Linkages Discussion Paper No. 12

International Service for National Agricultural Research

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Management of Intergroup Linkages for Agricultural Technology Systems

by

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AGRIVOC Descriptors

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CABI Descriptors

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INTRODUCTION TO THE ISNAR STUDY ON THE LINKS BETWEEN AGRICULTURAL RESEARCH AND TECHNOLOGY TRANSFER IN DEVELOPING COUNTRIES

In 1987, the International Service for National Agricultural Research (ISNAR) initiated a major international comparative study on the links between agricultural research and technology transfer in developing countries. Like other ISNAR studies, this study was developed in response to requests from agricultural research managers for advice in this area. It is being carried out with the support of the governments of Italy and the Federal Republic of Germany and the Rockefeller Foundation.

The objective of the study is to identify ways to strengthen the links between agricultural research and technology transfer systems in order to improve the following:

(a) the relevance of research efforts through a better flow of information about farmers' needs to the research systems;

(b) the transfer of technology to agricultural producers and other users of agricultural technologies.

Why the Study Was Initiated

Many sources have noted the problems of poor links between research and technology transfer in developing countries:

"Bridging the gap between research and extension is the most serious institutional problem in developing an effective research and extension system" (World Bank 1985).

"Weak linkages between the research and extension functions were identified as constraints to using the research in 16 (out of 20) of the projects evaluated" (United States Agency for International Development 1982).

"All the 12 countries (in which research projects were evaluated) had difficulties of communication between research institutions and extension agencies" (Food and Agriculture Organization 1984). The serious consequences of this problem are effectively summed up by a leading expert in the field, Montese Snyder: "The poor interorganizational relations between the extension agency and the research organization almost guarantee that research results will not reach the farmers, and if they do, farmers will not be able to use them" (*A Framework for the Analysis of Agricultural Research Organization and Extension Linkages in West Africa*. PhD dissertation, George Washington University, 1986).

Despite this situation, no major international study has been dedicated specifically to this issue. While there are some good evaluation reports and academic studies in individual countries, much of what has been written on the issue has been general or anecdotal. The results of practical attempts made to improve links have been disappointing.

A systematic study is needed to provide a set of simple, but not simplistic, suggestions on how research-technology transfer links can be improved in different situations.

Operational Strategy and Products

This is a four-year study divided into three stages. The first stage consists of a literature review, the development of a conceptual framework and case study guidelines, the production of 'theme papers' (see page iii), and pilot case study activities in Colombia. The second stage involves carrying out case studies in six additional countries—Costa Rica, Côte d'Ivoire, the Dominican Republic, Nigeria, the Philippines, and Tanzania. In each of these countries the studies will concentrate on specific subsets of the national research and technology transfer systems. They will also document the links involved in the generation and transfer of a small number of specific new agricultural technologies. In the third stage, the various materials that have been developed will be synthesized into applicable guidelines.

Four types of documents are or will be published as part of this special series of papers on research-technology transfer links:

1. *Theme papers* on key linkage-related topics. These have been written by specially commisioned international experts in the field.

2. *Discussion papers* which analyze one or a few major issues emanating from the case studies. About 15 such papers will be produced. Ten papers written by the case study researchers have already been published. The others, written by ISNAR staff and consultants, are in the process of being published. They focus on the most outstanding features of the links observed in the cases and draw clear conclusions about them for practical use by managers.

3. *A synthesis paper* which presents the lessons emerging from the case studies. This is being written by ISNAR staff.

4. *Guidelines* on how to design and manage the links between agricultural research and technology transfer for policymakers and managers concerned with the two activities. These are also being written by ISNAR staff, and will be published with input from the case study researchers, national managers, and others.

The theme papers were published during 1989. Most of the discussion papers were published in 1989 and 1990, and the synthesis paper and guidelines will be available in 1992. Individual copies of discussion papers are available from ISNAR on request, at the discretion of ISNAR.

LIST OF THEME PAPERS IN THE SPECIAL ISNAR LINKAGE SERIES (published in 1989)

No. 1. A Conceptual Framework for Studying the Links between Agricultural Research and Technology Transfer in developing Countries
David Kaimowitz, Moneze Snyder and Paul Engel

No. 2. Intergroup Relations in Institutional Agricultural Technology Systems
Paul Bennell

No. 3. Private Sector Agricultural Research and Technology Transfer Links in Developing Countries
Carl Pray and Ruben Echeverría

No. 4. The Political Economy of the Development and Transfer of Agricultural Technologies
Holly Sims and David Leonard

No. 5. The Effect of Changes in State Policy and Organization on Agricultural Research and Extension Links: A Latin American Perspective
Roberto Martínez Nogueira

No. 6. The Agricultural Research-Technology Transfer Interface: A Knowledge System Perspective
Niels Röling

On-Farm Client-Oriented Research Series. Comparative Study No. 4. Linkages between On-Farm Research and Extension in Nine Countries.
Peter T. Ewell

LIST OF OTHER DISCUSSION PAPERS IN THE SPECIAL ISNAR LINKAGE SERIES

No. 1. Institutional Linkages for different Types of Agricultural Technologies: Rice in the Eastern Plains of Colombia (1989)
Luis Alfonso Agudelo and David Kaimowitz

No. 2. Relations between Agricultural Researchers and Extension Workers: The Survey Evidence (1989)
Stephan Seegers and David Kaimowitz

No. 3. Placing Agricultural Research and Technology Transfer in One Organization: Two Experiences from Colombia (1989)
David Kaimowitz

No.4. The Impact of Improved Institutional Coordination on Agricultural Performance: The Case of the Nariño Highlands in Colombia (1989)
Paul Engel

No.5. Informal Linkage Mechanisms and Technology Transfer: The PACO Project in Côte d'Ivoire (1990) (also available in French)
Thomas Eponou

No. 6. Managing the Links between Research and Technology Transfer: The Case of the Agricultural Extension-Research Liaison Service in Nigeria (1990)
Johnson Ekpere and Isiaka Idowu

No. 7. Efectos de los Cambios Estructurales en el Ministerio de Agricultura y Ganadería de Costa Rica, sobre la Relación Entre Investigación y Transferencia de Tecnología en Maíz (1990)
Viviana Palmieri

No. 8. The Training and Visit System and the Links between Rice Research and Extension in the Matmara District of Sri Lanka (1990)
Stephan Seegers

No. 9. Integration and Overlapping Tasks: Some Cases in the Philippines (1990)
Herminia Arocena-Francisco

No. 10. Efficacité des mécanismes de liaison et types de technologies: Le cas des zones savanicoles de la Côte d'Ivoire (1990)
Thomas Eponou

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Contents

Acronyms

ATS	agricultural technology systems
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CES	Coconut Extension Service
CIAT	Centro International de Agricultura Tropical
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
DRI	Programa de Desarrollo Rural Integrado
ERI	Equipo Regional de Investigación
FSR	farming systems research
ICA	Instituto Colombiano Agropecuario
ISNAR	International Service for National Agricultural Research
MAG-CATIE	Ministerio de Agricultura y Ganadería–Centro Agronómico Tropical de Investigación y Enseñanza
MALD	Ministry of Agriculture and Livestock Development
NCDP	National Coconut Development Program
RCT	realistic conflict theory
USAID	United States Agency for International Development

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Management of Intergroup Linkages for Agricultural Technology Systems

Summary

This paper examines linkages between research and technology-transfer groups from the perspective of a payoff matrix (a concept borrowed from game theory). It analyzes tensions in group interactions in order to get at their structural causes. This approach is useful in situations where each group has its own responsibilities, its own objectives and autonomy to act, but where the activities of all groups taken together are interdependent and jointly determine the overall benefits and costs to the system in question. Under these conditions, two sets of interests are at play: those of each group and those of the system as a whole. Specific examples are drawn from the case studies developed as part of the ISNAR Research and Technology Transfer Linkages Project.

INTRODUCTION

Linkages between research and technology-transfer institutions in agricultural technology systems (ATS)[1] do not always work well. Among other weaknesses, relationships between groups performing different tasks can be riddled with conflicts and tensions that are very complex and difficult to manage. Handy (1985) reports that when he asked a group of top managers what their biggest problem was, managing interaction was at the top of the list, and middle managers felt that intergroup conflicts were seldom satisfactorily dealt with by top management.

This paper is intended to contribute to our understanding of the management of intergroup linkages in ATS. The paper has a dual purpose. First, it develops a framework to analyze the structural causes of intergroup tensions, conflicts, and inertia. Second, the paper uses this framework to synthesize the case studies of ISNAR's Research–Technology-Transfer Linkages Project (RTTL).

In practice, much of the management effort that goes into dealing with intergroup tensions concentrates on the symptoms without necessarily addressing the underlying causes. In fact, symptoms are often mistaken as causes. This paper aims to correct this bias by putting forward an analytical framework to help us understand the nature of the underlying causes of intergroup conflicts. This framework should also help in developing better approaches to managing group interactions.

The basic argument is that intergroup linkages involve complex interactions between partly autonomous groups. Each group is equipped with its own agenda, consisting of specific objectives and tasks, and endowed with its own responsibilities, spheres of autonomy and authority, and specific resources which must be brought together to achieve the broader objectives of the system as a whole. This process of interaction inevitably implies tensions between group and system interests. These tensions depend, in part, on the context in which various groups operate and interact.

The framework uses a payoff-matrix approach which, it is hoped, will provide a fruitful way of analyzing intergroup linkages and dealing with the causes of tensions, conflicts, and inefficiencies in intergroup interactions. The approach presented in this paper aims to define key questions to use in analyzing such situations. In fact, apart from illuminating the causes of structural conflicts and tensions, this approach also highlights the danger of situations where there are intergroup linkages but nothing gets done because conflicts are resolved through avoidance and, hence, often fail to be noticed at all (a situation depicted in figure 1).

This approach is used to analyze concrete cases in specific settings and to investigate how to find solutions for each situation. Using the framework in this way has proved practical and has yielded important lessons for management. From this perspective, this paper addresses itself explicitly to ATS managers and linkage practitioners whose responsibility is to deal with group interactions at different levels.

This paper has three sections. The first introduces the principal actors, task groups, and institutional contexts influencing linkage behavior. It stresses the importance of recognizing the existence of task groups as units having specific objectives, spheres of responsibility, and relative autonomy. It then reviews various attempts to explain why intergroup linkages often fail to work. Examples are given

1. Other writers refer to ATS as the *agricultural knowledge system* (AKIS) (Roling 1990) or the *technology innovation process* (McDermott 1988). In the context of this paper, ATS refers to a set of institutions and actors involved in the development and application of scientific techniques and methods to the problems of agriculture and farmers. As such, it covers more than just the agricultural research system.

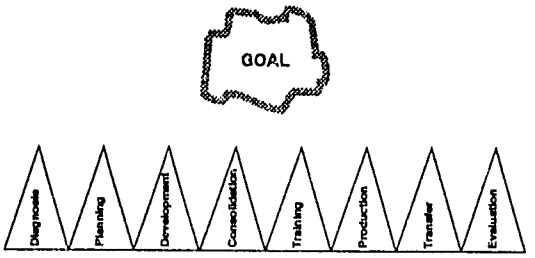

Figure 1. Agricultural technology task groups operating independently of one another and not serving the goal

to show that differences in status and level of training do not provide a sufficient explanation of such failures, nor do such explanations generally offer useful solutions. The conclusion is that to get at structural causes, a more comprehensive framework of analysis is needed.

The second section introduces the payoff-matrix approach which provides a tool for analyzing intergroup relations. In short, the argument is as follows. To function well, each group within an ATS requires room for autonomous action backed by appropriate resources, authority, and responsibilities. In working together, groups need to handle the tensions involved in achieving a common purpose while having distinct agendas of their own. The payoff matrix helps us conceptualize the types of outcomes such interactions can entail and shows that these outcomes are not necessarily optimal (either jointly or for the group). The solution, it is argued, is not to coerce (one or more) groups into a particular outcome but to analyze the context within

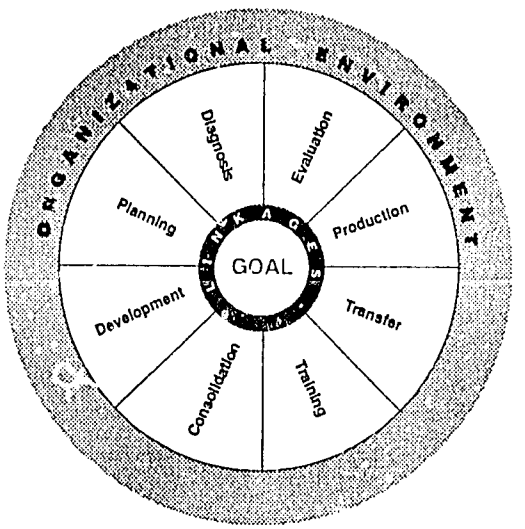

Figure 2. Agricultural technology task groups brought together by linkages and serving the goal adequately

which they cooperate (see figure 2). This helps us focus on the structural causes of tensions and inefficiencies that require broader management action to resolve.

The third section summarizes the findings of the case studies. This section illustrates how the broader analytical framework can be used to identify structural causes and, consequently, draw lessons for management.

GROUP INTERACTIONS: SYMPTOMS AND CAUSES

This section warns against confusing symptoms with their causes; this often happens when issues of intergroup linkages in ATS are analyzed. Consequently, managers frequently address symptoms rather than focusing on the underlying problems, a strategy that is not always very effective. To start with, this section briefly looks at the actors in linkage behavior and, subsequently, explores different ways in which tensions between them have been analyzed in relation to their symptoms or their causes.

The Actors: ATS Task Groups

Agricultural technology systems can be very complex, not least because of the nature and dimensions of the challenges they face. To achieve its goal, an ATS needs to fulfill a range of tasks with different skill and organizational requirements at different levels. To operate, therefore, an ATS needs to organize its tasks through the formation of specific task groups, which are key elements in the system. These task groups are more than people with skills and material resources at their disposal, although these are obviously essential attributes. To function well in the pursuit of their mission, groups also need guiding methodologies, responsibilities for and autonomy in deciding on a course of action, and a system of incentives and rewards. Furthermore, groups develop identities that secure their cohesiveness (Bennell 1990). That is, people tend to identify with the group they belong to and shape their behavior accordingly.

The composition of task groups in each ATS differs widely according to the group's task and its organizational design and inspiration. Task groups may include the following:

- apex managers involved in policy-making and setting the organizational climate;
- multidisciplinary team members doing diagnostic and/or evaluation surveys;
- researchers involved in technology development;
- researchers doing applied/adaptive work and/or transfer workers testing technologies for a variety of conditions;
- liaison officers interfacing between tasks and units;
- specialists training generalists and transfer workers;
- technology production professionals and multiplication and distribution agents;
- quality controllers and regulators of technologies (seed inspectors, quarantine enforcement officers, etc.);
- field transfer workers and credit and input agents, etc.

Interactions can take place between any of these groups. In the context of the RTTL study, we are concerned with interactions between groups performing tasks that are predominantly research oriented and those that serve a technology-transfer function. Unresolved tensions between these two sets of actors are of particular concern because they are largely responsible for much of the poor performance of ATS and the resulting low impact of research on agricultural production.

Explaining Intergroup Tensions

As discussed above, symptoms are often used to explain intergroup tensions rather than causes. In fact, conflicts among groups often surface in reciprocal accusations of others being "snobbish," having an "ivory-tower mentality," being "incompetent," being "politically motivated," etc. (Lecompte 1964; Hildreth 1965; Samy 1986; Seegers and Kaimowitz 1989). Not uncommonly, these conflicts are attributed to personality clashes resulting from various factors such as differences in status, in levels of education, or in hierarchical positions between members of different groups. Most arbitrators try to remedy the situation by recommending changes in one attribute or another of the conflicting parties — such as physical relocation of different units, narrowing the educational gap between groups, or restructuring individuals' positions in the hierarchy. These factors undoubtedly matter but they should be seen in context; alone they do not constitute a sufficient explanation for intergroup tensions. As Bennell (1990: 117) states:

> *It is quite common for social conflict to be attributed to personality clashes, both by observers and by participants. However, this still begs the question whether individual personalities are the real cause of conflict, or whether they are merely a symptom of poor relationships between groups as a whole.*

A good example of this point is provided by Dandhanin (1984) in his study of inter-role relationships in technology transfer in Thailand. His findings showed effective cooperation at the level of technical program planning and dysfunctional relationships at the level of field operations. Researchers, professionals, and training officers shared common backgrounds in training and experience; they were able to develop effective communication and interaction based on their shared technical knowledge, perception of problems, and expectations. At the field level, in contrast, the relationships between transfer agents and professional groups were strained and lacking in cooperation. Each group accused the other of not fully understanding farming conditions, of being inexperienced, and of lacking confidence.

In this case, transfer agents were trained in an attempt to bring the two groups together by narrowing the educational gap between them. But, in actual fact, they drifted further apart and the reciprocal accusations persisted. The reason was that education, by itself, was not the major problem. Dandhanin explains that the increased training for transfer workers was irrelevant in view of the responsibilities they had. The underlying causes of the problem were divergence in task orientation, role conflicts, and poor interorganizational morale. The information given to transfer workers by researchers was often not applicable or it arrived too late. Personality clashes were only symptoms of these deeper problems.

In Western Nigeria, Akinbode (1974) found that the relationship between the Faculty of Agriculture of the University of Ife and the Ministry of Agriculture was cooperative in the early period (1962–1969) when the faculty needed and received assistance from the ministry, which also played a complementary role of parenting the newly emerging university. Later, the relationship became less cooperative after the faculty, which was by then well established with support from USAID and the University of Wisconsin, successfully challenged the ministry for the mandate of research, training, and associated resources. As a result, cooperative arrangements such as joint research and training programs, staff secondment, sharing of physical resources, in-service training contacts, committees and meetings between the two parties suffered, and each one proceeded with its own agenda, disregarding the objectives and activities of the other despite the earlier cooperation.

Both cases make a point that Bennell (1990: 122), referring to realistic conflict theory (RTC), formulated as follows:

> *According to this [RCT] research, personality differences or previous relationships between individuals play only a limited role in influencing the nature of intergroup relationships.*

We are, therefore, faced with having to seek variables that play a more decisive role in influencing the nature of intergroup relationships.

In answering this question we need to take into account the fact that *an ATS that is principally staffed with professionals requires a set-up that allows groups of researchers and transfer agents to exercise initiative, assume responsibility, and enjoy a certain autonomy within a broader system climate and context.* Cooperation among groups then raises questions about prospective losses and gains for each partner. That is, an intergroup agenda that fails to address the fundamental concerns of member groups may end up frustrating one or more parties rather than promoting the integration of different group goals. For example, in an integrated development project, credit agents who uphold strict repayment criteria in supplying inputs to farmers may foil the efforts of transfer agents who advise farmers to use those inputs (Lakoh 1986). If the two cooperate they might find a common approach to achieving both objectives: the adoption of new technologies as well as the repayment of loans and interest.

Group interaction, therefore, is a process that involves matching various group objectives and needs with the overall goals of the system. In establishing linkages, groups invest skilled personnel and material resources; they need to agree on a wide variety of intangible issues relevant to their cooperation. These issues concern matters of authority, forms of partnership, job satisfaction according to the various groups' perceptions of professional quality and ethics, apportionment of the credit for success or the blame for failure, etc. In cooperation, these group assets, tangibles and nontangibles, become *stakes* invested in the joint effort. Groups are keenly aware that they can gain or loose these stakes, either as a group and as individuals belonging to a group.

This rationale leads Bennell (1990) to distinguish between two interrelated types of stakes pertaining to groups and the individuals within them: identity (expressive) stakes and instrumental stakes. Bennell (1990: 120–121) defines the former as follows:

> *Expressive stakes and processes concern the behavior of the individual that 'expresses who the person and the group he represents wants to be in the situation and . . . how he perceives and feels about other participants and the group they represent. . . . Both individuals and groups have identity attributes, all of which may be at stake in their relationship.'*

Instrumental stakes are defined as follows (Bennell 1990: 119–120):

> *Instrumental stakes are resources, both tangible and intangible, put at risk by each group undertaking shared activities. They reflect the commitment of each group, and its potential gains or losses in the joint venture.*

Hence, when cooperating, groups have different perceptions of their own work and that of others, as well as committing different resources to the joint effort. Consequently, groups may gain or lose when engaging in joint endeavors.

For example, controlled experimentation is necessary to provide researchers with statistically significant results, while transfer workers are more concerned about finding robust solutions to farming problems under uncertain conditions. Thus, when researchers and transfer workers have to plan or conduct joint trials, they may not be in agreement about such details. Trials designed by researchers for transfer staff to execute often fail to impress the latter, because the details involved may seem trivial to them.

There is also divergence in the scope of activities in research and transfer programs. Research programs are often organized around commodities, disciplines, or geographic areas. Transfer activities are organized around administrative zones, along with other development activities, and oriented towards a wide range of production system problems. Joint activities involving two or more task groups may go smoothly as long as there is correspondence of scope but may start to diverge when their scope diverges. According to the scope of their activities, transfer workers may prefer a group approach to reaching farmers, while researchers may want an individual approach for closer follow-up.

This approach toward intergroup relationships puts the emphasis on the context in which people or groups interact and guards against simple explanations. Groups do not fail to cooperate merely because they dislike one another, nor is cooperation rendered impossible because different groups pursue distinct agendas, each with their own specific goals. Even a strong drive such as selfishness is not a sufficient explanation for failing to enter into relationships that can be mutually beneficial. Nor do groups cooperate because of some altruistic motive of social welfare. *Whether groups cooperate or fail to cooperate depends on what is at stake for each of them and on the terms under which they meet.*

Group interaction, therefore, takes place within a context that is not neutral. Identity stakes and instrumental stakes are *structured* by the overall system, and hence, they depend, among other things, on how the system is managed. It is the overall design and management of the system that determines, to a large extent, the terms on which the different groups operating within it cooperate or fail to cooperate. Overall management sets the context for the distribution of resources across the different components of the system, its climate, and its policy environment. This sets

the boundaries within which different groups each define their room for maneuver and seek out cooperation.

We need to look, therefore, at the *structural conditions* that influence or determine the coordinative behavior of the task groups within a (sub)system. These include the system climate, resource allocation, and the policy environment. These are the principal means by which management can affect the outcome of group interactions — not by direct fiat or administrative decree, but by influencing the environment within which groups operate without impeding their ability to exercise initiative and to guard their autonomy.

This paper argues that management needs to concentrate on shaping the structural conditions in an ATS. The need for this may not be immediately obvious since tensions often appear to be caused by personality clashes — differences in status, education, or other factors. This is understandable. In looking at linkage behavior, identity stakes are more immediately obvious than the others. This partly explains why the success or failure of linkages is often attributed to whether personalities clash or get along. However, although tensions may manifest themselves more conspicuously at this level, they do not necessarily originate there, nor can they always be resolved by addressing factors of personal attributes alone. To get at the causes of a problem, it is necessary not to be distracted by its symptoms.

An earlier hypothesis of the RTTL study stipulated that positive external pressure was necessary for an ATS to be responsive to farmers' needs (Kaimowitz, Snyder, and Engel 1990). Subsequently, Kaimowitz (1992) has attempted to show the impact of such pressure on the performance of the subsystems studied. In that paper, however, the limitations of such oneway pressure as a means for securing lasting integration among ATS actors are made evident. The framework developed here seeks to explain why simple pressure will not do. What matters is to seek ways of influencing group behavior by affecting the structural conditions within which groups operate. To visualize this, we need a framework within which to locate questions about tensions in group interactions. This is the purpose of the next section.

MANAGING TENSIONS: THE PAYOFF-MATRIX APPROACH

This section develops a simple framework using the payoff-matrix approach (a concept borrowed from game theory) to analyze tensions in group interaction in order to get at the structural causes of such tensions. This concept is useful in situations where each group has its own responsibilities, its own objectives and autonomy to act, but where the activities of all groups taken together are interdependent and jointly determine the overall benefits and costs to the system in question. Under these conditions, two sets of interests are at play: those of each group and those of the system as a whole. In such a situation, groups do not always cooperate to achieve maximum gains for the system as a whole because such strategy may prove to be harmful to the specific interests of one or another group. Cooperation, therefore, is not necessarily the "natural" strategy for a group to pursue.

The Concept of a Payoff Matrix

Cooperation between groups implies that each group commits resources (stakes) to the joint effort and expects to benefit in terms of its own specific objectives. It is conceivable that a particular group may find itself called upon to commit substantial effort and resources to joint endeavors while the gains principally accrue to others. For example, controlled experiments designed by researchers alone but involving both researchers and transfer workers in execution may leave the transfer workers with a strong feeling that this form of cooperation demands their time, effort, and material resources while not necessarily responding to their needs. If such a situation continues, transfer workers may end up switching off support to the joint endeavor.

Hence, when analyzing intergroup linkages, it is not sufficient to assess the overall costs and benefits to the system as a whole, but the distribution of gains and losses (i.e., benefits minus costs) across groups should also be checked. These gains and losses involve both identity and instrumental stakes. In the example given above, transfer workers lose not only the resources they commit to the joint effort, but they are also left with little initiative and status in the process of cooperation. The payoff matrix is a simple tool to depict the perceived gains or losses of each group in the process of group interaction.

Figure 3 depicts a payoff matrix between two interacting groups: researchers and transfer workers. In this context, a group is *cooperative* if it is willing to make allowances for the interests of the other group (or groups). Cooperation, therefore, involves give and take.[2] A group that is only willing to participate on its own terms is said to be *uncooperative* (even if joint action effectively takes place). In our

2. What matters here is whether the group effectively commits resources to the joint endeavor or merely pays lip-service to it.

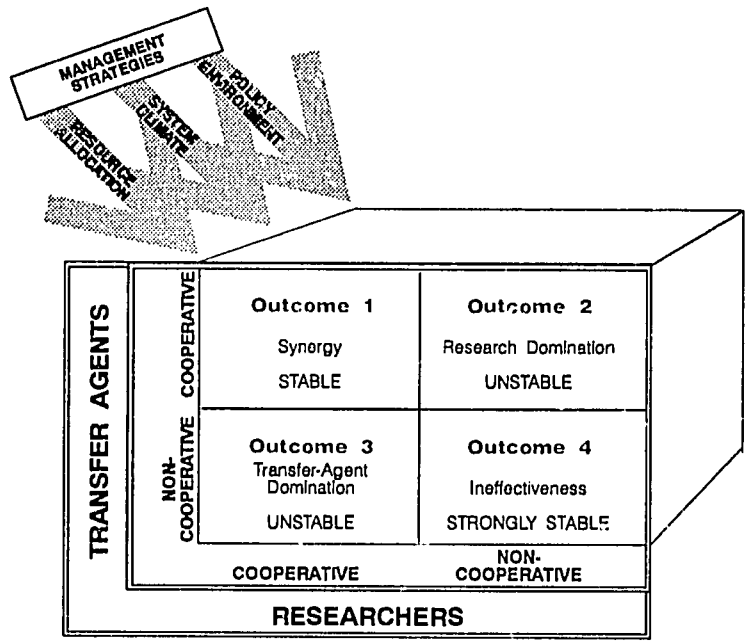

Figure 3. Payoff matrix showing strategies and situations resulting from such strategies between two interacting groups: researchers and transfer workers

example above, joint action (controlled experimentation) takes place, but in this hypothetical case, the researchers are seen to be uncooperative (they strictly pursue their own agenda), while transfer workers are cooperative but are losing out in the bargain (depicted by outcome 2 in figure 3). This type of situation is inherently unstable since transfer workers are likely to withdraw or limit their support (ending up in outcome 4 in figure 3). Obviously, they may not be able to do so formally, but apathy and lack of morale (which are often worse than overt tensions or conflict) may well produce this end result. Situation 4 (outcome 4, figure 3) is undesirable but, in contrast, very stable. It is stable because it is very hard to move away from once both groups are locked into it. The reason is that mutual distrust reinforced by actual experience makes it hard for any group to take an initiative towards meaningful cooperation; the perceived likelihood that the other group will take advantage of such initiative is great.

Situation 1 in figure 3 depicts the case where both groups cooperate meaningfully: each group gains individually and both groups together manage to achieve the system's objectives. This position is also stable, although weakly so. It is stable so long as mutual trust continues to be reinforced by actual practice. Hence, in outcome 1, the groups can agree on a joint strategy that yields synergy. But synergy concerns the system goals, while both task groups are first and foremost concerned with their immediate objectives. Thus, one group cannot always be sure the other is not going to pursue its own individual stakes. This is why such a joint strategy requires management action to be sustained.

Managing Structural Conditions

The question now arises as to what promotes or discourages cooperative behavior. This paper argues that it is not because of personality clashes or differences in status or education. The main reasons for cooperation (or a failure to cooperate) lie in the *structural conditions* that influence or determine the coordinative behavior of the different task groups within a (sub)system: the system climate, the patterns of resource allocation, and the policy environment. These are issues that directly concern the overall management of the system.

A group fails to cooperate for two reasons. First, because it dominates the scene and gets away with it (coercing other groups to comply with its agenda). Whether a group can do this is not just a question of personalities, but more important, of its access to resources, its position in the hierarchy, and its sphere of autonomy. These are in part determined by management actions. Second, a group may fail to cooperate as a defensive reaction to protect itself against other groups that try to set the tune. Again, this depends as much on the

structural conditions within which groups operate as it does on the personal attributes of individual group members.

The implication is that system management can influence the terms on which groups meet and map out a strategy for joint action. In dealing with intergroup linkages, therefore, managers should not only analyze the overall benefits and costs expected from joint action, but also the factors that shape and determine group interests in the process of interaction.

More specifically, in the case of ATS, in order to succeed, linkage activities require researchers and transfer staff to confront one another on equal terms and treat each other with professional collegiality in problem solving (Leonard 1977). In many systems, this can not be achieved because the underlying relationships between the two groups are stultifying and authoritarian. Administration by fiat or coercive directives do not work because groups require a certain autonomy and sense of responsibility to be able to act with initiative. Differences in education and/or training levels do not necessarily mean that the two groups cannot have compatible and complementary ideas. The crucial issue is to adopt a supportive rather than a carrot-and-stick management approach to create a climate that is conducive to genuine cooperation.

It is, therefore, intergroup dynamics along with the environment in which they take place that count. They influence the type of outcome (as depicted in figure 3) that results from linkage interactions. In particular, the dominance of one group or groups by another is likely to result in a lopsided definition of the joint agenda and creates conflict, resistance, or, worse still, apathy on the part of the dominated group(s). Two examples may illustrate this point better.

In Kenya, Leonard (1977) found that (over)education and training of transfer agents showed rapidly diminishing returns in terms of performance (including decoding of research messages into practical recommendations). This was most noticeable in the case of transfer agents with more than six years of schooling, which may seem paradoxical, but it can readily be explained with the aid of the figure 3. While the years of schooling enhanced their capacity to receive technical information, it also diminished their motivation proportionally, given their subordinate position vis-a-vis researchers, which left them with little initiative. This is depicted in figure 3 as outcome 2, which inevitably gravitates towards outcome 4 as job satisfaction decreases and apathy on the part of the better-educated transfer workers becomes the norm.

In contrast, the agricultural technology system of the People's Republic of China has often been interpreted as a good example of integration between research and technology transfer (Wuyts-Fivawo 1988a). Yet Chinese authorities have identified this as one of their major problems. Recent studies, moreover, have revealed weaknesses in the operationalization of that integration. Conroy (1987) shows that the policy of sending professionals to the countryside had a limited effect because, rather than achieving the desired complementarity, professional expertise was totally subordinated to local political power. In the later half of the 1980s, agricultural researchers refused assignments in the countryside, especially to the commune stations, because of what they considered as political harassment. Here, the starting point was unstable (outcome 3 in figure 3), but in this case, it was the researchers who opted out of a situation over which they had little control.

The use of the payoff matrix to explain linkage behavior is not meant to be rigid. This paper is not arguing that managers should make precise calculations of all costs and benefits associated with joint action for every group and, subsequently, map out a detailed set of gains and losses for each combination of individual group strategies. Rather, the framework put forward here is meant to help managers to stand back from the immediate symptoms of tensions and conflicts in intergroup linkages and focus their attention on its structural causes. It may then become apparent why some groups have good reasons *not* to cooperate. Some of these reasons may be structural problems that would be relatively easy to do something about; others may not be able to be resolved without significant alterations in the organizational setup of the (sub)system or training within it, etc.

In sum, the framework itself does not define what the problems are in any concrete sense, nor does it suggest fixed solutions. What it does, however, is allow us to map out relevant questions to identify problems and look for solutions. It gives us a way of posing questions to help us look for structural answers to real problems. The next section of this paper applies the framework to the case study findings.

STRATEGIES AND OUTCOMES FROM THE CASE STUDIES

It is not easy to do an empirical analysis of tensions in intergroup relations. Often the evidence is in the form of anecdotes, cliches, or stereotypes that are themselves symptoms of underlying tensions. Nevertheless, as argued above, these symptoms may reflect deeper issues with respect to the strategies and stakes that influence intergroup linkage behavior. More concrete evidence should come from the strategies groups pursue in interacting with others. These can be traced back to the pattern of resource allocation, as well as the institutional climate, how it affects the overall policy environment, and how it affects the actions of different groups within it.

This section reviews the case studies of the RTTL project. For these studies, researchers were asked to report on the differences between actors in linkage activities that they thought affected the performance of such linkages, and different researchers employed different approaches in analyzing these tensions. It should be noted that the basic framework suggested in this paper did not serve as a guide to this research but sprang from subsequent reflections on the reports and the questions they raised. Consequently, some of the information was incomplete in view of the framework employed here. However, this section reexamines the case studies using the payoff-matrix approach. Special attention is given to the following:

- the nature of the interacting parties;
- what was at stake in the interactions;
- what strategies different groups pursued;
- what management strategies were involved in enforcing them;
- whether (sub)system management acted upon symptoms or sought to redirect the structural conditions of the system;
- what outcomes the relationship had at the level of the actors and at the level of the subsystem.

Cooperative Strategies and Outcomes

An anticipated positive climate in Tanzania's coconut subsystem (Lupanga 1990). The National Coconut Development Program (NCDP) was set up to integrate all coconut rehabilitation activities in Tanzania. The program has its own national and expatriate staff to conduct research and transfer activities. Transfer agents were seconded from the general extension department of the Ministry of Agriculture and Livestock Development (MALD) and, together with subject-matter specialists, formed the Coconut Extension Service (CES) of NCDP. The transfer agents seconded from the ministry had different training, work experience, schemes of service, and motivational structures than the researchers, who had international experience and specialized training in coconut. The gap between researchers and transfer agents was significant, posing potential problems in linkage activities.

NCDP was able to avert the potential "identity" conflict by using subject-matter specialists as interface agents between the researchers and the MALD transfer agents. The subject-matter specialists were assigned to the field as liaison officers directly backstopping transfer agents. They advised on the management of the coconut nurseries that supplied planting materials to farmers; they also prepared manuals for transfer agents, prepared radio programs, and organized training on the various aspects of coconut technology. As members of the coordinating and planning unit of NCDP, they provided researchers with feedback from the field. Transfer agents were awarded bonuses for participating in linkage activities, which compensated for the gap in scheme of service between the two groups.

The subject-matter specialists succeeded in linking the two groups because they were versatile enough to appeal to both groups and were more acceptable to both than the two groups were to each other. Within the structure of the system, they were part of the coordinating and planning unit, which has a mandate for both research and technology transfer. As such, they were able to bridge potential identity differences without bias for or against the actors of either of the other two groups.

Table 1. Summary of the strategies and outcomes of group interaction among researchers and transfer agents in the Tanzania coconut subsystem

Actors:	• NCDP researchers • Transfer workers seconded from MALD
Interaction:	• Exchange of relevant technical information and feedback • Joint demonstrations and trials
Stakes:	• Relevance of technological information and feedback • Methodologies
Strategies:	• SMS liaison officers accepting and acceptable to both researchers and transfer agents
Enforcement:	• Allocation of SMS in liaison position as part of management
Outcome:	• Successful cooperation through liaison officers • Effective transfer of technology

Strategic allocation of resources in the Nariño highlands of Colombia (Engel 1989). In 1975 Colombia adopted a "go-straight-to-the-farmer" policy for agricultural technology through the Integrated Rural Development Program (DRI). In the Nariño highlands the DRI program received financial and technical support from the Dutch government. At the same time, funding was shifted from research to technology transfer. DRI channeled funds to adaptive research conducted jointly by project professionals and researchers under the control of ICA/Extension. Starved of resources, researchers moved into collaborative programs with subject-matter specialists, extension workers, and farmers. Collaborative task groups were formed to work on multidisciplinary surveys, multimedia campaigns, on-farm and on-station research, and special themes.

In the beginning, relationships between researchers and transfer workers were dominated by researchers (which is discussed below in more detail), but this changed to mutual cooperation. The channeling of resources into joint activities was used to enforce cooperation between researchers and transfer staff. This tactic was sufficiently compelling to end the mutual stereotyping (the two groups detested each other in the beginning) and to promote fruitful cooperation. Periodic joint coordinating meetings and biannual joint evaluations enhanced common understanding and strengthened cooperation between researchers and transfer workers. With time, collaborative task groups became the standard units for developing and transferring technologies that had greater impact on production. In 1985, however, financial support to the program ended and funds for joint adaptive research dried up. This resulted in the demise of collaborative task groups and a return to the original uncooperative relationship.

Table 2. Summary of the strategies and outcomes of group interaction among researchers and transfer agents in the Nariño subsystem of Colombia

Actors:	• ICA researchers • DRI project professionals
Interaction:	• Collaborative multidisciplinary surveys • Media campaigns • Joint on-farm and on-station research
Stakes:	• Financial resources and skills
Strategies:	• Team approach in joint adaptive research • Collegiality
Enforcement:	• Strategic allocation of resources to joint activities
Outcome:	• Successful cooperation for as long as the resources lasted • Effective transfer of technology

Dominating Strategies and Outcomes

A biased climate in ICA, Colombia (Kaimowitz 1988; Urrego 1989). By the time of this study, relationships between researchers and transfer workers in Colombia's public ATS had been generally alienated. In the 1950s, before the formation of the Colombian Agricultural Institute (ICA), they already had negative perceptions about each other's roles. Extension workers regarded researchers as patronizing, working in ivory towers, and not giving due recognition to extension contributions. Researchers regarded extension's involvement in adaptive research with disdain. The two groups were expected to conduct regional demonstration trials jointly, but the interaction was reduced to researchers issuing preweighed packages of inputs together with protocols detailing trial designs, sequences, and number of repetitions for transfer workers to implement. Afterwards, the researchers would appropriate the data, analyze it, and publish the results and/or present it on field days. Over the years, transfer workers grew more and more resentful about being taken for granted by researchers. They adopted a bureaucratic attitude towards joint research activities; accuracy in recording decreased, leading to inconclusive results and frequent experiment failures.

When ICA was formed as an independent public institution in 1962, it incorporated three functions: research as the principal function, with postgraduate training and technology transfer as less important. In 1968 ICA's transfer section was expanded when it incorporated the ministry of agriculture's extension service. Research-transfer relationships worsened, with researchers rejecting transfer workers as colleagues and regarding them as inferior.

In 1970, ICA set up rural development projects modeled after the Mexican Puebla projects. Researchers and technology-transfer professionals involved in the project had to collaborate on adaptive research. However, researchers continued to regard the technology-transfer professionals as data collectors, even though they had a comparable level of edu-

Table 3. Summary of the strategies and outcomes of group interaction among researchers and transfer agents in the ICA subsystem of Colombia	
Actors:	• ICA researchers • ICA transfer agents; project professionals
Interaction:	• Joint regional demonstration trials
Stakes:	• Image and position • Resources and skills • Methodology
Strategies:	• Researchers dominating all aspects of interaction
Enforcement:	• Institutional climate
Outcome:	• Researchers' domination undermined initiative and input of transfer workers • Ineffective transfer of technology (poorly conducted joint trials)

cation. Technology-transfer professionals complained about researchers' unwillingness to leave their stations and about their disregard for socioeconomic variables. They went on to set up their own trials — a move that resulted in a protest from researchers, who said it was neither in the mandate nor within the competence of the technology-transfer professionals to do their own trials. For a time they forced the projects to refer to those trials as "technological adjustments" and not as research. Disagreements between the two groups led to some projects being left unfinished.

Throughout ICA's brief history, researchers tended to assume a dominant role in relation to transfer workers, whom they regarded as subordinates. This was due not to any difference in the objective attributes of the two groups, but to the prevailing perception that research and transfer tasks were sequential or competitive rather than complementary. Other activities, though not directly disrupted, did not have as full an impact as they might otherwise have had.

Costa Rica — maize subsystem (Palmieri 1990a; 1990b). In Costa Rica's maize technology subsystem, there were divergent philosophies guiding the work and budgetary procedures for researchers and transfer staff. This impeded cooperation between the two groups with respect to planning and implementation of technology transfer. Measures to correct these problems dealt mostly with the departmental or geographical location of research and technology transfer rather than with the collaborative and reciprocal details of pooling, sharing, and exchanging resources and perceptions. Cooperation was not achieved between the groups.

Phase 1, a biased climate. Prior to 1985, the annual operational plan (PAO) for research and technology transfer comprised a list of trials each researcher thought necessary and possible in his/her respective zone. In the case of maize technology trials, the factors that affected the plan were (a) the support and influence of the International Maize and Wheat Improvement Center (CIMMYT) on variety trials, (b) the personal scientific interest of an entomologist at Los Diamantes research station at a time when maize pests were prevalent in the area, and (c) the contribution of the Ministry of Agriculture and the Center for Research and Training on Tropical Agriculture (CATIE) to the field trials.

Table 4. Summary of the strategies and outcomes of group interaction among researchers and transfer agents in the maize subsystem of Costa Rica, Phase 1	
Actors:	• Researchers • Transfer agents
Interaction:	• Joint annual operational plan for regional technology transfer
Stakes:	• Methodology, image, and position
Strategies:	• Researchers dominating
Enforcement:	• Institutional climate
Outcome:	• Researchers' domination prevented inclusion of input from transfer workers into the annual operational plan • The plan continued to be irrelevant for effective technology transfer

During meetings on the annual operational plan, transfer workers would present lists of problems detected in the region for inclusion in the technology trials for the area. However, researchers dismissed these as arbitrary because they were not compiled according to any "scientific" methodology. Thus, the plan was dominated by researchers' considerations, which were not immediately relevant to the needs of the regions and which did not reflect any significant interdependence between research and transfer.

In 1987, the Ministry of Agriculture decided to develop a more scientifically credible base for incorporating farmers' problems into the annual plan. It carried out an intensive socioeconomic survey based on a farming systems research methodology commonly used in the region (the *sondeo*). The survey made heavy demands on the transfer workers' time and other resources and interrupted routine work in the regions. However, much to the disappointment of those concerned, the results of the survey were never incorporated into the operational plan. The survey data had broad socioeconomic coverage which was said not to fit the narrow disciplinary or commodity research approach of the annual plan — the researchers maintained their dominance over the operational plan.

That same year, transfer agents in the Pococí and Guácimo regions, supported by the National Program for Basic Grains, set up demonstration plots to test the maize varieties and fertilizer applications recommended by researchers. The transfer agents wanted to prove to researchers how irrelevant their recommendations were to farmers' conditions. Contrary to the transfer agents' expectations, however, the researchers used this incident to demonstrate that transfer workers were not competent to manage trials. The transfer agents had selectively picked parts of the researchers' technological packages for use in the demonstrations — without consulting the researchers. Such was the discord between the two groups that research dominance (outcome 2) developed into mutual noncooperation (outcome 4).

Phase 2, sectional allocation of resources: In the situation described above, the authorities perceived the lack of relevant technologies as resulting from the physical and administrative separation of research and technology-transfer. In 1985 the two functions were merged under one directorate with separate subdirectorates, and the research subdirectorate decentralized research teams to the regions to compensate for the physical separation. However, budgets were allocated by subdirectorates, which did nothing to integrate the two functions. This happened when there was a general shortage of funds affecting all government services, particularly agricultural research and technology transfer. It is not surprising that this scarcity encouraged each group to jealously hang on to its own resources at the expense of cooperative activities.

In the regions, decisions about trial programs came to depend on funding commitments from the two groups. Researchers would propose trials that transfer workers might not wish to finance, and vice versa. For instance, in the case of the new maize varieties, researchers opted for trials aimed at maximizing yield per unit area; transfer staff insisted that economic viability (i.e., output per unit of material inputs and labor at prevailing opportunity costs) be included in the recommendation of technological packages and that the results contain alternative techniques from which farmers could select rather than fixed packages of recommendations.

This bargaining process ended in a stalemate, with each group defending its own point of view. The researchers felt that their plans were being unduly criticized and resented demands from transfer agents to incorporate new criteria into the trials. Transfer agents failed to appreciate the value of what was proposed by researchers. Technologies being transferred continued to have little relevance for farmers.

Recently, the authorities have started to strengthen the regional research teams as well as to consolidate budgets for technology transfer in the regions. It is hoped that these

Table 5. Summary of the strategies and outcomes of group interaction among researchers and transfer agents in the maize subsystem of Costa Rica, Phase 2

Actors:	• Researchers • Transfer agents
Interaction:	• Joint field trials
Stakes:	• Methodology • Financial resources
Strategies:	• Each group bargaining for the other to commit resources to activities of its preference
Enforcement:	• Sectional resource allocation for joint activities in the absence of mutual appreciation for cooperation
Outcome:	• Stalemate — neither group could accomplish its goals without the other • Ineffective technology transfer

measures will promote more solid cooperation between researchers and transfer workers.

Asymmetrical agreement and sectional resource allocation in the Colombian rice subsystem (Agudelo 1989; Agudelo and Kaimowitz 1989). Responsibility for rice technology in Colombia lies principally with the Rice Growers' Federation (Fedearroz), which is a commercial farmers' association. It provides technical services to its members in addition to representing their interests in other arenas. Fedearroz does not conduct any research, itself, but contracts with the public-sector research institute, ICA, to produce new rice varieties and other technologies. In the 1970s, direct assistance to rice farmers from Fedearroz was stopped and private agronomists were licensed to provide that service. This approach, however, weakened the transfer of technology considerably because each agency promoted its own concerns. In the end, Fedearroz had to resume the role of providing coordinated technical assistance.

ICA conducted rice research, while Fedearroz provided the funding, with assistance from the International Center for Tropical Agriculture (CIAT). This arrangement, however, was asymmetrical and did not fully meet researchers' needs. Resources were made available for conducting research, but publishing the results (which is essential for researchers' recognition and career advancement) was reserved for Fedearroz. This led researchers to narrowly interpret their obligation only as technology development (i.e., breeding) and not consolidation (i.e., adaptive research), although consolidation is necessary to translate the results of development into components of accessible technological packages. As a result, the technologies produced were not easily transferred.

Table 6. Summary of the strategies and outcomes of group interaction among researchers and Fedearroz project professionals in the rice subsystem of Colombia

Actors:	• ICA Researchers • Fedearroz rice production professionals
Interaction:	• An agreement for rice technology services from ICA for payment by CIAT on behalf of Fedearroz
Stakes:	• Reward and recognition • Resources and skills
Strategies:	• Fedearroz dominating
Enforcement:	• Agreement and funding by CIAT
Outcome:	• Fedearroz's domination restricted researchers input by retaining authorship of research results • Technologies produced under the agreement remained on the shelf

Noncooperative Strategies and Outcomes

Climate of passive competition and sectional allocation of resources in the Philippines seed potato subsystem (Francisco 1989). In the Philippines, when this study was done, two groups were engaged in research on seed potatoes: national researchers at the Northern Philippines Root Crop Research and Training Center (NPRCRTC), who did research and training; and seed inspectors from the Bureau of Plant Industry (BPI) in association with the Philippine-German Seed Potato Program (RP-GSPP), who did research and technology transfer. Both groups wanted the mandate on seed potato research, which was a high-priority activity. It was also an essential part of the national potato program and therefore crucial to both groups. The seed inspectors had their mandate on seed potato research through the RP-GSPP, which picked them because of their knowledge and experience in maintaining high standards of seed quality and their rich experience in field research. Thus, the two groups overlapped with respect to the mandate on seed potato research.

Relationships between the two groups, although cordial in appearance, were actually noncooperative. Linkages between them were characterized by mutual avoidance. Scheduled annual review meetings, where both groups presented their activities for discussion, were simply procedural and addressed neither specific issues nor their implications in any depth. BPI staff avoided antagonizing NPRCRTC staff — who were their potential teachers — and NPRCRTC staff avoided challenging more experienced partners. A meeting between the two groups to discuss the duplication of seed potato research was not effective because of inaccurate communication. BPI staff were quick to suggest that NPRCRTC researchers should leave seed potato research to them and concentrate on table potato research. This would consolidate their mandate in line with

Table 7. Summary of the strategies and outcomes of group interaction among NPRCRTC researchers and BPI seed inspectors in the potato subsystem of the Philippines	
Actors:	• NPRCRTC researchers (on-station research and training) • BPI seed inspectors (field research and transfer)
Interaction:	• Sharing activities of interdependent roles
Stakes:	• Image and position • Resources and skills
Strategies:	• Competitive
Enforcement:	• Institutional climate • Resource allocation by donor
Outcome:	• Mutual avoidance in tackling cooperation issues • Wasteful duplication of interdependent efforts • Ineffective transfer of technology

their RP-GSPP involvement. NPRCRTC researchers were not satisfied with this suggestion but did not voice their disagreement. For three years they stopped their research on seed potatoes but resumed again after they decided that their programs were suffering from the interruption. And the duplication continued.

Researchers in the two groups duplicated each other's activities because of concealed competition. Their strategies appeared to be cooperative but were actually not. Because the communication in meetings to discuss work or negotiate responsibilities was inaccurate, the status quo was maintained rather than improved. Underlying these problems was the perception that the mandates of the two groups were not complementary. Their interdependence was not appreciated and each group pursued what it felt were its responsibilities alone. This perception was not openly expressed because it would have opened a discussion on who had the rightful mandate and competence for carrying out the duplicated research. And individual stakes would have been put at risk.

Lack of coordinative policy in the Mpwapwa cattle subsystem in Tanzania (Lupanga and Kasonta 1990a; 1990b). When this study was carried out, the Livestock Production Research Institute (LPRI) at Mpwapwa had been developing a multipurpose cattle breed for milk and meat production under the stressful conditions of central Tanzania. This breed was to be tested, bred, and maintained in the livestock multiplication units (LMUs) in different parts of the country. At the time of this study, LPRI was administratively under the research division of the Ministry of Agriculture, while the LMUs were under the production division.

Besides their administrative separation and their different functions, the two groups also had different views about the methodology. For LPRI, the procedure was to produce a breed that would be tested, multiplied, selected for breeding stock, and distributed to production farms in central Tanzania. However, for the LMUs, this procedure was at times overshadowed by other imperatives, such as policy pressure to make quality livestock immediately available for meat

Table 8. Summary of strategies and outcomes of group interaction among livestock researchers and multiplication specialists in the Mpwapwa cattle subsystem of Tanzania	
Actors:	• LPRI researchers • LMU multiplication specialists
Interaction:	• Coordination of interdependent tasks
Stakes:	• Methodologies
Strategies:	• Mutual disregard
Enforcement:	• Policy environment • Institutional climate
Outcome:	• Lack of coordination foiled all actor's responsibilities • Transfer of technology was disrupted

and milk production. The assumption was that maintenance and improvement of stock would take care of itself. For instance, some cows found their way into intensive farming units for purposes other than those defined by LPRI. As time went on, the LMUs did not observe even the basic operations that were to take place under their mandate with respect to the breeding process, namely the multiplication and selection of breeding stock. In 1972, in response to agricultural policy directives, the ministry actually closed one unit, the Mabuki LMU, thereby setting LPRI's breeding program back several years.

In this subsystem, the two groups carried on in their separate locations as if their tasks were not interdependent and as if they believed that complementarity would take care of itself. However, by disregarding each other, they ended up foiling each other's programs and disrupting the transfer of technology.

CONCLUSIONS AND LESSONS

The payoff-matrix approach to the case studies demonstrates how groups involved in interactions fared in the pursuit of their objectives. The framework also reveals how management factors can actually condition the outcome of group interactions by tipping the scales one way or another, or by balancing them.

The main lesson from this approach is that, to find lasting solutions to tensions between groups that interact within an agricultural technology system, management must address the *causes* rather than the symptoms. These relate to the stakes involved for each group and the strategies each adopts, as well as the contextual factors that structure those stakes and strategies.

While in the short term, strategies based on dominance may preserve the status and spare the resources of the dominant group, they are not ideal in the long run. Such a strategy is ultimately less effective because there is a lack of input from the dominated member.

With regard to ATS managers, a style of management conducive to cooperation among groups is necessary for an effective transfer of technology. Administrative prescriptions or a laissez-faire attitude is not the answer. Rather, what works is pragmatic management based on appropriate manipulation of structural stakes.

The cooperative strategies and outcomes found in the case studies were all due to management actions. Management actions that established a favorable institutional climate and allocated resources in a balanced fashion were responsible for promoting cooperation among groups. They were different in each subsystem, depending on the size of the gap and the nature of cooperation required. Where the gap was greater, measures such as the allocation of liaison personnel were necessary to achieve cooperation. Retraining of transfer agents to the level of researchers was not necessary, nor would it have been effective if the differences in status were not changed.

In situations where group access to resources was of particular concern, strategic allocation of resources for interaction as well as for the individual group's own purpose helped to achieve cooperation. However, in order to have a sustained effect, this mechanism has to form part of the normal pattern of resource allocation. If it is just an ad hoc response to an apparent crisis or if it is induced by a special project, its effect will only be temporary.

The evidence from the case studies indicates that tensions among groups relate more to what groups do than to who they are professionally. It follows, therefore, that lack of appreciation of the complementarity between the tasks of each group is at the root of dysfuntional behaviors such as dominance or mutual disregard. Part of this problem is due to differential perceptions, based on the disciplinary backgrounds of the individuals involved. Researchers trained in the methodology of a particular discipline fail to appreciate problems expressed in the language of technology transfer. In the same way, transfer agents do not appreciate research jargon or that publication of research results is an important part of a researcher's career path.

Thus, for the purpose of linkages, methodologies need to be developed to facilitate complementary inputs from the different actors. In this respect, diagnostic survey methodologies have to be upgraded to incorporate elements that can be included in research programs. Similarly, research methodologies need to be expanded to provide for the complexity of production problems as experienced by transfer agents and farmers. ATS managers have to take this into account when they allocate resources and personnel.

Management tends to misallocate structural stakes, thereby failing to achieve cooperation among interacting groups. This is mainly because of a biased view of their interdependence: complementary tasks are viewed in a pecking order and more importance is attached to research than to the transfer of technology or to the interrelationship between the two. If the effectiveness of agricultural technology systems is to be maximized, managers have to understand the structural interactions that underlie cooperative behavior. They must attempt to balance the roles of the different participants and the connections between them.

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