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A NEW MODEL FOR TECHNOLOGY TRANSFER IN GUATEMALA

CLOSING THE GAP BETWEEN RESEARCH AND EXTENSION

by

Ramiro Ortiz, Sergio Ruano, Horacio Juárez
Francisco Olivet, and Adlai Meneses

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International Service for National Agricultural Research

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INTRODUCTION TO THE ISNAR STUDY ON ORGANIZATION AND MANAGEMENT OF ON-FARM CLIENT-ORIENTED RESEARCH (OFCOR)

Deborah Merrill-Sands
Study Leader

Introduction

In 1986, ISNAR initiated a major study on the organization and management of on-farm, client-oriented research (OFCOR) in national agricultural research systems (NARS). The study was developed in response to requests from NARS leaders for advice in this area and was carried out with the support of the Government of Italy and the Rockefeller Foundation. The objective is to analyze the critical organizational and managerial factors that influence the way national research institutes can develop and sustain OFCOR programs to realize their specific policies and goals.

What is OFCOR?

OFCOR[1] is a research approach designed to help research meet the needs of specific clients, most commonly resource-poor farmers. It complements — and is dependent upon — experiment station research. It involves a client-oriented philosophy, a specific research approach and methods, and series of operational activities carried out at the farm level. These activities range from diagnosing and ranking problems through the design, development, adaptation, and evaluation of appropriate technological solutions. Farmers are directly involved at various stages in the process.

In this study, OFCOR programs are analyzed in terms of the functions OFCOR can perform within the large research and extension process. We have identified the following seven potential functions as a framework for analyzing the organization and management of a range of on-farm research programs in nine national agricultural research systems. The functions are:

1) to support within research a *problem-solving approach, which is fundamentally oriented toward farmers as the primary clients* of research;

2) to contribute to the application of *an interdisciplinary systems perspective* within research;

3) to *characterize major farming systems and client groups*, using agroecological and socioeconomic criteria, in order to diagnose priority production problems as well as identify key opportunities for research with the objective of improving the productivity and/or stability of those systems;

4) to *adapt existing technologies and/or contribute to the development of alternative technologies* for targeted groups of farmers sharing common production problems by conducting experiments under farmers' conditions;

5) to *promote farmer participation in research* as collaborators, experimenters, testers, and evaluators of alternative technologies;

6) to *provide feedback to the research priority-setting, planning and programming process* so that experiment station and on-farm research are integrated into coherent program focused on farmers' needs;

7) to *promote collaboration with extension and development agencies* in order to improve the efficiency of the processes of technology generation and diffusion.

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1. The designation *OFCOR* has been used as distinct from *farming systems research* (FSR) because the latter has come to have very different meanings for different people.

Why is the Organization and Management of OFCOR Important?

Over the last 15 years, many NARS have set up OFCOR programs of varying scope and intensity to strengthen the link between research and farmers — particularly resource poor farmers. While significant attention has been given to developing methods for OFCOR, provisions for fully integrating this approach within the research process have been inadequate and the institutional challenge underestimated. With the accumulation of experience, it is clear that NARS have confronted significant problems in implementing and effectively integrating OFCOR into their organizations. In many cases, OFCOR program have become marginalized and have not had the intended impact on the research process.

Improved organization and management are crucial to overcoming these problems. Effectively integrating OFCOR within a research system implies forging a new research approach which complements and builds on existing research efforts. This is no small task. It involves establishing new communication links between researchers of diverse disciplines, extension agents, and farmers. It requires hiring people with the right skills or systematically training existing staff. It requires changes in planning, programming, review, and supervisory procedures. It creates increased demands for operational funds and logistical support for researchers working away from headquarters. And, it often involves working with one or more donor agencies. All of these make the management of OFCOR more demanding than that of traditional experiment station research.

This study focuses directly on these issues of implementation and institutionalization. We have analyzed and synthesized the experiences of diverse NARS in which OFCOR programs have been established for at least five years. The intention is to provide a body of practical experience upon which research managers can draw as they strive to strengthen OFCOR as an integral part of their research systems.

Operational Strategy and Products

Our approach has been to learn from the experiences of research managers in NARS. We have built the analysis around case studies of nine countries whose NARS have had sufficient time to experiment with and develop diverse organizational arrangements and management systems for implementing OFCOR. By region, the countries are as follows:

Latin America:	Ecuador, Guatemala, Panama
Africa:	Senegal, Zambia, Zimbabwe
Asia:	Bangladesh, Indonesia, Nepal

The study has generated four different types of reports: country case studies, discussion papers, comparative study papers, and synthesis papers. These are briefly described below and a complete list of the study's publications follows.

Case studies: The case studies are stand-alone products. Each is a comprehensive analysis developed by a team of national researchers with personal experience in the individual OFCOR programs. The cases provide useful insights and lessons on the general issues, as well as specific guidance for research policy and the organizationa and management of on-farm research in their countries.

Discussion papers: The discussion papers derive from the cases and are writeen specifically for research managers. They are short, analytic, pieces which highlight important experiences, lessons, or practical solutions to common problems encountered in the organization and management of on-farm research in national research systems.

Comparative study papers: The comparative study papers provide a systematic analysis across the case studies. Synthesizing the experience of the case study NARS, these papers provide practical advice for research managers on organizational and managerial issues central to the effective integration of on-farm client-oriented research within their research systems.

Synthesis papers: These are short papers designed to highlight the principal findings and conclusions from the study.

LIST OF PUBLICATIONS FROM THE STUDY ON THE ORGANIZATION AND MANAGEMENT OF ON-FARM CLIENT-ORIENTED RESEARCH

OFCOR Country Case Studies

No.1 Zambia: Organization and Management of the Adaptive Research Planning Team (ARPT), Research Branch, Ministry of Agriculture and Water Development. S.A. Kean and L.P. Singogo.

No.2 Guatemala: Organizacion y Manejo de la Investigacion en Finca en el Instituto de Ciencia y Tecnologia Agricolas (ICTA). S. Ruano and A. Fumagalli.

No.3 Bangladesh: The Evolution and Significance of On-Farm and Farming Systems Research in the Bangladesh Research Institute. M.A. Jabbar and M.Z. Abedin.

No.4 Nepal: Organization and Management of On-Farm Research in the National Agricultural Research System. B.N. Kayastha, S.B. Mathema, and P. Rood.

No.5 Zimbabwe: Organization and Management of On-Farm Research in the Department of Research and Specialist Services, Ministry of Lands, Agriculture and Rural Settlement. M. Avila, E.E. Whingwhiri, and B.G. Mombeshora.

No.6 Senegal: Organisation et Gestion de la Recherche sur les Systemes de Production. J. Faye and R.J. Bingen.

No.7 Ecuador: Organizacion y Manejo de la Investigacion en Finca en el Instituto Nacional de Investigaciones Agropecuarias (INIAP). R. Soliz V., P. Espinoza, and V.H. Cardoso.

No.8 Panama: Organizacion y Manejo de Programas de Investigacion Agropecuaria de Panama (IDIAP). M. Cuellar M.

No.9 Indonesia: Organization and Management of On-Farm Research in the Agency for Agricultural Research and Development. J. Budianto, I.G. Ismail, Sridodo, P. Sitorus, D.D. Tarigans, A. Mulyadi. (Forthcoming)

OFCOR Discussion Papers

No.1 Research Extension Liaison Officers in Zambia: Bridging the Gap between Research and Extension. S.A. Kean and L. P. Singogo.

No.2 Closing the Gap Between Research and Resource-Poor Farmers: A New Model for Technology Transfer Developed in Guatemala. R. Ortiz, S. Ruano, H. Juarez, F. Olivet, A. Meneses.

OFCOR Comparative Study Papers

No.1 Strengthening the Integration of On-Farm Client-Oriented Research and Experiment Station Research in National Agricultural Research Systems: Management Lessons from Nine Country Case Studies. D. Merrill-Sands and J. McAllister.

No.2 Organization and Management of Field Activities in On-Farm Research: A Review of Experiences in Nine Countries. P.T. Ewell.

No.3 Resource-Poor Farmer Participation in Research: A Synthesis of Experiences from Nine National Agricultural Research Systems. S.D. Biggs.

No.4 Linkages between On-Farm Research and Extension in Nine Countries. P.T. Ewell.

No.5 Staff Management Issues in On-Farm Client-Oriented Research: Lessons for Managers. R.J. Bingen and S.V. Poats.

No.6. Financial Resources and Management for On-Farm Research: A Review of Experiences in Nine Countries. E.H. Gilbert. (Forthcoming)

OFCOR Synthesis Papers

No.1 Management of Key Institutional Linkages on On-Farm Client-Oriented Research: Lessons from Nine National Agricultural Research Systems. D. Merrill-Sands, P.T. Ewell, S. Biggs, J. McAllister, J. Bingen and S. Poats.

No.2 Alternative Arrangements for Organizing On-Farm Client-Oriented Research: Lessons from Nine National Agricultural Research Systems. D. Merrill-Sands, P.T. Ewell, S. Biggs, J. McAllister, R.J. Bingen and S.V. Poats. (Forthcoming)

No.3 Guidelines for Research Managers: Lessons from a Comparative Study of On-Farm Client-Oriented Research in Nine Countries. D. Merrill-Sands, R.J. Bingen, S. Biggs, P.T. Ewell, J. McAllister, and S.V. Poats. (Forthcoming)

FOREWORD

The ISNAR study on organization and management of on-farm client-oriented research indicates that effective links with extension or other technology transfer agencies are essential for broad impact. Yet, forging such links has been a chronic weak point in many on-farm research efforts in developing countries. Sometimes, it is assumed that on-farm research can substitute for technology transfer efforts. The conclusions from our study challenge this assumption. On-farm research can provide a focal point for developing strong links, but direct links with farmers alone are not sufficient for wide dissemination of technologies.

The case study from Guatemala illustrates these points. It shows how strong collaboration between on-farm research and extension can bring about significant increases in production and net income for farmers.

The Instituto de Ciencia y Tecnología Agrícolas (ICTA) was one of the pioneers in developing on-farm client-oriented research. In the early years, ICTA gave little attention to developing links with extension. It was assumed that good technology, developed in close contact with farmers and verified through on-farm trials, would not require formal transfer efforts; it would sell itself. While this strategy proved successful for some improved varieties in the more favorable lowland areas, it was not appropriate for reaching resource-poor farmers operating complex production systems in the diverse and more marginal highland areas. A new approach was needed. After several attempts to promote stronger collaboration, an integrated research and extension effort, based on on-farm client-oriented research, has met with considerable success in serving this client group.

This paper analyzes the factors which inhibited the development of effective links between on-farm research and extension in Guatemala in the past, the reasons for the success of the new integrated research and extension approach, and the impact of the new approach on production and farmers' net incomes. While the Guatemalan model obviously cannot be transferred directly to other countries or institutional settings, the experience provides valuable lessons for research managers on how to use on-farm client-oriented research to promote strong research-extension links.

Deborah Merrill-Sands
Study Leader

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The Authors

When this paper was written in November 1989, Ramiro Ortiz was a technical consultant with the Dirección General de Servicios Agrícolos; Sergio Ruano was an independant consultant collaborating with the ISNAR study on the organization and management of on-farm research; Horacio Juárez was Director General of the Instituto de Ciencia y Tecnología Agricolas (ICTA); Francisco Olivet was Deputy Director General of ICTA;and Adlai Meneses was National Coordinator for PROGETTAPS.

Glossary of Acronyms

CAPA	Curso de Adiestramiento en Producción Agrícola (Training Course on Agricultural Production)
DIGESA	Dirección General de Servicios Agrícolas (Directorate General for Agricultural Services)
DIGESEPE	Dirección General de Servicios Pecuarios (Directorate General for Livestock Services)
ICTA	Instituto de Ciencia y Tecnología Agrícolas (Institute of Agricultural Science and Technology)
ISNAR	International Service for National Agricultural Research
OFCOR	On-farm client-oriented research
PROGETTAPS	Proyecto de Generación y Transferencia de Tecnología Agropecuaria y Producción de Semillas (Project for the Generation and Transfer of Agricultural Technology and for Seed Production)

Guatemala: Key Statistics

Country*

Area: 109,000 km^2
Population: 8.4 million
Population density: 77.1 persons/km^2
GNP per capita: US$ 950
% agricultural GDP in total GDP: 25**
% economically active people employed in agriculture: 56**
Index of food production per capita (1979-81 = 100): 94 (1985-87)
Daily calorie supply per capita (1986): 2307

Research System**

Number of researchers: 191
Number of technicians: 211
% researchers with advanced degrees: 21
% foreign researchers: 1
% researcher person-years allocated to OFCOR: 34

Notes:

* All figures for 1987, unless otherwise indicated
Source: *World Development Report 1989*, World Bank, Washington D.C.

** All figures for 1986
Source: Ruano and Fumagalli, 1988

INTRODUCTION

The Guatemalan Experience

How best to promote the widespread dissemination of the new technology needed to increase food production in a developing country? How can the gap between research and resource-poor farmers be closed?

One answer to these questions is to mobilize large numbers of technically trained people in a dynamic effort that integrates the development of technology with its dissemination. This is the approach taken in recent years by the Government of Guatemala, which has designed and implemented a new model for technology transfer. Besides integrating the efforts of on-farm researchers and agricultural extension agents, the new model includes the active participation of rural leaders, working with groups of farmers who conduct activities on their own farms. This has ensured that new technologies are relevant to farmers' circumstances, and has led to a considerable increase in the adoption rate through a multiplier effect. The effort as a whole has had a substantial impact on food crop production, producing results that have exceeded established targets.

Previously, the national research institute had not placed much emphasis on building strong links with extension. It was believed that new technology, verified on farm with farmers, would diffuse spontaneously, without a formal transfer effort. However, this approach was only partially successful, the impact being greatest with commercially oriented small-scale farmers in the more favorable lowland environments. A new approach was needed to reach resource-poor farmers in the more marginal and diverse highland areas. More systematic and participatory links with extension had to be developed.

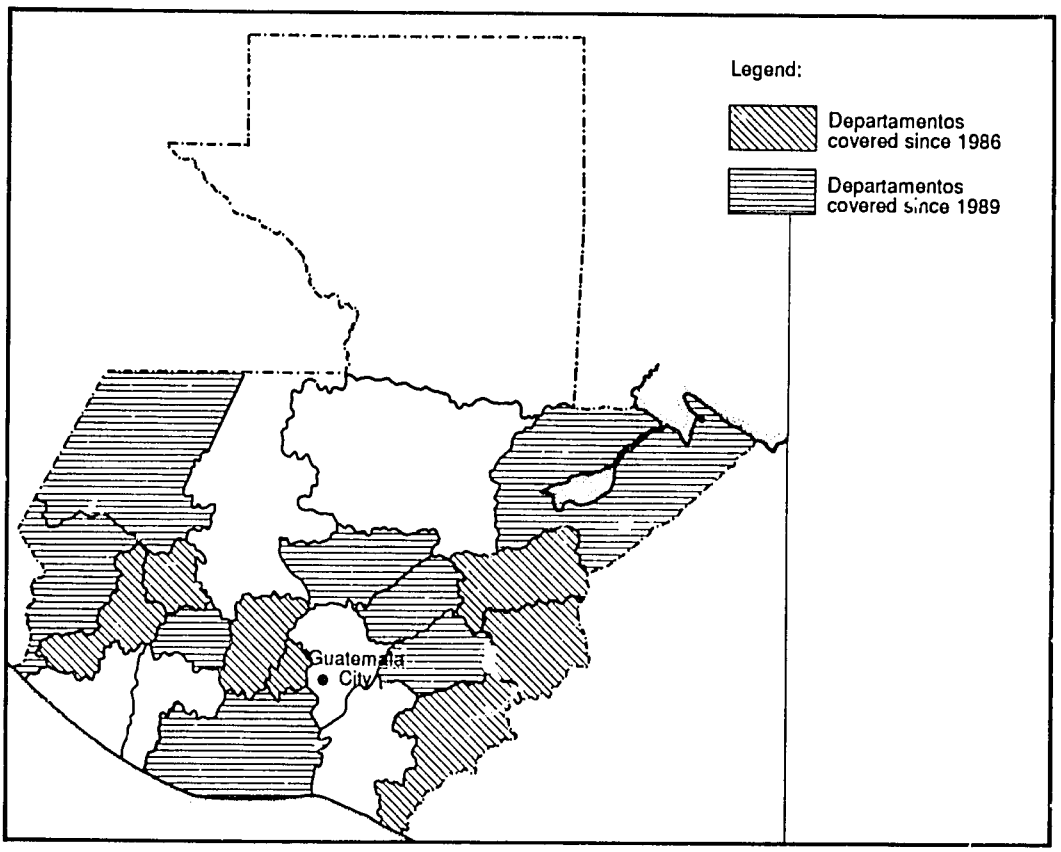
Efforts to develop these links began in the second half of 1986. Within a 3-year period, the work of 72 agricultural extension teams backed up by 20 on-farm researchers in seven of the 22 departamentos (subregions) of the country led to an estimated 80 000 resource-poor farmers — approximately one-tenth of the farming families living in Guatemala — adopting new technologies. In 1989, as a result of the success achieved, the new model was extended to eight more departamentos (*see* Figure 1 *overleaf*), thereby covering 68% of the country. The expanded effort involved 149 extension teams and 40 on-farm researchers. This expansion was achieved without additional external funding, underscoring the institutionalization of the effort.

The first seven departamentos were chosen using a matrix approach combining the following variables: population density, degree of rural organization, income level, land tenure, farm size, physical infrastructure, unemployment level, existing farming systems, importance of subsistence production, and local presence of the research institute and the extension agency.

Working with the new model, the 4-year targets for the number of farmers adopting new technology were exceeded in only 3 years, by which time nearly double the number of farmers originally planned had been reached. The areas affected have been predominantly subsistence-based agricultural systems in which little or no impact on productivity had previously been made. The national research institute had had on-farm research teams working in these areas, and had generated relevant technologies (mostly improved crop varieties), but on-farm activities had been limited relative to the large numbers

of small-scale farms. The adoption of new technologies in these areas is expected to lead to an increase in the 1989 crop harvest of 16 200 tonnes (staple grains and potatoes), almost all of which will be because of increased productivity. In terms of food security, this increase is enough to satisfy the annual food requirements of some 26 000 additional rural families.

Figure 1. Geographical Coverage of PROGETTAPS, the Integrated Research-Extension Program in Guatemala, 1986-89



Source: PROGETTAPS Coordination Unit/DIGESA

With the new model extended to the eight new departamentos, the productivity increase from the 1990 harvest is expected to be almost three times that of 1989 (that is, some 45 000 tonnes). These increases incur only a small increase in costs and do not require credit, the major additional item being the extra labor required for harvesting. Surplus labor is usually available on these small family farms.

The salient features of the new model, many of which developed or were modified as activities progressed (Ortiz and Meneses, 1989), are as follows:

- **The project built on a strong basis of on-farm and applied research**

  On-farm client-oriented research had been central to the approach of the national research institute since its foundation, with the result that technology relevant to the needs of resource-poor farmers had been developed.

- **The technical capacity of the extension teams was raised through a special program**

  The program's main component was training in the theory and practice of farming systems research and extension, and an introduction to the new technology transfer model. The aspects emphasized were constraint diagnosis with a systems perspective, the on-farm research approach, the linking of research with extension, and the need to ensure full participation by farmers. This provided the basis for a new phase of work involving intensive cooperation between research and extension in the pursuit of common goals.

- **The active involvement of farmers was promoted**

  Farmers were involved not only in the implementation of field activities but also in the planning of all the various phases of the technology innovation process.

- **The participation of rural leaders was sought**

  The role of these leaders was to spread awareness of the new technologies and give guidance in their management. Through their work with organized groups in the rural community, a multiplier effect was achieved.

- **The promotion and transfer of new and relatively simple technologies was emphasized**

  This approach, using fewer technological options, substituted for the previous technical assistance approach, in which more complex technological packages and an intensive one-to-one relationship between extension agents and farmers had been used. The aim of the new approach was to reach larger numbers of farmers and increase adoption rates.

- **Adoption of new technologies was facilitated through the development of small-scale seed production and dissemination by resource-poor farmers**

  Since the needs of the small farm sector were not being addressed by commercial seed companies, small-scale seed production and distribution was vital to the success of the project.

This paper presents a detailed account of the design and implementation of the new technology transfer model in Guatemala, in the hope that this experience will help other national research and extension systems develop their own models. The paper shows how on-farm research programs alone cannot disseminate technology widely among resource-poor farmers, in spite of having already generated technology relevant to these farmers. The lessons learned are presented at the end of the paper. Perhaps the main points of Guatemala's experience are, first, our realization that extension teams have tremendous potential, and that they can disseminate new technology faster and on a much wider scale when they become partners with on-farm adaptive research teams in a joint venture; and, second, our discovery that the involvement of rural leaders and farmers improves the amount and quality of on-farm research and the transfer of technology.

The Institutional Setting

Two organizations have played a key role in making the link with technology users: the national research and extension agencies, ICTA and DIGESA. The first is the Instituto de Ciencia y Technología Agrícolas, organized as a semi-autonomous institute outside the Ministry of Agriculture. It is responsible for conducting agricultural research at national level, with the emphasis on food crops and livestock. The institute is geographically decentralized, and has a strong on-farm adaptive research program accounting for nearly 80% of its workload and involving about 35% of its research staff on a full-time basis.

The second organization, DIGESA, is the Dirección General de Servicios Agrícolas, a centralized body within the Ministry of Agriculture. It is responsible for providing rural families with non-formal education and technical assistance in the use of new technologies, with the aim of helping these families improve their standard of living. It works directly with male and female farmers, housewives and young people in 4-S clubs modelled on the 4-H clubs of the US extension system. In recent years DIGESA has also been responsible for developing small-scale irrigation areas to diversify crop production, emphasizing non-traditional export crops. It is the country's largest and most powerful public-sector agency in terms of the number of professional staff employed and the geographical coverage achieved, having a total of 225 extension teams distributed over 21 of the 22 departamentos of the country.

The Country

Guatemala is a relatively small country, with 108 889 km^2 and 8.5 million people. However, it is highly variable, both in physical and in socio-economic terms.

It has all the different soil and climatic conditions found in tropical areas. Its topography ranges from flat in the coastal plain to rugged in the highlands. Two main mountain ranges cross the country from east to west, with more than 40 volcanoes within them. Temperature depends mostly on altitude, averaging around 25°C at sea level to almost 0°C above 4 300 meters. Precipitation is bimodal, with well-defined dry and wet seasons; annual rainfall ranges from around 500 mm in the semi-arid areas to around 6 000 mm in the humid tropical forest.

Guatemala has 23 different cultures. The indigenous Mayan account for around 45% of the population. The other large group are the mestizos, of mixed European and indigenous origin. Minority groups include European descendants and blacks.

The largely agricultural economy is highly polarized. A modern sector geared toward exports occupies most of the best land and accounts for relatively few farms, which are large in size. The majority of the rural population grow staple food crops for subsistence and the local market, on smaller farms located in less well endowed environments. Guatemala is generally considered the country with the most and best natural resources in Central America.

Chapter 1

ICTA's INITIAL STRATEGY: COMBINING RESEARCH AND TECHNOLOGY TRANSFER

Foundation and Philosophy: A Separatist Approach

The strategy of generating technology and transferring it directly to farmers through on-farm client-oriented research began in earnest in Guatemala with the creation of ICTA in 1973. The institute was established as part of a 5-year national development plan that reorganized the agricultural public sector. One of the plan's top priorities was the production of staple grains, the main producers of which were the small- and medium-sized farmers who constituted the majority of the rural population. These farmers now formed the major target group for public-sector research and extension. The main goal of the plan was to achieve food self-sufficiency.

Despite the existence of a separate public institution responsible for extension, ICTA developed its own strategy for technology transfer. The institute was able to justify this independant stance by pointing to its mandate. The law which created ICTA mandated the new institute to 'promote (the) utilization of generated technology'. This mandate empowered ICTA from the outset to go beyond technology generation and adaptation to assume transfer functions.

A further reason for ICTA's separatist approach to technology transfer was that the institute's philosophy and methodology conflicted with the more traditional approach established at DIGESA. ICTA's management did not see DIGESA as a strong partner in the technology transfer process. ICTA was a new and autonomous institute, specifically mandated to pursue the revolutionary approach that later became known as farming systems research, whereas DIGESA remained a centralized institution adopting the traditional 'top-down' approach. Most of ICTA's technical and scientific staff were new recruits, with young university graduates accounting for a high proportion, while DIGESA's technical personnel had not changed much in recent years, consisting mostly of high-school level professionals. ICTA's management believed strongly that 'good technology sells itself' and advocated an approach which focused on the broad transfer of verified technologies. In contrast, DIGESA's management believed that, 'because modern technology is beneficial, extension agents should be able to persuade farmers to use it'. They therefore saw technical assistance to farmers and other rural development issues as constituting their core responsibilities.

The On-Farm Research Program: Unrealistic Expectations

The way ICTA was structured, the philosophy that underlay its work, and the methodology it adopted belonged to a revolutionary period in the history of agricultural research that challenged the traditional, educational approach to technology transfer practised by existing extension institutions. In Guatemala the new approach deeply questioned both the tradition and its main exponent, DIGESA, to such an extent that this institution suddenly found itself overshadowed by the new research institute.

In 1971 ICTA submitted to the government a project paper which included a 5-year projection of the target areas and producers it intended to reach with new technology (*see* Table 1 *overleaf*). The document briefly mentions DIGESA in a technical assistance role, but the task of technology transfer

is stated as ICTA's exclusive responsibility, to be met through a strong on-farm research component. An estimated 82 000 rural families (17.6% of the rural population) were to be reached through on-farm research by the end of the 5-year period (Rockefeller Foundation, 1975).

Table 1. ICTA's Projections of Coverage during its First 5-Year Period, 1971-75

Crop	Total area in Guatemala ('000 ha)	Area to be covered by ICTA in 5 years ('000 ha)	(% of total)
Rice	10.0	10.0	100
Beans	109.0	14.0	13
Maize	630.0	100.0	16
Sorghum	51.0	10.0	20
Wheat	31.5	31.5	100
Total	831.5	161.5	20

Source: Ministerio de Agricultura, 1971

These projections explained what ICTA intended to do, but did not explain how it would do it. At that time, in Guatemala as elsewhere, virtually no experience had been gained in the conduct of on-farm research. Indeed, ICTA was one of the world's first national research institutes founded with this pioneering approach as its central program strategy. This implied a pragmatic approach to program building, allowing methods and principles to emerge gradually, as experience was gained.

The Operational Strategy: Organizing for Success

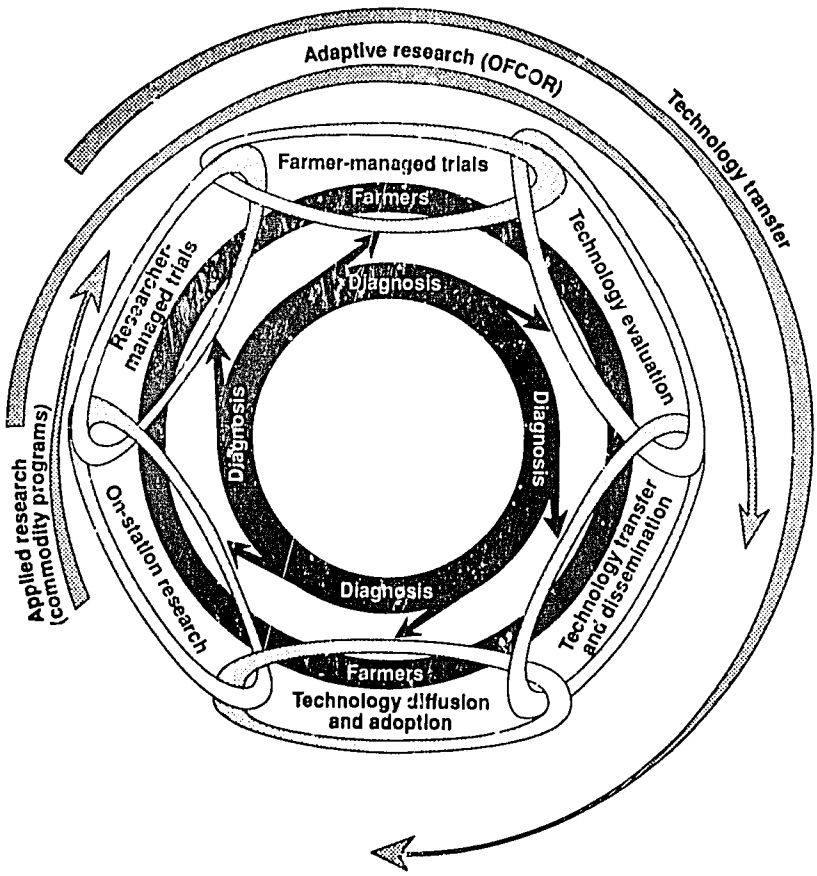
To concentrate human and financial resources and build up disciplinary interaction, one of the new institute's first major decisions was to work with a restricted number of crops (five in total). The idea was to organize strong commodity programs with sufficient numbers of specialists to guarantee critical mass. Another important decision was to focus applied research on plant breeding. Previous experiences in Guatemala and other countries had shown plant breeding to have the highest pay-off among the various technological components of a program.

Although plant breeding was to play a central part, ICTA's role was thought of not merely as applied research, but as spanning the whole cycle of research from on-station research, through researcher- and farmer-managed trials, to technology evaluation and transfer (*see* Figure 2). The technology generation part of the cycle was the responsibility of the commodity programs, but these specialized teams could not be expected to perform the other tasks in the cycle. To address these tasks, the institute decided to organize disciplinary support groups that would cut across the commodity programs. These groups would perform two main functions: some members of the group would complete aspects of specialized work that the commodity programs were not able to address (for example, on-farm evaluation of fertilizer applications), while others would take full responsibility for the tasks, such as evaluating the acceptability of new technology, that occupied the remaining part of the cycle.

An important principle, established at the outset of ICTA's operations, concerned the locations selected for the commodity programs' work. Applied research had to be conducted both on station and

on farm, under different soil, climate and management conditions. Moreover, promising technologies had to be tested under the existing socio-economic conditions of farmers. To organize and control the flow of appropriate technology to farmers, a special group was created, known as the Prueba de Tecnología (Technology Testing Department). The regional teams of which the department consisted had an average of four scientists, each with a field assistant. All team members live and work in the subregions, although they are attached to regional research stations.

Figure 2. ICTA's Technology Generation and Transfer Process



The Technology Testing Department, with its mandate to achieve an appropriate balance between applied and adaptive research, and to link the generation, adaptation, validation and transfer of technology, is ICTA's largest group in terms of staff and budget. Together with the Rural Socio-Economics Group, the department forms what ISNAR would call the on-farm client-oriented research (OFCOR) effort of ICTA. Besides ensuring the integration of activities — a substantial task in itself — this effort has had to cover a large number of locations and farmers (Ruano and Fumagalli, 1988).

ICTA's founding philosopny of on-farm research determined its organizational structure. In each of the regions where the institute operates, the national commodity programs (on maize, beans, wheat,

livestock, etc), and the disciplinary support groups (on soil management, seed production, plant pathology, etc) together make up a large regional team which is both multidisciplinary and interdisciplinary. The commodity programs conduct research in experiment stations and on farms, with the support of the technology testing teams. The commodity programs and support groups in the regions jointly plan their research agenda for each year on the basis of diagnostic studies (normally an informal survey known as a *sondeo*).

Regardless of their discipline or program, each region's researchers report to a Regional Director, who represents the Director General of the institute. The regional team consists of some or all of the following professionals: plant breeders, pathologists, animal scientists, soil scientists, and agronomists deployed in one to three technology testing teams. The tasks of each regional team include basic plant breeding and/or selecting materials at the regional experiment station (there is at least one station in each region), conducting trials in farmers' fields, monitoring trials managed by farmers, evaluating the acceptability of new technology to farmers, ensuring that farm records are kept by farmers, and, finally, conducting specialized socio-economic studies. The latter are the responsibility of the Rural Socio-Economics Group, which is organized at national level but sends staff to the regions as needed.

ICTA described its methodology as consisting of the following sequential stages:

1. *Understanding farmers' problems.* The farming systems and their constraints, farmers' management practices and the reasons underlying them, are studied through *sondeos*, and the collection of farm records. Researchers trained in social science research methods take a leading role in the surveys, which also include researchers from commodity programs, disciplinary support groups and technology testing teams (Hildebrand and Ruano, 1982).

2. *Generating and selecting technologies.* Technologies that will help to solve farmers' technical problems identified in the *sondeo* are developed and evaluated on station and on farm. The commodity programs, the technology testing teams, and the other support groups are jointly responsible for this stage.

3. *Testing promising technologies under farmers' conditions.* Here the regional technology testing teams and the farmers play the main role.

4. *Conducting farmer-managed trials.* Promising technologies are compared with the traditional technology by the farmers themselves. Farmers and the technology testing teams are jointly responsible, while the Rural Socio-Economics Group monitors farmers' evaluations.

These broad stages have been adhered to so far, although their definitions have been enhanced and the methodology has evolved on the basis of experience.

It was assumed that farmers' participation would ensure the expansion of geographical coverage to a wide range of conditions during and following the fourth stage. The farmer-managed trial would serve as a direct vehicle for technology transfer, and further expansion would depend mainly on the efforts of farmers themselves (Waugh, 1975). Technical assistance by DIGESA and other agencies was considered valuable but no critical. Personal, social and commercial relationships among farmers were thought to be the key.

Thus, when operations began, the assumption was that most of the appropriate technology emerging from the on-farm research would be adopted and disseminated by the farmers themselves: the more farmers participated, the greater the chances of widespread adoption and dissemination.

Initial Results: Problems in Reaching Resource-Poor Farmers

These assumptions proved to be only partly right. Where small-scale farmers were commercially oriented, considerable success was achieved, but ICTA's researchers and managers soon realized that their strategy had strong limitations in subsistence-oriented agricultural systems.

The dissemination of new technology proved to be a slow process in these systems because:

- The resource-poor farmers who first tested the new technology required more than one crop cycle to be convinced of its advantages.
- Relatives, friends and neighbors of these early adopters were similarly cautious (although in some cases they did adopt somewhat faster). Risk aversion was still a major factor determining the pace of adoption.
- When farmers wanted to adopt, there was usually not enough seed to satisfy demand. Farmers had to make the effort to obtain small quantities of seed and multiply it on their own initiative.
- Plant breeding for wheat and rice had focused on disease resistance. For both crops resistance broke down after 4 to 5 years. For many farmers it took this long for the new varieties to reach them.
- Technologies such as fertilizers and pesticides required training in their use. Such training may be complex, involving different management responses under different circumstances. ICTA alone could not adequately meet these training requirements.

In short, ICTA's initial strategy had been successful, but only in certain areas and with farmers operating under relatively favorable conditions. Although the institute had managed to reach quite large numbers of resource-poor farmers all over the country, its major impact had been on those located in the coastal plains and inland valleys. Bringing real benefits to subsistence farmers located in more densely populated areas and/or producing under less favorable and more diverse conditions had proved a more elusive goal.

Nonetheless, as Tables 2 and 3 (*overleaf*) show, by 1987 — the year in which the new technology transfer model finally took off — ICTA had made a substantial contribution to the dissemination of improved technology and to increased production at aggregate national level.

ICTA's impact had been not only on production but also on the seed industry, which had grown more than sevenfold in 9 years (1978-87). As a result, seed imports have been drastically reduced: in 1974 most (65%) of the certified seed of the country's main staple crops was imported; currently, no seed imports of maize, wheat and beans are needed, while those of rice are just 2% of requirements. It should be emphasized, however, that this domestic seed industry meets demand primarily from the commercial sector, not from small-scale subsistence farmers.

Table 2. Average Yields (kg/ha) of Staple Crops in Guatemala, 1976 and 1985

Crop	Year		Increase (%)
	1976	1985	
Maize	1 080	1 632	51
Beans	290	683	135
Rice	944	2 614	177
Wheat	1 275	2 166	70

Source: Departamento Agropecuario, Banco de Guatemala

Table 3. Certified Seed Production (tonnes) in Guatemala, 1978 and 1987

Crop	Institution	Year	
		1978	1987
Maize	ICTA	209	92
	Private firms	224	2 948
Beans	ICTA	21	13
	Private firms	9	50
Rice	ICTA	139	75
	Private firms	-	727
Wheat	ICTA	6	21
	Private firms	-	400
Total	ICTA	375	201
Total	Private firms	233 (38%)	4 125 (95%)

Source: Seed Production Discipline, ICTA

Chapter 2
THE SEARCH FOR SOLUTIONS

A Decade of Learning

In 1975, just 2 years after ICTA had begun its research, its first external review took place. A multidisciplinary team sponsored by the Rockefeller Foundation pointed out that ICTA did not have the capacity to deliver technology to all farmers on a national scale, but must rely on other agencies for technology transfer. In addition, ICTA should not regard these agencies as delivery agencies only: they might also provide valuable feedback on farmers' needs and problems (Rockefeller Foundation, 1975). An official document of the institute, published earlier in the same year (Waugh, 1975), had also reached the conclusion that ICTA should promote technology through other institutions as well as through its own teams.

Having understood the limitations of its initial strategy, ICTA had to change course. Management began trying to establish links with technology transfer organizations, both public and private.

Over the next decade several attempts at linkage were made. Some of them enjoyed a degree of success, others failed; none lasted. However, all of them taught useful lessons for the future attempt at integrating research and extension launched in the mid-1980s.

The DIGESA experience

Between 1974 and 1985 there were at least seven formal and informal attempts to improve linkages between ICTA and DIGESA. Some were agreements between top officials (Directors General) of both institutions, others were initiatives of middle-level staff (Regional Directors), and one was a combination of these. Informal agreements to cooperate at field level were also made between researchers and extension agents. Each attempt had its own combination of institutional arrangements. Broadly, the following types of arrangement were tried:

1. *A few extension agents were assigned to participate part-time in on-farm trials, in areas where new technology had already been validated.* The aim was to expand on-farm research activities and so promote technology transfer, by making extension agents more aware of ICTA's technology and training them in on-farm research methods. The problem was that extension agents had too many other duties to be able to handle these new responsibilities well. Moreover, Regional Directors did not fully support extensionists' involvement, and ICTA's researchers played only a coordinating role.

2. *All the extension agents of a given subregion were assigned part-time to conduct farmer-managed trials under the direct supervision of researchers in the same area.* This was a less complicated arrangement than the first one. It was expected to increase geographical coverage at the validation stage and make extension agents more aware of new technology. It was assumed that the extension agents would thereafter recommend the new technology on their own initiative. Problems arose because although this arrangement had the support of Regional Directors it did not have the support

of other important officials, including the supervisors of the extension workers and the senior staff of DIGESA's Planning Unit. Technology transfer work was still seen as an additional burden that would overload extension agents.

3. *An extension agent and a researcher, both working in the same area, were assigned part-time to supervise rural leaders conducting trials with cooperating farmers.* In this arrangement, made through an inter-institutional regional committee, the people directly responsible were local leaders — young people who had been formally trained by DIGESA in different aspects of agriculture. The idea was to increase farmers' participation and so multiply the effect of the validation and transfer stages, as well as to foster increasing links with extension. The main problems were a lack of understanding of the approach, and inadequate support from senior officials at headquarters.

4. *The entire on-farm research team of a given area was linked with a counterpart team of extension agents.* Following a brief planning session between the two parties, the same procedure as in 3 (above) was followed. In this arrangement the multiplier effect was significantly enhanced, but similar constraints arose.

5. *Extension agents from some areas were included in ICTA's annual training course in on-farm research, the Curso de Adiestramiento en Producción Agrícola.* The purpose was to make extension agents more aware of ICTA's philosophy and methodology, and to train them in the on-farm research approach. After the 10-month course, the extension agents included technology validation and transfer activities in their work plans. Validation was conducted through farmer-managed trials, but transfer was left in the hands of extension agents. This arrangement was not fully supported by either regional or headquarters officials, however. Traditional tasks within DIGESA retained priority, and technology transfer was comparatively neglected.

The World Neighbors experience

Although attempts to link with DIGESA provided valuable experience, the partnership between ICTA and World Neighbors was perhaps a more important prototype for the new model that would link research and extension in the 1980s. (World Neighbors is a USA-based non-governmental development organization, sponsored by the Lutheran Church and supported by OXFAM-America.)

In 1974, ICTA signed a cooperative agreement with World Neighbors. The project was a modest one in terms of financial resources, number of staff and geographical coverage, but an outstanding one in terms of its teamwork and the quality of its achievements. The project was located in the Indian village of San Martin Jilotepeque in the central highlands, where farmers and the staff of World Neighbors were already working in organized groups, experimenting with soil and water management practices. Yields had begun to increase, but new crop varieties and agronomic practices were needed.

ICTA and World Neighbors worked together to involve local volunteer leaders in testing some of ICTA's technologies. Three leaders were put on ICTA's payroll as part-time staff. They collaborated with an ICTA researcher in conducting on-farm experiments and farmer-managed trials throughout the San Martin area.

Researchers dealt directly with the leaders, who took responsibility for communicating with organized groups and conducting field trials with them. Each leader was able to manage approximately 60 field trials a year.

The project was highly successful. Besides bringing about an increase in productivity of 60% in maize and more than 100% in beans, it improved the farming system by diversifying it through the addition of wheat and potatoes. It also increased farmers' incomes. Unfortunately, political violence in the area forced the project to a premature end.

The Xelajú experience

In 1979, two ICTA on-farm researchers in the western highlands recruited local leaders and trained them to participate in the planning and implementation of on-farm research and technology transfer activities. Working with six paraprofessionals in an adult education program which was financed by the Ministry of Education, one researcher was able to organize the conduct of 141 farmer-managed trials in a single year. The other worked with six volunteer leaders in a cooperative, and organized 119 trials.

However, the sudden expansion in the number of trials outstripped the capacity of ICTA to make systematic observations and yield measurements. In addition, in adopting this approach ICTA felt it was bypassing DIGESA. The loss of scientific rigor and the duplication of extension activities dissuaded ICTA from pursuing this approach any further.

Problems of Institutionalization

Several factors impeded the establishment of a satisfactory relationship between research and extension, between extension and producers, or both. These factors were:

- *Researchers viewed extension agents primarily as implementors.* ICTA held interdisciplinary planning sessions to establish its research agenda in each of the regions in which it operated, but there was no firm commitment to including extension agents as partners in the planning and review sessions.

- *There was no sharing of responsibilities.* This was the result of the lack of joint planning.

- *There was little training*, either for extension agents in on-farm research, or for researchers in extension methods. Consequently, the two groups did not share a common approach.

- *Links depended on personal factors and were horizontal only.* When high-level verbal or written agreements were made, these were not translated into action at the field level because middle- and field-level staff were not motivated. When good professional relationships developed at field level, they were not backed up with support at higher levels, and were not institutionalized. As a result, collaboration occurred sporadically and fortuitously.

- *Considerable status differences existed between researchers and extension agents.* The better education, salaries and benefits of researchers made extension agents feel inferior, impeding the development of professional relationships. When cooperation occurred at all, extension agents played the role of assistants rather than partners.

- *ICTA tended to dominate.* Most of the initiatives were taken by ICTA, putting DIGESA in a passive, reactive role. This prevented participation on equal terms.

- *Extension agents were overloaded.* In most cases joint activities with ICTA were added on to their regular duties.

- *There was limited participation by farmers*, both in terms of the numbers of farmers involved, and in terms of the role they played: farmers were excluded from the planning stage.

- *The supply of inputs was insufficient*, often due to delayed delivery.

- *Appropriate technology was lacking*, especially in the early days. Guatemala has found that links between research and extension are difficult to develop and sustain when relevant technology is not yet available.

At the same time as these abortive attempts at linkage were occurring, ICTA's leaders were developing a project proposal with the aim of attracting additional external funding. One of the project's main objectives was to create formal, institutionalized links with DIGESA. The seed of the new model had been planted.

Chapter 3
DESIGN AND DEVELOPMENT OF THE NEW MODEL

A False Start: ICTA still Dominates

Working with the staff of DIGESA and other public institutions, ICTA's management wrote, in 1978, the first draft of a document outlining the Proyecto de Generación y Transferencia de Tecnología Agropecuaria y Producción de Semillas (PROGETTAPS) (Project for the Generation and Transfer of Agricultural Technology and for Seed Production).

One of the weaknesses of this document was the dominant role assigned to ICTA. In any case, political events overtook the planned revision and submission of this document. New management arrived at ICTA, and the embryonic PROGETTAPS, among other initiatives, was aborted.

The Second Draft: The Concept of Modular Systems

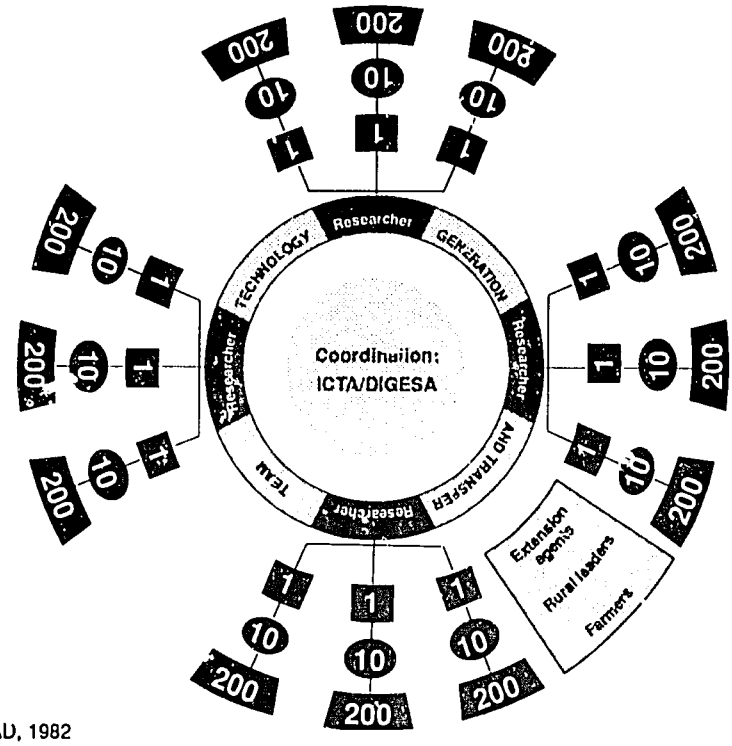
Two years later, further political change provided an opportunity to resurrect the PROGETTAPS idea. This time a draft allowing more balanced participation by ICTA and DIGESA was prepared. The new draft emphasized the production and supply of improved seeds, especially staple grains, although a number of other commodities were also to be included. The project was to have two main subprojects: the first was research and basic seed production; the second, technology transfer, technical assistance and mass production of improved seed.

This second draft contained the key idea that a modular system to generate and transfer technology would constitute the project's mode of operation (*see* Figure 3 *overleaf*). Each modular system established at subregional level was to have four on-farm researchers. To each researcher at least three extension agents would be assigned. Each extension agent would cooperate with an average of 10 to 15 rural leaders, and each of these would cover at least one group of 20 farmers, making a minimum target coverage of 2 400 families a year for each modular system. Implementation was to be the joint responsibility of ICTA and DIGESA, each of which would appoint a coordinator.

The flow chart of the technology transfer model (*see* Figure 4 *overleaf*) shows the various stages at which ICTA and DIGESA were to share responsibilities in different ways. The first two stages, technology generation and technology testing/validation, were to be mainly ICTA's responsibility, but were also to involve extension agents, first in constraint diagnosis (*sondeos*), then in on-farm experiments (generation) and again in farmers' trials (validation). The extension agents were to become familiar with the new technology as it developed, participate in evaluating its performance and, finally, make the technology their own through their knowledge of how it performed and how it should be managed. At the third stage (technology promotion/dissemination), DIGESA's agents were to take the leading role, while ICTA's on-farm researchers were to participate in order to obtain feedback from farmers and extension agents, and to provide technical support.

Working methods, which were spelt out in detail, were to consist of joint planning, on-farm experiments, farmer-managed trials, small-scale seed production plots, field days, village-level meetings, seminars, and review of results.

Figure 3. Modular System for Technology Generation and Transfer at Subregional Level



Source: BID/IFAD, 1982

Other important principles mentioned in the second draft were that: intensive training in on-farm research was to take place before the project started; joint planning, including rural leaders, was to be the rule, not the exception; responsibilities of each participant were to be clearly defined in advance; and seminars to channel feedback from farmers were to be built into the program.

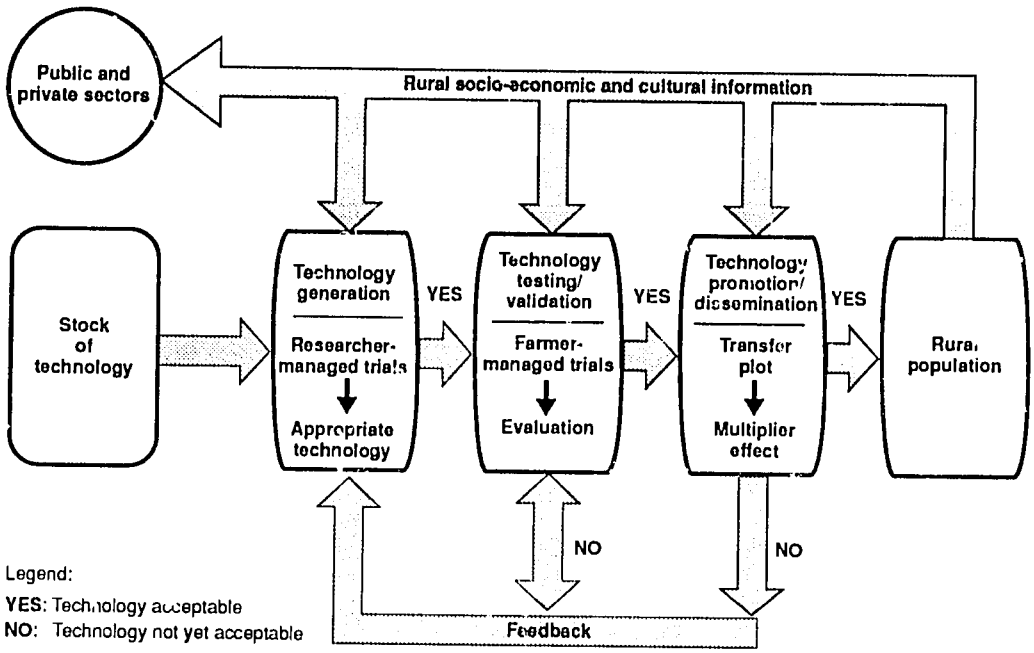
When the second draft was submitted to the Ministry of Agriculture, a new Minister had just been appointed. Because of his professional background — he was a veterinarian — the Minister proposed the inclusion of the livestock extension institution, the Dirección General de Servicios Pecuarios (DIGESEPE). This proposal delayed submission to funding agencies until the end of 1984.

The Final Version: Inclusion of the Livestock Service

The final version of PROGETTAPS was submitted to the Inter-American Development Bank and the International Fund for Agricultural Development in late 1984. New features in the final version were statements to the effect that, in areas where new livestock technology had been validated, the field-level modular system would include livestock specialists to ensure technology transfer, and that technology transfer specialists and rural leaders would participate actively in research, and researchers would participate in technology transfer.

In addition, the criteria for selecting rural leaders were better defined. They were to be of the local community, and full-time farmers and land owners. They must already be recognized as leaders in the

Figure 4. Flow Diagram of Technology Transfer Model used by PROGETTAPS



Source: Ortiz and Meneses, 1989

community, by whom they must be democratically elected. And they were to have basic mathematical ability and literacy.

Including the livestock extension service in the project meant that in some areas the number of extension agents assigned to each on-farm researcher could be increased (up to seven in some cases). This was one of the factors that enabled the project's coverage to expand well beyond the initial target (*see* Chapter 4).

Because the project began with relatively simple technology, livestock have not been a major focus of the project so far. However, they may well become one in the future. Having the livestock service involved in the project has helped forge closer links in preparation for this stage.

Supervision and Coordination: Solving the Leadership Problem

Previous experiences with inter-institutional projects suggested that one of the problems likely to affect the new project would be where its leadership should lie. To solve this potential problem, an Executive Coordination Commission was set up, to act as the project's senior management. Serving on the commission were the Vice-Minister of Agriculture, the Directors General of both ICTA and DIGESA, and the Coordinator of the Sectorial Planning Office for Agriculture.

Technical issues were to be dealt with by an inter-institutional Technical Committee consisting of senior scientists and technicians. Finance would be coordinated by a special unit serving as a link between the funding sources and the institutions conducting the project.

A third level of coordination was to be provided by the National Council on Technology Generation and Transfer, which was to consist of the regional coordinators for research and extension within PROGETTAPS, in addition to the members of the Technical Committee.

An internal document on policies and procedures was developed, in order to provide clear terms of reference for all the participants. Finally, a monitoring and evaluation unit was set up within the Sectorial Planning Office.

Chapter 4
IMPLEMENTATION AND IMPACT

Easier Said than Done

Designing the new project proved easier than implementing it. Implementation began in the second half of 1986 with a workshop in each of the five regions to be covered during the first phase. At the workshop the Technical Committee presented the new model to each of the newly formed research-extension teams that were to integrate their activities within each departamento. Exhaustive discussions took place on why integration had not worked before. One positive outcome was that members of both groups got rid of their frustrations by letting them come out in the open, and this helped to lay the foundations for a more healthy relationship in the future. Unfortunately, however, the new model was not well presented, with the result that most of the participants failed to grasp its essence.

As a result, after the workshop the activities of most participants continued just as before. Only two on-farm research groups understood the potential of the new model; they made the most of the project's first few months, guiding their extension colleagues through the initial process of integration.

A Fresh Start

A local consultant specialist in technology transfer, who also had a strong background in on-farm research, joined the project during its second year, in 1987. His arrival provided a second opportunity for ICTA and DIGESA to grasp their new roles in the integrated effort.

The consultant was assigned to work within the extension service, with responsibility for identifying the necessary linkage mechanisms that would get on-farm researchers and extension agents to interact positively. After studying the situation, he developed a work plan that would make DIGESA a major contributor to the integrated effort. This work plan, which was endorsed by management after presentation and discussion at a 2-day workshop, recommended:

- *A training program for all the field personnel involved in the research-extension effort.* Initially, this would increase understanding of the farming systems approach and of the new model for technology generation and transfer. The program would establish common ground for the members of the research-extension team, who would then share the same philosophy, use the same methods and pursue the same objectives.

- *The use of the transfer plot instead of the demonstration plot as the center from which new technology would radiate.* This was a critical change. The main features of transfer and demonstration plots are contrasted in Table 4 (*overleaf*). The transfer plot is managed by a cooperating farmer who invests in the new technology and becomes, together with the rural leader, the spokesperson for it. Because transfer plots are farmer managed their numbers can be substantially increased, promoting rapid and widespread dissemination.

- *Creating organizational mechanisms within DIGESA to enable it to execute the new project more efficiently.* The functions and role of the PROGETTAPS regional coordinators — the new posts established within DIGESA — were defined so as to ensure their freedom to work with ICTA and to decide how the project's budget would be spent. How these regional coordinators would be technically responsible and would support the extension teams, and the kind of relationship they would have with the different levels in the chain of command within the region (Regional Director, subregional leaders, and supervisors) were also specified. In contrast to earlier extension efforts, it was clearly stated that extension agents would dedicate most of their time and effort to technology transfer activities.

Table 4. Features of Traditional Demonstration Plots compared with the Transfer Plots used by PROGETTAPS

Feature	Traditional demonstration plot	PROGETTAP's transfer plot
Objective:	Promotion via demonstration	Transferring by doing
Management:	Extension agent	Farmer, backed up by rural leaders and extension agent
Investment:	Extension agency	Farmers
Evaluation:	Yield	Economic impact
Number of variables:	Several; technological package	Very few; often seed only
Type of technology:	Modern; capital-intensive	Intensive in available factors only
Purpose of design:	Designed not to fail	Designed to be appropriate

Understanding the New Model

The first part of the training program strengthened the knowledge of both extension agents and on-farm researchers of the role of each institution and each participant in the new technology transfer model. Then, in a series of short intensive courses, people were trained in the characterization of rural life and production systems, the analysis and interpretation of on-farm research data, and the definition of recommendation domains.

This training proved especially beneficial to the extension agents, who had no experience in these topics. It allowed them at last to understand the process through which technology passes before being selected for transfer, helping them to believe in the technology. In addition, they acquired a better understanding of the new model and of their own contribution to its implementation. The training enabled the extension agents to begin an all-out effort in technology transfer. The research-extension teams at last began to share the same philosophy and methods, and realized that they were pursuing the same objectives. This established the foundation for positive interaction and successful collaboration.

To ensure that the model was correctly applied in the field, the training program included a 'technical back-up' component. The consultant and the national coordinator within DIGESA established an intensive program of field visits and working sessions with the extension agents in each of the project's departamentos.

The Project Takes Off

Rapid expansion

In 1987, DIGESA decided to launch large numbers of transfer plots that would serve as centers from which new technology would radiate. With this decision the organization switched its strategy to transferring technology rather than providing technical assistance. This switch made sense because the technologies selected for transfer were already known to be appropriate to farmers' conditions. It allowed a rapid expansion of the work with groups of farmers organized around rural leaders, helping to generate a multiplier effect.

In 1988 promotion activities increased still further (*see* Table 5). The most effective mechanisms for promotion were the 'transfer days', held at 'transfer stations'. These stations are clusters of on-farm experiments, farmer-managed trials and transfer plots separated by short distances, where the entire integrated research-extension effort can be seen in one visit. On a transfer day, large groups of farmers are invited and exposed to the new technologies. Rural leaders and the cooperating farmers managing the plots act as main spokespersons for the technological innovations.

On the basis of 7 300 farm records collected in 1987-88 and 12 500 in 1988-89 (the sample was different for each year), the new PROGETTAPS model was estimated to have had a substantial impact on more than 80 000 resource-poor farmers (*see* Table 6 *overleaf*). The numbers shown in Figure 3 had proved very conservative: the coverage is far larger than originally planned, with each modular system reaching well over the target of 2 400 farmers a year.

Table 5. Activities of PROGETTAPS, 1986-88

Type of activity	Number per year				
	1986	1987	1988	1986-88	1989
Farm trials	193	99	242	534	422
Farmer-managed trials	274	724	248	1 246	368
Transfer plots	506	2 876	2 547	5 929	4 630
Seed plots	-	11	719	730	1 722
Communal gardens (vegetables)	-	-	445	445	898
Transfer days	23	122	678	823	1 241
Farmers' tours[1]	11	76	275	362	415
Agricultural encounters[2]	13	63	267	343	342
Farm records	367	4 580	2 735	7 315	12 500

Source: PROGETTAPS Coordination Unit/DIGESA

Notes:
1. On farmers' tours, groups of farmers are conducted through the region by the extension teams, who show them how technologies perform in different environments.
2. Agricultural encounters are meetings of farmers, who are invited to discuss technical issues with the extension team in the field.

Table 6. Impact of PROGETTAPS on Crop Production and Net Income of Farmers in Project Areas

Crop	Yield (kg/ha) without Project (1985)	Yield (kg/ha) with Project (1989)	% Increase[1]	Average net income[2] increase/ha (%)
Maize	1 380	2 666	93	32
Beans	620	1 120	81	40
Rice	1 767	4 201	138	n/a
Wheat	1 450	2 975	105	38
Sorghum	1 600	2 221	39	n/a
System				
— maize	1 020	1 417	39	n/a
— sorghum	840	1 132	35	n/a
Potatoes	5 200	19 310	271	130
Vegetables	18 786	26 135	39	n/a
Broad beans	900	2 000	122	n/a

Source: 1. Dirección Tecnica-PROGETTAPS-DIGESA (Ministerio de Agricultura, Ganadería y Alimentación, 1990)
2. DIGESA farm records, 1987-88 and 1988-89

Appropriate technologies

Perhaps the main reason why adoption rates were high was that appropriate technologies were selected for transfer. These technologies were already available because of ICTA's previous on-farm research in the project areas. The criteria used to select technology for transfer were:

- *Simplicity:* the nature of the technology and its management had to be easy to understand. The technologies chosen for transfer were almost invariably seed-embodied.
- *Productivity and profitability:* the new technology had to have good potential in terms of increasing yields while incurring low additional costs. The nature of the technology was important here, in that cost increases due to the requirement for additional labor were preferred to high initial investment costs.
- *Availability of inputs:* any inputs required by the new technology had to be readily available.
- *Relevance:* the new technology had to respond to a need identified through the *sondeos*.
- *Potential impact:* the new technology had to be appropriate to the farming system in order to ensure widespread dissemination. In addition, the increases in production resulting from it would have to be both stable and sustainable, as well as high.

Most of the technology transferred during the early stages of the project has consisted of new crop varieties, but now other kinds of technology are being discussed and transferred. Subjects covered include soil science, resource management, seed nurseries and reforestation.

Rural leaders: Key to transfer and feedback

A total of 4 300 rural leaders, about a third of them women, have so far been hired by the Ministry of Agriculture. They work part-time, representing the public-sector agricultural institutions and serving as a link between them and the rural community. They are elected by their communities on the basis of their ability as farmers, their leadership qualities and their willingness to serve the community, where they are generally well known and respected.

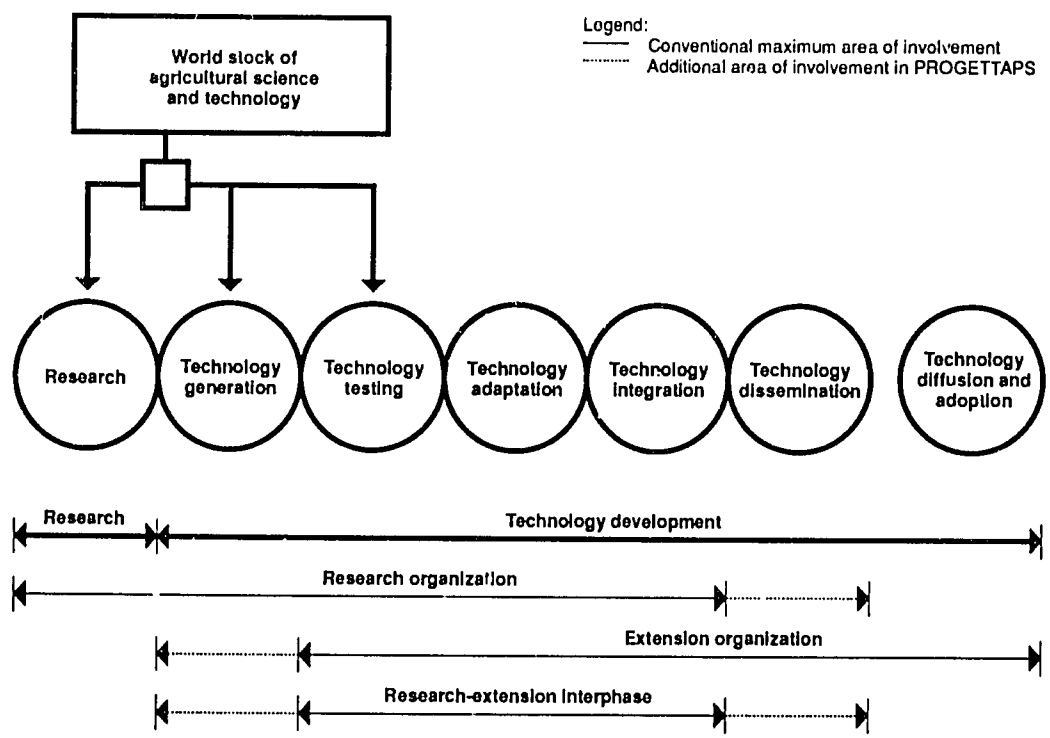
Around 75% of these rural leaders have been involved in PROGETTAPS. They are a key element in the technology transfer process, managing transfer plots, collecting farm records, and conducting transfer activities with groups of farmers. They have acted as a channel for feedback to guide the research programs, and have helped establish a seed distribution system. Their participation has been highly successful, leading to far wider dissemination of new technology than was achieved previously. Their success is based on their ability to get messages across clearly, their credibility within their communities, and their dedication to their work.

Despite their many commitments, rural leaders must alternate a fortnight spent with their group with a fortnight spent on their own farm. Care is taken not to remove them from the rural environment, not to change them into trainers or bureaucrats.

Emphasizing integration

One of the most important mechanisms for integrating research and extension was to promote joint participation in every phase of the technology innovation process. This message was repeated as many times as was necessary to the five research-extension teams until all of them developed an integrated approach to the planning, execution and evaluation of their activities. This provided the extension agents with the opportunity to participate in on-farm research and to get to know the characteristics of the new technologies and how to manage them. It also provided on-farm researchers with the opportunity to become involved in extension activities (transfer plots and transfer days) and to receive feedback directly from farmers. The resulting research-extension 'interphase' is depicted in Figure 5.

Figure 5. The Research-Extension Interphase developed by PROGETTAPS



Source: Adapted from Farming Systems Support Project, 1985

The most important and beneficial result of 3 years' experience in developing an integrated research-extension program is the belief each group now has in the ability of the other group to get the job done. Mutual respect has laid the foundation for improved cooperation and integration.

Intensifying farmer participation: Consultative groups

Since 1987, the policy within PROGETTAPS has been to involve farmers more and more. It has been stressed that successful technology transfer requires participation rather than education. Besides joining in field activities, farmers have been invited to take part in the planning of future activities. This has been brought about through what are known as *grupos de consulta* (consultative groups) (Ortiz, 1988).

The consultative groups consist of the rural leaders assigned to one of the extension teams and at least one member from each of the farmer groups formed by the rural leaders. This makes a total of around 30 people, to whom the research-extension team presents its proposed work plan for the coming season. These groups are becoming increasingly active in providing feedback on work plans, realizing that they can steer research activities to ensure their relevance to local problems.

Small-scale seed production

To accelerate technology transfer, DIGESA has developed small-scale seed production and distribution among resource-poor farmers (Ortiz, 1989). The existing seed industry was unable to meet the substantial demand from the small farm sector.

Beginning in 1988, extension agents worked closely with farmers, helping them produce seed for themselves and a surplus to market in the local community. Whether bartered or sold, this seed is now reaching a large number of farmers (*see* Tables 7 and 8).

Table 7. Small-Scale Seed Production by Resource-Poor Farmers, 1988-89

Crop	Number of seed plots	Production area (ha)	Seed produced (tonnes)	Number of farmers who obtained seed
Maize	406	47.2	69.2	10 200
Beans	363	82.7	81.4	9 556
Wheat	426	28.5	54.8	5 275
Potatoes	329	14.3	222.3	6 706
Faba beans	59	2.7	3.6	816
Rice	1	0.7	1.4	16
Total	1 584	176.1	432.7	32 569

Source: PROGETTAPS Coordination Unit/DIGESA

Table 8. Small-Scale Seed Production by Resource-Poor Farmers, Planned for 1990

Crop	Number of seed plots	Production area (ha)	Estimated seed production[1] (tonnes)
Maize	365	28.8	92.4
Beans	548	37.2	45.0
Wheat	362	15.8	35.8
Potatoes	552	11.0	275.5
Faba beans	135	5.9	19.4
Rice	14	4.5	17.6
Sorgum	30	8.7	26.8
Soybeans	20	2.7	5.5
Total	2026	114.6	518.0

Source: PROGETTAPS Coordination Unit/DIGESA

Note:
1. This estimated seed production will be distributed among approximately 50 000 farmers

Integrating the extension teams

As already stated, the extension system in Guatemala works in three subject areas: agriculture, home economics, and youth education. Local extension offices normally have one professional for each of these areas. When PROGETTAPS began it brought with it resources and prestige that benefited only the extension agent working in agriculture. However, by 1987 the new approach had started to include the other two agents, who were recruited and trained in the integrated approach and the characteristics of the new model, just like their agricultural colleagues. This substantially increased the number of technically trained people transferring new technology. By 1988, home economics teachers were managing transfer plots with their groups of housewives, and one home economics teacher had become involved in seed production. The youth club promoters were also cultivating transfer and seed plots with their groups of young people. Both kinds of group held transfer days, participated with the agricultural extension agent in conducting a *sondeo* in their area, and helped to collect farm records.

The integrated extension team is now the basic unit responsible for technology transfer. The teams plan and implement all technology transfer activities within the public sector. It is to these teams that the ministry assigns newly recruited rural leaders. Their incorporation within the project has deepened its impact in the local community.

Coordination at several levels

As already mentioned, PROGETTAPS has three different hierarchical levels at which coordination takes place: the Executive Coordination Commission, the Technical Committee, and the National Council on Technology Generation and Transfer.

These three groups are responsible for the major decisions on how the new transfer model is to work, and when and where activities should be expanded. The Vice-Minister of Agriculture and the members of the Executive Coordination Commission have visited each departamento regularly to see the on-farm activities, meet the people working at field level, talk to rural leaders and farmers, and find

out whether and how the project is achieving positive results. The Technical Committee meets regularly and visits the field frequently, keeping up-to-date with the project's status in each departamento. The council meets every 2 months in one of the original seven departamentos. In the course of the meeting, members visit on-farm research and transfer activities.

These three levels of coordination have helped sustain the project and have generated a willingness to share responsibilities. They have been a key mechanism for institutionalizing the new transfer model within the national research and extension system.

Improved feedback

Feedback in the national system has been considerably strengthened through the PROGETTAPS model. This is because:

- The links formally established at several administrative levels have been kept active and supported by medium- and high-level officials. For example, the Vice-Minister of Agriculture has visited the project areas regularly, accompanied by senior management of all three participating institutions.

- ICTA's planning sessions have been modified and extended to include participants from DIGESA, following recommendations provided by ISNAR's study on on-farm research (Ruano and Fumagalli, 1988). The participation of the commodity programs is also much more active now. Feedback from the consultative groups of farmers is received before each session and is an important input to the meeting.

- Efforts to obtain feedback from the farming community have focused on using simple means of gathering basic information, without involving too many variables. A decentralized information gathering system has been developed. Each region is responsible for collecting its own information, using microcomputers to process data collected through a single-sheet questionnaire.

ICTA's previous feedback from on-farm research was far more limited in scope: fewer on-farm trials and fewer farmers participating. With the new model, participation and coverage have been substantially enhanced, with the result that feedback has been greatly increased.

Further expansion

The success achieved with the new model has encouraged the various institutions involved to increase the geographical coverage of PROGETTAPS. As stated earlier, from working in only seven departamentos in 1986-88, the project expanded in 1989 to cover 15 out of the country's total of 22 departamentos. The criteria for selecting these new areas were that an on-farm research team was already present there and that the local extension agents had already done the introductory training course. In addition, the consultant assigned to DIGESA had already trained extension teams outside the original areas covered, in response to requests from the teams themselves.

Chapter 5
LESSONS LEARNED

Guatemala's success in closing the gap between research and resource-poor farmers depended on meeting three major conditions in three successive stages. First, on-farm research had to generate appropriate technology that would be easy to disseminate and would be rapidly adopted. Second, the extension institution had to be brought into the effort, made familiar with the technology, and encouraged to broaden the coverage. Third, rural leaders and their groups had to be encouraged to participate so as to increase dissemination still further.

A number of important lessons emerge from this experience:

- **Relevant technology must be available**

  That success came so quickly once effective links were achieved was the direct result of having a research institution that had already generated appropriate technology. ICTA's commodity programs and on-farm research teams had developed technologies suited to farmers' conditions across a wide variety of climates, soil types, and management systems.

- **Extension services can be effective in technology transfer**

  The PROGETTAPS experience shows how the real potential of extension institutions to promote technology transfer on a large scale has been underestimated. The difference in achievement between the early and the more recent years of the project shows how important it is to invest resources in training extension agents. In Guatemala, training focused on developing a common approach between research and extension. Extension agents were trained in the philosophy, methodology, and approach of farming systems research. This stimulated a shift from the traditional extension approach to a much more participatory client-oriented model.

- **Rural leaders can serve as a vital link between extensionists and farmers**

  In many developing countries, extension agents are expected to link directly with all members of the farming community, a task that, in terms of sheer numbers, is clearly beyond their capacity. In Guatemala, this problem was successfully overcome by recruiting rural leaders to mobilize the local community and promote the adoption of technology.

- **Technology transfer models are country-specific**

  Guatemala's new model for technology transfer was designed on the basis of Guatemalan experience and to suit the Guatemalan institutional context, and it uses aspects of Guatemalan society and culture to enhance its impact. The PROGETTAPS model could be used in other countries, but it would have to be modified to suit national conditions.

- **Good organization and staff motivation are essential**

  Good organization and motivation have contributed as much to the success achieved as have plentiful resources (vehicles, gasoline, fertilizers, etc). This was underscored when the flow of

funds suddenly stopped because of a government cash crisis: the pace of work slowed down but it did not stop — awareness of the importance of their work drove the field teams (and especially the extension agents) to continue in spite of resource limitations. As the technology transfer consultant observed, 'the resources available will establish the area covered and the amount of work conducted; but the quality of the work is defined by the technological model used and the individual capability of the transfer agents.' The investment in training the extension agents to help them understand their role and identify their contribution had paid off handsomely. Moreover, the early success generated increased commitment among the field teams, increasing the intensity and efficiency of the integrated effort.

- **Specialists with experience in both research and technology transfer are needed**

  The role of the technology transfer specialist, who was Guatemalan and a former Technical Director at ICTA, was critical in establishing the new model. He designed the training program and acted as its main instructor; he devised new organizational arrangements and proposed new strategies; and he provided technical back-up to senior management, middle-level officials and field workers. A key to his success was his background in both on-farm research and extension. Also, being recruited locally, he knew the local institutions and their cultures.

- **Direct contact between field staff and senior administrators reinforces integration**

  Direct contact between field staff and senior staff in the ministry and in the research-extension system, achieved through the Executive Coordination Commission and the Technical Committee, was important in three ways. First, it motivated the field staff: when they saw that their bosses were interested in their field activities, they became confident that this time integration was really taking place. Second, it enabled the heads of research and extension to understand the project's potential impact on resource-poor farmers, and persuaded them to support the integration of the field teams. Third, it was the vehicle through which senior management gained confidence in the new model and decided to expand its coverage.

- **Senior decision-makers trained in on-farm research are more likely to provide support**

  Having people with a background in client-oriented on-farm research at decision-making levels was crucial to the design and implementation of the PROGETTAPS model. Several senior staff in the system had had on-farm research experience, including the Vice-Minister (now Minister) of Agriculture, the Directors General of both ICTA and DIGESA, the Deputy Director and the Technical Director of ICTA, and the consultant at DIGESA.

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