WORKING PAPER No. 35

Structural Linkages for Integrating Agricultural Research and Extension

by

Robin Bourgeois

International Service for National Agricultural Research

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

Of the 13 centers in the CGIAR network, ISNAR is the only one that focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on research policy, organization, and management issues, thus complementing the activities of other assistance agencies.

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AGROVOC Descriptors:

research; extension activities; management; technology transfer; diffusion of research; organization of research.

CAB Descriptors:

agricultural research; diffusion of research; management; technology transfer; organization of research; extension.

CONTENTS

CASES

GLOSSARY

(Definition of terms as used in this paper)

Coordination	the use of established rules (or the creation of new rules) to deal collectively with shared tasks.
Integration	a process whereby a unified, functioning whole is formed in order to produce an expected result. Here, integration between agricultural research and technology transfer is expected to produce relevant knowledge or technologies for those who need it.
Merging	merging is used either (1) to bring institutionally distinct units under a common administrative roof, (2) to have a single administrative body instead of several parastatals or semi-autonomous institutions, or (3) to build an interdisciplinary team with people seconded from separate units.
On-Farm Client-Oriented Research Study	a major ISNAR study on the organization and management of this type of research in national agricultural research systems. OFCOR is a research approach designed to help research meet the needs of specific clients, most commonly, resource-poor farmers. Its activities range from diagnosing and ranking problems through the design, development, adaptation and evaluation of appropriate technological services. Farmers are directly involved at various stages in the process.
Participation	having a share in something. Here it is used to characterize the involvement of people who are concerned with linkages.
Partnership	relation involving close cooperation between parties having specified and joint rights and responsibilities.
Research-Technology Transfer Linkages Study	a major ISNAR comparative study on the links between agricultural research and technology transfer in developing countries. Its objective is to identify ways to strengthen links in order to improve the relevance of research efforts and the transfer of technologies to agricultural producers and other users.
Standardization	a process of simplifying tasks so that the work to be done is easy to understand and the skill requirements are minimized.
Structural linkage	a formal mechanism (permanent part of the organization's or system's structure) set for the purpose of increasing integration between at least two separate units or organizations in charge of different but interdependent tasks, or between people belonging to at least two separate but interdependent units or organizations.
Task	work imposed by circumstance, with an obligation to perform or responsibility for performance.
Task interdependence	the relation between tasks due to the fact that they are part of a global process even though they have been separated from each other.
Task specialization	the way the work is defined and delimited in order to perform a function in a particular environment.

ACRONYMS

AERL	Agricultural Extension Research Liaison Service, Nigeria
AGRITEX	Department of Agricultural, Technical and Extension Services, Zimbabwe
CES	Coconut Extension Service, Tanzania
COFRE	Committee on On-farm Research and Extension, Zimbabwe
DR&SS	Department of Research and Development, Division of the Ministry of Lands, Agriculture and Rural Resettlement, Zimbabwe
INTA	Instituto Nacional de Tecnología Agropecuaria, Argentina
ISABU	Institut des Sciences Agronomiques du Burundi
NCDP	National Coconut Development Program, Tanzania
OFCOR	On-farm Client-Oriented Research
OFR	On-Farm Research
RELO	Research Extension Liaison Officer
T&V	Training and Visit system developed by the World Bank

FOREWORD

In the past five years, ISNAR has given high priority to developing sound advice for research managers on how to strengthen links with technology users — technology transfer agencies and farmers.

A working group of senior ISNAR staff of diverse experience and disciplinary backgrounds has focused on developing this program area. Under the guidance of this working group, ISNAR has carried out two major research projects which have advanced our knowledge and understanding of this complex area: the study on organization and management of on-farm client-oriented research and the study on research-extension linkages. The Governments of Italy and Germany and the Rockefeller Foundation supported this research. The studies, carried out in collaboration with research teams in 16 developing countries, are designed to produce practical advice for research managers. In the last three years, the studies have generated numerous case study reports and analytic papers. In late 1989, ISNAR convened an international workshop, Making the Link with Technology Users, to review and discuss the studies' findings and preliminary conclusions. Over 50 research managers, scientists, international advisors, and ISNAR staff members attended.

Dr. Bourgeois' paper derives from this concentrated effort to improve our understanding of the policy and institutional factors shaping the links between research and technology users. There are multiple ways of analyzing linkages. Dr. Bourgeois has not tried to cover all approaches. Rather, in this paper, he has tackled one of the most challenging aspects: organizational and structural considerations. He provides a concise and tightly argued discussion of how organizational factors affect linkages. He then systematically assesses the respective advantages and disadvantages of three common types of structural linkage mechanisms: direct supervision by a common manager, liaison positions, and coordinating committees.

Dr. Bourgeois wrote the paper in close collaboration with staff members, consultants, and national researchers working with ISNAR on this topic. He draws heavily on case materials produced by the two studies and weds this elegantly with insights taken from organizational theory. An earlier version of this paper was presented at the 1989 International Workshop and the final version has benefitted significantly from the workshop discussions and managers' feedback. This paper reflects a significant advance in our understanding of the organization and management of linkages and will be an important input into future work in this area. I recommend it to managers, practitioners, researchers, and advisors and consultants working in this area.

Deborah Merrill-Sands,
Convenor, ISNAR Working Group on Linkages with Technology Users

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This document is the result of an intensive collaboration between ISNAR researchers and national researchers responsible for case studies. An earlier version of this paper was presented at the International Workshop "Making the Link with Technology Users" convened at ISNAR, The Hague, The Netherlands, in November 1989.

The author wishes to thank in particular the members of ISNAR's Working Group on linkages with Technology Users for their valuable input. Comments from Deborah Merrill-Sands, Thomas Eponou, David Kaimowitz, N'Guetta Bosso, Howard Elliott, as well as editing by Gerry Toomey, have enabled me to sharpen the focus of this working paper. However, I am responsible for any remaining errors.

SUMMARY

Many gaps exist between agricultural research and extension. These are due to institutional, functional or communication problems which often result, in turn, in research results not reaching farmers or being irrelevant to their needs. These integration problems between two major tasks in agricultural development are extremely complex, involving technical, environmental and organizational factors.

There is no single, perfect solution to the problems of integration within agricultural research and technology-transfer systems. There is not even any general management model that applies to most circumstances. There are many ways that this issue may be approached: the structural one, the functional one, etc. . . . This paper focuses on the structural aspects of integration with specific reference to three major mechanisms: direct supervision, coordination positions or units, and permanent committees. It describes the possible roles that managers can play, the room they have for maneuver, and the factors to be considered in using such mechanisms. These issues are highlighted by case studies, findings from the literature, and other ISNAR research.

This paper argues that for integration to have legitimacy in the eyes of those whom it affects, a simple manipulation of a few elements of the organizational structure is not enough. There is a need to implement policies and procedures that promote integration within the system.

Two conditions for legitimacy seem preeminent: participation and partnership. It is assumed that when people know what to expect from the inclusion of collaborative activities in their work, they are more willing to take the plunge and to act in a way that meshes their own strategies and interests with the institution's objectives.

Structural Linkages for Integrating Agricultural Research and Extension

Robin Bourgeois

For agricultural research to contribute to development, there must be strong links between researchers, farmers and technology-transfer agencies. Otherwise, there is a high risk that innovations resulting from research will lack relevance or that relevant technologies will be ignored by farmers.

Close links have many practical benefits. They ensure that researchers concentrate on farmers' priority needs and that the latter remain abreast of technical innovations. They also promote farmers' access to the information, inputs, and services needed to support a technology.

Strong links ensure that research results from experiment stations are used to expand farmers' opportunities. They also increase the likelihood that farmers' knowledge and experience with new technologies are fed back to researchers. This in turn ensures that technologies are adapted to local agroecological and socioeconomic conditions.

Research and extension leaders are increasingly asked to organize and manage various links, both within and between research organizations, technology-transfer agencies and farmers. This paper concentrates on those links that are formally incorporated into the structure of the set of organizations charged with producing and delivering technologies for agricultural development. These are called "structural links", meaning a formal mechanism (permanent part of the organization's or system's structure) set for the purpose of increasing integration between at least two separate units or organizations in charge of different but interdependent tasks, or between people belonging to at least two separate but interdependent units or organizations.

Why Structural Links Matter

A leading author in organizational structure defines the structure of an organization "simply as the sum total of the ways in which it divides its labor into distinct tasks and then achieves coordination among them" (Mintzberg 1979:2). As an organization's framework, structure helps to channel and regulate the flow of information, resources, and authority both within and outside the organization. Therefore, it may (or may not) provide favorable conditions for linking its constituent elements.

Different patterns of organizational structure are responsible for problems in producing and transferring agricultural technologies relevant to farmers' needs The lack of fit between agricultural research and technology-transfer organizations is often related to issues in organizational structure. Kaimowitz et al. (1989), for instance, identify areas where agricultural research and technology transfer may not be in step:

- Research is organized on a national basis, while technology transfer is provincial.
- Research units follow agroecological distinctions, while technology transfer follows administrative ones.
- Research is sometimes divided into disciplines, while technology-transfer operations are divided by commodities or geographical areas.
- Research may focus on a single commodity, while technology transfer has a more general focus.

- Research services can be targeted on one client group, technology-transfer services on another.

Structural links discussed here represent a potential for improving the relevance and effectiveness of agricultural technologies. Their main advantage is that, being part of the structure, their sustainability is theoretically higher. This is important since some case studies describe technology-transfer processes which finally failed because linkages did not last. In the case of the PACO project in Ivory Coast, Eponou (1989) shows that informal linkages were crucial to the development and delivery of technologies during one phase of the project. His analysis, however, identifies the fragility of informal links as their major drawback. "The removal of just one person from the chain may have the effect of disrupting the whole linkage process, as there is no guarantee that that person's successor will play the same role" (Eponou 1989:6).

Managers' interest in structural linkages is illustrated by some of the questions raised by participants in an international workshop held at ISNAR:[1]

- In what contexts can the mechanisms be used?
- What are the effects of structural adjustment on linkages?
- Why is merging of research and extension not sufficient to ensure integration?
- Is it effective to put a person "in between", or should both institutions set up positions responsible for maintaining links?
- How should coordinators be monitored?
- Does coordination without authority work?

These questions reflect the difficulties managers usually face in managing integration as part of their job duties. Indeed, major efforts in the area of structure are often undertaken with mixed results. Decentralization follows centralization, semi-autonomous parastatals are created and then merged, formal units are introduced for the purpose of linking research and extension. It is difficult to know whether, how, and why such structural changes have succeeded or failed since minimal evaluation is carried out.

Why Managers Should Be Concerned With Managing Structural Linkages

Managers often consider structural conditions to be outside their control. True, there are certain constraints and the room for maneuver may be limited. But still, decisions and actions are possible. What is required is an understanding of some concepts and principles, as well as knowledge of specific situations. These can be helpful in analyzing what the problems are and how to tackle them.

First of all, managers have to be convinced that integration is vital. In Section 1, integration is shown to be a specific need in agricultural research and technology transfer, given the expected outputs, the way tasks are defined, and the various institutions and individual actors involved.

Section 2 gives a basic framework for the major structural arrangements for linking research with technology transfer and farmers. It also provides some principles to enable managers to take decisions and implement them, creating opportunities for integration.

Structural arrangements are simply the framework into which other elements fit. In Section 3, the will to integrate, both at the management and individual levels, is highlighted as a key to successful integration.

1. Making the Link between Agricultural Research and Technology Users, International Workshop, ISNAR, November 19-25, 1989, The Hague, the Netherlands. Participants were research and extension leaders, and policymakers.

1. THE NEED FOR INTEGRATION

This section provides evidence of the need for integration in agricultural research and technology-transfer activities. It is based on the fact that numerous and diverse tasks have to be performed. These tasks, however, are not independent. They require coordination if the common goal of producing relevant technologies for diverse groups of farmers is to be achieved.

Specialization Of Tasks In Agricultural Research And Technology Transfer

Organizational theory argues that different types of organizational arrangements are more effective for different types of work. Results of large comparative studies show that there is no best way to organize work, but that not all ways are equally effective (Burns and Stalker 1961, and Chandler 1966 cited by Galbraith 1977).

The type of work to be done, the way it is divided into specialized tasks, its complexity, and the amount of information or communication needed to perform it properly condition the organizational structure.

For example, work may be divided into simple tasks through a high level of specialization and standardization so that almost no job skills or knowledge are required to perform them. This is referred to as the "machine bureaucracy" model (Mintzberg 1979). This is characterized by proliferation of rules and procedures, formalized communications, large units grouped according to function, and centralized decision-making. A typical example is the mass production firms that arose from the Industrial Revolution.

But when a well-defined job becomes increasingly complex, it can be carried out only by individuals with a high level of knowledge and skill. In this case, the way the work is organized is often referred to as the "professional bureaucracy" model. This is characterized by standardization of skills and decentralization of control over the work. Still, there are rules and regulations for providing the expected outputs. Examples of this model include universities and hospitals. To a certain extent, it can also be applied to agricultural research.

But there is no clear cut or discrete structure for agricultural research and technology transfer. They are both part of a process, whose aim is to increase food availability for human beings and promote rural development. This is a continuous process because both "ends" — conception and end use — are intertwined, the latter modifying the former. Thus, problems addressed lead to new problems to be addressed and so forth.

Indeed, to conceive, develop, produce, and deliver relevant technologies is a complex mandate. Complex because of the large range of activities and clients. Complex because of diverse and changing environmental constraints and the difficulty in achieving standardization of products, qualifications, and tasks. Thus, both the scope of the work (too much to do) and the scope of the required knowledge (too much to think about) cannot be covered with a single task.

In the literature on industrial firm development, numerous examples show that as the environment becomes more complex, organizations become more specialized (Lawrence and Lorsch 1969, Aldrich 1979). This is also true for the agricultural sector. Often, specialization in agricultural research and in technology transfer can widely differ.

By definition, the mandate of most national extension services is to reach farmers in all regions of the country. National extension is a tool for implementing policies. As such, the organizational structure of technology-transfer services has specific characteristics. Such services are usually hierarchical, highly centralized, heavily regulated, and standardized according to civil service procedures. Decentralization in decision-making is rare and regional boundaries between different units are based on administrative criteria rather than on socioeconomic or agroecological considerations.

Agricultural research, an open-ended process of scientific inquiry, generally has a country-wide mandate but also has to deal with local conditions. The organizational structure of research is often a compromise between centralization and decentralization, between vertical and horizontal delegation of authority. Tasks, skills, and processes are not easily standardized. And, at the regional level, research is based on agroecological rather than administrative criteria.

These different organizational requirements, resulting from different tasks, are often one of the main reasons why research and technology- transfer activities are separated into different organizations.

The primary distinction between two major tasks — research and the transfer of technologies — is not the only one. Each of these tasks is divided into subtasks.

Subtasks related to technology transfer are technology production,[2] delivery of technologies to farmers, and monitoring and evaluating technologies. Technology production may be achieved through the private sector (for instance, seeds or fertilizers production). It is also true for some extension activities. In other cases, public extension or non-government agencies may be in charge of diffusing technology and advising farmers.

The literature on the industrial sector makes a distinction between basic, applied, and adaptive research to characterize the specific tasks of R&D. The findings show clearly that organizational considerations depend on the type of research (Allen 1979, Howells 1990).

Basic research, as a long-term activity, is performed in well-endowed, highly sophisticated institutions with access to world knowledge. It is often organized on a disciplinary basis, and its scientists need a large measure of freedom to interact.

Applied research, with its medium-term orientation, is often organized nationally. It frequently takes a thematic approach.

Adaptive research and technology production and delivery are specific to regional or even lower levels, with a short-term, sometimes profit-oriented objective. It is rather structured according to location-specific considerations.

Agricultural research activities, too, can be grouped into these three research[3] subtasks. Usually, agricultural research organizations carry out a combination of these three types, but no specific arrangement has proven generally better than another. As Korten et al. (in Whyte and Boynton 1983:238) state, "There are three main bases governing the structure of the agricultural research organization. The research unit may be organized according to discipline, crops and geography/area. . . . Each method of organization solves certain problems of coordination, communication, and so on but also creates new ones."

Missing tasks

ISNAR's study on Research and Technology-Transfer Linkages has identified integration problems likely to occur where there are 'missing tasks'. This term refers to a situation where ". . . no unit is assigned to or effectively carries out one of the tasks necessary for the development and delivery of new technologies" (Kaimowitz, Snyder and Engel 1989:21).

Technology consolidation and technology production are two tasks that often go unassigned — which unfortunately results in unused technologies. For example, CBB-resistant[4] cassava varieties in Nigeria and the IDSA 6 rice variety in Côte d'Ivoire were not available in sufficient quantities for farmers

2. The process of producing the materials in sufficient quantity and making them available to those responsible for technology delivery.

3. In the case of adaptive research, or technology consolidation, results of basic and applied research are translated into specifications for a technology and efforts are made to ensure that these are appropriate to the target farmers. Adaptive research also includes all the work carried out to determine how best to present and package a new technology and how to identify potential users.

4. *CBB* stands for cassava blight bacteria.

because seed production agencies did not perform that task.

In the first case (Ekpere 1989), it was mainly due to the fact that the production of cassava cuttings was not a priority for the seed production agency and that the multiplication rate of cassava was low (1 Ha is needed to produce enough cuttings to plant 10 Ha). In the second case (Eponou 1989), the lack of effective linkages between the research institute and the seed production agency limited the availability of the technology. Thus, the institute was obliged to produce seeds but on a scale that did not allow sufficient production to meet demand.

Weak definition of tasks

Missing tasks are not the only problem. Poorly defined tasks — ones which have no "institutional home" — can also seriously undermine technology transfer. The on-farm client-oriented research (OFCOR) approach and its institutionalization attempted to address the problem of tasks not being clearly assigned. These tasks — especially identification of farmers' specific needs and the conduct of adaptive research for resource-poor farmers — were falling into an institutional gap, with no organization firmly in charge of them.

Even when there is no missing task and responsibility for each task is clearly assigned, integration cannot be completed without coordination between interrelated tasks. 'The greater the specialization of tasks, the greater the need for integration.' This is a principle often emphasized in the literature on organization (Rogers and Whetten 1982).

Interdependence Of Tasks In Agricultural Research And Technology Transfer

Division of labor, whatever its type, increases interdependence between the different subtasks that are created (Galbraith 1977). As organizations/environments become more complex, tasks become more specialized and the level of interdependence therefore increases.

Because agricultural research tasks and technology-transfer tasks are part of the continuous process of agricultural development and contribute to the final objective of improving global food availability, they are interdependent. And recent trends in agricultural development have increased the complexity of agricultural research and technology transfer. The most important of these trends are:

- a stronger focus on equity and resource-poor farmers which increases the complexity of socioeconomic factors to be considered in research;
- more attention paid to sustainability and natural resource management, which increases the complexity of research based on agroecological considerations;
- the development of public and private institutions, which increases institutional complexity;
- the development of biotechnologies, which increases technical complexity.

According to Thompson's (1967) typology, those kinds of task interdependence that best characterize agricultural research and technology-transfer systems are "reciprocal interdependence" and "team interdependence."

The first means that the outputs of one unit are the inputs for another and vice versa. Research results are used as inputs for the task of transferring technologies to farmers; in turn, knowledge of farmers' problems and their use of technologies are inputs for research to improve existing technologies, or design new ones.

Team interdependence means that some members of each unit participate directly in the activities of other units. For example, at the field level, researchers and extension workers work together as a team on the definition, execution and analysis of results of a specific research program.

But this view of interdependence is new and, in many cases, has not yet been fully accepted by the relevant institutions themselves. On-farm research has often been seen as sequentially tied to experiment research; only

recently has it moved from a feedback function towards team interdependence. Similarly, research and technology transfer were initially considered two different activities contributing to the same goal. Technology transfer was seen to be sequentially linked to research, that is, incorporating research findings into packages. Today, it must be recognized that "neither research nor extension can fulfill its responsibilities without the operational involvement of the other" (Bennell 1989).

How agricultural research and technology-transfer work are actually organized in different countries shows that task interdependence results in institutional interdependence and individuals' interdependence.

Interdependence of institutions

For many reasons — political, historical, technical — national agricultural research and technology-transfer activities are usually carried out by several distinct institutions (Eisemon, Davis and Rathgeber 1985). It is common to find universities, research institutes, ministry departments, and parastatals in charge of one or another aspect of these tasks in the same country. This set of institutions has a nationwide dimension. To be effective, it has to achieve the overall objective assigned to agricultural research and technology transfer in a country. Thus, distinct organizations are supposed to share a common goal, the achievement of which requires integration. Furthermore, as part of the national set of institutions, they are not only interdependent in terms of tasks related to a common goal, but also in terms of resource use.

Interdependencies between institutions must be recognized and dealt with. This is not easy to do because these institutions often have different mandates, organizational structures, and working procedures.

Interdependence of individuals

Individuals, too, are interdependent. They are expected to organize their work according to the task interdependence dictated by the nature of their job. For example, an on-station researcher may have the task of incorporating the results of on-farm research into her program to ensure relevance. This would require her to make arrangements to meet and cooperate with on-farm researchers.

But, ultimately, people organize themselves according to their own perception of what is needed and feasible at the time. The on-station researcher, to continue the example, might have scarce resources at her disposal and therefore decide that driving to remote villages to meet with researchers and farmers is not a high priority.

In effect, one cannot rely exclusively on the goodwill of individuals to interact with others. Institutional, environmental, and physical constraints often weigh heavily on the individual worker, and can be perceived as preventing the performance of interdependent tasks. Linkage mechanisms in general are necessary to ensure that these constraints do not hinder the process of agricultural development through agricultural research and technology transfer.

Missing links

As with missing tasks, missing links between interdependent tasks have a negative influence on the whole process of technology generation and delivery. Links are missing when two or more tasks that should be coordinated are not. The most obvious cases of missing links are those where researchers and technology-transfer workers are ignorant of each other's activities.

Missing links have negative consequences. They can result in unnecessary duplication of efforts, irrelevant research results, and inappropriate recommendations to farmers. All of them have heavy cost implications: resources are not only used to duplicate activities but also wasted because of the lack of results.

Thus, establishing linkages should be considered not only in terms of the cost, but also, and firstly, in terms of the resources to be saved by using appropriate linkages, and how great their impact can be.

Linkage mechanisms in general are part of a structural framework that may or may not provide an appropriate environment for integration.

Organizations are composed primarily of units. Unit grouping — the process of concentrating people in basic work units — helps to integrate their work in a specific domain for a specific purpose. For example, a plant pathologist, a plant breeder, a rural sociologist, and a soil scientist may be put together to work on bananas. In this case, the primary focus of the work is the commodity — bananas. Because the institution needs to develop an expertise in bananas, people with different but complementary skills, performing different and specialized but complementary tasks, are brought together. Their interaction in the banana research unit is expected to produce results that would be impossible to achieve if they worked in separate units. This is the reason for unit grouping. Thus, organizing a unit around a commodity, region, discipline, or function necessarily reflects the priority given to one task.

An organization or a set of organizations has many different goals, and unit grouping alone cannot deal with all the interdependencies necessary to achieve those (Mintzberg 1979) — for instance, ensuring a high quality of scientific research, a regional focus, a multicommodity orientation, and prompt response to farmers' needs. Dealing with the numerous interdependencies requires complementary measures.

Two common and challenging concerns in agricultural research management illustrate this point at the decision-making level: the case of merging research and technology-transfer activities, and the integration of on-farm and on-station research.

Merging research and extension

Merging is a process of unit grouping that can be applied to agricultural research and technology-transfer activities. Although it is often considered an appropriate solution to the problem of linking research and extension, some case studies provide evidence to the contrary and suggest that merging can raise unexpected problems (see Case 1, p.8).

Different situations prevail in developing countries. They show that the term merging is used to characterize widely differing cases. This is mainly due to the different levels at which a merging process is achieved.

Merging is used either (1) to bring institutionally distinct units under a common administrative roof, (2) to have a single administrative body instead of several parastatals or semi-autonomous institutions, or (3) to build an interdisciplinary team with people seconded from separate units.

Only the first two reasons for merging are discussed here. The last point will not be detailed because it is more properly an issue of "people management" whose implications were discussed at the beginning of this section in terms of interdependencies.

Two major benefits are expected from merging. First, it permits a physical proximity, thought to promote improved communication and mutual understanding between extension workers and researchers. Secondly, it is thought to increase efficiency. For instance, the time lag between the completion of research findings and their adoption might be shortened, institutional boundaries may no longer be an obstacle to communication, and researchers could more easily participate in in-service training of extension workers. Furthermore, the creation of a single administrative structure is expected to simplify and facilitate the exchange of information and, more generally, communication, because norms, rules, and procedures are the same for all.

The Instituto Nacional de Tecnología Agropecuaria (INTA) in Argentina has successfully adopted the strategy of merging research and extension into one institute. Arnon's analysis (1989:790) of factors in its success concludes that "... the INTA example does not prove that the improved relationship between the two services is due to the common administrative framework."

A case study in Tanzania (see Case 2, p.9) shows also that it is difficult to clearly ascribe success in technology transfer to merging. In this case, the special project approach brought coconut researchers and extension workers under the same roof, but is this the reason for its success? The fact that the National Coconut development Program (NCDP) is well-financed, well-equipped, and flexible, and provides good incentives and working conditions, may well be the principal reason for its success.

Perhaps the major advantage of a merger is that institutions appear more effective according to donors' criteria and therefore more able to attract funding, which in turn improves performance.

In Colombia (Case 1) a comparative study (Kaimowitz 1989) has identified conditions under which an institution that combines research and technology transfer is likely to succeed. First, technology transfer is not politicized. Second, the work centers on one commodity, region or problem. Third, the size of the institution is not unmanageably large. And fourth, linkages are actively managed.

Other examples provide evidence that merging can actually hinder performance. Merging research and extension does not by itself generally solve problems of communication that may have arisen when the two activities were in separate institutions. For example: "The extension division in ICA continued to have no direct contact with the research division" (Trigo et al, 1982).

Differences between research and extension staff — in professional orientation, objectives, methods, and administrative procedures — can be so great that there is no other alternative but to place them within different bodies. The Colombia case shows that merging cannot by itself solve all problems. In particular,

Case 1. Colombia: Merging research and extension

The Instituto Colombiano Agropecuario (ICA) is the country's public sector national research body, with a mandate to improve performance in many types of crop and livestock production throughout the country. The Coffee Growers Federation is a quasi-private organization with a regional focus, dedicated mostly to the production and marketing of coffee. In the former case, research and extension were merged in 1968; in the latter, the two activities have been together since the federation was founded.

Following the 1968 merger, ICA became a larger, more complex organization, with a broader range of clients, including resource-poor farmers. Management had difficulty in focusing on long-term goals or carrying out detailed analyses of specific problems. Conflict between the institute's research and extension groups grew, fueled by overlapping mandates, status differences, and competition for resources. In addition, research became politicized through its association with rural development. The failure to effectively integrate research and extension at ICA may well have led to the decline in institutional performance noted by several observers from the mid-1970s onwards.

In contrast, interaction between research and extension workers in the Coffee Growers Federation is more intensive and better coordinated. Unlike ICA, the federation concentrates on a single crop and clientele. Researchers and extension workers have been able to focus more sharply on a narrower range of common concerns. The federation has created a strong institutional culture in which status differences and the competition for resources between research and extension have been minimized. Lastly, the federation's private status has enabled it to avoid politics. The overall result has been a high level of performance: coffee yields in Colombia have increased rapidly, and there has been an effective response to coffee rust and coffee bean borer, two major threats to the industry.

Source: Merrill-Sands and Kaimowitz 1990, reproduced with their permission.

those related to specific causes, such as conflicts or lack of resources, have to be addressed with specific measures.

Managers, then, need to investigate the real reasons for the absence of linkages or communications between people in charge of research and technology transfer. Merging does not seem helpful in handling such problems unless it is carefully designed to develop, or is accompanied by, a new environment favorable to solving the problems.

The case studies teach us that, for various reasons, merging might not be the best option. It is still possible, however, to improve working relationships between research and extension even when they are in separate institutional units. In that case, inter-unit integration — which may be achieved through the structural linkages discussed later — becomes necessary.

Integrating on-farm and on-station research

By definition, on-farm research is faced with numerous interdependencies: with on-station research, with farmers, with technology transfer. At the same time, it has to deal with different work orientations: by commodity (singly or in groups), by discipline, by agro-ecological zone.

Thus, several options exist for integrating OFCOR into the overall system of agricultural research and technology transfer. In light of the findings of Merrill-Sands and McAllister (1988), we briefly discuss here two possible arrangements and their implications: (1) having a separate multidisciplinary, regional on-farm research team, and (2) placing on-farm research within a commodity program.

Case 2. Tanzania: The National Coconut Development Program (NCDP)

NCDP is a special project within the Ministry of Agriculture, created in 1979. Its mandate is to stop the coconut industry's decline which is due to, among other reasons, the advanced age of the palm population, pests, lack of improved materials, poor crop husbandry, and lack of research.

Three bodies were involved in the creation of NCDP: the Ministry of Agriculture and Livestock Development (MALD) for the Tanzanian Government, IDA for the World Bank, and GTZ for the Federal Republic of Germany.

National researchers and extensionists were seconded from MALD. Researchers work in the different research sections: agronomy, pest control, disease control, breeding, and farming systems research. The extensionists work in the different units of NCDP's Coconut Extension Service: information and training, nursery development, estate advisory branch, and five regional smallholder advisory branches.

Within 10 years, NCDP has been able to achieve a lot, both on the research and extension sides. Specific technologies have been delivered to and used by farmers. Hybrid seeds and seedlings are available, techniques for pest and disease controls are delivered to farmers, and recommendations for proper crop husbandry are given. Hundreds of village extension workers have been trained in coconut palm development.

Source: Lupanga 1990.

The first option gives priority to the interaction of those disciplines needed for a systems approach. It permits the development of a core of on-farm research expertise by concentrating skills and disciplinary interactions in one team. It also permits the development of regional expertise by gaining knowledge and understanding of regional agricultural constraints that farmers face and researchers have to address. However, the first option also increases the distance between station-based research and on-farm research. This is due to geographical dispersion and institutional mandates which often limit the possibility of bridging the differences in methods and focus and set up organizational barriers between on-farm research and on-station research.

Not all systems have enough resources to build their own separate on-farm research units. Thus, the second option may be chosen. Its emphasis is on a theme — a commodity or the management of a natural resource, for instance. It facilitates communication between on-farm and on-station research. It has the advantage of using available resources to support on-farm research. But it can also hinder the application of a systems perspective in diagnosing problems and analyzing results. The mandate of commodity research and the rigidity usually attached to its resource management do not easily permit the introduction of such integrated approaches based on farmers' problems. Furthermore, it is not conducive to building a cadre of scientists having expertise in on-farm research, because expertise is dispersed throughout the structure.

In many institutions, the preferred option is to combine both. But, whatever the grouping option, it has to be complemented by other integration measures, structural or otherwise, to make sure that the associated interdependencies are covered (Merrill-Sands et al. 1990).

Issues and implications

Integration of research and technology transfer through unit grouping seems to be successful only when it expresses a set of truly interdependent tasks — as when organized around a specific problem, region, or commodity. As a consequence, one of the manager's priorities when looking at unit grouping issues is to analyze the level of correspondence between the different elements to be grouped.

Some principles can be formulated from analysis of ISNAR's studies and from the literature. Though they certainly need further refinement and verification, they are presented here as guidelines for managers.

The choice of a basic structure should reflect the most important task interdependencies, whether they are based on a function to perform, a technical speciality, a product orientation, or a target group (Galbraith 1977, Robbins 1984). This is a fundamental principle of the literature on organization. How people are grouped into units varies according to the basic themes they are required to work on, and groups should be set up according to the interactions necessary for a specific objective to be achieved.

Grouping can help to avoid duplication of effort. In general, grouping people whose work might otherwise overlap can increase efficiency. In cases where the group members actually work in close proximity, informal communication often flourishes. If group members have similar professional backgrounds, mutual understanding develops. Having tasks clearly defined within the unit also limits duplication because complexity is reduced and control is facilitated.

When units are set up to focus on a particular commodity or geographical region, rather than on professional specialization or discipline, problems are more complex. Necessary interactions relate to a specific output or objective rather than a specific type of activity. Most research units are defined this way. People with different backgrounds, who perform different activities and have different concerns, are grouped, and only proximity, which provides opportunity for close interaction, increases integration.

There are limits to the size of a workable group. Too many people makes for units of unmanageable size and may be an obstacle to effectiveness. The literature shows that there is an optimum size for specialized research units (Stankiewicz, in F.M. Andrews 1979). Five to seven people has been proposed (Berelson and Steiner 1964) as the size of unit beyond which there are growing disadvantages,

among these the tendency for a unit to divide into factions.

Nickel (1989:64) points out that "there seems to be an optimum size of research teams and institutions that produces the highest productivity and creativity." The fact that, for product innovation, large companies use a small task force, working group, or project team illustrates the point.

One concern with multidisciplinary units is that a large number of different professions represented can lead to communication problems. It becomes difficult for unit members to develop a common understanding, language, and approach. Integration occurs then only at a very general and superficial level. Expertise is reduced to individual competency and no team work really increases it.

Unit grouping, whatever form it takes, cannot, by itself, ensure the numerous interactions that must take place (Mintzberg 1979). Therefore, other means of integration are needed both within and between units. For example, well-functioning units often develop team spirit, which contributes to effectiveness. This can, however, lead to communication problems with other units. Each unit develops its own jargon, procedures, rules and norms, and creates its own structure. These are likely to impede inter-unit activities, unless appropriate measures are taken. "Assigning responsibility for on-farm research to a separate group of researchers allows the development of expertise and specialized skills in on-farm research. . . . This model however sets up significant organizational barriers to integrating on-farm to station-based research" (Merrill-Sands et al, 1989).

2. OPPORTUNITIES FOR INTEGRATION

The general principles and specific examples provided earlier illustrate two crucial points. First, there are many ways of grouping people into specialized units, and the way in which units are grouped can be seen as a tradeoff. On the one hand, unit grouping is intended to increase integration, develop a certain type of expertise, and reduce duplication of effort and overlap. On the other hand, with unit grouping comes the risk of losing other types of expertise, manageability, and task orientation.

Second, and as a consequence, further integration both within and between units is required for the expected results to be achieved. This means that other measures are necessary to ensure that not only a few, but most of the interdependencies between agricultural research and technology-transfer work are covered.

Indeed, managers are increasingly convinced they have to do something about it. But what? There is no single answer to this question. This section attempts to show that intervention is possible and that major principles and current knowledge on the subject can be of assistance in managing integration.

Managers' Room For Maneuver

Organizational structures are not immutable. They can be modified to facilitate integration. In particular, managers can make adjustments so that parts of the modified structure function as a linkage mechanism. The head of a research institute can, for instance, create a new unit and position it in the existing organizational structure so that it can perform a liaison role between other units. But he can also decide to give that role to an existing unit and provide this unit with the necessary resources and knowledge to fulfill this new assignment, or he can set up a permanent committee with people from different units regularly meeting to achieve the necessary liaison.

The extent of modifications that can be made depends on how much power the manager has. The head of an on-farm research team in a commodity program can hardly change the way on-farm research activities are grouped in the institution. But a manager at the research department level or higher could effect such changes. Similarly, general managers can organize activities in their institutions but cannot modify the way tasks are divided within the national system.

Basically, managers can choose between several alternative means of integration: unit grouping, direct control, creation of specific roles, use of committees, or a combination of these. Unit grouping has been discussed in the previous section. The following will describe the pros and cons of the other three means, and outline what managers need to do to make them work effectively.

Choice And Implementation Of Structural Linkages

Here we will focus on structural linkages, both vertical and lateral. By structural linkage we mean a formal mechanism (permanent part of the organization's or system's structure) set for the purpose of increasing integration between at least two separate units or organizations in charge of different but interdependent tasks, or between people belonging to at least two separate but interdependent units or organizations.

From the literature on structures and organizations (Mintzberg 1979, Galbraith 1977), three main types of structural linkages can be identified:

- the process of **direct supervision** through hierarchical lines;
- **coordination positions or units;**
- **permanent coordination committees.**

Mayntz (1979) shows that the type of interdependence, the position in the structure, and the level of hierarchy are important variables that condition the functioning of public organizations. These elements apply also to the design of appropriate structural linkages. They relate to three questions:

- What type of interdependency are we trying to manage?
- At what level will it be effective to put a structural linkage in place?
- How much authority do we want to give the linkage mechanism?

The first question relates to the identification of units or institutions that have to work together and to what has to be achieved as a result of integrating their efforts. There is a distinction between integration for technical reasons and integration for administrative reasons. For instance, secondment of extension staff to a research team through research-extension liaison officer (RELO) positions can be an effective way to integrate research and technology-transfer activities. However, this arrangement faces serious administrative problems: it is not clear to whom such individuals should report for purposes of work monitoring, evaluation, and promotion. In general, the assumption that technical integration will automatically meet administrative requirements is a major cause of failure (Case 3).

Galbraith (1977) emphasizes that the choice of an appropriate form of horizontal relationship (this applies to liaison positions and committees) is based on the amount of information that is still required for task performance. For instance, if managers only share a common concern, they can interact directly. But if substantial contact is needed, or if several units are involved, with recurring problems, more complex forms should be added to the existing ones.

The second question refers to the most appropriate place for structural linkage mechanisms. What is the purpose for creating a structural link? Aiken et al. (1975) provide evidence that the level at which coordination is desirable depends on the types of elements to be coordinated. They distinguish between coordination for the purpose of securing resources and funds, program coordination, coordination with clients and recipients, and

Case 3. Zambia: Experience with research-extension liaison positions

In the early 1980s, Zambia began to use research-extension liaison officers (RELOs) as one of several mechanisms aimed at bridging the gap between on-farm research and extension. Extension professionals are seconded to provincial multidisciplinary adaptive-research teams. RELOs have proved very useful for such tasks as revising crop recommendations, organizing on-farm verification trials of promising technology, coordinating provincial demonstration programs, and preparing extension materials and newsletters. They have also increased the feedback from extension to research and have begun to influence the direction of research. In so doing, they have helped raise the status of extension workers.

Despite these achievements, there have been several implementation problems. The most important is that RELOs, awkwardly straddled between two departments, have to report administratively to the Provincial Agricultural Officer in extension, but technically to the Chief Agricultural Research Officer. This has led to ambiguity as to who is responsible for recruitment and performance evaluation. Promotions have also been difficult to obtain since RELOs are integrated within a research team, yet it is their extension supervisors, with little direct knowledge of their work, who must recommend them for advancement. Ambiguity in job descriptions is a second problem. It has frustrated the recruitment and retention of competent staff and has led to some duplication of tasks with subject-matter specialists.

Source: Merrill-Sands and Kaimowitz 1990, based on Singogo and Kean 1990, reproduced with their permission.

information coordination. These distinctions influence the choice of structural linkages.

What, then, is the appropriate level at which to position structural linkages? Two ISNAR studies document the importance of having linkage mechanisms at several administrative levels:

- Findings from the study on On-Farm Client-Oriented Research show that "the most successful cases of integration of on-farm research and extension are those in which links have been forged simultaneously at several levels of the administrative hierarchy of the organizations involved: technicians in the field, scientists and administrators at the regional level, and high-level national committees" (Ewell 1989:27).

- One of the major hypotheses of the study on the links between agricultural research and technology transfer is that "formal and informal linkage mechanisms at several administrative levels (for example, national, regional, operational) are essential for high performance." (Kaimowitz, Snyder, Engel 1989:25).

In practice, effective organizations use a combination of different linkage mechanisms, coupling them at the same level or at different levels. However, choosing the wrong level for structural linkages has been identified as a frequent error (Rogers and Whetten 1982). Linking all elements may not be possible, and Mulford and Rogers (in Rogers and Whetten 1982:29) emphasize that taking actions at one level does not imply that other levels do not need further attention.

The third question relates to the delegation of authority, the responsibility for action, and the accountability for integration. It takes into consideration the vertical relationship that may exist between the elements that have to be linked. How these different components of power are concentrated or delegated makes more or less feasible the different types of structural linkages. Moreover, they condition the role managers have to play to ensure proper functioning of structural linkages.

These questions will be discussed for each of the three types of structural linkages we have identified. A synthesis table (Table 1, p.15) summarizes the main characteristics of the three structural linkages.

Direct supervision

The basic principle of direct supervision is that one individual or unit of the hierarchy takes responsibility and is accountable for integrating the work of others. Integration becomes part of the general activities of the manager. This case is characterized by the following answers to the three questions:

- **Type of interdependency**: We are trying to manage technical and administrative interdependency, under the same institutional roof. Tasks are sequentially linked.

- **Level of link**: The units to be linked are at the same level but the management of integration must occur at least one level higher in the hierarchy.

- **Authority conferred**: The manager has authority, accountability, and sometimes responsibility for action.

Three types of direct supervision are commonly used (see Fig. 1, p.17):

Supervision of separate specialized units under the same head. Managers give clearly assigned tasks to each unit but are responsible for integrating the outputs at their own level. This is possible when outputs are discrete and their production does not require the direct interaction of various units. An example in the area of research is the aggregation of regional survey data for use by national-level planners: a research department head assigns specific research tasks to different regional units and then uses their reports as raw material for national-level analysis. Another example concerns the area of extension. Under the Training and Visit (T&V) system, extension workers carry out highly standardized tasks, such as disseminating a uniform message to farmers and reporting directly back to their supervisor. Here, there is no need for the extension workers to interact with each other.

The team approach. People sharing a specific focus are grouped in a unit where this focus is the primary interdependency. Outputs are

Table 1: Characteristics of the Three Structural Linkages

	Direct Supervision	Liaison Positions/Units	Coordination Committee
Description	- One individual is responsible & accountable for integration of the work of others at a lower level of the hierarchy than his own.	- A person/small group is given responsibility for achieving integration, without authority. - Integration for technical interdependence. - Mutual adjustment/informal communication through a formal channel.	- Permanent committee with management authority. Members have a role/stake in the activities to be coordinated. - Coordination for technical and administrative interdependence and joint decision-making. - Authority, accountability and responsibility for action.
Main Advantages	- Appropriate for technical and administrative interdependence. - Quick response to changes. - Rapid flow of information.	- Time and resources are devoted specifically to integration. - Show the interest/need for integration. - Develop expertise in liaison task.	- No intermediaries. - Many parties involved. - Low level of resources. - Cost can be shared by participants. - Multiple, simultaneous interactions.
Main Disadvantages	- Technical accuracy limited by distance from operational level. - Consumes managers' time.	- Integration may be considered as only the integrator's job. - Can create new integration problems. - Limited by number of people/units to integrate and their level of difference. - Inappropriate for situation marked by serious conflict.	- No continuous basis of work. - Difficulties in bringing all members together for meetings. - Tend to end with more discussion than action/decision.
Suitable for:	- Small units/systems. - Centralized organizations at middle -level management (stations, region, program). - Decentralized systems.	- Large systems with specialized tasks. - Not suitable for high levels of structural diversity.	- Decision-making needs for major collaborative activities. - Larger systems. - Centralized and decentralized systems.
Requirements	- Competent leadership. - Supervisors having respect and authority.	- Need strong management commitment. - Qualified staff available. - Specific resources available.	- Require some management principles to be followed (see p.22-23).

integrated at the unit level. Managers have authority and accountability but are not responsible for actually carrying out the work. Their mission is to ensure that integration effectively occurs. The manager is usually a senior researcher.

Responsibility for integration is delegated to an intermediate level, resulting in a specific integration task. The new position or unit has formal authority to ensure integration, and is accountable for integration to a higher general supervisor. The National Coconut Development Program in Tanzania (Case 2) has a Coordination Unit placed just below top management. It is the most powerful coordination tool in the institute, since top management is directly involved in the work of this unit. Moreover, decision-making power is attached to the unit: it plans the work and draws up the budget.

Direct supervision has advantages and disadvantages. To begin with, having a common supervisor is an effective way to promote integration in different groups, control it, and ensure that the activities undertaken are consistent with well-stated priorities and identified problems. Furthermore, the common supervisor is in a good position to respond quickly to changing conditions by making immediate adjustments to integration activities. In that sense, it is an efficient form of coordination because it permits a rapid flow of information.

A major disadvantage of direct supervision stems from the fact that top managers are sometimes ignorant of technical issues because they are removed from day-to-day field operations. This lack of awareness can become a problem when they directly supervise integration activities. What is gained in terms of breadth of perspective is lost in terms of technical accuracy. The farther the manager is from the technical level, the less effective he or she will be at integration through direct supervision.

As a structural link, direct supervision has certain limits. For example, having too many people or units to manage in too many specialties can overwhelm a manager, severely limiting the amount of time available for direct supervision of each. "The greater the complexity, the less effective is hierarchical control in integrating the different contributions" (Martínez Nogueira, 1989:5). And because integration through direct supervision requires a lot of a manager's time, it ends up competing with other management tasks. In practice, it is often the first thing to be neglected.

The most important management requirement for direct supervision to be used as a structural linkage is competent leadership. The time supervisors are ready to make available for integration and the degree of respect and authority they command influence their effectiveness.

Nickel (1989) argues that a limiting factor for management in general is the size of an institution, specifically when it becomes so large that the director cannot be familiar with the work of each scientist. This applies to managing integration through direct supervision. Mintzberg (1979), for instance, states that the need for direct supervision implies a decrease in the size of units.

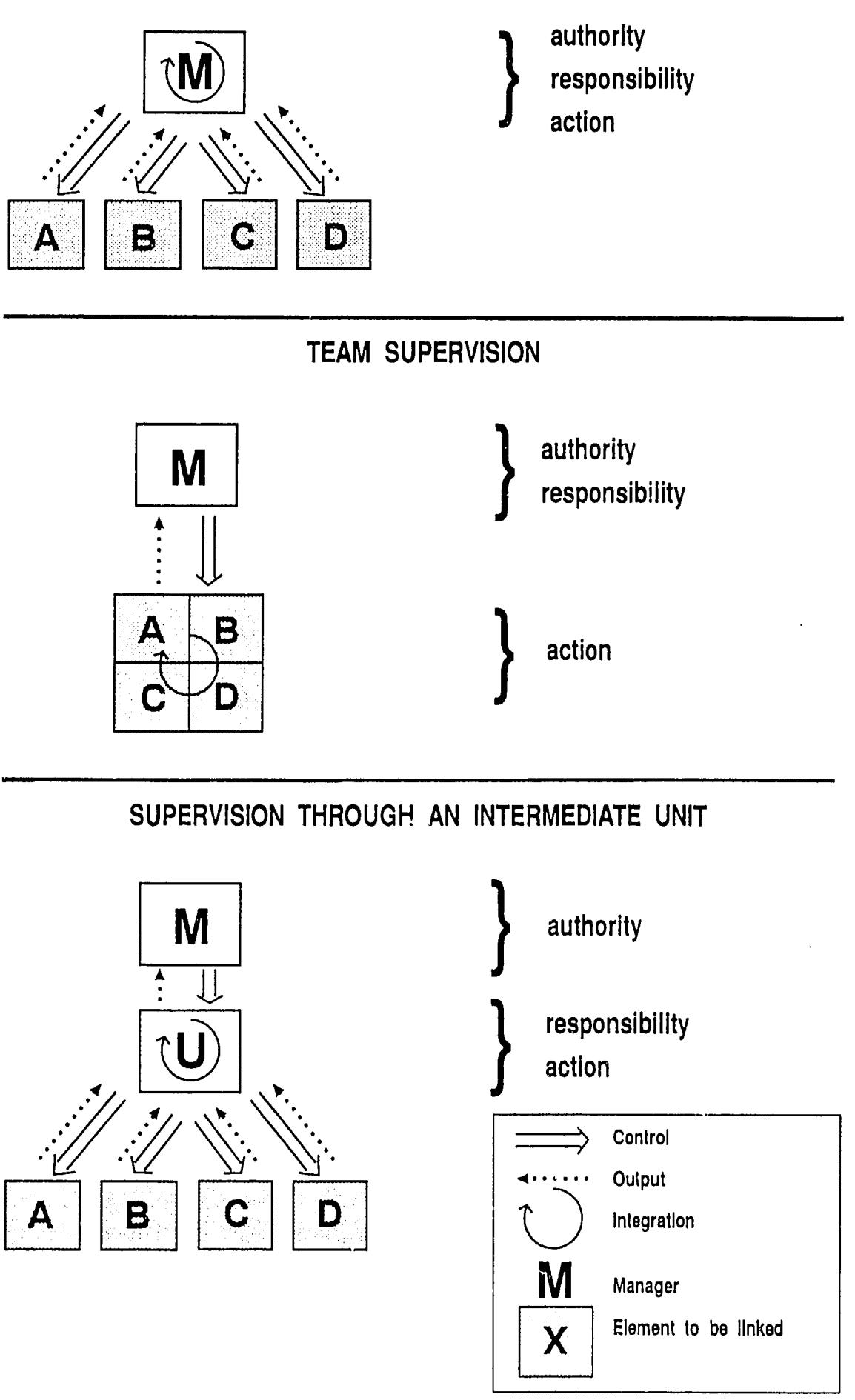
Direct supervision is suited mainly to organizations with a centralized structure, and works best at middle-management level. The OFCOR project, for example, shows that at this level managers (regional, station, and program directors) have fewer competing requirements and are more available and effective for coordination between on-station research and on-farm research (Merrill-Sands and McAllister 1988).

Systems of smaller size, where the number of units and the number of people per unit remain low, can usefully function with direct supervision as a major structural linkage.

Liaison positions or units without formal authority

The Nigerian case (Case 4, p.18) illustrates the second type of structural linkage used for integration: the liaison position or unit. Its important characteristic is that this person or small group is given the specialized task of integration, but has no formal authority. The literature and our cases use different terms for this mechanism. Here the terms "liaison agents, units, or positions", "coordinators", and "integrators" are used interchangeably to refer to the idea of having a formal, special-

Fig. 1: Three ways of using direct supervision to promote integration



ized role for linking elements whose outcomes need to be integrated. Creating a new task to be performed by such an intermediary is based on the following answers to our three questions:

- **Type of interdependency:** We try to manage especially technical, and seldom administrative, interdependencies, within and/or between institutions. These interdependencies are not ensured by basic structural arrangements such as task definition or unit grouping.
- **Level of Link:** Horizontal linkages are necessary, that is, linkages at the level of the units to be coordinated. At the unit level, the liaison role can be structurally and/or geographically separated from the elements to be linked or attached to one of them.
- **Authority conferred:** No authority is given to the intermediary staff, but they are responsible for carrying out integration. However, in some cases, coordinating units have power over the elements to be coordinated due to their position in the hierarchy

Case 4. Nigeria: Experience with an agricultural research-extension liaison unit

In 1963, responsibility for research in Nigeria's Northern Region was transferred from the Ministry of Agriculture to Ahmadu Bello University. At that time, the ministry set up a Research Liaison Service to ensure that research continued to respond to the needs it identified. The service performed well in its early years. Extension specialists, based in research departments, concentrated their efforts on dissemination activities and developed effective research-extension links.

Between 1969 and 1975, when the ministry was decentralized into six separate state institutions, the liaison service, which was to serve all states, was placed in the university's Institute for Agricultural Research. As part of the university's system, the service's staff became more professional and independent, and took on more responsibility for adaptive on-farm research. Direct collaboration with researchers diminished and relations became more conflictive, as extension staff began to challenge the relevance of on-station research.

In 1975 the university decided to separate the liaison service from the research institute for two reasons: the service had developed a solid subject-matter base of its own, and autonomy would allow it to criticize research without fear of reprisals.

Autonomy proved a mixed blessing, however. It provided the freedom to criticize research and stimulated the development of expertise in generating specialized extension communication materials and training events. But at the same time it led to reduced contact with the research institute and an expansion of the roles and activities the service was expected to perform. The service became an implementing, rather than a coordinating, agency.

Recognition of the service as a national institute came in 1987, placing additional demands on its limited resources by further expanding the number of client institutes whose needs it was expected to meet. The service is now overextended and underfunded.

The Nigerian experience shows that, for liaison units to be effective, managers must strike a delicate balance: they need to build a unit sufficiently competent in the skills of both research and extension to be an equal partner in collaborative activities, but at the same time they need to restrict both the power and the scope of such a unit in order to prevent the duplication of activities and the dilution of impact. Maintaining this balance is more difficult in large countries with organizationally complex national systems.

Source: Merrill-Sands and Kaimowitz 1990, based on Ekpere 1990, reproduced with their permission.

or the function they perform (see direct supervision, case 3, p.16).

Formal liaison agents use mutual adjustment, the process of working through informal communication. Basically, they help to provide a formal channel for informal communication. The liaison role can be separate from the units they link or attached to one of them.

The major types of liaison roles commonly used in agricultural research and extension are as follows:

- **part- or full-time secondment**: one person is seconded from one unit or organization to work with another unit in the same or in another organization, as in the case of the Coconut Extension Service at NCDP in Tanzania (Case 2);

- **research-extension liaison officer or unit**: highly variable arrangements, from structurally and geographically separated (AERL in Nigeria) to geographically and structurally attached to research (RELO in Zambia) or to extension;

- **pre-extension unit**, usually attached to research institution (Case 5);

- **commodity-based extension service** structurally and geographically attached to a research institute or program (NCDP in Tanzania);

- **subject-matter specialists** structurally and geographically attached to extension (Benor and Baxter 1984).

Liaison positions or units have several advantages and disadvantages. First the advantages. When the volume of necessary contacts grows between different units, it is useful to set up a specialized role to handle such communication. With liaison positions or units, time and resources are specifically allocated for integration. As a consequence, everyone in the organization is aware of the importance

Case 5. Burundi: The Pre-Extension Service

Agricultural research in Burundi is conducted mainly at the Institut des Sciences Agronomiques du Burundi (ISABU). Extension services are located in the Ministry of Agriculture and the Sociétés Régionales de Développement.

The task of the Pre-Extension Service at ISABU is to contribute to an efficient transfer of technologies from research to extension. It is composed of two researchers and one graphic artist. Their principal activities are the production of technical leaflets (5 to 10 per year) and videos to help the extension service understand technical knowledge developed by ISABU's researchers. Training of extension staff is the second thrust of the Pre-Extension Service. Finally, it provides researchers with some feedback with the suitability of the technologies they are disseminating and any problems encountered in their use.

The Pre-Extension Service does not deal directly with all field extension agents: there are too many of them. It has neither the mandate nor the capacity to engage in extension work, to train farmers, or to produce material for direct distribution to farmers. Thus, the Service's principal clients are extension officers. The audiovisuals and training aimed at them serve not only to enhance their understanding and mastery of new technologies, but also to facilitate their task of transmitting this understanding and these skills to the field extension agents who must disseminate them to farmers.

The Service is one unit within ISABU's structure. Staffed by a social scientist and an agronomist, it has the capacity to maintain a dialogue with researchers. This dialogue is necessary if the Service is to keep abreast of all programs.

Source: Contant and Bourgeois 1988.

attached to developing linkages within the organization or between organizations.

A second advantage is that expertise in liaison tasks can develop. The creation of a specialized task, especially when accompanied by measures to provide related training and knowledge, is likely to result in the development of an internal capacity in the area of liaison/coordination.

Third, managers are sure that, even though they do not have much time for coordination, this vital task will be performed. The formal assignment of a liaison role guarantees that the task will not be neglected.

Finally, gaps between the different parties are more easily bridged because there is a specific role for this purpose.

One disadvantage of a liaison position or unit is the risk that people will act as if integration is solely the "integrator's" job. Managers in particular might be inclined to abandon any commitment to integration since a specialized unit or person is in charge of it. Furthermore, the liaison role is often unclear and people end up concentrating on other activities that are not properly coordination — for instance, conducting adaptive research or demonstration trials instead of linking people.

Paradoxically, coordination positions or units often create new integration problems, as in the case of AERLs in Nigeria (see Case 4). Rather than improving communication between units, they function as an additional barrier (Anon 1989). This is often the case when liaison units develop their own procedures, language, and objectives, adding to the complexity of coordination management.

Galbraith (1977:115-116) states that liaison roles "work when two managers or functions are involved. When problems arise involving seven or eight departments, direct contacts are not sufficient to reach a joint decision". This statement can reasonably be applied to determine the limits on the effectiveness of liaison positions or units in agricultural research and technology transfer. What is important is not only the number of units to be linked, but also the distance (in interest, in thought, in location, in organization) between them. The greater the distance is, the more frequent and closer the direct contact must be. Thus, it is very likely that liaison positions are less useful when several highly differentiated units are involved.

This type of structural mechanism, because it lacks formal authority, is inherently limited in its ability to resolve conflicts. Informal communication, the main tool of their coordinating activities, is simply not powerful enough to be effective. Thus, it often needs a strong support from senior management.

Most of the disadvantages of liaison positions or units result principally from improper management. Strong management commitment is necessary in the following areas:

- **Definition of responsibilities.** Managers must remember that a liaison position or unit only carries out integration. Responsibility and authority for integration remain the manager's concerns. They must let all the actors (both liaison agents and those being coordinated) know that they are personally committed to integration and therefore fully supportive of coordination activities.

- **Internal policy.** A consistent internal policy is necessary for effective integration through formal liaison roles. Rewarding integrators often causes difficulties. Individuals low in the hierarchy may perform their liaison roles very effectively. But this contribution may be ignored by management because they operate outside the reward system. Thus, they have no hope of improving their status or being promoted because the organization's reward policy does not recognize the value of their work. It may be that these people are being systematically penalized even though they are doing a good job. Singogo and Kean (1989) document similar problems faced by RELOs in Zambia (Case 3). Rewarding integration is an area where managers have to ensure consistency. The creation of a specific liaison function should always be accompanied by a fair reward system. Moreover, as Lawrence and Lorsch (1967) stated: "Integrators need to feel they are being rewarded for their total product responsibility, not solely on the basis of their performance as individuals."

- **Access to information.** People in liaison roles must have a good knowledge of the activities, procedures, norms, methods, and domains of the different units they have to coordinate (Lawrence and Lorsch 1967). Access to knowledge and information, then, is crucial. Without it they are impeded in the effective performance of their tasks. Information is often a source of power, which people do not want to share. Admittedly, informal communication is a major channel for such information; still, managers should guarantee that all relevant information is available to liaison agents.

- **Participation in decision-making.** Having a role in decision-making is a strong stimulus for effective coordination, increasing commitment to integration. But the contribution of liaison agents or units must be based on real expertise in their domain — expertise recognized as such by the peer groups to be coordinated — rather than on their positional authority (Lawrence and Lorsch 1967). The success of the Coconut Extension Service staff at NCDP is largely due to the fact that their knowledge on coconut was comparable to that of the researchers at the very beginning. Progressively, both have increased their expertise, so that each recognizes the other as a relevant interlocutor.

- **Staff selection or recruitment.** The choice of staff is crucial. Simply telling someone to "go out and liaise" is not sufficient. Detailed job descriptions are necessary to help find the most appropriate candidate. Personal competence is a major factor. Coordinators are influential primarily because of their knowledge and expertise and not because of any authority that may be attached to their position. They must be skilled at resolving conflicts. To be effective, coordinators must understand the professional lingo and way of thinking of the various people whose efforts they are coordinating. For instance, on-station research focuses on long-term projects and solutions to scientific and technical problems; on-farm research looks for mid-term solutions to client groups' problems; and extension workers have a short-term outlook and need practical tools and technologies. Differences in their ways of thinking impede effective collaboration among them. Coordinators have to speak the language of each group, otherwise they will be rejected by some of them.

- **Matching individuals' interests with the institution's needs.** People in liaison positions or units are individual actors with personal interests and specific perceptions of their working environment and role. These characteristics determine in part the strategies they develop in their professional activities. A certain amount of convergence is necessary between integration objectives at the institutional level and these individual strategies. It is difficult to identify underlying motives of individual behavior, but it is still possible to match the requirements of a coordination role with individual characteristics: empathy, cooperative rather than competitive personality, sociability, initiative, persuasiveness, imagination, dynamism, open-mindedness, and breadth of interests.

The most serious limitation on setting up liaison positions or units is the availability of qualified staff. Managers should be cautious about creating such positions if there are no competent people to fill them. If demand for coordination services exceeds supply of qualified candidates, then the managers must decide which requests are most urgent and create positions only in those cases. For example, in Zambia, delays in recruiting RELOs to be staffed with the ARPT team have reduced the level of research-extension activities undertaken. The Zambian case (Singogo and Kean 1990) shows that high turnover also reduced program continuity.

Not every organization can afford liaison positions or units. The level of resources available is a factor in choosing such linkages. Because specific human, financial, and physical resources, need to be allocated to the liaison function, only organizations with sufficient resources can develop such linkages. The implementation of liaison units, for instance, should not result in scarcer resources for other professional units, unless a higher priority is attached to liaison roles. Such a reduction would not only limit the working capacity of the unit to be linked and therefore reduce the need for integration, but it would

also cause resentment and create conflict. Indeed, the liaison unit would be seen as a competitor instead of a partner.

Committee approach

The third type of coordinating mechanism is a permanent committee with management authority. It is staffed by individuals with a role or stake in one or more of the activities to be coordinated. For example, members could be managers, field workers, advisers, donor, clients, or government officials. In this paper, only permanent committees are considered structural linkage mechanisms. Ad hoc committees, task forces, and project groups are viewed as management linkage mechanisms.

This case is characterized by the following answers to the three questions:

- **Type of interdependency:** Technical and administrative interdependency, including joint decision-making.
- **Level of link:** The units or institutions to be linked are not necessarily at the same level, but management of the linkage involves the participation of their leaders.
- **Authority conferred:** The committee has authority, accountability, and, through its individual members, responsibility for action.

Coordinating committees can operate nationally, regionally, locally, or between units or institutions. A typical example is the regional coordinating committee in which researchers meet extension agents and regional administrators.

Permanent committees have the advantage of being able to bring together people from many different units without having to assign intermediaries who may not be fully aware of each unit's concerns. They can interact directly.

The level of resources needed to operate such committees can be kept rather low. Each participant can contribute from his or her own budget or special funds can be allocated to it.

A major disadvantages of using committees is that they do not work on a continuous basis. Therefore, this type of linkage mechanism cannot easily respond to sudden needs or changes, especially when participants are geographically dispersed.

Committees are often seen as an easy way to deal with integration. However, the proliferation of committees results in reduced rather than increased effectiveness. Members may feel that they spend more time in committee discussion than doing their main job. Because committees can divert much time from other activities, their use should be maintained at a reasonable level. Nickel (1989) advocates the use of ad hoc committees to supplement standing (permanent) committees. The former can tackle a specific issue and then disband, making an efficient use of scarce resources.

The impact of a committee depends on the way it is organized and managed. Following certain principles is a key to successful committees:

- **Participants should feel a need for a committee** and be committed to having a successful coordination mechanism. Nickel (1989:68) advises managers to "select only attendees who are directly involved and able to deal effectively with agenda items."
- **Members must be key people** with authority or responsibility to implement committee decisions. An important factor for Zimbabwe's Committee on On-farm Research and Extension (COFRE) was the presence of "managers with the authority to act decisively in committing resources to collaborative activities and to initiate new directions of research when required" (Merrill-Sands and McAllister 1988).
- **Committee membership should be balanced**. The various parties should be represented in relation to the role they play in the collaborative activities being coordinated. Also, members should be around the same level of seniority and their authority to implement committee decisions should be similar.
- **Committees must be decision-oriented** and not simply a forum for talk. Consultative committees have poor results. People regard them as a waste of time: "We have lots of meetings but nothing ever happens."

- **The scope or mandate of the committee must not be too broad.** Otherwise no consensus can be reached concerning the results to be achieved. Furthermore, a narrow committee mandate makes it easier for each party to select suitable representatives.

- **Committees need strong support from higher levels of authority.** COFRE, for instance, considerably benefitted from the frequent participation of the directors of the government research and development body, DR&SS, and of the extension service, AGRITEX. Facilities and incentives have also to be provided at least in the early stages of committee creation.

- **Committee management requires skilled organizers.** Ineffectiveness of committees can often be traced to poor organization. Skills needed for this work include the ability to formulate agendas, run efficient meetings, develop consensus, clarify and sum up decisions reached, ensure accurate minutes are taken and distributed, and foster communication between meetings.

When is the committee approach desirable? Committees are helpful to develop linkages between participants from different units or organizations when decisions have to be made. These decisions should not concern daily routine and administrative details, but major specific issues — for instance, annual research program orientations.

Small systems may use this approach but not systematically. In larger systems, when geographical and professional distance between institutions or units is great, committees represent an appropriate and effective way of promoting integration, provided that the above principles are followed.

Combined linkages

Structural linkages discussed in the earlier section have been grouped into three categories to simplify the analysis. Real cases, however, show that often it is difficult to separate the various structural mechanisms used for integration into such clear-cut categories. Two examples illustrate the complexity of integration through structural linkages.

In the Philippines, a highly complex research and development system has evolved. Its complexity is not surprising given the size and diversity of agricultural research and technology-transfer institutions in the country. At the higher national and regional levels, several structural linkages have been created. The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) can be seen as a meta-coordination unit served in its mission by 14 regional consortia, whose basic structures include (Gapasin 1990):

- a regional coordinating body, committee, council or board, setting policies for the regional consortium;

- a working group reviewing the regional R&D program and budget;

- commodity teams reviewing and evaluating specific aspects of the regional program;

- a secretariat, headed by the regional consortium coordinator and staffed with unit coordinators.

This complex organization combines three mechanisms for coordination: direct supervision, because PCARRD, through its funding role, not only coordinates but also determines and controls the content of the programs; liaison positions such as consortium coordinators and unit coordinators; and the committee approach through the regional coordinating bodies.

Despite, or maybe because of, this complexity, the effectiveness of the consortia varies. Gapasin (1990:36) states that "success rests on strong leadership and the willingness of all institutions concerned to participate."

But smaller systems can also develop complex structural linkages to ensure integration between agricultural research and technology transfer. In Burundi, where the Institut des Sciences Agronomiques du Burundi (ISABU) is responsible for agricultural research and the Ministry of Agriculture for technology transfer, several linkage mechanisms are no being implemented (see Case 6, p.24).

This example shows that the Atelier de Recherche requires additional coordination mechanisms if it is to play an effective liaison role.

Considerations In Developing Structural Linkages

A number of factors limit or facilitate the functioning of structural linkages. ISNAR case studies and the literature mention several as being important in the selection of appropriate linkages. Size, mandate, and complexity of the national agricultural research and technology-transfer system are major considerations as are its structural diversity, degree of centralization, and institutional flexibility. The risks attached to the establishment of structural linkages have to be analyzed as well, and alternatives to structural integration are possible. These will be reviewed in this section.

In choosing an appropriate structural linkage, managers should consider these factors in combination, rather than individually. Paying too much attention to one factor may result in a wrong choice. In the end, only managers have the necessary information and perspective to make the right choice. The following is intended as an aid in making that decision.

Size, mandate, and complexity

In general, increased size leads to increased complexity, and greater size is associated with greater specialization. Even a small system with a broad mandate is very complex, but it is not able to specialize tasks as much as a larger system because of resource constraints. Units in a small system are forced to undertake a large range of tasks, and integration of tasks takes place mainly at the level of the individual.

For small systems, structural linkages are generally not recommended. The advantages of structural integration are outweighed by the required time and cost. Informal communication and joint activities are usually suffi-

Case 6. Burundi: Ateliers de Recherche

The agricultural Ateliers de Recherche are a useful innovation of the Institut des Sciences Agronomiques du Burundi (ISABU). Their design and implementation followed an initiative of a researcher who wanted to prove that technologies developed by ISABU where relevant for farmers despite the lack of visible proof they were being adopted. After its initial success, the Atelier concept was further developed to respond to government officials' criticism that ISABU was not sufficiently effective in producing technologies for the farmers. Several Ateliers are being operated and, if they continue to succeed, all regions will eventually benefit. The functioning of these Ateliers relies on several structural linkages:

- a specialized research task whereby a team of two researchers and four technicians working with farmers and extension workers tests technologies produced by ISABU's researchers;
- regional permanent coordinating committees in which the Atelier's researchers meet regularly with heads of extension services;
- direct supervision of each regional Atelier de Recherche by the head of the department to which the Atelier belongs;
- coordination between the regional Ateliers de Recherche by a national coordinator attached to headquarters.

Source: Contant and Bourgeois 1988.

cient. But in those cases where structural linkages really are desirable, integration through direct supervision is usually the most feasible option. This is because the number of people or units to be coordinated is generally manageable and not much is needed in the way of extra resources.

Larger systems usually conduct more specialized tasks and have numerous units. Integration through direct supervision should be limited to the higher levels. At lower levels, integration is achieved primarily through the grouping of people into units, in a way that best reflects the organization's objectives (by function, product, target group, or geographical area). Larger organizations also need coordination positions and units because the task of integrating resources, activities, and outputs of different units is particularly complex and requires specific resources and expertise.

Size, mandate, and complexity are also important factors in deciding whether to use the committee approach. In larger organizations, where greater specialization usually occurs, a unit can deal with only a few task interdependencies. The use of coordination positions may be limited because there are too many units to link. Committees are appropriate because they provide an opportunity for multiple, simultaneous interactions. Furthermore, they consume less resources than coordinating units.

Diversity, centralization, and flexibility

Coordinating positions or units are often confronted with the difficulty of having to link units or organizations with differing structures. The literature (Lawrence and Lorsch 1967) recommends that in such cases the coordinating unit itself have an intermediate structure capable of dealing with this diversity.

A high level of structural diversity limits the applicability of the committee approach. Selecting the right people for committee work becomes more difficult when institutions have very different organizational features. A group of people considered to be key actors by one institution may not be recognized as such by people from other institutions, especially when the patterns of centralization and delegation of authority widely vary from one organization to another.

The degree of centralization refers to the vertical distribution of power associated with the vertical division of labor (Galbraith 1977). Highly centralized systems or organizations, where power is concentrated at the higher levels, do not generally permit structural linkages other than direct supervision and high-level committees. Because power is located far above the place where technical issues are debated, coordination positions or units at that level become useless.

Systems in which authority is decentralized require coordination positions and units or committees. Because in a decentralized system the units to be coordinated are quite powerful, the coordinating mechanism itself must have sufficient authority to deal with them effectively and with credibility.

In agricultural research and technology-transfer systems, flexibility refers to the capacity of an organization to respond to changes in its work environment, and to the level of autonomy individuals are given. For example, NCDP's Regional Coconut Extension Officers (RCEOs), who have their duty station with the respective Regional Agriculture Development Officer, have the task of increasing production in the region, following NCDP's policies and strategies. They have thus to report to CES at NCDP's headquarters. This would lead to inefficient and limited activities if rigid procedures with formal consent were required before any action could be taken. Fortunately, RCEOs are encouraged to avail themselves of all chances for coconut development and to act without the prior consent of CES in Dar-es-Salaam within certain limits. This helps to "cut red tape" in a situation where communication is difficult (Barkey 1988).

OFCOR studies show that organizational flexibility has a positive impact on integration because it allows managers to create, improve, or otherwise modify linkages. Institutional rigidity limits chances for developing effective integration. But too much flexibility has a negative impact on integration, since division of responsibilities and control over

resources may not be well defined (Merrill-Sands and McAllister 1988).

Coordinating positions and units are more effective if they have the flexibility to allow individuals to alter their routine behavior to include collaborative activities. But such structural mechanisms, of course, should not reduce organizational flexibility by introducing new sets of rules and procedures, impeding further adjustments. Similarly, organizational flexibility increases the effectiveness of lower-level committees.

Highly rigid institutions need structural mechanisms to achieve integration. Coordinating positions or units with formal authority (under direct supervision) are more appropriate because they are consistent with the organization's management style.

The risks of integration

The creation of structural mechanisms for integration involves certain risks as described below. However, it is in cases of poorly designed integration — where objectives are unrealistic or structural mechanisms are not appropriate, for example — that the risks are highest.

- **Loss of autonomy**. The disruptive nature of coordination documented in the literature on organizations (Roger and Whetten 1982) applies also to integration. The creation of structural mechanisms to promote integration can be perceived as a threat to individual, unit, or organizational autonomy. Formal participation in joint activities may mean some loss of control over resources and programs. The trade-off is always carefully analyzed by each party, and integration is usually rejected or neglected if it turns out to be a losing game.

- **Costs of integration.** Managing integration is expensive. It eats up the participants' time, as well as the manager's. It costs even more when formal coordination functions are created since not only time but also extra financial, physical, and human resources are needed. In some cases, these have to be diverted from existing resources. In any case, the level of integration depends on available resources.

- **Dysfunctions due to extensive integration.** Dysfunctions result from over-integration. First, there may be a reduced capacity to adapt to changes in the environment because rules and procedures have become overly formalized and standardized. Integration should not become an administrative burden.

  Second, individuals, units, or organizations required to interact with a multiplicity of other people and organizations are faced with competing interests and interdependencies. One of the most common conflicts arises between requirements for participating in horizontal coordination and vertical program activities.

- **Too many changes.** In many countries, major structural changes aimed at integrating research and technology transfer did not achieve the expected objective of producing and delivering relevant technologies to farmers (Palmieri 1990, Faye 1989). The case study in Costa Rica (Case 7, p.27) shows that these changes resulted in greater resistance to further changes and loss of confidence of researchers and technology-transfer agents.

Alternatives to integration through structural linkages

Other linkages such as joint collaborative activities, meetings, training, and informal contacts, can serve as alternatives or complements to structural linkages. They are discussed in papers issued by the two ISNAR studies on on-farm client-oriented research and research-technology transfer linkages (see Eponou 1989, Merrill-Sands and McAllister 1988, Merrill-Sands et al 1990, Ewell 1988 and 1989, Bingen and Poats 1990, Bennel 1989). Indeed, numerous examples cited in this paper (from Colombia, Burundi, the Philippines, Zambia, and Tanzania) illustrate issues and provide lessons in managing other types of linkages.

Earlier, it was stressed that integration is a way to avoid duplication of effort. But in some

cases, redundancy is an alternative to integration.

People might end up duplicating the work of others because they consider their colleagues to be incompetent. When task interdependence threatens productivity because of the shortcomings of one of the parties, the best strategy may well be to become less interdependent — by carrying out the other party's tasks.

The cost of coordination can also lead to alternative strategies. An institution might undertake other tasks if it perceives the development of structural linkages to be too expensive. Resources saved — because they are not used for linking — can be allocated to other activities. When this results in a broader institution's scope, it may attract more funding, as is the case with numerous agricultural R&D projects.

Case 7. Costa Rica: Reorganizing research and extension

The Ministry of Agriculture and Livestock in Costa Rica is responsible for both research and extension. Between 1980 and 1989, the ministry went through several reorganizations designed, among other things, to improve the links between research and extension. These changes included: putting research and extension in the same department; several alterations to the extension organization chart; creating a research-extension planning unit; regionalizing research and extension; adopting the Training and Visit system of extension; reorganizing research into commodity programs instead of disciplines; and forming commodity programs involving research and extension.

With reference to maize technologies in the Atlantic Coast region, none of these changes had an important, identifiable impact on either research or extension or the links between them at the field level. There were few changes in the number of research and extension activities, their topics, or their methodology that could be attributed to the reorganizations. Links between the two activities remained weak and little new maize technology was adopted.

The study conducted by Palmieri (1990) concludes that the reorganizations were too frequent. Not enough was done to educate staff about the reasons for the changes or to persuade them of their necessity. There was insufficient attention to field-level links and methodologies. Resource limitations were at the root of many of the field-level problems, but these were not addressed by changing the boxes in the organization chart.

Source: Merrill-Sands and Kaimowitz 1990, based on Palmieri 1990; adapted with their permission.

3. THE WILL TO INTEGRATE

Structural changes alone cannot solve integration problems. They are effective only when they also induce changes in organizational and individual behavior. As Korten et al. state (Whyte and Boynton 1983:241):

> "Structural innovations, such as the placement of research and extension functions under the same leadership and the introduction of formal coordinating mechanisms at various organizational levels, are only partial answers to the integration need. . . . Truly effective integration also calls for attention to the reorientation of training, redefinition of roles, and substantially increased attention to managerial process."

The preceding chapter highlighted the use of several structural mechanisms to provide opportunities for integration. How do these mechanisms operate in practice? The answer depends on how far the actors involved are willing and able to go to make them work. Integration, defined as a process, implies a dynamic. Managers act as initiators or catalysts, specific actions of integration provide the momentum, and participation of all parties at the operational level ensures continued development of the dynamic.

Managers As Initiators

Korten (Whyte and Boynton 1983:241) calls for "a long-term participatory process involving the key actors at various levels" in order to work out the structures, roles and relationships that are appropriate to any given setting.

Managers who are able to anticipate the need for integration allow the different parties to contribute early on to the planning of activities. This increases the likelihood that organizations or units will produce results relevant to clients' needs. It also means that structures and procedures will be in place and ready to function when needed.

Integration is not an end in itself, but a means to improving an organization's performance. In designing an integration strategy, managers have to define the nature and the degree of integration required. Many national agricultural research systems face continual resource constraints and, in this context, it is impossible to achieve the ideal level of integration. Managers have to be realistic by concentrating on priority linkages.

Integration, which requires both operational resources and individuals' time, cannot just be added to existing programs. Case studies leave no doubt that individuals rarely accept the extra burden. Personal interest and the professional responsibilities for which individuals are held directly accountable take precedence over joint efforts. Managers must provide guidelines to help individuals to make rational choices among alternative tasks and to ensure the availability of necessary resources.

Promoting integration requires that managers constantly act as catalysts.

One permanent indication of the value that managers attach to integration is the existence of resource allocation guidelines for staff. But these should be accompanied by other tools, particularly rewards for successful performance of integration tasks. Professional coordinators ought to be rewarded for their performance according to two criteria: how well the units or people they are attempting to coordinate have contributed to achieving the final product, and how well they themselves have performed as individual coordinators.

Creating A Dynamic For Integration: Participation And Partnership

It is usually not possible for managers to be responsible and accountable for integration and, at the same time, fully involved in it. Such a burden would limit their capacity to work effectively on other tasks. What the manager can do, though, is act as the catalyst and allow others to provide the momentum and ensure development of the necessary dynamic.

Managers might consider full or partial delegation of the integrator's job to be sufficient to ensure participation. However, unless all actors involved are given the right to participate, this delegation does not generally work effectively. As we stated earlier, the various players in the development, delivery, and use of technology — namely the on-farm researchers, on-station researchers, technology-transfer workers, and farmers — differ markedly one from the other. Each group has its own fields of interest, sets of objectives, and perceptions of the working environment; yet each is expected to play a role in integration.

Effective commitment of individuals depends on how closely institutions' objectives and activities coincide with the various actors' personal strategies (Crozier-Friedberg 1977). Conscious of this problem, Galbraith (1977) emphasizes the role of reward systems for integrating individuals and organizations, especially the fact that not all reward systems are equally effective, and that they depend on the task, the structure, the people, and the policies. This means that specific attention should be given to the institutional context in which people are expected to promote integration, particularly by providing accompanying measures to make this environment more favorable to integration activities.

Nickel (1989) advises agricultural research managers to give a voice to individual members to involve them in decisions that directly affect them. Referring to Argyris, he states: "The ability to permit participation by subordinates and others without their feeling threatened is a recognized characteristic of successful executives."

However, some case studies show that more than simple participation is needed for successful integration.

In Tanzania, the Ministry of Agriculture's extension workers seconded to NCDP (see Case 2) showed an above-average level of commitment, because they work in a highly favorable environment. Not only are they well paid or rewarded, they are also considered by the researchers as colleagues and competent interlocutors. They are partners.

Abedin and Chowdury (1989:20) emphasize also "a partnership relation between extension and research" as a necessary condition to building effective links between research, extension, and farmers.

Partnership implies that both parties have specified, joint rights and responsibilities. It is still a hypothesis at this stage of synthesis in the RTTL project that partnership is associated with successful structural linkages. If this proves to be true, we will try to develop the idea to provide managers with experiences in how to add partnership/initiative to participation/consultation in setting structural linkages.

CONCLUSION

Using or creating structural mechanisms to link agricultural research and technology-transfer tasks may be an adequate way of getting the expected output: relevant technologies or knowledge for agricultural development.

A detailed analysis shows that the main structural linkages (direct supervision, liaison, position or units coordinating committee) are not equally feasible and appropriate for different situations discussed.

Four factors condition their selection and therefore their effectiveness:

1. What purpose they serve.
2. How they fit into the existing structure.
3. How they are managed.
4. The main actors' level of commitment.

The role of the manager is essential for effective linkages, whatever the type. It mainly consists of choosing the most appropriate type of linkages, ensuring availability of resources and a favorable policy context, and getting people's participation through partnership.

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