



Private-Sector Perceptions of Public Agricultural Research: A Case Study in Costa Rica

Frank Hartwich, Daniel Blank, and Matthias von Oppen

The aim of this study was to analyze how private agribusinesses in Costa Rica perceive public agricultural research organizations and universities. Empirical data indicated that private companies had reservations about collaborating with public research organizations, mainly because public organizations lack relevant research and development (R&D), and there were concerns about the confidentiality of results. If public research organizations are to form effective partnerships with private companies with regard to technological innovation, they must be more proactive in providing service and show that they are capable of responding to companies' demands, with relevant results in a timely manner, under agreed ownership arrangements. However, forming such partnerships should not become an overriding aim: public research organizations should only consider collaborating with, and rendering services to, private institutions when to do so is compatible with the public interest.

Introduction

Private firms establish partnerships for many reasons. They may, for example, wish to benefit from complementary assets or the synergy arising from joint learning and the collaborative development of new knowledge. Two firms may consider forming a partnership if one has technological expertise and the other controls a distribution channel (vertical integration). In such a case, a partnership would allow them to capture the market for a new product through the existing marketing channels. Alternatively, companies competing in the same market may collaborate to accumulate the necessary assets to develop an innovative new product (horizontal integration); in this case, collaboration allows both partners to enter the market for the new product and both increase their profits as a result.

One type of partnership involves collaboration between the private sector (e.g., producers, cooperatives, and companies) and public research organizations specifically for conducting research and development (R&D). In these public-private partnerships, the aim is usually to develop innovations that serve both public and private interests. However, public-private partnerships are unique in that the partners are not equal and have very different interests: on one side is a nonprofit public research agency responding to social development goals, and on the other is a profit-oriented private company.

Partnerships for R&D can be seen as arrangements for vertical integration, connecting innovation and technology development with production, processing, and

marketing in what is usually termed a supply chain. The latter is an industrial arrangement that allows buyers and sellers separated by time and space to progressively add and accumulate value as products pass from one member of the chain to the next (Hughes 1994). Public-private R&D partnerships can contribute to the development of supply chains by providing private entities with knowledge of innovations and technology that they themselves cannot produce on their own. Furthermore, the public sector can guide development efforts to specific supply chains or parts of supply chains, e.g., by supporting innovations that lead to specific regional, social, or environmental developments.

However, many private companies remain skeptical regarding the benefits of forming an R&D partnership with government research organizations—particularly in developing countries, where there is considerable public and private need for innovations. Companies may be wary of the many complications that can arise from dealing with the bureaucratic public sector. They may also have other concerns, including whether the research organization has the capacity to deal with "real-world" problems, whether the results will be relevant and can be protected from competitors, how their investment in the partnership can be monitored, and who will make any necessary decisions.

The objective of this study was to determine whether, and in what way, the private sector in Costa Rica is interested in collaborating with public research organizations. The ways in which public agricultural research has been—and possibly continues to be—important to private agribusinesses were analyzed, as were compa-

nies' perceived needs for R&D and their degree of satisfaction with public R&D. The resulting paper is aimed primarily at researchers and administrators in public-sector R&D who are considering collaborating with the private sector and hence are interested in the latter's perceptions of public research organizations. The findings may also be of interest to product and marketing managers of those private companies and cooperatives seeking to collaborate with public institutions for research and development.

Arguments in support of R&D partnerships

Vieira and Hartwich (2002) argued that, despite having different objectives, public and private entities share some common interests, and innovations can produce benefits for both parties. This "common interest space" is the environment in which public-private partnerships evolve (box 1).

Box 1: Partnership Characteristics

There is no uniformity in the terminology used in relation to partnerships. Terms used to indicate very similar relationships include partnerships, networks and alliances, cooperation, collaboration, coalition, and joint ventures. Here, partnerships are defined as follows:

Partnerships: all arrangements between institutions from different sectors (including the public and the private) that have agreed to work together toward shared and/or compatible objectives.

Mutual public-private partnerships: cooperative arrangements between two or more institutions involving the exchange or sharing of resources; arrangements between public and private sector entities in which there is shared authority and responsibility, joint investment in resources, shared liability, risk taking, and mutual benefit.

Minimum **requirements** for partnerships:

- a common interest space;
- active partners;
- interdependent and complementary contributions of the partners;
- an open, horizontal relationship of a cooperative nature;
- autonomy of each partner;
- mutual trust.

Public-private partnerships in the context of R&D can be seen as institutional responses to the demand for innovation. This concept of "responding to demands" was proposed in relation to public-private partnerships for agroindustrial R&D in Latin America by Vieira and Hartwich (2002), who assumed that the factors of technology "push," market "pull" (Dosi 1982) (and, in this case, public pull—i.e., the demand of the public for research contributing to social goals) all contribute to our understanding of why and how partnerships for innovations are formed. The demands in question change with the level of development of agroindustry and are specific to particular countries, sectors, or supply chains. Nevertheless, spillovers

can occur between different supply chains, sectors, and countries, allowing the various participants to learn from the experience of others and to adopt successful practices developed elsewhere.

There are two ways in which partnerships can result in development: through macro (sector) development and micro (firm) development.

The (macro) public-sector view

Public-private partnerships can contribute to sectoral development (including that of the agricultural sector) by bringing together—via supply chains—the various participants necessary for concerted development. The supply chains of the agricultural sector, for example, often unite primary producers of agricultural products (or their umbrella organizations), government agencies, ministries, export promotion bodies, and national and international funding organizations and donors. The public sector has traditionally invested in agricultural research, since it was expected to generate social benefits. Public-private partnerships for agricultural research have been promoted as a solution to this problem, since in such cases both public and private sectors provide funding, profit from mutual synergies and reach the critical mass of knowledge and technology generation necessary to improve the competitiveness of the agricultural sector. However, the public sector may only be inclined to invest in such partnerships when the pursuit of private profit also yields a social benefit (Springer-Heinze 2002). In this respect, public-private partnerships are different from privatization: they preserve the public sector's role in leading development efforts through innovations, while improving its efficiency and relevance.

The (micro) private-firm view

Innovation is crucial if firms are to compete successfully in the increasingly competitive local and international markets for primary and processed agricultural products. Entrepreneurs in developing countries are eventually forced to innovate in order to compete in such markets, particularly in infant industries and in those markets involving transnational companies. However, in many developing countries, the private sector lacks the intellectual and financial capacity to develop and adopt innovations. Private industry tends to underinvest in R&D, either because management lacks a strategic vision of innovation, or because risk-aversion prevents them from investing in activities that only pay off in the long term. Consequently, companies may rely entirely on the public sector's attempts to import or generate innovations. By forming partnerships with the public sector, private firms can gain access to knowledge and innovations that can allow them to maximize their profits. Furthermore, such partnerships allow firms to direct the R&D process in such a way that the innovations produced more closely fit their needs. When public-private partnerships are funded by public donors, much-needed capital can be channeled into R&D, allowing firms to become much more competitive as a result.

Private-sector rationale for forming partnerships

What makes private companies form partnerships? The literature on this issue indicates that more partnerships are formed between private companies during phases of accelerated economic and institutional development (Sell 1994). In a similar way, the incidence of collaboration in the R&D sector also seems to be positively correlated with economic development. For example, in a study of collaborative R&D during a time of accelerated economic growth in Germany, Narula and Hagedorn (1997) estimated that the number of newly created R&D partnerships increased from 300 per year in 1980 to 700 in 1994.

Narula and Hagedorn (1997) also indicated that not only does the number of partnerships change with the level of economic development, but also the type of partnership. In Germany, for example, joint ventures (i.e., partnerships between two private companies that involve equal contribution of funds) have declined substantially in the past 20 years. On the other hand, improvements in infrastructure tend to increase the level of collaboration between companies. This is particularly true of improvements in communication, since they facilitate data exchange over long distances. Globalization (which is often accompanied by a reduction in trade barriers), industrialization, and the increased technological interdependence between companies, universities, and public research organizations are all important additional factors that promote collaboration (Sell 1994).

The theory underpinning the economics and strategic management of joint ventures suggests that a range of parameters determines whether or not firms enter into partnerships (box 2). Following Stief (2000), we can distinguish two main criteria that companies consider when establishing collaborative relationships.

Benefit-oriented criteria

Benefit-oriented decisions are influenced by (1) shared risk, (2) access to resources, (3) change of market structure, (4) flexibility, and (5) learning. Sharing risk and gaining access to otherwise inaccessible resources are among the most obvious benefits that can arise from partnerships, but they can also offer the possibility of combining the various strengths of the partners in order to penetrate new markets. Partnership arrangements also have the advantage of flexibility, since they can usually be changed and/or dissolved at short notice. Finally, partnerships offer the benefit of joint learning and cross-fertilization of ideas: collaborative R&D often generates clearer and more wide-ranging results than does R&D performed in isolation.

Cost-oriented criteria

The cost-oriented approach to decision making is based on the calculation of production- and interaction costs. **Production costs** arise from the generation of outputs. In partnerships, such costs are expected to decrease with increasing size of the production activity, as a result of the positive effects of "economies of scale" and "economies of scope." **Interaction costs**

Box 2: Why Private Firms Form Partnerships

Private agroindustrial firms may find that R&D partnerships are favorable to them when the benefits of entering the partnership outweigh the costs. This situation may arise as a result of some or all of the following:

Benefit-oriented criteria

- Partnerships offer access to information and experienced scientific and engineering staff, who can provide unique perspectives and expertise. They complement the firm's core capabilities and provide a basis for joint learning.
- Partnerships can position a firm in order to be the first to enter a new market. Firms in concentrated industries use partnerships to collude or to gain market power at the expense of competitors.
- Partnerships can enhance the profile and credibility of private companies and become an important part of their public image.

Cost-oriented criteria

- Partnerships offer access to unique facilities, perhaps available only in government organizations, thereby allowing the private sector to avoid the large capital outlay needed to purchase, contract, or rent such facilities. Examples include large plant-breeding facilities, biotechnology laboratories, and programs for the preservation of natural resources.
- Cooperative R&D with government laboratories allows firms to experiment with an idea, or to develop it gradually without having to commit resources fully to its development. In this way, firms can minimize or reduce their risks.

arise from the division of labor and are composed of (1) the cost of initiating the partnership, (2) the cost of drawing up legal agreements between partners, (3) the cost of ensuring that the partners comply with the agreement, (4) the cost of adopting the innovation, and (5) the cost of transferring it to a wide range of users. Interaction costs increase with the degree of complexity of the collaboration and may be further influenced by characteristics related to the output of the partnership, including product variability, specificity, suitability for coding, and separability. The variability of an output is an indication of the need to adapt it to new conditions (e.g., a plant variety to new soils). Low specificity implies alternative uses, (e.g., several groups of potential users for a plant variety, such as subsistence- and large-scale farmers). "Coding" implies an output that can be described in words, by mathematical formulae, or by graphical means. Separability expresses the extent to which research outputs can be decomposed into separate parts (e.g., a technology "package" that includes varieties, agronomic techniques, etc.).

Van der Meer (2000) estimated that, in partnerships between private companies, transaction costs (costs of interaction) fluctuate at about 0.5% of the partnership's budget, whereas in public-private partnerships, they can amount to up to 5%. Given the different interests of the partners in public-private R&D partnerships, the costs of negotiation are not expected to be as high as those in other collaborative arrangements, since

there is little to disagree on with regard to the use of the outputs—each partner profits in their own way. The situation only becomes complicated if property rights and royalties become an issue. There may, however, be some disagreement regarding the level of commitment expected from each member. In addition, communication costs within such partnerships may be relatively high because of the difficulties involved in communicating with partners from such different backgrounds.

The various criteria used by firms when deciding to enter a partnership can be visualized in the form of a matrix (table 1) which includes the benefit- and cost-oriented criteria applied to the three alternatives of (a) cooperation (in a partnership mode), (b) remaining independent (i.e., conducting R&D within the company), and (c) subcontracting the R&D function to an external agency. Table 1 includes some suggested internal company weightings for each of the criteria, but there are no universal standards for such weightings: they depend on the type of company, its culture, its aversion to risk, etc.

Table 1. Example of a Private Company’s Decision Matrix on Acquiring Innovations

Criterion	Company-specific weighting (in %) (example)	(a) Cooperation/partnership	(b) Internal execution	(c) External execution
Production costs	30			
Interaction costs	20			
Risk	5			
Resource access	5			
Change in market structure	10			
Flexibility	20			
Learning	10			
Total	100			

Internal ratings to be assigned by product managers and/or strategic decision makers

Source: Based on Stief (2000)

The output of R&D activities can be divided into results from "basic research", "applied research" and "development research". Along this continuum, the characteristics of the R&D outputs change: for example, both the specificity of an output (i.e., its spectrum of use), and its variability (i.e., the possibility of adapting it to different uses), are greater in applied research than in development research (see table 2):

- **Basic research.** The outputs of basic research are often difficult to structure and hence to separate. Basic research therefore tends to be poorly suited to collaborative arrangements. Nevertheless, it can be conducted within partnerships if a suitable form of cooperation is chosen. Basic research requires the most intensive sociocultural ties and independent organizational units are therefore recommended.
- **Applied research.** The outputs generated by applied research are easier to structure and to separate than are

those of basic research. Furthermore, their variability is lower, so that the probability of achieving the desired result is higher. In addition, since applied research tends to be more short term than basic research, partnerships need not be sustained for as long.

- **Development research.** The outputs of development research are of low variability and are suitable for coding. Since development research has to generate outputs in a relatively short time, it is unsuitable for complex joint-ventures with their high start-up and agreement costs. Smaller projects or a reduced number of joint activities are more appropriate.

What are the implications of this research hierarchy with respect to companies’ decisions to enter into partnerships? Chiesa and Manzini (1998) suggested that integrated forms of collaboration—such as joint-ventures or partnerships between firms—are preferred if the collaboration is not focused on a specific technology, product, or project, and the objectives are broad and/or multiple. Thus, the decision of whether or not to enter into a collaborative arrangement depends not only on the type of research, but also on the specificity of the innovation to be developed. Partnerships are well suited to producing innovations with high variability (i.e., which can serve a broad range of purposes). However, contract research is more appropriate if a very specific innovation is being sought (e.g., to solve a particular processing problem within a particular company).

Research methods

The research for this paper was conducted in the context of the ISNAR project "Public-Private Partnerships for Agroindustrial Research in Latin America," funded by the German Federal Ministry for Economic Co-operation (BMZ). The aim of the project was to provide guidelines on when and how to build

Table 2. Suitability of R&D Outputs for Collaborative Arrangements

Criterion	Basic research	Applied research	Development
Variability	High	Moderate	Low
Specificity	Low	Low	Moderate
Suitability for structuring	Low	Moderate	High
Suitability for coding	High	High	High
Separability	Low	Moderate	High

Source: Based on Stief (2000)

and promote public-private partnerships for agroindustrial research.

Costa Rica formed an interesting case study, because it has undergone accelerated agricultural development over the past few decades (SEPSA 2001). During this period, the agricultural sector in Costa Rica maintained and expanded its share in many international markets for high-quality agricultural products despite increased international competition (WTO 2001). Costa Rica is the world's second-largest banana producer and also has important coffee and oil palm industries, as well as niche markets for high-value products such as organically grown fruits and vegetables. One could argue that Costa Rica's "positioning" on the world market is the result of substantial investment in innovation. The state has subsidized innovation development and has also provided credits, extension services and—sometimes—market regulation. Many innovations, however, were either imported or developed directly by large-scale companies. Nevertheless, since both public bodies and private industry have engaged in substantial amounts of R&D, it was considered valuable to determine how much of Costa Rica's economic development could be attributed to collaborative research in the development of innovations.

This question was addressed from the perspective of the private sector, using the following three sources of data:

A survey conducted in 2002 by the national export promotion body (Promotora del Comercio Exterior de Costa Rica [PROCOMER]). This survey assessed company managers' perceptions of their firms' innovation needs. PROCOMER thus provided raw data for this study, including a subset of data related to agroindustrial firms. Of the 160 agroindustrial companies interviewed by PROCOMER, 108 were exporting companies and 52 were nonexporting. Within these two groups, four size classes of companies were distinguished: micro, small, medium, and large. The small, medium, and large companies each represented around 30% of the exporting group, with micro companies representing approximately 10%. In contrast, roughly 50% of the nonexporting group were micro companies, approximately 30% were small, 10% medium, and 5% large.

A telephone survey of 21 private agroindustrial companies, representatives of which were extensively questioned on their perceptions of, and experience with, public-sector research. These 21 companies were those willing to respond from an initial sample of 50, randomly selected from the telephone directory. The size of the companies varied between six and 3500 employees, with annual turnovers ranging from USD0.1 million to USD350 million. Most companies employed a small number of scientists, although one large company employed 21 scientists.

Two case studies of existing partnerships, one each in the banana and coffee sectors. These were conducted to gain a deeper understanding of the "functioning" of partnerships within these two supply chains. The case studies represented two alternative funding schemes for collaborative agricultural research, one used by the Corporación Bananera Nacional (CORBANA) and other by the Centro de

Investigaciones en Café (CICAFAE). These two organizations have arisen as result of the public sector's retreat from research activities in these sectors. Both organizations have sectoral mandates and respond to public needs, but are funded mainly by the private sector. As a result, their boards have a particularly strong private-sector component, including representatives from both processing and exporting companies. CORBANA is financed entirely by private companies in the banana sector, while CICAFAE (together with the other branches of the national coffee institute (Instituto de Café [ICAFAE]), is financed partly by a 1.5% levy on the value of exported coffee products and partly by grants provided by the government and various regional organizations.

Results

Companies' needs for innovation

The answers to some of the questions addressed by the PROCOMER study are shown in table 3.

Table 3. Selected Results from the PROCOMER Study of Agroindustrial Firms

	Exporting companies (N=108)	Non-exporting companies (N=52)
Do companies' possess adequate technology?	Yes = 73%	Yes = 85%
Do national universities constitute an important source of innovation?	Yes = 37%	Yes = 17%
Is the company planning to introduce a new product?	Yes = 39%	Yes = 38%
Is the company planning to change any current products?	Yes = 42%	Yes = 36%

Source: based on data from the PROCOMER study

Judging from the PROCOMER survey, companies in general did not appear to be dissatisfied with the technologies that they had access to, although the proportion expressing satisfaction was higher in the smaller and nonexporting companies than in the larger and (especially) the exporting companies. Given this level of satisfaction, it was perhaps surprising that approximately 40% of the companies wanted to introduce new products or to realize changes in their current products. Companies did not apparently foresee any problems in acquiring sufficient new innovations to allow them to dispose of technology that they considered adequate at the time of the survey. However, they did not appear to view the universities (mainly Costa Rica University, the National University, the University of Distance Education, and a number of smaller universities), as an adequate source of innovation: only 37% of the exporting and 17% of the nonexporting companies

believed that universities could provide adequate technology for their businesses, despite the fact that in Costa Rica the universities constitute the main source of innovation.

Further analysis revealed that, averaged across all interviewees, medium-sized companies were the most in need of innovation. If the nonexporting companies were considered separately, it was the larger companies that were most in need of innovation. Presumably, larger exporting companies are able to develop technologies on their own or with the assistance of a (foreign) parent company. These companies were also more prepared to subcontract innovation development to universities and research laboratories.

Although the results are not presented in table 3, the survey also revealed that small companies were less interested in innovation than were the larger ones, perhaps because smaller companies were less confident of the continuity of their markets. Very few of these companies planned to launch new products. It might be valuable for the government to consider encouraging small companies to become more innovative and hence better prepared for competitive market scenarios.

Companies' perceptions of public research

The telephone survey of the 21 agroindustrial companies revealed that they accomplished their R&D activities in a variety of ways (table 4). The majority conducted at least part of their R&D internally. However, several companies subcontracted all of their research and development (either to public or private organizations), and some conducted no R&D at all.

When companies were asked to quantify their perception of the information flow from public research to the private sector, the response was moderate (question 2: mean score = 2.7). A similar rating was achieved for their perceptions of the degree to which public research is oriented towards private sector needs (question 3: mean score = 2.5). However, when invited to comment directly on their experiences with public research organizations (questions 4 and 5), the companies produced more negative than positive observations. Thus six interviewees believed that public research institutions had no appropriate responses to their needs, while three either found them too expensive, too slow, or lacking in market orientation, or they anticipated patent problems. A total of 21 negative comments were received, compared to only four positive responses (table 4).

Table 4. Selected Results from the Telephone Survey of Agroindustrial Firms

Question	N=21
1. Does the company execute R&D: (i) internally; (ii) via contract; (iii) in collaboration with other organizations?	(No. of interviewees responding with yes) <ul style="list-style-type: none"> • Internal = 19 • Contracting public = 4 • Contracting private = 7 • Jointly with public = 2 • Jointly with private = 6
2. How well is the information from public research communicated to the private sector?	• Mean = 2.7 (Range of possible responses: 1 = very badly to 5 = very well)
3. To what degree is public research oriented towards companies' needs?	• Mean = 2.5 (Range of possible responses: 1 = very little to 5 = very much)
4. What are the positive attributes of public research?	<ul style="list-style-type: none"> • Interdisciplinarity of research work (n=2) • Contact with public institutions (n=1) • Low cost of research (n=1)
5. What are the negative attributes of public research?	<ul style="list-style-type: none"> • No appropriate responses to private sector problems (n=6) • Expensive (n=3) • Patent problems (n=3) • Slow (n=3) • Research is too basic (n=2) • Organization is too bureaucratic (n=2) • Information is not passed on at the end (n=2)

Companies' satisfaction with public research

CORBANA and CICAPE both arose as a result of the private sector's perception that public sector attempts at developing the banana and coffee industries—although good—were not sufficient. As the public sector gradually withdrew from research in these areas, private companies—particularly the medium sized nontransnational companies—became aware of an innovation gap which, unless bridged by private-sector contributions, would endanger the competitiveness of the two sectors. As a result, the private sector established joint research institutions in close collaboration with the Ministry of Agriculture.

Both the banana and the coffee sectors reported positively on the collaboration between private companies and public research organizations. Interviewees indicated that the success of CICAPE and CORBANA is partly the result of research efforts—by both public and private entities—that respond very precisely to the demands of the private sector. The public sector now actively promotes collaborative projects between public organizations and particular companies and supports these activities by competitive grant schemes (e.g., those provided by the National Council for Scientific Research and Technology (Consejo Nacional de Investigaciones Científicas y

Tecnológicas [CONICIT]). However, such collaborations are still relatively few in number, and most research is conducted directly by CORBANA and CICAFAE or is made available through subcontracts.

Public and private financing of R&D

In 1998, the total investment in R&D in Costa Rica was USD34 million—equivalent to 0.3% of gross domestic product (GDP). Of this, 44% was contributed by the private sector, 38% by the public parastatal university system, and 18% by the public sector (MICIT 2000). In the same year, public support for agricultural research amounted to USD2.1 million (equivalent to 0.15% of agricultural GDP)(WTO 2001).

The relationship between private companies' satisfaction with public research and a range of possible explanatory variables was analyzed by stepwise regression (adjusted $r^2 = 0.295$), which revealed that the only significant factor explaining such "satisfaction" was the proportion of company research funded by the public (i.e., the greater the level of public investment, the higher the companies' level of satisfaction). Private companies appeared to be unable to appreciate R&D that required substantial funding from their own resources, even if the results might be of considerable benefit to them.

The state contribution to research in the banana sector (which is largely dominated by transnational companies) is low and focuses only on selected areas such as reducing pesticide inputs to improve the health of banana workers and similar issues. In contrast, state involvement in the coffee sector is of more significant public interest, since there are approximately 70,000 coffee producers in Costa Rica. A considerable part of CICAFAE's core budget is thus provided by the state in order to ensure that these producers have access to production and processing technology that enables them to operate profitably. This core state funding is complemented by several sources of research funding available via various competitive grant schemes run by the Ministry of Agriculture and the Ministry of Science and Technology. In total, it is estimated that 50% of all investment in the Costa Rican coffee sector comes from the state. Even so, given the size and importance of the sector and the low investment potential of many of the smaller producers, this figure probably indicates public underinvestment in coffee research.

Improving the usefulness of public research to the private sector

The results of both the PROCOMER study and the telephone survey suggest that the public sector must make a greater effort to respond to the demands of the private sector. In order to become a more attractive partner, the public sector must offer a competent research service which is both reliable and confidential.

In the telephone survey, companies were explicitly asked how public research organizations could become more valuable partners in innovation development. Representatives from several companies stated that public research organizations

should improve their level of information exchange with users and orient their research more towards private demand. At the same time, many also emphasized that public research organizations should maintain sufficient critical mass to allow them to continue to conduct interdisciplinary work. It was also mentioned that overlapping of R&D activities could be avoided through better coordination of activities and a clearer distribution of tasks among different institutions.

As a result of the analysis, the public sector's response to private sector demands could be improved in various ways:

A central research register publicizing R&D competencies would be invaluable, since many companies are still largely unaware of exactly what the universities and public research organizations have to offer. Also, many R&D institutions have still not properly defined their clientele and overlapping roles are common. A national register—i.e., a government policy document assigning and explaining the roles and mandates of different bodies—would do much to help bring together private companies and public research organizations.

Better legal services and/or advice on establishing collaborative R&D projects are urgently needed, since most collaborative research projects seem to generate goods and services of mixed character, i.e., half private and half public. It is important to clarify issues related to property rights in order to avoid conflict over the redistribution of any benefits arising from collaborative research. In Costa Rica, intellectual property rights are protected by various institutions: plant breeders rights, for example, are protected by the Law on Biodiversity (Ley No. 7788 of May 27, 1988), while intellectual property rights arising from other innovations fall within the remit of either the Registry for Industrial Property or the Registry for Authors' and Related Rights, both of which come under the umbrella of the National Registry (Registro Nacional). All of these institutions could provide legal services or advice on establishing collaborative R&D projects. Legal units at research organizations could also provide more support when formulating partnership contracts.

Outreach units to promote and facilitate negotiation with the private sector should be created at research organizations and universities in order to improve the ability of such organizations to respond to private needs. Most researchers are already capable of applying for public competitive funding schemes, but are generally less familiar with establishing joint projects and activities with the private sector. The proposed outreach units should also act as guardians of public interests and public policy. The use of public resources for R&D that addresses the needs of only a few companies should be carefully considered.

Researchers from the public sector should be involved in joint research planning with the private sector. Researchers are generally used to planning research projects according to their scientific perception of the problem, but in public-private collaborations, the objectives and activities of the R&D project should be jointly planned and implemented. Both public and private partners should take the time to plan the research and negotiate the fine details of each project before it starts.

Training and sensitization sessions should be conducted for research staff and administrators in order to improve their ability to approach and negotiate with private-sector entities.

Conclusion

Establishing partnerships with public research organizations could be an attractive option for companies wishing to acquire much-needed knowledge and technologies at low cost. However, it would appear that many companies are still reluctant to enter into partnerships with public research organizations, especially if they have to meet some or all of the costs.

The results of this study suggest that companies in Costa Rica perceive public R&D—provided mainly by universities and some public institutes—as being of little value. The principal underlying reasons for this include the rather limited focus of public research on private-sector needs, lack of faith in the ability of the public sector to produce relevant results, concerns over confidentiality, the time needed for public research to produce results, and the level of bureaucracy within public institutions.

In the past few years, public research organizations have had to address the difficult question of how to improve their relationships with the private sector. All public-private partnerships should be carefully considered: public research organizations should not enter into partnerships with private companies merely to acquire funds or maintain research activities. If the level of benefit to the public does not justify the public resources used, then such partnerships should not be formed.

If, on the other hand, there is sufficient public benefit to justify a collaborative R&D project, then there are several issues that public research institutions should consider. Joint research planning, staff training, and sensitization could substantially improve their understanding of the private sector's needs. A public register detailing "who does what" in research, together with a sound legislative base governing intellectual property rights, would also increase the private sector's readiness to enter into partnerships with public R&D institutions.

Private companies, in their turn, should bear in mind the importance of R&D to the success of their businesses. In many

cases, private sector companies have a rather limited appreciation of the importance of innovation to their own survival—as evidenced by their unwillingness to contribute to funding of joint R&D projects. It seems that in Latin America, the prevalent approach in most companies is to search for ad hoc solutions to problems rather than to invest in long-term strategies that might enable both small and large companies (and their associated farming communities) to gain a strategic position in particular markets.

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Laan van Nieuw Oost Indië 133, 2593 BM The Hague
P.O. Box 93375, 2509 AJ The Hague, The Netherlands
Tel: +31 70 349 6100 • Fax: +31 70 381 9677
www.isnar.cgiar.org • E-mail: isnar@cgiar.org

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