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# ASSESSING THE IMPACT OF INTERNATIONAL RESEARCH: CONCEPTS AND CHALLENGES

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### Abstract

Drawing on the lessons of previous impact assessments and reviews of research programs and management literature, this paper attempts to clarify a number of concepts related to impact assessment and its use in managing research. Most impact assessments attempt to measure changes at the farm level and to establish causal links with research. This approach is more appropriate for assessing the impact of national programs than that of international centers. This is because the principal output of international centers is research and development (R&D) technology (not production technology) and the principal impact of international centers is institutional impact (not production impact). Even at the national level, in most cases it is analytically impossible to establish a causal relationship between research and production impact. Ex ante and ex post impact assessments are less useful for research management than are operational impact assessments that are conducted thoughout the R&D process. Impact assessment is most useful when it is conducted within a management framework that clearly specifies the intended clients of research systems and their technology needs.

## Introduction

In this paper, the term *impact assessment* is used in the conventional, dictionary sense of "determining the significance, importance, value, or power of an event, idea, etc., to produce changes." During the last quarter century, impact assessment has stimulated considerable interest and a prestigious body of literature in the field of agricultural economics. All centers in the Consultative Group on International Agricultural Research

(CGIAR) system are now expected to conduct impact studies on a routine basis. The results are to be used for planning by the group's Technical Advisory Committee (TAC) as well as by the individual centers. Aside from the TAC and the centers themselves, at least two other groups are interested in assessments of international research: donors and the national agricultural research systems (NARS) of developing countries (Nores 1988).

Early impact studies were generally of an ex post nature, aiming to measure and demonstrate the benefits of research in order to counteract the initial, largely unfounded, criticisms of the green revolution (Ruttan 1982). More recently, the focus has shifted from the past to the future: What research areas promise the greatest potential impact and thus merit research attention? Ex ante assessment is becoming an important component of formal procedures for establishing research priorities within the CGIAR system (TAC Secretariat 1985).

The ex post studies have generated much useful information on the costs and benefits of agricultural research. Perhaps their greatest value has been to demonstrate the exceptionally high returns to several agricultural research programs, and the substantial underinvestment in agricultural research at both the national and international levels (Evenson 1987).

In apparent contradiction to the high returns reported in impact studies, most program reviews note serious managerial and operational problems within the NARS. Clearly, increased spending on agricultural research in country "X" does not guarantee high returns. In many instances, poor management, not funding, is the principal constraint on research impact.

The apparent contradiction between the high returns to research projects and the managerial problems of research systems has a simple explanation: Many research projects or activities have been extraordinarily successful and have generated significant social benefits; however, sustaining a productive research system that generates a continuous flow of valuable new technology has proven to be difficult. Stated plainly, we know more about how to do research than about how to run agricultural research systems. In more general terms, we are better at handling the technical aspects of development than the institutional aspects.

These statements are borne out by a growing body of evidence contained in two quite distinct bodies of literature: (1) reviews and evaluations of development programs in developing countries and (2) management studies of private enterprises and public-service institutions in developed countries.

For World Bank projects as a whole, the following has been concluded (Israel 1987: 2, 4):

> The physical components of programs have been successful about twice as often as have institutional development components. In the reviews of difficulties and delays in implementation, managerial or institutional problems emerge as the most important causes, although their exact nature is seldom defined and analyzed in detail.
>
> Contrary to expectations, the patterns of results of institutional development programs was stronger by sector, subsector, and activity than by country. The most successful were found in industry, telecommunications, utilities, and finance; the least successful in agriculture, education, and services. Within institutions, technical and financial activities fared the best, while maintenance, personnel issues, and coordination were the least successful.

Concerning agricultural research and extension, the World Bank has carried out a review of 128 projects in 10 countries (World Bank 1983: iv-v).

> The study found marked inadequacies in several countries in their resource allocation to and among research and extension, reflecting weaknesses in planning and monitoring processes in these countries. It also observed more frequent concern in development plans and project documents with the quantity of resources allocated for research and extension than with the effectiveness of their use and their impact.
>
> While the bank has successfully supported the development of physical research facilities, this success has not yet been matched by improvement in the management of these facilities or the development of institutional arrangements conducive to their proper utilization.

Studies of private firms in the USA and elsewhere have shown that research is one of the most difficult activities to manage and that new knowledge (e.g., that stemming from research) is one of the riskiest sources of innovative opportunity (Drucker 1985).

In light of the above, it is not surprising that while individual research projects have generated high returns, many research systems are operating at far below their potential. Agricultural research potentially offers extraordinarily high returns in developing countries. However it also presents some of the most difficult management problems.

What is surprising is that so little attention has been directed to understanding and improving the management of agricultural research in developing countries. In many senses, the research process is treated as a mysterious "black box" in which technologists (hard scientists) employ the modern tools of science to transform human and financial resources into new technologies. Economists and policymakers may set research priorities and evaluate the results, but what goes on inside the box remains the province of the technologists. The purpose of this paper is to de-mystify some aspects of the process and to identify some potential avenues for improving the management of agricultural research through innovative assessments of impact. This paper's central thesis is that impact assessment is most valuable as a management tool when it is conducted as an integral and continuous part of the research process. Many of the arguments presented apply to extension as well as to research. For that reason, many references are to research and development (R&D) rather than research alone.

## The Global R&D System

Impact assessments are sometimes based on the erroneous assumption that international agricultural research centers (IARCs), NARS, and farmers are closely linked in a linear fashion with technology flowing from the former toward the latter. Nothing could be farther from reality. Agricultural R&D systems are becoming increasing large, complex, and interactive, both within countries and at the global level (Ruttan 1987; von der Osten 1987).

### Principal Actors and Linkages

Not only the IARCs, NARS, and farmers, but also many donor agencies, universities, international programs and associations, bi- and multilateral special projects, extension agencies, charitable organizations, and private enterprises are actively involved in agricultural R&D. While they play a strategic role, the IARCs are a very small part of the global system; their budgets represent only about 5% of the total funding for agricultural research in developing countries (CGIAR 1985). Those of us in the international centers usually view the publicly funded agricultural research institutes as our principal partners in development. However, we are not the NARS' only partners, nor are they ours.

Figure 1 illustrates some (by no means all) of the linkages connecting an international center (CIP), a single donor, a university, and a private firm in the USA, and a special project, a university, a private firm, a farmer, the national research institute, and the extension agency in Peru. The situation illustrated here is a highly simplified representation of the real world, in which many more linkages operate.

The multiplicity of linkages, and the fact that technological change builds on the stock of accumulated knowledge — not only that generated by formal research systems but also that generated by farmers themselves[1] — makes it extremely difficult to measure the impact of an international center at the

[1] An important discussion of farmer innovation is in Richards (1985).

farm level. The following example, derived from Franco and Schmidt (1985), illustrates how complex the chain of causation can be:

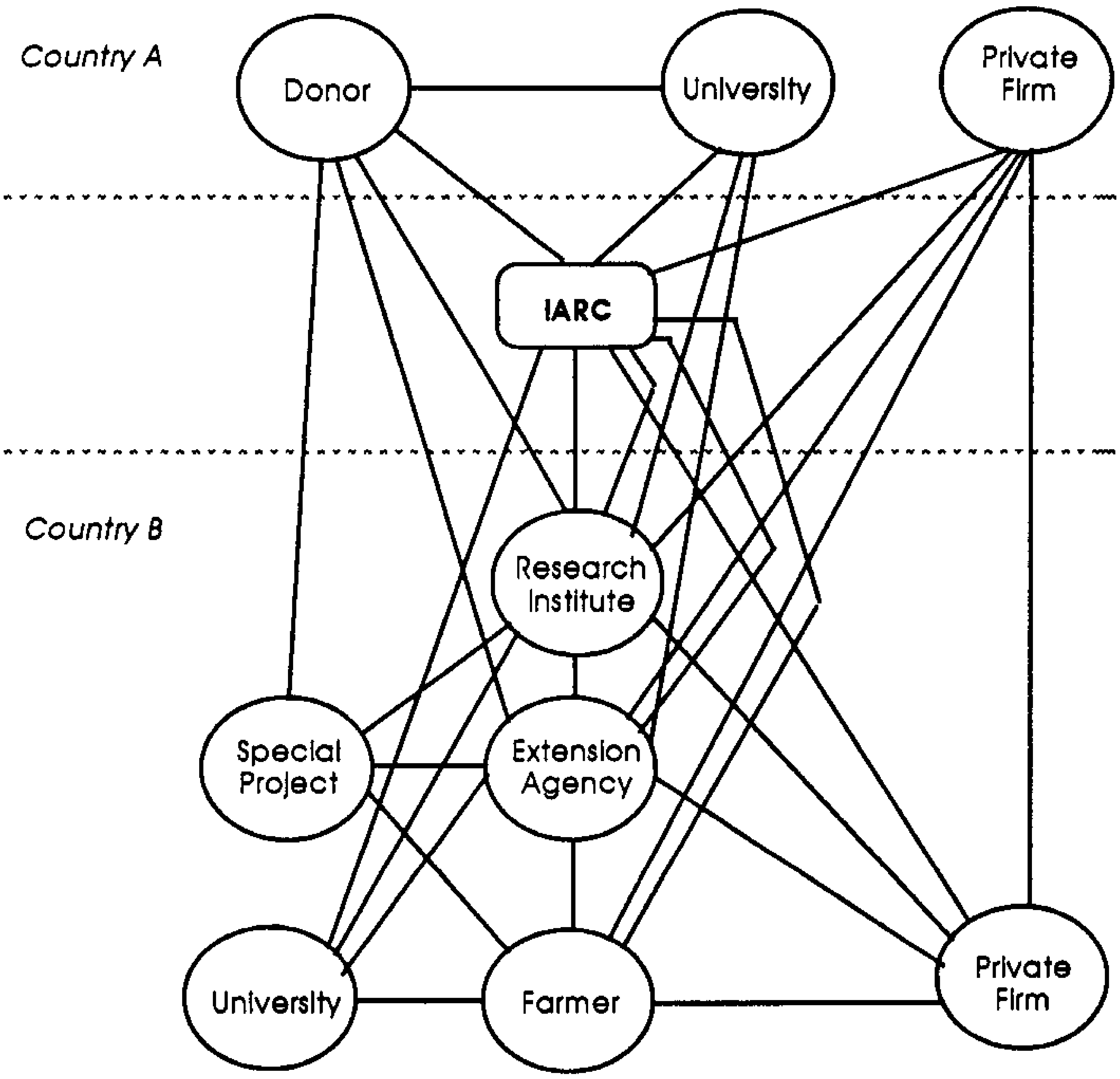


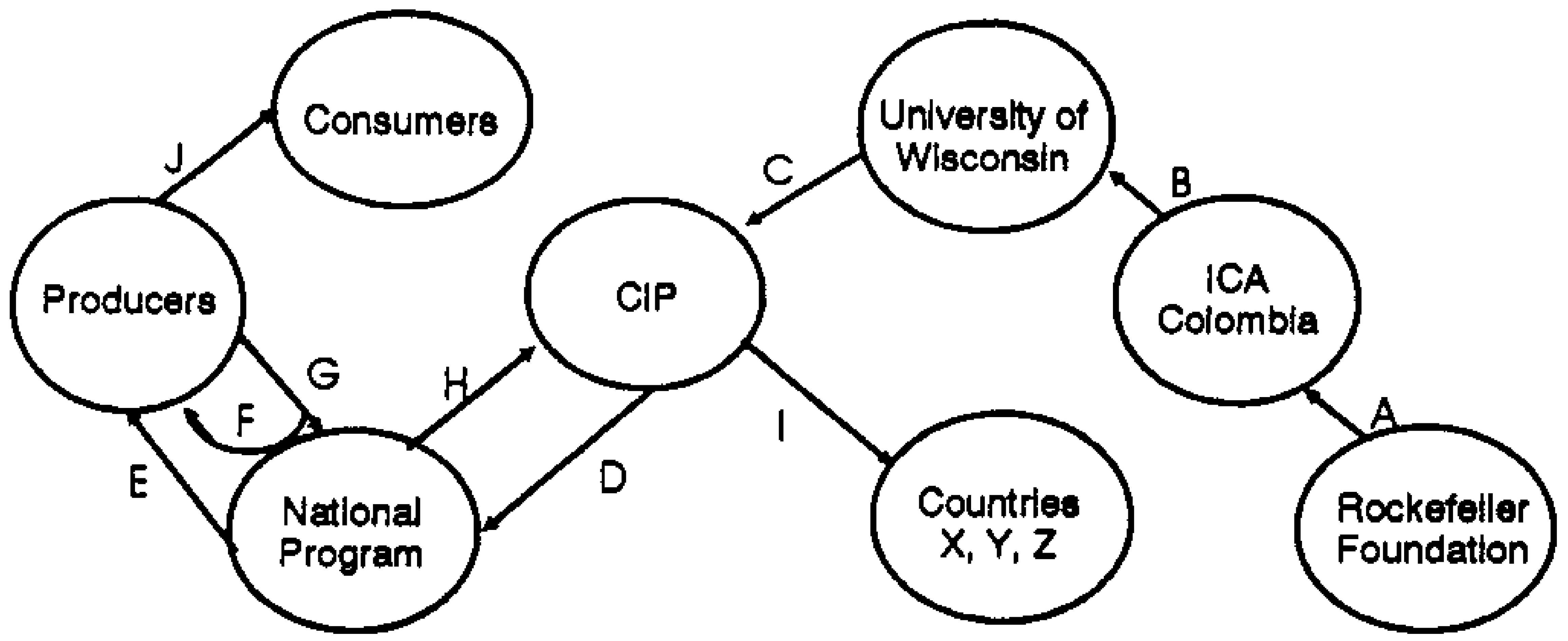

**Figure 1. An illustration of some R&D linkages**

In the early 1970s the Peruvian Ministry of Agriculture requested that CIP help combat a serious outbreak of bacterial wilt in potato crops in northern Peru. To this end, CIP obtained resistant breeding lines from the University of Wisconsin. These lines had been developed from potato samples sent to Wisconsin by Colombia's National Agricultural Research Institute (Instituto Colombiano Agropecuario: ICA). Part of ICA's work had been financed by the Rockefeller Foundation. Researchers tested potential new varieties on government experiment stations in northern Peru. Two resistant varieties were released by the Ministry of Agriculture in the mid-1970s. One of these, called "Molinera," is now among the most widely grown potato varieties in northern Peru.

Farmers grow Molinera in several areas where bacterial wilt is not, and never has been, a problem. They do so because it is early maturing, it sells well, and it has some resistance to a fungal disease, late blight. Researchers had not selected Molinera for these traits. Their presence was coincidental.

From advanced variety trials, Peruvian farmers also kept and multiplied at least two other clones that are not grown in the area. One has gained such importance that it was recently named and officially released as a Peruvian variety. CIP has also distributed this clone to other developing countries as a potential new variety along with Molinera.

Such multiple causation, illustrated for this case in Figure 2 is the norm rather than the exception in agricultural research (Drucker 1985: Chapter 9), making the identification of clear causal links virtually impossible. As noted in a recent, stimulating paper by Murphy and Marchant (1988), the same holds true for agricultural extension programs. The authors conclude that in most cases it is analytically impossible to establish a causal relation between extension services and yields. They propose to shift the




A. RF supported ICA.
B. ICA sent germplasm to Univ. of Wisconsin.
C. Univ. of Wisconsin sent breeding lines to CIP.
D. CIP & Peru's National Program (NPP) selected varieties on Cajamarca Experiment Station & on-farm trials.
E. NPP named & released 2 resistant varieties.
F. Farmers selected 2 more varieties from on-farm trials.
G. NPP named one of these an "official" variety.
H. CIP included promising Cajamarca material in its own breeding program.
I. CIP distributed the new varieties to other developing countries.
J. More potatoes produced in Cajamarca.

**Figure 2. An illustration of multiple causation in agricultural R&D: The Cajamarca case**

focus of monitoring and evaluation away from agricultural results (yields) and toward the provision of project services and farmers' responses to them (Murphy and Marchant 1988: 6-11).

## Research Institutes as Public-Service Institutions[2]

The ultimate goal of R&D is to discover or revise facts (research) that have a practical, beneficial application (development). Private industrial firms can capture a large part of the benefits from their investments in R&D through the sale of patented commodities. In agriculture, private firms seldom have the incentive to carry out R&D activities because the results are improved practices that cannot be patented or marketed at a profit. There are notable exceptions, of course, such as the development and marketing of hybrid maize and the successes of privately owned agrochemical and seed multiplication operations.

The manager of a private firm has a clear criterion — expected profits — for selecting among enterprises, production methods, and distribution strategies. The board of directors also has clear criteria for evaluating the firm's economic performance. In contrast, agricultural research institutes and extension agencies lack these market-driven criteria for decision making.

The CGIAR and many national agricultural R&D systems are moving in the direction of ex ante and ex post impact assessments as surrogates for market prices and competition.

Publicly funded agricultural research is a service, and the institutes that conduct it have many of the same characteristics and management requirements that other public-service institutions, such as universities, schools, hospitals, labor unions, charitable organizations, and a range of government agencies also possess. Management specialists have observed that public-service institutions are inherently less entrepreneurial and innovative than business enterprises. One reason is that public-service institutions are financed from "budgets" provided by donors or taxpayers rather than from the proceeds generated by sales. In other words, they are paid for their efforts rather than for their results. "Success" in public-service institutions is often equated with the size of the budget rather than the value of the products and services provided. This generates a tendency to accumulate programs and expand the bureaucracy. Seldom are programs critically assessed and terminated.

A second reason is that service institutions depend on a multiplicity of constituents who tend to oppose significant change in existing programs or

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[2] This section draws heavily on Drucker (1985).

development of new programs which may compete for budgetary resources. For this reason, major changes in public-service institutions usually result from external forces, like funding crises or external reviews, rather than from internal management decisions.

Finally, and most important, a public-service institution exists to "do good." Its mission and goals tend to be phrased in moral absolutes rather than in economic terms that are subject to a cost-benefit calculus. Aiming to maximize rather than optimize, the public-service institution can never attain its goal. The closer it comes, the more effort is required to achieve further gains.

Several entrepreneurial policies have been recommended to enhance the innovativeness and performance of public-service institutions:

- Clearly define the institution's mission.
- Focus on clients' needs and on objectives (the business dimension) rather than on programs and projects (the organizational dimension).
- State realistic goals that are genuinely attainable.
- Focus management on a constant search for innovative opportunities rather than on optimization or expansion of current programs.
- Recognize that all products and services, organizational structures, internal processes, distribution strategies, and even goals have a short productive life span.
- Periodically reassess objectives in the light of achievements (failure to achieve an objective often indicates that the objective is inappropriate).
- Abandon whatever is obsolete and unproductive and terminate programs that represent mistakes, failures, or misdirected efforts.
- Evaluate programs in terms of satisfaction of clients' needs.

### Mission and Clients

The first point listed above calls for defining an institution's mission in terms of its clients' needs; the last point calls for evaluating results in terms of satisfying clients' needs. The mission of the CGIAR follows:

> Through international agricultural research and related activities, to contribute to increasing sustainable food production in developing

countries, in such a way that the nutritional level and general economic well-being of low-income people are improved.

Who are the clients of agricultural R&D and what are their needs? In the term "client-oriented research," the client is generally assumed to be "the farmer." However, as illustrated by Figure 1, both international centers and national research institutes have numerous clients. An important function of impact assessment is to identify those groups of clients on which the institute should focus and their needs for new agricultural information.

At the national level, priority clients may include public and private extension services and different classes of farmers in different regions.[3] At the international level, the number of potential client groups is even greater. Clearly, priorities need to be established.

International centers generally view their priority clients to be the NARS — publicly funded agricultural research institutes in developing countries.[4] This has profound implications for the types of products and services that an international center should produce and for the level at which a center's impact should be assessed.

## Types of Technology and Types of Impact[5]

It is useful to distinguish between two broad types of technology that may be generated by an agricultural research program — production technology and R&D technology — and the corresponding two types of impact — production impact and institutional impact. *Production technology* refers broadly to all methods that farmers, market agents, and consumers use to cultivate, harvest, store, process, handle, transport, and prepare food crops and livestock for consumption. *R&D technology* refers to the organizational strategies and methods used by research and extension programs in conducting their work.

R&D technologies include scientific procedures for genetic engineering, screening germplasm, disease identification and eradication, and rapid multiplication of vegetatively propagated crops. They also include organizational models, like the integrated commodity program, and institutional strategies for program planning and evaluation, training, networking, on-

[3] *Consumers*, the ultimate beneficiaries of agricultural research, are not clients per se.

[4] In fact, many international centers also work with a range of public and private agencies. In some instances, the NARS have been by-passed in order to achieve a quicker, more direct impact at the farm level. Largely due to the specter of inadequate funding for publicly funded agricultural R&D, international centers are presently actively searching for ties with the private sector.

[5] This section is based on Horton (1986).

farm trials, and interdisciplinary team research involving social and biological scientists (Table 1).

*Production impact* refers to the physical, social, and economic effects of new cultivation and post-harvest methods on crop and livestock production, distribution, and use and on social welfare in general (including the effects on employment, nutrition, and income distribution). *Institutional impact* refers to the effects of new R&D technology on the capacity of research and extension programs to generate and disseminate new production technology.

With extremely few exceptions, impact studies have focused on production impacts and have overlooked impact (positive or negative) at the institutional level. While new production technologies are of undeniable value, they are not the only, nor are they the most important, outputs of international centers. This is because production problems change over time, and national programs — not international programs — must solve most of them. A stream of new production technologies is needed to solve future production problems and maintain agricultural growth. Hence, R&D technologies that improve the capacity of national programs to generate new production technology can give international programs a substantial multiplier effect.

As Evenson (1987) and others have shown, the greatest beneficiaries of international agricultural research are countries with strong national programs. In fact, strong NARS are essential to the accomplishment of the CGIAR's basic goals. Because of the great variability of farming systems and production problems, national and subnational programs have a comparative advantage in generating production technologies, whereas interna-

**Table 1. Examples of R&D Technology and Production Technology**

| R&D technology | Production technology |
|---|---|
| Germplasm<br>Advanced lines<br>Breeding strategy | New potato variety |
| Tissue culture<br>Virus testing techniques<br>Certification | Improved seed |
| Principles of integrated pest management | Recommended IPM system |
| Storage principles | Improved storage design |

tional programs have a comparative advantage in generating R&D technologies.

The first international agricultural research centers, CIMMYT and IRRI, produced new varieties of wheat and rice. However, shipments of seed — the classical, physical technology transfer — are now only one of several mechanisms used by international programs to achieve impact. Even the new seeds produced by international centers are now best viewed of as R&D technologies, rather than finished production technologies, since they are usually destined for breeding or screening programs rather than for immediate use by farmers.

## Center Programs and the Supply of R&D Technology

The CGIAR system is hard-science and hard-technology oriented. The system was created to capitalize on the great potential contributions of applied research to food production that were illustrated by the spectacular impact of rice and wheat breeding on crop yields beginning in the 1960s. It was expected that international breeding and complementary research programs for other crops and for livestock could generate similar impact. It has gradually been recognized that the type of breakthrough represented by the discovery and rapid spread of high-yielding varieties of rice and wheat is the exception, not the rule, in agricultural R&D. Nevertheless, most international centers maintain that breeding and genetics are their most important programs, with other activities considered as complementary.

As evidence of the lack of impact of many breeding programs mounts, attention has shifted somewhat to the "softer" sciences and technologies. In the late 1970s and 1980s, centers experimented with on-farm and farming-systems research approaches as ways to improve the practices and welfare of small farmers in the absence of high-yielding new varieties. In some instances, on-farm research techniques were also used to identify farmers' problems and enlist farmers' participation in the generation and diffusion of new technologies. (Ashby, Quiroz, and Rivera 1987; Rhoades and Booth 1982).

The CGIAR's growing commitment to supplying institutional technology is reflected clearly in the program of the International Service for National Agricultural Research (ISNAR), which has the following goal:

> To assist developing countries improve the effectiveness and efficiency of their agricultural research systems through enhanced capacity in the areas of research policy, organization, and management (ISNAR 1987: 10).

In the commodity centers, management reviews, ex post impact assessment, and long-term planning are now routine. Senior center staff are also benefitting from a specially designed management training course. The next section discusses some ways in which impact assessment can be used to improve research management and the improved supply of institutional technology to NARS.

## Operational Impact Assessment

The current paradigm for impact assessment is based on investment project analysis. It elevates the impact assessor to the level of a project planner (ex ante assessment) or evaluator (ex post assessment), who functions outside of the project itself. Ex ante and ex post impact assessments are most useful for assessing investment projects that have a well-defined technology, a fixed time frame for implementation, a market for output, and a central capital component. Examples are factories and powerplants.

Ex ante and ex post assessments are far less useful in the case of research, which is best treated as a long-term process rather than a discrete project. Research is as much an art as a science. Research processes cannot be clearly specified in advance — they evolve as discoveries are made. The time frame is unpredictable. The practical outputs are difficult to anticipate and generally they are unmarketable. Serendipity is an inherent characteristic of the research process. The better the research, the more abundant the fortunate accidental discoveries. The most critical determinant of the result is not the financial investment but the quality of work, which is influenced by many environmental factors.[6] Hence, in research the relation between costs and benefits is much less predictable and measurable than it is in "standard" investment projects in industry and capital-intensive services like power generation.

Broad priorities need to be set for research before substantial sums of money and valuable human resources are committed to work on specific commodities, factors of production, or location-specific problems. Hence, ex ante assessment is essential. However, managers need to keep potential impact at the center of their thinking throughout the R&D process. As discoveries are made, as clients' needs change and as the environment (funding, economics, politics) evolves, there is a need to continuously steer activities toward those that offer the greatest potential impact.

It is generally believed that the useful roles for social scientists are at the extremes of the agricultural R&D process. Early on, social scientists can

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[6] *Environment* here connotes communication linkages, working conditions, and professional incentives as well as the braoder economic and political environment.

generate useful information about farmers' traditional practices. After research is done, they can facilitate technology transfer and measure the resultant changes. Little or no role is seen for social scientists in the operational aspects of research.[7] This view, stated most clearly, and humorously, by James Cock (1979) is still accepted by most technicians as well as social scientists. However, operational impact assessment — working throughout the R&D process to determine the value of new technology[8] to produce changes that contribute to the institution's mission — can contribute significantly to an institution's effectiveness and impact.[9] Operational impact assessments require an interdisciplinary framework and an understanding of clients' needs.

## Meeting Clients' Needs: Prescribed and Felt

Scientists — not just in agriculture but in all fields — often work to fulfill the prescribed needs of their clients — those which researchers believe merit attention — rather than clients' felt needs. The experiences of CIP and many NARS in improving potato storage provides a useful example of the dangers of working to solve prescribed, rather than felt, needs. For years, potato researchers and extension agents have worked to promote and improve the storage of consumer potatoes on the erroneous assumption that it would benefit farmers in their areas (Rhoades 1985).

> In the 1970s, storage research and demonstration programs were underway throughout the Andes. The lack of technology transfer and impact was assumed to result from poor extension and farmers' ignorance. In 1977 an anthropologist conducting research on storage in highland Peru found that few farmers were interested in storing potatoes for market because prices were unpredictable. (He also quickly learned another reason why farmers did not store: It was illegal to store consumer potatoes in Peru at the time!) However, virtually all farmers stored seed potatoes, and they were interested in improving seed storage. The implication for management was clear: Research could have a greater impact by focusing on storage of seed, not consumer potatoes. CIP's storage research program was redirected and practical ways to improve seed storage were quickly discovered. This information was communicated to researchers and extension agents in many countries and has been practically applied by farmers as well as by seed programs in at least 15 countries.

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[7] *Operational* is defined here as having to do with the operation or working of a system or process.
[8] *Technology* is defined broadly as the application of knowledge for practical ends.
[9] Cases are presented by Rhoades (1985), Horton (1986), and the publications cited therein.

## Tapping Knowledge in the "Real World"

There is a tendency in the scientific community to segregate knowledge and technology into two types: "modern" knowledge and technology that is derived from scientific R&D and "traditional" knowledge and technology that has been developed by people at work. The former is considered inherently superior to the latter — biotechnology is better than natural selection; high-yielding varieties are better than native ones; certified seed is better than farmers' common seed. What is often ignored is that most of the knowledge and technology used in agriculture — in fact in most sectors of most economies — has been developed by people working outside of the scientific community. Scientific research is the foundation of vital new knowledge for innovation, yet most knowledge-based innovations have been made by laypeople rather than by scientists or technologists. Drucker (1985: 119) provides an explanation:

> [Scientists and technologists] tend to be contemptuous of anything that is not "advanced knowledge," and particularly of anyone who is not a specialist in their own area. They tend to be infatuated with their own technology, often believing that "quality" means what is technically sophisticated rather than what gives value to the user. In this respect they are still, by and large, nineteenth-century inventors rather than twentieth-century entrepreneurs.

Successful entrepreneurs realize, and capitalize on, the value of "real-world" knowledge and innovation. For example, software developers for microcomputers encourage users to report bugs, problems, and gaps in products and to suggest solutions. The firms reward users who suggest innovations by giving them free, updated software. Updates are then marketed to other users.

Unfortunately, involving users in R&D is less common in public-service institutions like agricultural research institutes. Agricultural researchers tend to view their clients, especially the poorer ones, as lacking in knowledge and technology. Consequently, as Richards (1985) has noted, indigenous agricultural knowledge is "the single largest knowledge resource not yet mobilized in the development enterprise."

On the assumption that traditional varieties should be replaced, seed programs in developing countries usually certify only "improved varieties" that have been officially released by the ministry of agriculture. In fact, many of these new varieties never become popular with farmers. The basic reason is not that farmers are traditional but that many new varieties do not meet local requirements. In North America as well, nearly all potatoes are still traditional varieties; only one modern variety that has been produced by a scientific breeding program is grown on a significant scale.

Fortunately, in Canada and the USA, seed programs certify any variety that farmers want to grow. Clearly, limiting seed certification to new varieties seriously limits the impact of seed programs in developing countries. One goal of operational impact assessment is to find and capitalize on opportunities generated outside the formal R&D system.

## Capitalizing on Unexpected Successes[10]

Scientists, and even businessmen, often fail to take advantage of unexpected successes, preferring to stay on the planned course of action. This can be a fatal error in any field, but especially in a research-based one, where discovery is the goal and the practical applications of discoveries are impossible to predict. The development and marketing of computers provides an example (Drucker 1985):

> In the 1940s, Univac had developed the most advanced computer but decided not to market it for business use because it was intended for science. IBM, which decided otherwise, soon established a leading position in supplying both business and the scientific community with computer equipment.

In agricultural research, we tap only a small portion of our potential impacts, because we ignore, or suppress, unexpected successes. For example, it is well known that farmers often keep seed from variety trials conducted on their farms. In many cases researchers go to great lengths to stop this on the grounds that varieties should not be "released" until they are adequately (read *scientifically*) tested. Yet, the evidence clearly indicates that farmers have a comparative advantage in selecting new varieties that fit the complex local requirements for production, marketing, and use. The example of how the Peruvian Ministry of Agriculture and CIP picked up a new variety from farmers, introduced it into the local seed system and distributed to other countries (Drucker 1985: 4-5) illustrates how unexpected successes can be capitalized on to maximize impact.

Another illustration from Drucker (1985) relates to the seed storage case cited in the previous section.

> Potatoes kept in the light turn green and they can be kept longer before they sprout. For years, the principles of diffused-light seed storage have been well-known by researchers in the Andes, but until the 1970s, no attempt had been made to apply it on farms. In the context of a problem-oriented farming systems project, a field team found that diffused-light storage had a significant impact on the time seed could be stored, on seed vigor, and on subsequent yields. Farmers began

[10] The ideas for this and the following section came from a reading of Drucker (1985).

> applying the new technology even before on-farm trials were completed. Capitalizing on this unexpected success, and banking on its potential global impact, the post-harvest team introduced the principle to a number of countries through training, workshops and on-farm trials. The result was widespread farmer adaptation of the technology to fit local needs. Clearly storage principles, not designs (the analogue of technological packages for crop production) were responsible for the impact. This information was fed back into training materials and workshops.

What does this have to do with impact assessment? Crucial to its success was a continuous assessment of approaches — both technical approaches to seed storage and institutional approaches to national programs and farmers. The question was, Which approach is likely to achieve the greatest impact in the greatest number of areas? The methods were usually simple: bull sessions, arguments, back-of-the-envelope calculations, conversations with farmers, simple on-farm trials. The results were seldom published.[11] Nevertheless, operational impact assessment played a key role in this work, which has been CIP's most successful program to date.

## Dealing with Incongruities

When a program fails to meet expectations, the usual reaction is to increase efforts to ensure future success. The result, however, is usually another failure. Incongruities between expectations and achievements are often a sign that the goal is unrealistic, that the strategy is inappropriate, or that conditions have changed.

The lengthy, costly experiences of CIP and scores of national programs with seed programs provides a useful illustration. Farmers do not plant potato seed per se but tubers that they have purchased or kept from the harvest of a previous crop. Seed tubers are generally the most costly and problematic input in potato production, representing from 20% to 50% of the total production cost. Seed programs have also been the most costly and problematic aspect of potato improvement programs. More donors and more governments in developing countries have spent more money attempting to establish viable seed programs than they have on any other aspect of potato improvement. The results have usually been far below expectations. The "hardware" aspects of the programs have been reasonably successful: laboratories and greenhouses have been built, equipment has been installed, and seed has been produced. However, most programs have encountered serious difficulties distributing the seed produced, assuring quality standards, and maintaining the program after foreign funding and expertise has been

[11] Rhoades, Horton, and Booth (1986) and several other publications discuss the methods in general, but the assessments themselves seldom produced publication-quality results.

withdrawn. Few seed potato programs have been able to sustain production of more than a few percent of the national seed requirement. The result: whereas ex ante impact assessments place seed at the top ot the R&D agenda, ex post assessments show poor returns to many investments in seed programs.

Operational impact assessments in a number of countries are helping to pinpoint the reasons for failure as well as promising avenues for future concentration. First an example from Peru, based on Prain and Scheidegger (1988):

> In Peru, since the 1940s potato improvement has centered on seed, the goal being to improve seed quality (reduce virus incidence) in the highlands. Potato is the country's major staple food and it is the leading income source of poor small highland farmers. In contrast to expectations, most seed produced was sold in coastal areas which produce only about 10% of the crop and where incomes are relatively high.
>
> In 1977, CIP and Peru's Ministry of Agriculture initiated on-farm research to test recommended technologies under farmers' conditions. Improved seed was the central component of the recommended package. To our surprise, the improved seed performed only a little better than farmers' common seed. Since it cost much more, use of improved seed actually reduced farmers' incomes.
>
> This finding led to a redoubling of efforts to improve seed quality. After several years it was determined that the best possible seed yielded only about 20% more than farmers' common seed. This unexpected, and to many researchers inconceivable,[12] finding stimulated interdisciplinary research on how farmers manage their seed to maintain high quality. Biological research was also begun on the spread of virus diseases and their impact on yields at high elevations.
>
> Efforts in the seed program were split into two separate thrusts: one, following more or less traditional lines, was directed to supplying the needs of coastal farmers. An entirely new institutional strategy was developed to feed a small amount of high-quality seed of native varieties into highland farmers' traditional seed systems.
>
> In the project as a whole, which had the central aim of improving the welfare of small highland farmers, the emphasis has shifted away from seed toward other factors which might have a greater impact. These include tillage and control of soil-borne pests.

[12] Inconceivable because "improved seed" is by definition better than farmers' seed(?!).

An example from South Korea (Horton et al. 1988) illustrates how an incongruity between objectives and achievements can reflect changing conditions, which make it essential to continually reassess the potential impact of both technical and institutional innovations.

> In the 1970s, potato production fell dramatically in Korea. An economic study conducted at the time concluded that this was due to rapidly rising incomes and a negative income elasticity of demand for potatoes. In fact, the decline in production resulted from a collapse in the country's seed system due to uncontrolled infection with virus diseases. Beginning in 1979 a new technical scheme was established, based on modern techniques of virus detection and elimination, on sterile (virus-free) in vitro maintenance, and on rapid multiplication of early seed generations on 15 hectares of land under screenhouses.[13] After screenhouse multiplication and field multiplication on the experiment station, a provincial seed farm, and a private growers' association, certified seed was sold to farmers in other parts of the country. Fields were inspected for virus diseases during each multiplication.
>
> The system has been strikingly successful. In 10 years, largely as a result of the seed program, national potato yields have doubled. Nevertheless, the certification system has never been able to supply more than 15% of the nation's seed requirements. A careful assessment revealed that a significant amount of seed was "leaking" from the formal system each year. It was being multiplied in a parallel, informal system in the private sector. The reason for this leakage was that official prices for high-quality seed were far below the opportunity cost [Figure 3].
>
> The study concluded that whereas the initial institutional arrangements were needed to establish the seed program, these same arrangements are now a major constraint to further increases in potato production and use. Proposals were made for increasing the role of the private sector in seed multiplication and for focusing the NARS's activities on producing basic seed stocks, on quality control and on other high-priority research areas, including post-harvest technology and release of new varieties.

The cases presented in this section are intended to illustrate the utility of a range of types of impact assessments conducted in-house within a R&D program at the operational level. Their principal goal is to improve the operational management of the program, rather than to set overall priorities or to provide quantitative measures of the benefits. Their results may not be scientifically rigorous; they are, however, extremely relevant for research management.

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[13] Multiplication in screenhouses was to avoid entry of aphids which transmit potato virus diseases.

## Challenges

Introducing impact assessment into agricultural R&D institutions at the operational level represents a significant institutional innovation, and as with all such innovations, there are challenges on both the supply and demand sides of the equation. On the demand side, the principal challenge is to make research instiutions more business-oriented — more concerned with understanding and generating technology that meets client needs. A practical problem in the way of stimulating a demand for operational impact assessment is the belief that scientists know what farmers need. A related problem is the lack of confidence in the ability of the soft sciences — anthropology, sociology, and management — to contribute productively to agricultural research.

On the supply side, there is as yet no client-oriented framework for managing agricultural research in developing countries. Without such a framework, research managers and scientists will continue to find little use for the results of impact assessments, except as sources of information for public relations campaigns.

A suitable framework for assessing institutional impact is also lacking. If impact assessment continues to focus on changes in production, the results will have limited value for managing international centers. Finally, well-

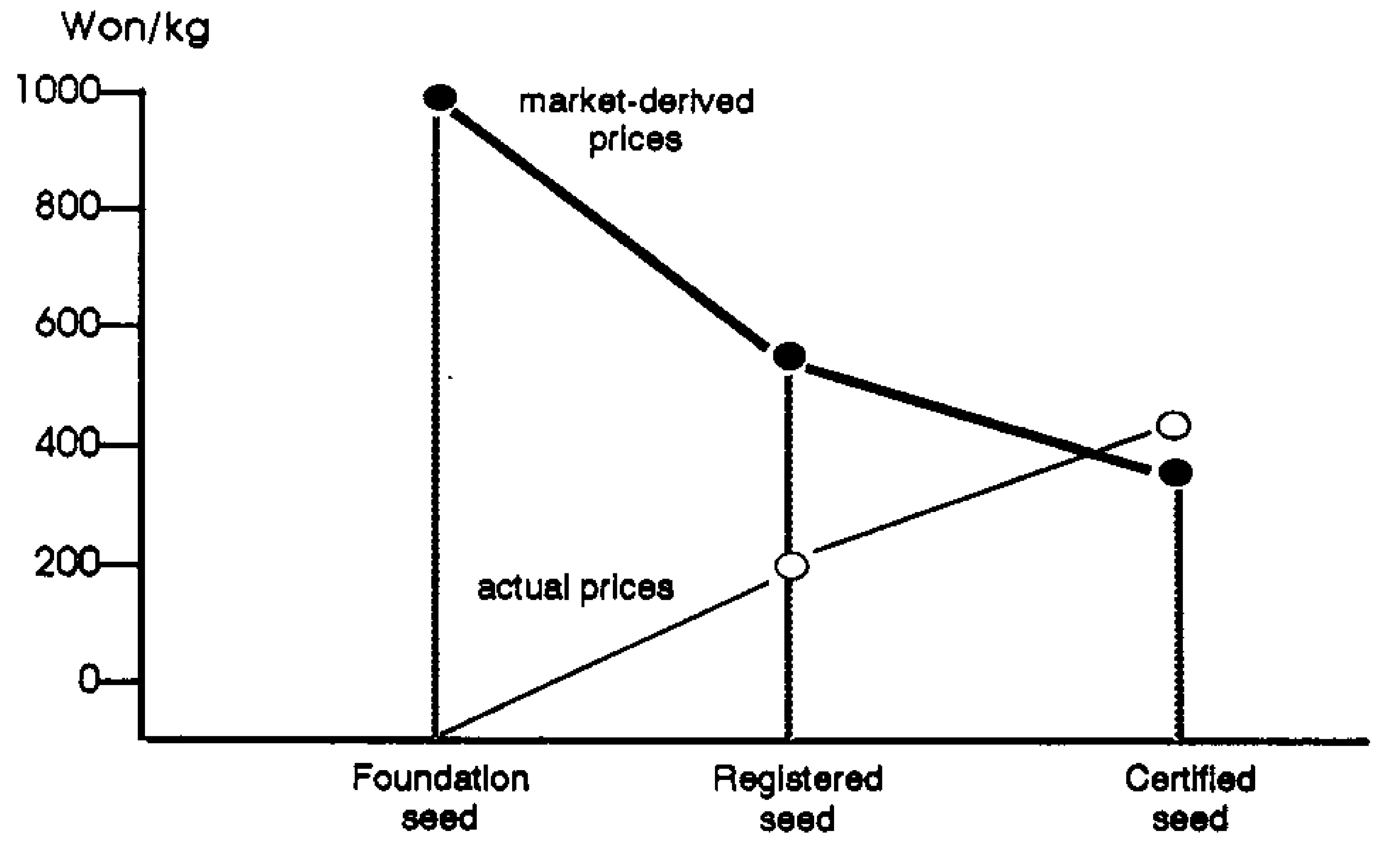


**Figure 3. Actual and market-derived prices of foundation, registered, and certified seed**

trained managers and social scientists with experience in agricultural R&D are needed — people who can contribute productively to the development of needed management frameworks and their implementation on a day-to-day basis.

## "Getting the Business into the Organization"

As noted earlier, a common problem of public-service institutions is their tendency to be preoccupied with internal, *organizational* issues rather than with the external, *business* issues. Scientists tend to become fascinated with the problems they work on and to become so wrapped up in the research process that they loose sight of its ultimate purpose: practical application by clients. As Egan (1987) and others have noted, the central challenge to service institutions is to "get the business into the organization" — to focus on markets, customers, mission, the products and services that satisfy customers' needs and wants, and the environmental conditions (e.g., economics, politics) that affect their delivery and use. Only when an institution is business-oriented can impact assessment contribute significantly to management. The participation of senior managers of the CGIAR in management training courses represents a significant positive step in the direction of making the research centers more business-oriented.

## Toward a Management Framework for Agricultural Research

A substantial body of knowledge has been developed over the last 40 years on management of private firms. However, only recently have attempts been made to apply management principles to public-service institutions.[14]

Recent work has focused on the management of urban-based public-service institutions in developed countries. Little attention has been directed to the special needs of agricultural research institutions in developing countries.

An important exception is Israel (1987), who offers two reasons for this. One is that development theory and practice have by and large been in the domain of economists who, with exceptions like Schumpeter, Hirschman, and Libenstein, have been concerned first and foremost with issues of allocative efficiency rather than operational efficiency. Second, the disciplines of management science and development administration have not been particularly successful in tackling the problems of developing countries, much less of agricultural R&D (Israel 1987: 3).

[14] When Peter Drucker wrote his classic management text, The Practice of Management, in 1954, he stated in the opening chapter that its principles were intended strictly for private enterprises. In contrast, in his 1986 book, Innovation and Entrepreneurship, he dedicates a full chapter to entrepreneurship in the service institution.

ISNAR (1987: 18) has identified 12 critical factors that affect NARS's capacity and management:

- interactions between national development policy and agricultural research;
- formulation of agricultural research policy: priority setting, resource allocation, and long-term planning;
- structure and organization of research systems;
- linkages between NARS and policymakers;
- linkages between NARS, the technology-transfer system, and users;
- linkages between NARS and external sources of knowledge;
- program formulation and program budgeting;
- monitoring and evaluation;
- information management;
- development and management of human resources;
- development and management of physical resources;
- acquisition and management of financial resources.

Similar lists of critical factors and suggested remedies are found in numerous program review documents. These may provide a useful starting point for constructing the needed management framework for agricultural research in developing countries. Needed is a comprehensive review of these reviews to extract general lessons for agricultural research management. A serious effort is also needed to adapt relevant principles from the developed-country literature on public-service institutions to meet the special needs of agricultural research managers in developing countries.

### Assessing Institutional Impact

Since NARS are the priority clients of international centers, it is essential to have measures of impact at the institutional level. It has been noted by Nores (1988) and others that the distinction between institutional impact and production impact does not facilitate impact assessment because enhanced institutional capacity should be assessed by the value of its output, which in turn should be assessed in terms of production impact. "Institutional impact cannot be disassociated from production impact. As they interlink, both types of impact need to be assessed as part of the same studies" (Nores 1988: 287).

The same view permeates TAC's present approach to priority setting in the CGIAR system. The important distinction between production technology and R&D technology is recognized, but no serious attempt is made to measure institutional impact.[15]

The argument that institutional impact cannot, or should not, be assessed in isolation from production impact calls into question the validity of all external reviews of agricultural R&D programs. As Norton (1985) notes, review teams practically never have access to detailed information on production impact. Yet reviews of both international centers and national systems are increasingly common, and they present a wealth of information and recommendations on the organization, management, and performance of research institutes.

The solution is not to negate the importance of institutional impact and focus only on production impact but to develop methods for measuring it, based on a general management framework for agricultural research institutes.

One obvious gauge of impact, probably the most relevant one but the one least frequently used, is for an institution to ask its customers what they think. How valuable do the NARS feel an international center's products and services are? The CIP (1984) impact study was based on the simple principle of asking the clients what they thought about CIP's work. ISNAR's annual "User's Meeting" is a mechanism for gauging potential impact through direct interaction with clients.

## Needed Institutional Innovation

Improving the management of agricultural research institutes now presents one of the greatest challenges to the development community. Significant institutional innovation is needed to make the evolving global research system more aware of, and responsive to, its clients' needs. Present conditions seem propitious for the needed innovation. However, this will require that a broader dialogue be established, involving not only biological scientists and economists but also the softer sciences like anthropology, management, and organizational sociology. Most important, effective, two-way dialogue is needed with the NARS.

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15 USAID apparently still does not appreciate the importance of institutional impact, and focuses its assessments on production, income, consumption, and the (physical) environment (Kumar 1987)

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