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ISNAR

International Service for National Agricultural Research

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

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**Integration and Overlapping
Tasks:
Some Cases in the Philippines**

by

Herminia Arocena-Francisco

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International Service for National Agricultural Research

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

DAVID KAIMOWITZ¹

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

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

- (a) the relevance of research efforts through a better flow of information about farmers' needs for the research systems;
- (b) the transfer of technology to agricultural producers and other users of agricultural technologies.

Why the Study Was Initiated

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

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

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

"All the 12 countries (in which research projects were evaluated) had difficulties of communication between research institutions and extension agencies" (Food and Agricultural Organization 1984). The serious consequences of this problem are effectively summed up by a leading expert in the field, Monteze Snyder: "The poor interorganizational relations between

the extension agency and the research organization almost guarantee that research results will not reach farmers, and if they do, farmers will not be able to use them" (*A Framework for the Analysis of Agricultural Research Organization and Extension Linkages in West Africa*. PhD dissertation, George Washington University, 1986).

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

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

¹Study Leader, 1987-1989. Thomas Eponou assumed leadership of the project in 1990.

Operational Strategy and Products

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

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

1. *Theme papers* on key linkage-related topics. These have been written by specially commissioned international experts in the field.
2. *Discussion papers* which analyze one or a few major issues emanating from the case studies. About 15 such papers will be produced, written by the case study researchers. They will focus on the most outstanding features of the links observed in the cases and draw clear conclusions about them for practical use by managers.
3. *Synthesis papers* which present the lessons emerging from the case studies. These are being written by ISNAR staff.
4. *Guidelines* on how to design and manage the links between agricultural research and technology transfer for policy makers and managers concerned with the two activities. These will also be written by ISNAR staff, with input from the case study researchers, managers of national systems, and others.

The theme papers were published during 1989. Most of the discussion papers were published in 1989 and 1990, and the synthesis papers and guidelines will be available in 1991. Individual copies of discussion papers are available from ISNAR upon request, at the discretion of ISNAR.

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

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

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

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

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

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

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

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

**LIST OF OTHER DISCUSSION PAPERS
IN THE SPECIAL ISNAR LINKAGE SERIES**

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

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

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

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

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

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

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

MEMBERS OF THE STUDY GROUP ON THE LINKS BETWEEN AGRICULTURAL RESEARCH AND TECHNOLOGY TRANSFER

Advisory Committee

John Coulter
David Leonard
Niels Röling

Burton Swanson
Eduardo Trigo
Taiwo Williams

ISNAR Working Group on Linkages

T. Ajibola Taylor
N'Guetta Bosso
Robin Bourgeois
Thomas Eponou
Hunt Hobbs

David Kaimowitz²
Deborah Merrill-Sands
Willem Stoop
Larry Zuidema³

Case Study Researchers

Dolores Alcobar, Philippines
Luis Alfonso Agudelo, Colombia
Assemien Aman, Côte d'Ivoire
Corazón Asucena, Philippines
Emiliana Bernardo, Philippines
Alexander Coles, Costa Rica
Johnson Ekpere, Nigeria
Thomas Eponou, Côte d'Ivoire
Hermina Francisco, Philippines

Isiaka Idowu, Nigeria
Eduardo Indarte, Dominican Rep.
Ildefons Lupanga, Tanzania
Viviana Palmieri, Costa Rica
Agapito Pérez Luna, Dominican Rep.
Kouadio Tano, Côte d'Ivoire
Soumaila Traore, Côte d'Ivoire
Germán Urrego, Colombia

Theme Paper Authors

Paul Bennell
Ruben Echeverría
Paul Engel
Peter Ewell
David Kaimowitz
David Leonard

Roberto Martínez Nogueira
Carl Pray
Niels Röling
Holly Sims
Monteze Snyder

Project Staff

Thomas Eponou
(Study Leader)

Anna Wuyts
(Research Assistant)

²Joined IICA, 1990

³Returned to Cornell University

Integration and Overlapping Tasks: Some Cases in the Philippines¹

Herminia Arocena-Francisco²

Summary

Critical to the attainment of integration among member agencies in any agricultural technology subsystem³ are agreements on domain correspondence and consensus and the existence of interdependence based on differences in level of competence and/or access to resources. Once these factors are present, concerned agencies are more

willing to follow through on agreements in order to achieve a significant level of integration. Task overlap is usually associated with the absence of significant integration among concerned agencies; likewise, there are particular tasks where the overlapping of activities results in higher performance in the subsystem.

INTRODUCTION

To help national agricultural research systems (NARS) address the issue of integration and overlapping tasks, among the other issues related to research and technology transfer linkages (RTTL), the International Service for National Agricultural Research (ISNAR) has carried out an RTTL project covering seven countries including the Philippines. This paper presents the experiences in the Philippines related to the following hypotheses of the RTTL study on integration and overlapping tasks (Kaimowitz et al., 1989):

1. Integration Hypothesis:

"Significant integration only occurs if the partners involved perceive all of the following to exist: interdependence, domain consensus, domain correspondence, competence, and capacity to follow through an agreement."

2. Redundancy Hypothesis:

"Task overlaps are associated with higher performance."

The integration hypothesis defines the factors believed to be critical for significant integration:

- competence: there must be the belief by both parties (research and technology transfer) in each other's staff capability and resource capacity;
- domain correspondence: a common set of clients and topics of concern;
- domain consensus: definition of what each party's role should be and the scope of each other's activities;
- interdependence: a belief that their joint undertakings will benefit collaborating parties, either from each other or a third party;
- capacity to follow through an agreement: the belief that the linked institutions or units have the capacity to follow through whatever has been agreed upon.

Implicit in the hypothesis is that all of the factors mentioned above must be present if significant integration is to be realized. Evidence from case study results will be presented to ascertain the presence or absence of these factors as the subsystem's performance is appraised.

With regard to the redundancy hypothesis, the conditions under which overlapping of tasks from technology development to delivery took place and the impact of this redundancy on the subsystem's performance will be evaluated. The reasons for task redundancy, like competition for resources

1. An earlier version of this paper was presented at the Research and Technology Transfer Linkages Conference sponsored by the International Service for National Agricultural Research in The Hague, Netherlands, September 25-30, 1989.
2. Herminia Arocena-Francisco is an associate professor and director of the Highland Socio-Economics Research Institute, Benguet State University, La Trinidad, Benguet, Philippines.
3. A *subsystem* is defined as a set of agricultural research and technology transfer institutions that have been involved in the development and delivery of technologies for a specific group of users.

(both tangible and intangible), and the desire to maintain independence, among other things, will be established.

This paper discusses relevant results of the case studies done on the potato subsystem in the Philippines (Francisco,

1989a). The first section deals with the integration hypothesis. The task overlap hypothesis is discussed in the second section, and the lessons learned are summarized in the last section.

INTEGRATION

Core institutions⁴ of the seed potato subsystem

The limited availability of high-quality, disease-free planting materials is a major constraint in developing the potato industry in the Philippines. Hence, most of the activities of the different research and extension units involved in potato development in the last 10 years have been concentrated in improving seed potato production.

Before 1977 when the Philippine-German Seed Potato Project (RP-GSPP) and the Philippine Potato Program (PPP) were launched, there was a very limited supply of high-quality seed tubers, which were mainly imported from Europe. Most of these imported tubers were used for research because of a law prohibiting importation of seed potatoes. The cost of planting materials remained very high and most potato farmers used low-quality seeds from their harvest. As a consequence, the average yield of table potatoes in the highlands was 6.5 tons/ha in 1977, compared to the potential yield of 35 tons/ha in experiment stations.

The high-income potential in potato production partly accounted for the Philippine government's increased interest in developing the potato industry for the highlands. This led to the establishment of a national potato program under the Department of Agriculture. The main agencies involved included the Bureau of Plant Industry of the Department of Agriculture, which operated the Baguio-Buguias Experimental Complex and the Philippines Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD).

PCARRD's initiative to promote potato research and development (R&D) was influenced by its collaboration with the International Potato Center (CIP) which had a Southeast Asian regional office at PCARRD headquarters in Laguna. CIP introduced germplasm materials for testing in the Philippines. It also trained Filipino researchers at CIP head-

quarters in Peru and in regional training in the Philippines with other Southeast Asian potato researchers. In addition, some potato technologies and research methods were introduced into the country by CIP.

PCARRD coordinated meetings of the agencies involved in the initial efforts to promote potato R&D in support of the development plans of the Philippine government in the highlands. These agencies subsequently formed the National Potato Committee. Meantime, the Department of Agriculture, through the Bureau of Plant Industry, signed a collaborative agreement with the German Foundation for Technical Assistance (GTZ), which resulted in the implementation of the Philippine-German Seed Potato Program (RP-GSPP).⁵ GTZ provided funds to develop the seed-potato industry in the highlands by improving the subsystem's capability to produce high-quality planting materials and improve the Bureau of Plant Industry's seed certification scheme.

The involvement of CIP and GTZ in potato R&D supported the Philippine government's effort to improve the potato industry in the highlands. They provided new technologies and trained researchers, extension workers, and farmers in potato production and postharvest. Another program that played an active support role was the Southeast Asian Program for Potato Research and Development (SAPPRAD). Through SAPPRAD, a network of five Asian countries collaborated in developing and sharing information and technologies. CIP and the Australian government funded SAPPRAD with contributions from the national governments of the collaborating countries. Other agencies that provided research grants were the International Development and Research Centre (IDRC) of Canada and the International Fund for Science (IFS) of Sweden.

4. "Core" institutions are the central institutions that perform the basic tasks of technology development and transfer in the subsystem, while the "noncore" institutions are those that assist the core institutions or the end users of the technology by offering services or inputs.

5. The RP-GSPP is a bilateral agreement between the German and the Philippine governments through the Bureau of Plant Industry under the Department of Agriculture. The Philippine government was mainly responsible for the provision of the project's manpower requirements and infrastructure facilities. The GTZ took charge of the technical expertise and training of the researchers, extension workers, and farmers engaged in the production of both seed and table potatoes. It also provided funding for other inputs to the program.

Non-core institutions

State colleges and universities also played an important role in potato R&D in the Philippines. The most important was the Mountain State Agricultural College (now Benguet State University). Benguet State University operates the Northern Philippine Root Crops Research and Training Center (NPRCRTC), which has the national responsibility for potato research in the Philippine national R&D network. Benguet State University is situated in the principal potato growing area (Benguet Province) in the highlands. In addition, the University of the Philippines at Los Baños (UPLB) maintains a research station of its Institute of Plant Breeding on the Benguet State University campus, which carries out potato breeding work.

There are several large private firms engaged in potato production in the highlands for the processing market. These include HALSEMA, Inc.; Silayan, Inc.; and Univer-

sal Robina Corporation. They are active contributors to the subsystem. The farmers also make up an important component of the subsystem.

A summary of the roles performed by these different groups that make up the subsystem, with their specific mandates, is presented in Table 1.

All R&D activities of these agencies are coordinated by the National Potato Program under the Department of Agriculture and PCARRD. This program had very limited funds to carry out its functions, and it relied on PCARRD resources and coordinating mechanisms to keep it operational for many years. The program also received some funds from the RP-GSP. As a result, it had very limited impact on the subsystem.

Status of integration in the potato subsystem

The participation of various agencies in the seed potato subsystem is characterized by active but largely uncoordinated efforts. Exceptions to this were the close relationships formed between the Department of Agriculture and Bureau of Plant Industry with GTZ and between Benguet State University and NPRCRTC with CIP.

The most sustainable linkage mechanisms used to coordinate the activities of the agencies involved in the seed potato subsystem at the "macro" level are joint planning and review of projects. This started during the planning of the National Potato Program (PPP) with the initiative of PCARRD. It was coordinated with PCARRD's annual review of projects involving all research agencies in the region.

PCARRD and the Highland Agricultural Research Consortium (HARC) sponsored this annual meeting where the research accomplishments and plans of the different agencies were discussed. This joint meeting contributed to the cordial relationship that existed among these agencies. During these meetings, there was very limited interaction among the researchers involved. Although the research results from individual agencies were reported, the information was not analyzed across agencies and the areas of overlapping activities were not discussed and resolved.

Although the relationship among the participants in the subsystem was cordial, it was not very close. The atmosphere that prevailed was "nonconflictual avoidance," with each group trying not to offend the other. This may be due to the teacher-student relationship of many of the people involved. Many Bureau of Plant Industry researchers were graduate students at Benguet State University where

NPRCRTC researchers were graduate faculty members. As a result, the Bureau of Plant Industry researchers tried very hard not to antagonize the NPRCRTC researchers. On the other hand, Bureau of Plant Industry researchers were more senior than NPRCRTC researchers, so they needed to be respected. In the prevailing situation, the efforts of PCARRD to get the two groups to meet periodically got them closer to each other.

The most common linkage mechanisms that evolved within the subsystem included joint on-farm research trials, surveys, and technology-transfer activities, such as in the case of diffused light storage technology. The agencies involved in developing and transferring this technology included the Bureau of Plant Industry, the Department of Agriculture extension service, Benguet State University-NPRCRTC, local government, farmers' organizations, and CIP. CIP provided coordination and technical support. This collaboration led to the rapid adoption of diffused light storage technology that occurred between 1978 and 1982.

CIP used the "farmer-back-to-farmer" approach⁶ in developing and testing diffused light storage technology. An anthropologist and post-harvest specialist were provided by CIP as members of the team. In this approach, farmers were involved in identifying problems, evaluating solutions to the problems, and implementing the selected solutions.

6. The "farmer-back-to-farmer" approach used by CIP consists of involving farmers in domain identification, evaluation of alternative solutions, and implementation of selected solutions. Farmers are partners from the beginning to the end of the problem-solving process.

Table 1. Institutions Involved in the Seed Potato Subsystem and Their Mandates

Institutions	Mandate	Activities/Roles
Department of Agriculture–Baguio Buguias Experiment Complex (BBEC) of the Bureau of Plant Industry	Agricultural development through the conduct of research on semitemperate crops	<ul style="list-style-type: none"> • certification of seeds • production of basic and pre-basic seeds and their maintenance • limited production of certified seeds (bulking of seed-board-approved cultivars) • provision of seed loans to seed growers' associations • procurement and storage of certified seeds • research and extension on seed potato production, such as varietal screening, crop protection and management, rapid multiplication technique (RMT), etc. • germplasm collection and maintenance
Benguet State University-NPRCRTC	To develop production and post production technologies on root crops	<ul style="list-style-type: none"> • germplasm collection, maintenance, and breeding for the highlands • crop management, crop protection, post-harvest and utilization, socioeconomic, and farming systems research • extension and training • seed multiplication using RMT • research on and production of RMT stem cuttings
Institute of Plant Breeding–Benguet State University	To collect, breed, and maintain germplasm stores	<ul style="list-style-type: none"> • Germplasm collection, breeding, and maintenance • TPS research and breeding • lead agency in the national cooperative testing and potato seed board trials
PCARRD	To build up and sustain an efficient and effective national agricultural and resource research system	<ul style="list-style-type: none"> • monitor, evaluate, and review R&D activities in the different agencies in the subsystem • publish research findings and mature technologies for wider dissemination
CIP	To develop technologies that will increase potato production in developing countries where it is now grown and to permit its growth in nontraditional potato environments	<ul style="list-style-type: none"> • provision of improved germplasm • varietal testing, screening, post-harvest technologies, and research in alternative planting materials like RMT and TPS • support of national potato programs like NPRCRTC varietal improvement program and post-harvest research, BIBAR farmers in Mindanao, etc. • training for researchers, extension workers, and farmers, both locally and abroad • limited funding; library/publications
Department of Agriculture–Extension Service	To provide technical advice to farmers	<ul style="list-style-type: none"> • in charge of transfer of recommended technologies • other activities related to Department of Agriculture projects

Table 1. (continued)

Institutions	Mandate	Activities/Roles
SAPPRAD	To promote potato production in member countries of Southeast Asia and to work towards self-sufficiency in potato R&D in the region and within member countries	<ul style="list-style-type: none"> • promotion of the lowland potato • production and research in coordination with the Department of Agriculture and local agencies • development of locally adaptable varieties jointly with IPB and CIP • training, workshop, and utilization of research results through publications • production of limited planting materials in collaboration with the Department of Agriculture and highland farmers for use of lowland farmers
Private companies and nongovernment agencies - Silayan, Inc. - Halsema, Inc. - Universal Robinson Corp.	To ensure a continuous supply of preferred potato cultivars	<ul style="list-style-type: none"> • purchase processing potato from farmers under a contract financing and marketing scheme
Nongovernment offices - Benguet - FCDC Farmer-Cooperators	To assist small potato farmers in increasing their level of income	<ul style="list-style-type: none"> • support training • produce seed potato and sell these to lowland potato farmers in support of the Department of Agriculture's lowland potato program • provide part of their farms in exchange for inputs in the conduct of adaptive or on-farm research

CIP played a very active role in ensuring that all the agencies involved collaborated in the project. Thus, CIP was responsible for the high level of integration among these agencies and the high performance of the subsystem in promoting this technology. However, by 1982, CIP stopped its coordinating role as it focused its activities on other areas in potato research. Although post-harvest teams from the Bureau of Plant Industry and NPRCRTC continued to work on diffused light storage, the momentum created earlier was difficult to sustain because of the withdrawal of CIP leadership. This experience shows that a strong lead group is important in initiating collaboration and that it must continue its role to sustain the integration that is formed. The case of diffused light storage technology and the seed potato subsystem clearly shows the temporary nature of integration that is based on a special project. Subsequent surveys, done in 1986 and 1989 by Francisco et al. (1988), showed that the rate of adoption of diffused light storage technology had decreased from its 1982 level.

This Philippine experience shows the tendency of many NARS to discontinue involvement in a technology once it is "delivered" to its clients. They rely mainly on the farmer-to-farmer mode of technology dissemination, but farmers have varied interests, and because there is a large amount of new information that reaches them, they can sustain their interest only for short periods. Hence, the technology-transfer effort can only be sustained for a short time.

That such a situation arose may have been due to the fact that the technology was no longer relevant to the farmer's situation (i.e., high market price for table potatoes compared to the low price of seed potatoes). In the highlands, many farmers do not store seed potato for the usual eight-to-nine-month period; instead, they sell them as table potatoes for immediate cash. Then they purchase seed tubers just before planting. If they have to store their potatoes for only a few months, they need dark storage instead of diffused light storage. Hence, the technology is not relevant anymore.

Considering the interrelationship among the agencies in the subsystem (a micro analysis), the key elements needed for significant integration of agencies are analyzed as outlined below.

Domain correspondence and consensus. As mentioned earlier, the seed potato subsystem in the Philippines has two core agencies: Benguet State University-NPRCRTC and the Department of Agriculture-Bureau of Plant Industry, both based in Benguet, the major potato producing area in the highlands. Potato farmers are concentrated along the Mt. Trail, while the seed potato producers are situated at higher elevations. Since these two agencies have the same service area and the same commodity focus, they have a common domain correspondence.

With the establishment of the RP-GSPP and, subsequently, the PPP, potatoes became a priority crop in the area. The PPP tried to provide a sharp delineation of the role and scope of responsibilities (domain consensus) of these agencies in R&D. Benguet State University–NPRCRTC was to focus its efforts on table potatoes, while the Bureau of Plant Industry would work on seed potatoes. The evidence collected, however, indicated that this agreement was not implemented. There was a misunderstanding on the part of the agencies involved. The NPRCRTC continued to work on seed potatoes because, as a national center, they felt that they should concentrate their effort on the most important constraints in potato production, which involved the seed potato and not the table potato.

The continued involvement of NPRCRTC on seed potato R&D, however, casts some doubts on whether a domain consensus really existed between the two agencies. Since NPRCRTC management felt that the basis of the delineation of the scope of activities was “not fair,” then the agreement was not binding.

The lesson to be learned from this experience is that domain consensus should be carefully deliberated upon and the conditions of the agreement should be clear and understood by all. There should be in-depth discussions to thrash out possible areas of conflict. Then all parties to the agreement should accept the conditions without reservation, and these conditions should be the basis for establishing areas of collaboration and implementation.

Competence. NPRCRTC researchers have higher academic qualifications than Bureau of Plant Industry researchers, which gives them greater competence because of better training. On the other hand, Bureau of Plant Industry researchers have longer professional experience in research, which gives them greater competence due to greater experience. Further, the Bureau of Plant Industry has developed better research facilities through the RP-GSPP. NPRCRTC has started to improve its research facilities with the support of CIP, IFS, and IDRC.

Both groups felt that they were well equipped to carry out their work on potato R&D, and they have both continued to pursue independent work on related or similar tasks. Conflicts have arisen at times because the methods that the researchers have followed in performing similar experiments differed and both groups claimed that they were correct. This points out to overlaps that need urgent resolution.

The situation described above shows that when two groups perceive that they are equally competent — whether in reality or imagined — to carry out a task, then integration is not possible. Each group believes that it cannot gain knowledge from the other nor complement the other's expertise through integration. Sometimes one group doubts the competence of the other, resulting in independent conduct of

similar activities. This might be the case in the potato subsystem in the highlands.

Interdependence. Another possible reason for the absence of significant integration between the Bureau of Plant Industry and NPRCRTC was the lack of interdependence between them. Each one felt that the other agency did not have anything significant to offer in terms of resources or knowledge or that collaboration would not result in any benefit to its own program.

As to the observed independence with respect to tangible resources, on one hand the Bureau of Plant Industry received funds from GTZ through the RP-GSPP. On the other hand, NPRCRTC received technical and some financial assistance from CIP in addition to the training opportunities for its staff. Availability of financial resource to both parties was a major factor that contributed to the lack of interdependence and subsequent low level of integration in the subsystem. There was little incentive to collaborate.

Willingness to follow through on agreements. In the mid-1980s, the situation changed. The members of these core agencies in the seed potato subsystem expressed a desire to form closer relationships. This coincided with the imminent termination of the RP-GSPP and CIP's expansion of its activities to the lowland. It was probably this reduction of resources that triggered the move towards closer integration between NPRCRTC and the Bureau of Plant Industry. Meetings were held to discuss plans for collaboration between them. However, no significant integration resulted. Although the people involved felt that closer integration would maximize the use of limited resources, no one really wanted to make it happen. The intense feeling of competition among the researchers continued to persist.

In summary, it was seen that the reasons no significant integration existed in the seed potato subsystem are an absence of domain consensus, a lack of interdependence among the core agencies involved, and an unwillingness on the part of the agencies to integrate their activities. Furthermore, the intense competition due to similar levels of competence among the researchers precluded lasting integration. However, there was a relatively high level of performance in the subsystem. This can be attributed to the high level of integration between CIP and NPRCRTC and, separately, between GTZ and the Bureau of Plant Industry.

The Bureau of Plant Industry had few personnel involved in extension, since this is the responsibility of the Department of Agriculture extension service. The Bureau of Plant Industry focused its activities on on-farm research and transfer of technologies for other commodities. However, due to the inadequate number of extension workers in the highlands, Bureau of Plant Industry researchers had to carry out extension work also. A number of key informant-researchers said that since they knew the technical aspects of the technology, they could also extend this to farmers;

however, they were able to reach only a few farmers because of time limitations. Also, the Bureau of Plant Industry and NPRCRTC have the same farmer-cooperators, which further limited the number of farmers whom they could serve and decreased the resources allocated to other farmers. As a result, the agencies preferred that the Department of Agriculture's regular extension workers carry out the transfer of technology in the subsystem, as they did in the special project on Optimizing Potato Productivity (OPP) in 1982.

NPRCRTC also used researchers as extension agents. The technologies developed by the center were delivered to farmers by these researchers cum extension workers in a very limited way because they were busy conducting research. It has been estimated by the NPRCRTC director that only five percent of the target seed-potato producers received information about the rapid multiplication techni-

que developed by the center early in 1989. Because of the limited cooperation among the agencies in the subsystem, many new technologies have not been delivered to farmers.

The Bureau of Plant Industry and NPRCRTC management need to recognize that the Department of Agriculture's extension service is in charge of technology transfer. The Department of Agriculture extension workers, however, are also preoccupied with their regular activities in addition to the demands of special programs like the Highland Agricultural Development Project. The responsibility of delivering technologies within the subsystem should be accepted as part of their regular functions. The majority of the highland farmers in the area grow potatoes; hence, these farmers are also their clients. The RP-GSPP has trained many extension workers on the new seed potato technologies, and the subsystem must make advantage of this increased capability within the extension service.

OVERLAPPING OF TASKS

Overlapping of tasks, as shown in the Bureau of Plant Industry and NPRCRTC experience, is associated with the absence of significant integration among the agencies involved in the seed potato subsystem in the Philippines. This was due to the substantial but independent resources available to core agencies of the subsystem and to similarities in the level of competence of Bureau of Plant Industry and NPRCRTC researchers. As a result, these agencies perceived that neither would benefit from collaborating with the other.

Another example is the case of the rapid multiplication technique programs of the Bureau of Plant Industry and NPRCRTC. The two programs started about the same time following a rapid multiplication technique workshop held in the Philippines in 1979 which was sponsored by CIP. Each agency conducted trials to refine the technology to check its adaptability to different potato cultivars used in the subsystem. The separate rapid multiplication technique programs were justified by the high demand for rooted stem cuttings, which cannot be met by the current capacity of production, and for the varying cultivars promoted by the Bureau of Plant Industry and NPRCRTC. Although this may be a valid reason for overlapping tasks in rapid multiplication technique, substantial savings in resources could have been made if the two agencies had collaborated in fine-tuning the technology. Each agency could have benefitted more if they had shared their research findings.

Once a technology has been tested and is ready for delivery, then overlap may be more justifiable because it may

lead to better dissemination of the technology. The involvement of more agencies may extend the coverage so that more farmers can be reached. The key informants cited this reason to justify overlapping tasks in the case of rapid multiplication technique.

A similar case involved potato breeding. There are several breeding programs in the subsystem. This was justified, however, because of the differences in the breeding materials handled by each program. In this situation, task overlap is associated with higher output and, hence, higher performance in the subsystem.

The two cases in the seed potato subsystem show that task overlap does not always result in low performance. There are situations where more agencies are needed to increase the output of the subsystem in order to increase the clientele coverage. Furthermore, a closer working relationship may generate better results at certain tasks, such as those in technology development. The problem is not caused by many agencies working in the same area but, rather, whether they collaborate on the tasks.

Another lesson that can be gleaned from the Bureau of Plant Industry and NPRCRTC cases is that greater integration in the subsystem may minimize task overlap. An example of this is the case of the diffused light storage technology that caused significant but temporary integration among the agencies doing potato R&D in the highlands.

LESSONS LEARNED FROM THE SUBCASE ANALYSIS

There were two hypotheses about integration that were examined:

1. **Integration:** The study found that the critical factors leading to successful integration are presence of domain consensus and correspondence, interdependence of agencies involved, acceptance of the other agency's competence, and willingness of all concerned to implement the agreement. Integration occurred because these conditions were met. But lack of domain consensus, interdependence, and willingness to follow through on agreements hindered integration.

2. **Task overlap:** the study found that overlapping of tasks may result from a lack of significant integration among the agencies involved in a subsystem and can lead to negative results. However, overlapping of tasks may also give positive results in activities such as crop breeding where more new varieties are obtained. It can also be derived from the study that overlap in technology delivery is associated with higher performance, compared overlap in technology consolidation, which is associated with lower performance.

Achieving these critical factors

Building these crucial factors into the system is one of the challenges for research managers. Managerial strategies to

sovere these challenges were not discussed here because they are not within the scope of this paper.

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