MAKING THE LINK

AGRICULTURAL RESEARCH AND TECHNOLOGY TRANSFER IN DEVELOPING COUNTRIES

edited by David Kaimowitz

Published in Cooperation with
the International Service for National Agricultural Research (ISNAR)

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Preface

Policy makers in developing countries face difficult challenges in agriculture. To help finance foreign debts and import essential goods, agricultural exports must rise. Fast-growing urban centers demand more foodstuffs and industrial raw materials from the countryside. Persistent rural poverty constrains labor productivity and foments political instability. Protectionism, technological change and stagnant demand are creating downward pressure on the world market prices of many agricultural goods. In many places there is little new land available for cultivation and no simple technological "fixes" to increase production. Exisiting production is threatened by poor water and soil management and unsound agricultural practices.

Potentially, national institutions which import, generate, adapt, validate and transfer agricultural technology can be powerful tools for meeting these challenges. It is their job to identify new opportunities, help farmers and consumers solve their current problems and develop the country's knowledge base and infrastucture regarding agricultural technology.

This potential, however, is not being fully met, partly because agricultural agencies often have poor relations with the agencies responsible for delivering technological support to farmers. This results in inadequate follow-through and a breakdown in the flow of information. Thus, research efforts are less likely to be relevant and farmers are less likely to receive the information and inputs they need.

Many sources have noted the 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 for 16 (out of 20) of the projects evaluated (United States Agency for International Development, 1982).

> All 12 countries (in which research projects were evaluated) had difficulties of communication between research and extension agencies (Food and Agriculture Organization, 1984).

Because of the serious consequences of this problem, in 1986 agricultural research managers from a number of countries requested that the International Service for National Agricultural Research (ISNAR) conduct a study to identify key factors which influenced the effectiveness and efficiency of links between research and technology transfer and recommend ways to improve them.

In the discussions on how to implement the study, it soon became obvious that the existing literature on the subject was largely anecdotal or prescriptive, and would not provide the necessary basis for the study. A fresh approach was needed, and ISNAR decided to ask several internationally recognized experts on the subject to write a series of papers examining the relevant issues. Six papers were written, each one approaching the problem from a different, yet complementary, perspective. We then wrote a conceptual framework which pulled together the principal hypotheses put forward in these papers and developed some areas which were not covered by the papers.

This book is the outcome of these efforts. The first paper, by Niels Röling, introduces the concept of an agricultural knowledge and information system (AKIS) and the activities which such a system must perform. Röling gives some principles for managing an AKIS, including the need for user control, the importance of calibrating the different elements of the system, and the potential for linkage mechanisms to fill in the gaps which exist between these elements. He then discusses various methodologies for researching an AKIS and at the end of the paper provides a checklist of common AKIS disorders.

The authors of the second paper, Holly Sims and David Leonard, show how external pressure on research and technology transfer institutions can improve system performance. They give particular attention to the opportunities for, and limitations of, pressure from national policy makers, donors, farmers' organizations and commercial firms. Although the paper applies to a broad range of developing countries, the examples and authors' own experiences come largely from former British colonies in Asia and Africa.

The paper by Roberto Martínez Nogueira traces the growth and increasing complexity of the demands placed on research and extension agencies by policy makers in Latin America and their effect on links between the two groups. Research and extension evolved from being small organizations, which were limited in scope and personally managed by their directors, to forming part of large complex bureaucracies controlled by elaborate planning mechanisms, with multiple audiences, and an increasingly sophisticated technical division of labor. This process continued until the situation became unmanageable. Now there is a trend towards decentralization, privatization, more qualitative planning methods, horizontal coordination

between government agencies, and greater integration between extension and adaptive research tasks.

Paul Bennell examines the linkage problem from the perspective of social psychology. He notes that researchers and extension agents are separate groups, each with its own background, training, experience, responsibilities, status and physical location. Occupational theories and theories about intergroup relations, including Realistic Conflict Theory, Social Identity Theory, group characteristics and intergroup contact theories, are each shown to have something to offer in helping to understand and improve the relations between these groups.

Two papers discuss important special cases of research-technology transfer links: farming systems research and the private sector. Peter Ewell looks at how on-farm, client-oriented research initiatives in nine countries of Africa, Asia and Latin America coordinated their activities with extension. Although these programs made research more relevant, they could only complement, not substitute for, specialized technology transfer efforts. Just because research is participatory, conducted on-farm and uses a systems approach does not necessarily mean there will be good relations with extension. Good relations are found only in countries that have made a strong and explicit effort to create them.

Carl Pray and Ruben Echeverría focus on research-technology transfer links within the private sector and between the private and public sectors, and on the lessons public sector managers can learn from their private counterparts. Unlike public extension, marketing is a high status activity in the private sector, with at least as much status as research. This helps to ensure research relevance and to eliminate poorly conceived research projects at an early stage. The private sector spends a greater portion of its budget on linkage activities such as preparation of promotional materials and training of marketing staff. Company size and the pattern of industrial organization in particular products heavily influence the types of links which emerge.

David Kaimowitz, Monteze Snyder and Paul Engel summarize the key points from the previous papers, grouping these points according to whether they are concerned with political, technical or organizational factors. They also add certain new elements, such as how links vary depending on the type of technology involved, the problems posed by unfamiliar environments or farming systems, and the importance of whether institutional responsibilities are divided based on the activities involved or on the type of clients.

Through reading each other's papers and engaging in ongoing discussions, many of the authors came to share similar views. Nevertheless, no attempt was made to resolve discrepancies between authors, apart from standardizing terminology as far as possible.

ISNAR is currently completing the second stage of its linkage study, involving empirical case studies in Colombia, Costa Rica, Côte d'Ivoire, the Dominican Republic, Nigeria, the Philippines and Tanzania, from which additional lessons will undoubtedly emerge. This book does, however, reflect the progress we have made on the linkage issue to date. We hope that by sharing our ideas with a wider audience we may stimulate further debate.

Funding for the research came from the Governments of Italy and the Federal Republic of Germany, the Rockefeller Foundation and ISNAR. Without their support this effort would not have been possible. Needless to say, any mistakes in the papers are our own.

David Kaimowitz
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The Agricultural Research-Technology Transfer Interface: A Knowledge Systems Perspective

Niels Röling

The links between agricultural research and technology transfer in developing countries are generally recognized as a major bottleneck in agricultural technology systems and have received inadequate attention in the past (Sands, 1988). A basic concept in this paper is that research and extension should not be seen as separate institutions which must somehow be linked. Instead, scientists involved in basic, strategic, applied and adaptive research, together with subject-matter specialists, village-level extension workers and farmers, should be seen as participants in a single Agricultural Knowledge and Information System (AKIS).

The concept of an AKIS has been extensively discussed in the literature, using a number of different nomenclatures and definitions (Bunting, 1986; Engel, 1987; Lionberger and Chang, 1970; Nagel, 1980; Rogers et al., 1976; Röling, 1986a and 1988a; Swanson and Claar, 1983). I define an AKIS as follows:

> An AKIS is a set of agricultural organizations and/or persons, and the links and interactions between them, engaged in such processes as the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilization of knowledge and information, with the purpose of working synergically to support decision making, problem solving and innovation in a given country's agriculture or a domain thereof.

The concept of an AKIS should be distinguished from that of a management information system. The former is the entire system that produces the

knowledge used in agriculture. The latter evaluates the productivity or other aspects of an enterprise (not necessarily an agricultural one) in order to help management make decisions. A substantial body of knowledge has been built up in recent years on methods for analyzing the effectiveness of management information systems, but no comparable set of methods exists for analyzing AKIS.

The Interface between Research and Technology Transfer

The AKIS serves as a conceptual framework within which to consider the interface between research and technology transfer, the central area of concern of this paper. Present knowledge about this interface is scanty. What is more, traditional methods of data gathering and analysis do not lend themselves easily to empirical research on this subject: "The lack of suitable measures to objectively assess the strength (of links between research and extension) continues to be a problem" (Sands, 1988).

Within an AKIS, the research-technology transfer interface is an especially important one in determining the performance of the whole system. The AKIS is vulnerable at this interface because major transformations of knowledge, information and technology have to take place there and because bottlenecks in their flow have grave consequences. All too often, the interface suffers from both an institutional and a functional vacuum.

Historically, research has stopped too early in what should be a continuous and dynamic process of developing and diffusing new technology. Researchers have been physically and mentally isolated from farmers and have handed down an unfinished, untested product to extension staff. Extension contact staff — squeezed between the farmers they live among, who often ridicule the technologies they bring, and their superiors, who demand results in line with policy directives — have been caught in a crisis of morale (Collinson, 1985).

Improving System Design

The total impact of an AKIS should be more than the sum of the impacts of its constituent parts: an important goal of the analysis, design and management of an AKIS is to increase the synergy of its components. Research results that remain unused, farmers without access to technology transfer services, extension that has no links with research — all are signs of an AKIS that is not operating synergically. And all provide good reasons for taking the AKIS as a whole, rather than its individual parts, into consideration when seeking to improve matters.

Recent approaches to improving agricultural technology systems, such as farming systems research (FSR) and the Training and Visit (T and V) system of extension, are efforts to improve AKIS synergy. The T and V system seeks to create regular information flows between research stations, subject-matter specialists, extension workers, contact farmers and followers. It can be seen as a management tool for improving the interconnectedness of AKIS components. FSR is a participative method for developing technology. It seeks to ensure goodness-of-fit between technology and its users, by emphasizing the importance of collecting information from and about farmers before designing technology and while testing it. FSR represents an important step toward user control as an essential ingredient of successful technology development.

On-farm research, considered by some to be a phase of FSR and by others as a desirable component of all agricultural Research and Development (R & D), allows direct contact between farmers and researchers, and has been shown to be as important an influence on applied research programs as the published results of basic and strategic research (Biggs, 1983). On-farm research is, again, a way of improving the interconnectedness of the AKIS, and is a critical step toward user control.

Even the formal incorporation of T and V, FSR or other mechanisms within an AKIS does not, however, guarantee that effective links will be established. For example, the introduction of T and V in Sri Lanka led to the formal institutionalization of a regular meeting between research and extension staff to ensure their linkage, but the following views, expressed by research officers, suggest that this dialogue between research and extension leaves something to be desired (Blok and Seegers, 1988):

> In rice, mostly the problem is that extension says a recommendation is not working. Research officers then have to demonstrate that this is because the cultural practices were not followed correctly.
>
> With respect to paddy, most problems were solved before and extension people have to be reminded of the old solution.
>
> The chairman asked extension (workers) to be short on the reading of messages because mostly ... the research officers have heard these for seasons so they won't have much response. Even if, for example, the scientific approach to land preparation is taken up in the bi-weekly training, the research officers won't discuss why farmers didn't take it up for they already know the reason: lack of money.
>
> Research will inform extension if there is any alteration in the recommendation.

I believe that the rapid emergence of knowledge management as an important issue for food security, agricultural sustainability and other challenges makes it imperative that we seek new tools with which to manage knowledge and information. Modeling the AKIS may provide us with such tools. Although no universally appropriate model can be developed, modeling will allow us to discern what principles of knowledge management need to be applied under given circumstances to obtain different development objectives.

This paper aims to explore the usefulness of the AKIS concept for improving the management of links between research and technology transfer. The first section looks at some of the development issues facing AKIS management. The second section discusses the components needed when modeling the AKIS. In the third section, issues in the management of AKIS are explored. The final section summarizes and draws some conclusions, focusing on knowledge management.

Management issues are the major concern of this paper. Although it is notoriously difficult to transfer successful management solutions from one context to another, it may be possible to identify some general principles. Because of the uncertainty I must attach to them at this stage, I call these principles *management hypotheses*. They appear in italics in the text of this paper.

Development Issues

This section examines some of the development issues which management must consider when designing a new AKIS, or manipulating an existing one. International interest in the links between research and technology transfer, and in the removal of bottlenecks in AKIS, reflect the fact that agriculture is becoming increasingly driven by technology. Other issues, too, have stimulated international awareness of the need for more effective AKIS management. The sustainability of agriculture is perhaps the major one, but gender and equity issues are also very important. Information technology has stimulated increased interest in AKIS management because of its potential for increasing the efficiency with which knowledge and information are created and shared.

Technology-Driven Development

Agricultural development requires a mix of conditions (Haverkort and Röling, 1984). Although the precise nature of the mix depends on the

context, it usually includes good infrastructure, access to credit, water, land, markets, input delivery, social organization, relevant technology and rewarding prices (Mosher, 1966). As agriculture develops, the need for this mix is increasingly met, giving farmers more control over their environment. The greater their control, the more important knowledge and technology become as the major determinants of development (Jiggins, 1988). In other words, technology development increasingly drives agricultural development, as the other essential conditions are effectively provided for.

Even in areas where the essential conditions for development have not been met, the effect of technology-driven development is felt through competitive market pressures. New technology is usually adopted slowly at first. Early innovators (Rogers, 1983) capture large profits because they are too few to affect the market price. However, soon others copy their example. Total production begins to rise, exerting downward pressure on prices. Further down the line, farmers have to adapt in order to stay in business, but their investment already has a low return. At the end of the line, farmers see their incomes drop and can do little about it. Those who are unwilling to adapt, whose farms are too small or for whom the new technology is not appropriate, lose out. The European Economic Community (EEC) has lost some 60% of its farmers in the past 20 years through this process.

Thus improved agricultural output and efficiency result from a continuous flow of new technology, leading to reduced farm gate prices and hence to market pressures on producers to innovate in order to stay in the game. Farmers who cannot keep up are eventually squeezed out. This process is in full swing in many developing countries, or at least in some of their better-endowed areas (Lipton and Longhurst, 1985). The real incomes of the majority, especially of resource-poor farmers, in such countries as the Philippines (Cordova et al., 1981), India (Swaminathan, pers. comm.) and Sri Lanka (Wijeratne, 1988), have declined drastically in recent years.

Those leaving farming are often absorbed by the industrial and service sectors. However, non-farm employment opportunities are not growing fast enough in many areas affected by technology-driven development. It has been argued that, in such situations, AKIS management should concentrate on targeting technology development to support the livelihoods of resource-poor farmers, and on human resource development programs to help such farmers become effective users of technological opportunities (Röling, 1986b).

Improving the efficiency of an AKIS increases the degree to which technology drives agricultural development. Steering that development in desired directions, instead of allowing it to be governed only by the market, is a demanding challenge. To meet this challenge, developing countries may have to do things industrial countries have not succeeded in doing, but with fewer resources.