Nc, Nd, Ne.	7: E, G, ZIb, Ia, Nb, Nc, Nd.
b. Joint planning exercises.	14	12: E, G, P, Sa, Sb, ZIa, ZIb, Ia, Ib, Nb, Nc, Nd.	6: ZIb, Ia, Ib, Nb, Nc, Nd.
2. Joint programming and review meetings.	17	13: E, G, Sa, ZA, ZIa, B, Ia, Ib, Na, Nb, Nc, Nd, Ne.	9: E, G, Sa, ZA, Ia, Ib, Nc, Nd, Ne.
3. Joint release of recommendations.	7	1: ZA.	0
4. Periodic joint visits to the field.	15	13: E, Pb, Sa, ZA, ZIa, ZIb, B, Ia, Ib, Na, Nc, Nd, Ne.	8: ZA, ZIa, ZIB, Ia, Ib, Na, Nd, Ne.
5. a. Collaboration in trials.	14	7: Pb, Sa, Sb, ZA, ZIb, Nb, Nc.	3: Sb, ZA, Nc.
b. Collaboration in formal surveys.	5	2: ZA, ZIa.	0
6. Facilitation of informal consultation.	14	12: E, Pb, Sa, Sb, ZA, ZIa, ZIb, Ia, Na, Nc, Nd, Ne.	8: E, Pb, Sb, ZIa, ZIb, Na, Nc, Nd.
7. Formal guidelines for allocating researcher time to collaborative activities.	11	5: ZA, ZIa, Ia, Nc, Ne.	1: Ia.
8. Specific allocation of funds for collaborative activities.	11	4: Ia, Nb, Nc, Nd.	1: Ia.
9. Assignment of responsibility for coordination to a specific individual or group.	16	14: E, G, Sa, Sb, ZA, ZIa, ZIb, Ia, Ib, Na, Nb, Nc, Nd, Ne.	7: ZA, ZIb, Ia, Ib, Nc, Nd, Ne.

Notes:

[1] The 17 OFCOR situations studied are grouped as follows: Ecuador, 1 (E); Guatemala, 1 (G); Panama, 2* -- Caisen (Pa), Dual-Purpose Cattle Project (Pb); Senegal, 2 -- linkages within DRSP (Sa), linkages with programs external to DRSP (Sb); Zambia, 1 (ZA); Zimbabwe, 2 -- institutes (ZIa), FSR Unit (ZIb); BARI, 1 (B); Indonesia, 2 -- multi-institute (Ia), single institute (Ib); Nepal, 5 -- Cropping Systems Program (Na), FSR&DD (Nb), LAC (Nc), PAC (Nd), NRIP (Ne). *When referring to the NARS-level program, treated as one (P); otherwise the two cases are separated because they have had very different types of linkages with OSR.

[2] Number of case study situations in which use of mechanism was explicitly mentioned. Information not available for all mechanisms in all cases.

[3] Represents situations where the mechanism has been used.

[4] Refers to the frequency of situations in which the case study writers specifically credited the mechanism with strengthening integration.