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IFPRI Discussion Paper 00708

June 2007

# Sharing Science, Building Bridges, and Enhancing Impact

## Public–Private Partnerships in the CGIAR

David J. Spielman
Frank Hartwich
and
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International Service for National Agricultural Research Division
and
Communications Division

## INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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## ABSTRACT

This study, which examines the role of public–private partnerships in international agricultural research, is intended to provide policymakers, research managers, and business decisionmakers with an understanding of how such partnerships operate and how they potentially contribute to food security and poverty reduction in developing countries.

The study examines public–private partnerships in light of persistent market failure, institutional constraints, and systemic weaknesses, which impede the exchange of potentially pro-poor knowledge and technology. The study focuses on three key issues: whether public–private partnerships contribute to reducing the cost of research, whether they add value to research by facilitating innovation, and whether they enhance the impact of research on smallholders and other marginalized groups in developing-country agriculture.

The study examines 75 projects undertaken by the research centers and programs of the Consultative Group on International Agricultural Research (CGIAR) in partnership with various types of private firms. Data and information were obtained through document analysis, semi-structured interviews with key informants, and an email survey of CGIAR centers. The resulting analysis provides a characterization of public–private partnerships in the CGIAR and describes the factors that contribute to their success. These finding are important to improving both public policy and organizational practices in the international agricultural research system.

**Keywords: Agricultural R&D, CGIAR, innovation, public–private partnerships**

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AATF | African Agricultural Technology Foundation |
| CGIAR | Consultative Group on International Agricultural Research |
| CIAT | International Center for Tropical Agriculture |
| CIFOR | Center for International Forestry Research |
| CIMMYT | International Maize and Wheat Improvement Center |
| CIP | International Potato Center |
| CLAYUCA | Latin American and Caribbean Consortium to Support Cassava Research and Development |
| CSO | civil society organization |
| FAO | Food and Agriculture Organization of the United Nations |
| FARA | Forum for Agricultural Research in Africa |
| FLAR | Latin American Fund for Irrigated Rice |
| ICARDA | International Center for Agricultural Research in the Dry Areas |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| IITA | International Institute of Tropical Agriculture |
| ILRI | International Livestock Research Institute |
| IPGRI | Bioversity International, formerly the International Plant Genetic Resources Institute |
| IPR | intellectual property rights |
| IRRI | International Rice Research Institute |
| ITPGRFA | International Treaty on Plant Genetic Resources for Food and Agriculture |
| IWMI | International Water Management Institute |
| NGO | nongovernmental organization |
| PPP | public–private partnership |
| R&D | research and development |
| WARDA | Africa Rice Center |

# 1. INTRODUCTION

The changing nature of science, technology, and innovation in developing-country agriculture necessitates new approaches to conducting research and development (R&D). Public–private partnerships in agricultural R&D are increasingly viewed as an effective means of conducting advanced research, commercializing new technologies, and deploying new products for the benefit of small-scale, resource-poor farmers; food-insecure consumers; and other marginalized groups in developing countries. The purpose of this study is to examine how public–private partnerships, or PPPs, in agricultural R&D stimulate greater investment in pro-poor science, technology, and innovation in developing-country agriculture.

PPPs are commonly defined as collaborations between public- and private-sector entities in which partners jointly plan and execute activities with a view to accomplishing mutually agreed-upon objectives while sharing the costs, risks, and benefits incurred in the process. Collaborations of this type can help overcome many of the impediments posed by market failure, institutional constraints, and systemic weaknesses in agricultural research by building on complementarities, exploiting synergies, and distributing costs and risk between the public and private sectors. There is, however, limited rigorous analysis of the role of PPPs in the context of developing-country agriculture to confirm that they are actually fulfilling this role. This study attempts to fill this gap by analyzing 75 projects undertaken by the research centers of the Consultative Group on International Agricultural Research (CGIAR) in partnership with various types of private firms.[1] Key research questions examined in this study are as follows.

First, do public–private partnerships reduce the costs of research? Research cost management is important to centers facing increasingly restricted funding from donors, and to firms looking for a cost-based edge over the competition. Thus, the issues are whether PPPs reduce research costs by realizing complementarities and scale economies;

[1] Established in 1971, the CGIAR is a nonprofit alliance of countries, international and regional organizations, and private foundations to mobilize agricultural science to reduce poverty, foster well being, promote agricultural growth, and protect the environment. The CGIAR supports 15 international centers that work with national research systems, civil society, and the private sector to achieve these goals.

whether they reduce research costs to the extent of making feasible those projects that are otherwise prohibitively costly when undertaken in isolation; and whether these reductions offset the coordination costs associated with a PPP.

Second, do public–private partnerships facilitate innovation? Innovation processes rely on practical outcomes—that is, the introduction of information and knowledge into socially or economically relevant products and practices. The issue is thus whether interactions between centers and private firms move research from proof of concept to product deployment, and whether these same interactions promote co-innovation or the creation of new knowledge otherwise unattainable by either agent acting independently.

Third, do public–private partnerships enhance impact by increasing outreach to the poor? A significant portion of the work undertaken by the international agricultural research system is targeted to developing knowledge and technologies that serve the needs of vulnerable social groups in developing countries. The issue is thus whether PPPs are sufficiently pro-poor to justify further investment, and whether these investments are appropriately balanced between short-term goals—that is, moving technologies off the shelf and to vulnerable groups through new or alternative distribution channels—and long-term goals—accessing cutting-edge science and technology to conduct research with potentially positive impacts for these same groups.

Data for this study were obtained from three sources: an analysis of CGIAR system, center, and program documents relating to PPP projects; semi-structured interviews with key informants directly or indirectly engaged in the partnerships; and an email survey of CGIAR centers on projects involving PPPs.[2]

Findings suggest that centers and their private-sector partners are exploring a variety of PPP-based approaches to conducting R&D. Each new approach brings with it innovative solutions to improving project management and financial incentives; navigating complex legal, contractual, and regulatory frameworks; managing and mitigating risk; and marshaling greater political interest and will behind PPPs. However,

[2] Details of these PPP projects are available in a searchable online database at http://ifpri.catalog.cgiar.org/pppdbase.htm.

the potential benefits of PPPs have yet to be fully realized in the CGIAR, suggesting that extensive challenges remain.

Thus, this study attempts to provide stakeholders—policymakers, research managers, and business decisionmakers—with a greater understanding of how PPPs operate in international agricultural research; how opportunities for synergies in research can be better exploited; how problems and pitfalls can be avoided; and how the potential costs, benefits, and risks of research can be distributed more equitably across the public and private sectors.

This study is presented as follows. Section 2 offers a review of the literature on PPPs in research and, more specifically, in agricultural research. Section 3 sets forth a conceptual framework for in-depth analysis of PPPs in agricultural research. Section 4 details the methods and data used in this study, followed by a discussion of results and findings in Section 5. Conclusions are offered in Section 6.

## 2. LITERATURE REVIEW

PPPs are commonly defined as collaborations between public- and private-sector entities in which partners jointly plan and execute activities to accomplish agreed-upon objectives while sharing the costs, risks, and benefits incurred in the process. On occasion, however, this definition is too narrow to capture the richness of experience gained from other types of interactions between the public and private sectors. Hence, the definition is expanded in this paper to include any type of formal or informal arrangement between public- and private-sector entities, such as knowledge-sharing networks, technology financing, or subcontracted research.[3]

The term public–private partnership first came into popular use during the 1980s in the search for alternatives to the privatization of public services. These PPPs focused primarily on outsourcing public services to private operators in the fields of education, health, and infrastructure, or more comprehensive programs of urban and rural economic development that directly engage both the public and private sectors (Osborne and Boughn 1990; Gerrard 2001). Arguably, such PPPs offered an alternative to privatization by combining assets from both the public and private sectors to improve efficiency and reduce risk, while balancing the private sector's standard profit motives with contractual limitations on the accumulation of profits.

Since their emergence, PPPs have been the focus of extensive study in a variety of disciplines, including economics, public administration, and management science. A survey by Hagedoorn, Link, and Vonortas (2000) divides the literature on research partnerships into three analytical categories:

1. industrial organization approaches that focus on analyzing the economics of inherent failures in the market for scientific and technological knowledge;
2. transaction-cost theory approaches that address the implicit costs of producing and exchanging knowledge under different institutional regimes and organizational structures; and

[3] For more nuanced discussions of definitions, see Linder 1999; Hagedoorn, Link, and Vonortas 2000; and Schaeffer and Loveridge 2002.

3. strategic management approaches that examine how firms compete, network, or collude in an effort to accumulate and deploy resources and capabilities to strengthen their market positions.[4]

A fourth category, the innovation systems approach, examines how collaborations between public and private agents in the generation, exchange, and use of knowledge are conditioned by internal behaviors, practices, and routines, and by the external social and economic context within which they operate (see, for example, OECD 1998).

In the field of science and technology, PPPs are typically designed to enhance sectoral competitiveness by combining resources from the public and private sectors to achieve economies of scale and scope, exploit complementarities, and realize synergies in R&D (von Hippel 1988; Doz 1996; Reid, Bussiere, and Greenaway 2001). This literature review, while by no means exhaustive, examines key studies to shed light on the conceptual foundations, methodological approaches, and empirical evidence on PPPs in science and technology, specifically with regard to developing-country agriculture.

## Terminology, Typologies, and Measurements

As a starting point, we examine the term "partner" in closer detail. Rarely is there a common understanding of what constitutes a public- or private-sector partner in the literature on PPPs. Farmers, for instance, are often considered private-sector partners when their participation is critical to the conduct of research, such as in a participatory research project or in product testing. But since farmers might also be defined as the beneficiaries, clients, or end-users of research outputs, they are omitted from our definition of partner. Farmer organizations and producer associations operating on a commercial basis are nevertheless included because they operate collectively as organizations not unlike a firm (Table 1).

[4] The study by Hagedoorn, Link, and Vonortas (2000) examines research partnerships in the manufacturing sectors of industrialized countries only, drawing empirical evidence from the United States, Europe, and Japan to provide insight into the reasons why firms participate in research partnerships; nonetheless, many of the findings are relevant and applicable to the present study.

**Table 1. A classification of public–private partners**

| Classification | Type of organization | Example of organization |
|---|---|---|
| Private | Local firm (registered in a single developing country) | Western Seed Co. (Kenya) |
| | Foreign firm (registered or operating in a single industrialized country) | Li-Cor (United States) |
| | Regional firm (registered or operating in more than one developing country) | SeedCo (Zimbabwe) |
| | Multinational firm (registered or operating in multiple countries) | Monsanto (United States) |
| | Farmer or producer organization | La Federación de Productores de Arroz (Colombia) |
| | Industry association | Croplife International (Belgium)<br>World Cocoa Federation (United States) |
| | Private research organization | Centro de Investigaciones en Palma de Aceite (Colombia) |
| | Charitable foundation | Monsanto Fund (United States)<br>Barwale Foundation (India) |
| Public | National agricultural research organization | Kenyan Agricultural Research Institute (Kenya) |
| | International agricultural research center | International Maize and Wheat Improvement Center (CIMMYT); International Centre of Insect Physiology and Ecology (ICIPE) |
| | Public university | Huazhong Agricultural University (China) |
| | Advanced research institute | Institute for Genomic Research (United States) |
| | International/development organization | United Nations Development Program |
| Civil society | Nongovernmental organization | Save the Children (United States) |
| | Community-based organization | Local village organizations associations |

Source: Authors.

Philanthropic or charitable organizations pose a similar classification problem. While their motives are often comparable to those of bilateral or multilateral donor organizations, they may also have close associations with their corporate parent that influence their activities. For the purposes of this paper, charitable foundations are considered private-sector partners where a corporate entity can be directly associated with the funding, governance, or activities of the foundation. Thus, philanthropic organizations, such as the Rockefeller or Ford Foundations, that have no connection with

an identifiable corporate parent are not considered private-sector partners, while the Barwale Foundation or the Syngenta Foundation for Sustainable Agriculture are.

Next, we examine the ways in which PPPs are categorized, a difficult task given the context-specificity of each partnership. For example, PPPs may be classified according to the form that knowledge takes within the partnership. This may refer to the nature of its appropriability, such as a pure public good (nonexcludable and nonrival), a pure private good (excludable and rival), or some form in between (Dalrymple 2006). This may also refer to its underlying nature, such as scientific or technical knowledge, or organizational or managerial knowledge, as well as codified and explicit knowledge, or tacit and implicit (Arrow 1962; Howells 1995; Hall et al. 2002). Or it may refer to the origin of the knowledge, for example, from foreign sources of discovery or through reorganization of internal and indigenous practices (Clark 2002; Malerba 2002).

Other taxonomic properties highlight the ways in which knowledge is generated, exchanged, and used within a PPP—that is, how partners define a problem then generate and ultimately apply the knowledge needed to solve it. The conventional approach describes a continuum from basic, to strategic, to applied, to adaptive research (for example, Lele and Coffman 1996). Other studies add the concept of imitation to this continuum (Arnold and Bell 2001), while still others emphasize the importance of differential learning processes obtained through the partnership process and differences in the accessibility and accumulation of knowledge over time or among agents—a property that partly depends on an agent's capacity to exchange, learn, and absorb (Revilla, Sarkis, and Acosta 2005).

Still other key taxonomic properties include type of partner, size of partner (measurable in terms of funding, revenues, R&D investments, or other such metrics), extent of collaboration, roles and responsibilities, stage of research, type of output, type of actors, organizational form, geographic specification, the number of PPPs engaged in by a single actor, and the purpose of the PPP (Anderson, McNiven, and Rose 2002).

These properties allow for analysis of different types of collaborations between the public and private sectors, ranging from formal, codified technology transfers

between public and private research organizations to informal networks of innovators and entrepreneurs studying new production techniques or ways of supplying goods to market. Codified knowledge-management approaches, for example, are often associated with structured relationships among partners to transfer knowledge through formal arrangements, such as partnership agreements, material transfer agreements, licensing, contracting, or other tools to maintain formal management of the knowledge sharing process. Tacit knowledge-management approaches rely more on intangible, social aspects of interaction among partners to transfer and integrate knowledge, such as learning-by-doing, scientific employee exchanges, participatory and action research, and other learning-oriented processes.

Alternatively, Schaeffer and Loveridge (2002) categorize research collaborations by distinguishing among several different models:

1. follower–leader models, based on upfront public investments made to reduce the costs and risks to subsequent investment by the private sector;
2. buyer–seller arrangements, where public agencies contract private firms to provide goods or services;
3. joint ventures, where the public and private sectors invest in well-defined time-bound projects that involve some degree of joint decisionmaking and risk-sharing; and
4. PPPs, characterized by a greater degree of joint decisionmaking and risk-sharing, along with a tendency toward more open-ended relationships.

Using their classification system, a joint venture would include an arrangement whereby a firm provides a university with a patent to promote further research, in return securing the rights to that research. A PPP, on the other hand, would describe an arrangement whereby a public university grants a startup firm with exclusive rights over a patent in exchange for an equity position in the firm.

Link (2002) classifies PPPs in the context of the U.S. research system as (a) technology development partnerships, (b) industrial problem-solving partnerships, (c) technology financing partnerships, (d) start-up assistance, and (e) teaming or strategic joint-research alliances. His taxonomy compares the economic objectives for creating partnerships against the public resources they mobilize. Economic objectives include

leveraging public R&D funds, enhancing industrial competitiveness, and leveraging industrial R&D, while public resources are described as financial, research, and infrastructural resources. He finds that cooperative R&D agreements (CRADAs) provide strategic access to all three forms of public resources to achieve the primary objective of leveraging public R&D.

This particular model has proven effective in promoting the commercialization of public agricultural research in the United States (Day-Rubenstein and Fuglie 2000; Fuglie and Schimmelpfennig 2000; Parker, Castillo, and Zilberman 2001).[5] It also mirrors many of the goals and resourcing strategies of PPPs in the CGIAR, as will be demonstrated later.

## The Study of Public–Private Partnerships in Developing-Country Agriculture

PPPs in agricultural R&D are increasingly popular in development-community rhetoric (see, for example, DFID 2003, USAID 2004, and WEF 2005). PPPs are expected to benefit public research systems by providing access to cutting-edge research tools, materials and proprietary knowledge; regulatory experience and skills needed to carry products through regulatory processes; and the know-how associated with product development, deployment, and marketing (Pray 2001; Pingali and Traxler 2002; Spielman and von Grebmer 2006). Such arrangements are also expected to benefit private firms by providing access to emerging markets in developing countries; locally specific scientific expertise and genetic materials; and opportunities to strengthen corporate social responsibility programs, corporate image, brand recognition among customers and the general public, and investor confidence (Byerlee and Fischer 2002; Hall and Yoganand 2004; Reinhardt 2004; Hall 2005).

[5] See Naseem, Omamo, and Spielman (2006) for a survey of the literature on the determinants of private investment in agricultural R&D, the market and institutional constraints that limit private investment growth, and the incentive mechanisms that can strengthen private investment responses in agricultural R&D—from both demand and supply sides—particularly in relation to pro-poor growth in developing countries.

The popularity of PPPs also stems from an environment of weak growth in public R&D expenditure in many developing countries and growth in private sector investment in the global agricultural R&D sector (Table 2).

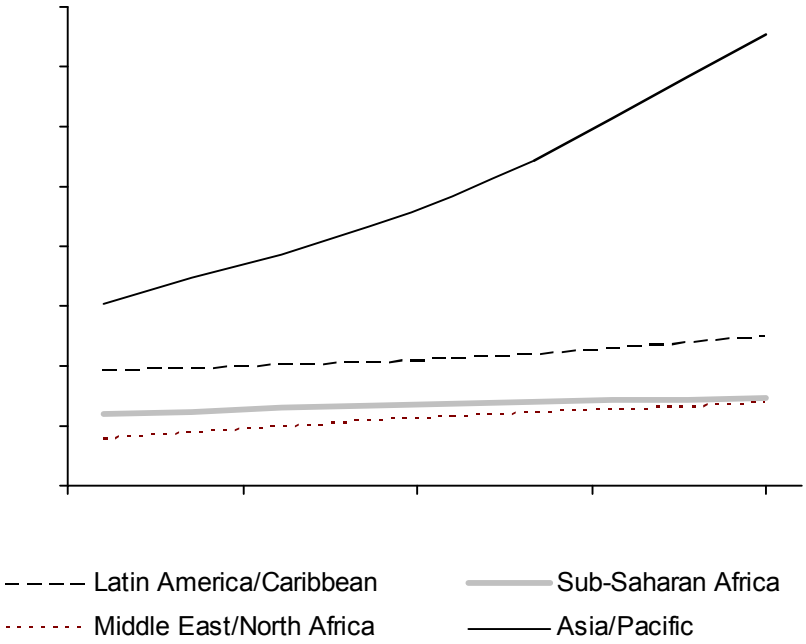
**Table 2. Public- and private-sector expenditure on agricultural research, c. 2000**

| | Expenditure (2000 million U.S. dollars, PPP adjusted)[a] | | | Share of total expenditure (percentage) | |
|---|---|---|---|---|---|
| **Region** | **Public** | **Private** | **Total** | **Public** | **Private** |
| Developing countries | 12,819 | 862 | 13,682 | 93.7 | 6.3 |
| Industrialized countries | 10,191 | 12,086 | 22,277 | 45.7 | 54.3 |
| Total | 23,010 | 12,948 | 35,958 | 64.0 | 36.0 |

Source: Pardey et al. 2006.
[a] Figures are expressed as real expenditures, calculated by deflating nominal expenditures in local currency using a 2000 price deflator and converting to U.S. dollars using purchasing power parity exchange rates for 2000.

To be sure, public expenditure on agricultural R&D is growing slowly in many developing countries and stagnating in regions such as Sub-Saharan Africa (Beintema and Stads 2006; Pardey et al. 2006) (Figure 1). And while the decline in donor funding for agriculture has reversed itself since 2003 with new donor commitments and new funding vehicles and programs, the long-term effects of the 15-year decline in research funding are evident in the quality of research infrastructure and scientific personnel in many developing countries. Private expenditure on agricultural R&D, on the other hand, is growing rapidly in some developing countries with increased domestic and global market opportunities, progress in the development of advanced agricultural technology, and stronger regulatory regimes that favor private investment (Pray and Fuglie 2001; Pray 2002).

**Figure 1. Public spending on agricultural R&D, by region, 1981–2000**




Source: Pardey et al. 2006.

Many of the studies on PPPs in developing-country agriculture focus on agricultural biotechnology, biosafety regulation, intellectual property rights (IPR), and ways in which proprietary knowledge can be transferred from the private sector in support of pro-poor PPPs. See, for example, Pray (2001) on biotechnology PPPs in Brazil, China, and India; Rausser (1999), Rausser, Simon, and Ameden (2000), and Byerlee and Fischer (2002) on IPR management tools to facilitate technology transfers and manage risks in agbiotech PPPs; and Krattiger (2002), Roy and Christy (2005), and Spielman, Cohen, and Zambrano (2006) on regulatory regimes to enable PPPs that accelerate the deployment of agbiotech applications.

While the emphasis on cutting-edge science and technology is not necessarily misplaced, Chataway (2005) and Hall (2005, 2006) suggest the need for greater analysis of the organizational practices and behaviors that allow for more effective exploitation of PPP–based approaches in agbiotech research. They argue that studies of PPPs (whether in

agbiotech or otherwise) should emphasize concurrent innovations at the institutional and organizational levels, explore more informal partnerships within clusters and networks and in more downstream research areas, and take a more systemic approach to institutional and organizational change in pursuit of greater innovation in developing-country agriculture. Hall's insights capture the importance of evolution in PPPs—that is, the movement through sequences of interactive learning cycles that allow for re-evaluation and readjustment of the collaboration. Studies by Hartwich, González, and Vieira (2005) on PPPs in agro-industrial research and Ekboir and Parellada (2002) on PPPs to promote zero-tillage cultivation provide useful illustrations of this focus.

## The Study of Public–Private Partnerships in the CGIAR

Other studies on PPPs focus specifically on the CGIAR given its pivotal role in the international agricultural research community. Özgediz and Nambi (1999) examine PPPs in the context of other forms of inter-organizational collaborations in the CGIAR, offering some of the earliest definitions, typologies, and recommendations for promoting partnerships in the system. Their study suggests the need for closer analysis of CGIAR partnerships, a better understanding of strategic fit among partners, efforts to build mutual trust among partners and exploit the natural role of centers as knowledge brokers, and improvement in the management of partnerships.

A later study by Binenbaum, Pardey, and Wright (2001) homes in on the issue of strategic fit and honest brokerage by examining how the PPP model can be applied to the exchange of proprietary knowledge between the CGIAR and the private sector. This theme is repeated in a study by Spielman and von Grebmer (2006) that examines why this PPP model is not more common in the CGIAR, pointing to mutually negative perceptions on the part of both sectors, prohibitive direct and indirect costs, and risks associated with the use of proprietary knowledge. Henson-Apollonio (2005) offers technical insights into the specific design of collaborative agreements for use by centers in exchanging proprietary knowledge with the private sector.

Center-specific studies provide further insights into PPPs in the CGIAR. An early study by Denning and Bernardo (1995) on partnerships to commercialize improved seed and agricultural machinery by the International Rice Research Institute (IRRI) suggests that such efforts incurred significant intangible costs that necessitate further exploration of alternative management approaches for partnership-based projects. Other studies describing the operating principles of a successful PPP include Patiño and Best (2002) on the Latin American and Caribbean Consortium to Support Cassava Research and Development (CLAYUCA) of the International Center for Tropical Agriculture (CIAT); Reddy, Bussiere, and Greenaway (2001) and Gowda et al. (2004) on the Hybrid Parents Research Consortia of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); and Binenbaum (2006) on the Latin American Fund for Irrigated Rice (FLAR).

A study by Ayele, Chataway, and Wield (2006) examines 12 partnership-based agricultural biotechnology projects in Kenya, five of which include CGIAR centers, namely the International Maize and Wheat Improvement Center (CIMMYT), the International Potato Center (CIP), and ICRISAT. Findings suggest that these partnerships tend to be small, donor-dependent, and loosely coordinated; highly supply-driven rather than end-user oriented; and limited in scope with respect to their impact on agricultural innovation and poverty reduction.

Several other center-specific studies also highlight the role of PPPs in the context of organizational innovation. For example, studies of ICRISAT's PPP experiences by Hall et al. (2003) and Dar and Bantilan (2006) describe how the interplay between public and private research actors in PPPs is critical to promoting innovation in the center's organizational behaviors and practices. A study by Smith (2005) of the East Coast Fever (ECF) Vaccine project of the International Livestock Research Institute (ILRI) similarly describes how the collaborative, disembedded nature of a PPP helps to overcome organizational sclerosis and inward-looking tendencies of research organizations, and

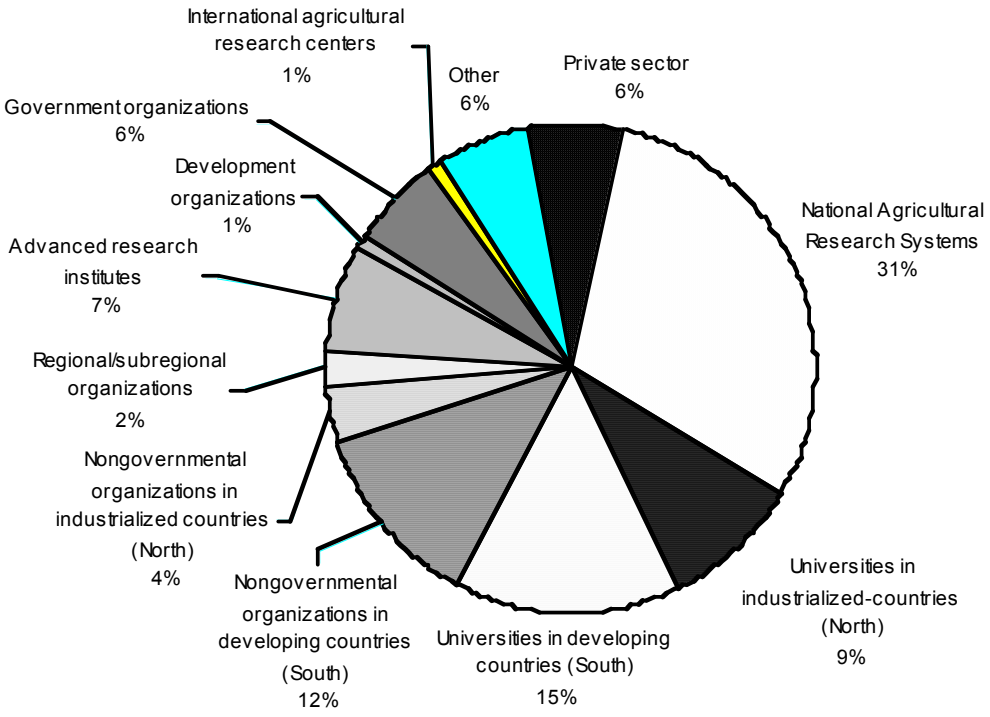
how a market-oriented, results-based outlook drives partners to produce real outcomes.[6] A study of watershed research at ICRISAT by Shambu Prasad, Laxmi, and Wani (2006) draws similar conclusions about organizational change and institutional learning, as do studies of IRRI's capacity to manage intellectual property by Egelyng (2005) and CIAT's Rural Agroenterprise Development Project by Lundy, Gottret, and Ashby (2005).

There are, however, few system-level studies of PPPs in the CGIAR. A notable exception is a recent study conducted by the CGIAR Science Council Secretariat (2006) of collaborative research projects in the CGIAR. Results from its survey of 14 centers show that the private sector represents only 6 percent of the 3,395 organizations working in collaboration with the centers, while a second survey of 11 centers shows the private sector represents just 4 percent of the centers' highly relevant collaborations (Figure 2).[7] The study's findings suggest that the private sector's role in the CGIAR is marginal relative to the role of its traditional partners in the public sector.

[6] Goldberg (2001) also offers insights through a case study analysis of the early stages of the ECF vaccine project that highlight associated organizational changes within ILRI.

[7] Note, however, that the CGIAR Science Council Secretariat (2006) study encounters the same definitional problems described earlier, including the term "collaboration." The report suggests that the completeness of information reported by the centers was affected by how the center categorized their partners (public, private, civil society, and so on); which unit was involved in the collaboration (that is, whether the partnership was conducted at an individual, project, divisional, or organizational level); and how information was aggregated (for example, by theme, project, activity, or task).

**Figure 2. Types of organizations with which the CGIAR System collaborates**




Source: CGIAR Science Council Secretariat 2006.
Notes: N indicates North (that is, industrialized countries); S, South (that is, developing countries); RO, regional organizations; SRO, subregional organizations; ARI, advanced research institutes; DEVO, development organizations; GO, governmental organizations; and IARC, international agricultural research centers.

Common to many of the studies on public–private partnerships in the CGIAR cited above is the argument that, while PPPs are a constructive means of promoting technological, institutional, and organizational innovation, their success often rests on meeting the following important requirements:

- Clearly defined objectives, roles, and responsibilities that are compatible with the incentive structures, competencies, and/or comparative advantages associated with individual partners
- Bridge-building mechanisms to overcome tensions caused by the cross-sectoral mistrust, misperceptions, and unclear expectations of partners
- Mechanisms to ensure commitment and ownership—that is, ways to ensure that all partners contribute to the innovation process; that the relationships between partners remain durable and sustainable; and that roles, responsibilities, and benefits are distributed equitably

- Organizational innovations—that is, internal changes in structures, behaviors, and practices—as well as technological innovation
- Tools to manage and mitigate risk both individually and jointly, particularly in the context of uncertain research outcomes or a risky research environment
- Innovative mechanisms (both formal and informal) to manage the exchange and use of knowledge, particularly knowledge that is proprietary or subject to some form of IPR

These findings are examined in detail throughout the remainder of this paper.

## 3. CONCEPTUAL FRAMEWORK

Conceptually, PPPs are one of several means of organizing the production of some output—in this case, agricultural knowledge and technology. The knowledge production process is subject not only to the usual constraints imposed by the costs of physical and human capital, but also to constraints associated with the exchange and use of knowledge. In other words, certain barriers impede the otherwise smooth process of exchanging and using knowledge necessary to the innovation process. Here, these barriers are described in terms of market failure, institutional constraints, and systemic weaknesses, each of which is discussed below (Table 3).

**Table 3. Market failures, institutional constraints, and systemic weaknesses**

| Type of failure | Common examples |
|---|---|
| Market failure | Public goods research on new agricultural technologies for "orphan" crops such as millet, sorghum, roots, and tubers |
| Institutional constraints | Absence of IPR regimes to reward innovators; asymmetries of information between seed buyers and sellers |
| Systemic weaknesses | Mistrust and misperceptions between agents; inability to communicate or resolve conflicts |

Source: Authors.

### Market Failure

Conventional market failure in the exchange of knowledge results from several factors including the public goods characteristics of knowledge (that is, its nonexcludable and nonrival properties), limited willingness or ability to pay by farmers with constrained market access or purchasing power, the inability of small firms to access the capital markets needed to finance knowledge acquisitions, and poor market infrastructure (Martin and Scott 2000; Dalrymple 2006).

A classic example of market failure in agricultural research is commonly found in developing-country markets for improved planting materials for "orphan" crops of marginal commercial value, such as sorghum, millet, groundnut, pigeonpeas, cassava, or sweet potato (Tripp 2000; Herdt 2001). In cases where farmers can replant saved seed, capturing the gains conferred by research, and private firms cannot prevent them from

doing so through legal or technological means, the profit-maximizing private firm will optimally choose not to invest in research, thus creating a chronic undersupply of improved seed (see Evenson and Kislev 1973 and Pray and Fuglie 2001). This necessitates public-sector intervention in the market, typically through the financing and management of plant-breeding programs.

PPPs attempt to address this market failure in another way—by strengthening market and nonmarket incentives for private investment in agricultural research (see Day-Rubenstein and Fuglie 2000 and Fuglie and Schimmelpfennig 2000). PPPs can encourage private investment by implicitly subsidizing the cost of conducting private research, for example, by providing access to publicly held plant genetic materials that are otherwise difficult for the private sector to access or by providing valuable assistance in navigating unfamiliar regulatory or administrative procedures. They can also encourage private investment by providing certain externalities appropriable by the firm, for example, by assisting firms in their efforts to strengthen corporate image, social responsibility programming, and brand recognition as a means of securing support from customers, investors, and the general public.

### Institutional Constraints

Yet the concept of market failure represents just one way of examining impediments to the exchange of knowledge. The absence of effective institutions to govern knowledge exchange provides another perspective on the problem. Instruments, such as property rights regimes and contract enforcement norms are essential to ensuring the costless exchange of knowledge. Where they do not exist or are not sufficiently robust, knowledge exchange may incur transaction costs above and beyond the actual outlays and opportunity costs associated with the exchange (Williamson 1975, 1985).

Alternatively, institutional mechanisms may emerge to minimize these transaction costs, thus encouraging knowledge exchange (Williamson 1991). Returning to our earlier example, consider the institutional mechanisms commonly developed in response to market failure for improved planting material. IPR, such as plant variety protection and

breeders' rights, are mechanisms developed to reward innovators for their successful investments in cultivar improvements, thereby reducing the transaction costs associated with contested claims over the rights to innovation rents, while simultaneously incentivizing innovative behavior. Similarly, quality assurance and certification systems for planting materials are mechanisms designed to address information asymmetries resulting from the inability of farmers to make ex ante assessments of seed quality when such information is known only by the seller (Tripp and Louwaars 1997; Gisselquist and van der Meer 2001; Tripp 2001).

Where institutional mechanisms are insufficient to facilitate knowledge exchange, other organizational mechanisms may emerge. Vertical integration of an entire value chain, for example, is a firm's solution to its inability to otherwise enforce contracts with suppliers, ensure timeliness of supply, or control for the quality of inputs to its production process (Williamson 1991). In keeping with the example given above, consider the approach taken by Monsanto, a multinational cropscience firm, with the introduction of a genetically modified insect-resistant cotton cultivar in Mexico. Farmers and gin owners were engaged in contracts that obliged farmers to forfeit their right to save seed, while farmers were further obliged to accept spot checks of their cultivated land by Monsanto, have their cotton ginned in Monsanto-authorized gins only, and accept other provisions meant to protect Monsanto's IPR and its ability to appropriate a portion of the benefits accruing from its investments in research (Traxler et al. 2003; Traxler and Godoy-Avila 2004; Smale et al. 2007). In short, Monsanto organized the production process to address its concerns that the legal environment would not provide adequate recourse in the event that farmers or ginners replanted or sold saved seed without payment to the firm in consideration for its research investment, embodied in the improved cultivars.

But where such institutional or organizational arrangements are absent or difficult to arrange, PPPs are an alternative method of addressing the transaction cost problem. PPPs are an organizational arrangement that overcomes such institutional constraints as the absence of sufficient regulation and enforcement; the prohibitive costs of exchanging knowledge between public and private researchers through market mechanisms; the

prohibitive costs of producing knowledge in isolation; or the inability of a given agent to use knowledge that is overly complex, context-specific, or dependent on more than one agent.

However, the relative benefits of a PPP over alternative arrangements must also be considered against the coordination costs associated with organizing, executing, and sustaining the PPP. Coordination costs are typically incurred by efforts undertaken to ensure the sustained commitment and participation of parties to a PPP and to prevent free-riding, whereby partners minimize their contribution relative to their expected benefits. Commitment mechanisms incur costs associated with allocating time and effort to strengthening trust, awareness, and leadership; conducting repeated interactions among partners; or monitoring other partners' contributions.

### Systemic Weaknesses

Such issues suggest the need to dig deeper into the underlying nature of coordination among heterogeneous innovation agents. A systems perspective addresses this need by providing a more nuanced understanding of agents' routines, behaviors, and practices; the nature of their actions and interactions; and the dynamics of their learning and change processes (Nelson and Winter 1982; Lundvall 1988; Metcalfe 1988). The systems perspective offers insights into the formal and informal organizational structures, routines, procedures, and behaviors needed to create environments that allow individual and collective expressions of innovative capabilities (Revilla, Sarkis, and Acosta 2005).

In the exchange of knowledge, systemic weaknesses are reflected in the inability of agents to learn about each other, identify areas of complementarity and synergy, build and sustain trust through interpersonal or organizational relationships, communicate and exchange ideas effectively, or respond to leadership. For example, while the transfer of a transgenic construct from a private firm to a public research organization may provide scientists with an important tool to further their research in plant varietal improvement, a simple contractual exchange fails to bring with it several implicit elements. This might include assurances to the firm that the construct will be carefully stewarded to prevent

misuse or abuse, an understanding that the construct will be used for the public good rather than private benefit, or an unwritten agreement the construct will be used in conjunction with exchanges of the tacit knowledge relating to its effective application (see Spielman and von Grebmer 2006).

Thus, PPPs attempt to address weak innovation systems by opening opportunities for interactions and learning processes that can potentially lead to synergistic innovation processes. The implementation of a partnership "platform" for example, brings with it not only exchanges of resources and materials embedded with technical or scientific knowledge, but also exchanges of implicit knowledge, such as routines and behaviors that can improve the efficiency of the entire innovation process.

## 4. METHODS AND DATA

The conceptual complexity of PPPs described above suggests the need to study not only their outcomes and impact—such as farmer adoption rates for a new crop variety or the rate of return on a research investment—but also the partnership process and the evolution of the partners themselves. To do so, this study relies primarily on qualitative methods of inquiry to assemble data and information for analysis. The study uses four specific tools—document analysis of PPP–related materials, semi-structured interviews with key informants engaged in PPP projects, an email survey of center PPPs, and development of a functional typology of PPPs—described below.[8]

### Document Analysis

The analysis of PPP–related documents focused on materials available in the public domain and internal materials made available through personal communications. Documents examined by the study team included descriptive project literature, project evaluations, corporate publications, conference proceedings, press releases, and website information obtained from the public domain, as well as documents provided by centers and firms, such as material transfer agreements, letters of agreement, terms of reference, business plans, commercialization agreements, financial reports, internal presentations, personal communications, and partnership engagement policies.

Additional documentation was extracted from the proceedings of a conference held in 2005 on PPPs in international agricultural research (IFPRI 2006). Taken together, the document analysis generated an initial inventory of 48 PPPs in the CGIAR. This information was then used to identify centers for further study through the key informant

[8] Note that this study does not use cost–benefit analysis or scorecard/benchmarking tools to quantify or compare PPPs. These potentially valuable tools were not applied here for several reasons. First, these tools would require that PPP performance be quantified. This is difficult to do, given that the vast majority of PPPs in the CGIAR are ongoing projects with outputs still in the pipeline. Second, tools such as scorecard/benchmarking would require some criteria against which to evaluate PPP performance. While the CGIAR and center research priorities offer something of a benchmark, comparisons of PPP performance against these priorities are often difficult to quantify. Third, the diverse objectives and characteristics of PPPs in the CGIAR suggest that comparisons across PPPs, while feasible, may not in fact contribute to an understanding how PPPs reduce costs, enhance innovation, and reduce poverty.

interviews and to design a CGIAR center survey of PPPs that led to the identification of a total of 75 PPPs.[9]

## Key Informant Interviews

Based on the inventory, the study team identified, for further examination, five centers currently engaged in PPP projects. Within each center, the study team chose several focal PPPs with a view to ensuring some degree of heterogeneity in terms of PPP type and the availability and accessibility of partners. A total of six focal PPPs from four centers were examined based on information gathered from interviews with key informants drawn from public, private, and civil society partners (Table 4).

Additional PPPs were also covered in the interviews to obtain supplementary information on cross-cutting issues; however, the availability and accessibility of partners (particularly from the private sector) were more limited in these cases.[10]

[9] This figure is inclusive of all CGIAR centers and programs. Note that while the CGIAR Challenge Programs were included in the initial document analysis and subsequent interviews, there was no information to suggest that components of the existing Challenge Programs were PPPs, as defined here. Also note that document analysis was also conducted to determine whether the three centers that did not respond to the email survey (described below) were nonetheless involved in PPPs. Results are presented in Table 8.

[10] These partnerships included the On-Farm Innovative Enterprises in Watershed Program at ICRISAT, Allanblackia Development for Smallholder Cultivation at the World Agroforestry Centre, the Latin American Fund for Irrigated Rice at CIAT, and various commercialization activities at the International Centre of Insect Physiology and Ecology (ICIPE), a non–CGIAR center. The inclusion of ICIPE in this study provided insight into alternative partnership approaches taken by a research organization with a mission, mandate, and program bearing both similarities to and differences from those of the CGIAR centers.

**Table 4. Focal CGIAR centers and public–partnership projects**

| Focal center/location | Focal partnership |
|---|---|
| International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patencheru, India | Agribusiness incubator and hybrid parent line consortia |
| International Center for Tropical Agriculture (CIAT), Palmira, Colombia | CLAYUCA and rose powdery mildew research |
| International Livestock Research Institute (ILRI), Nairobi, Kenya | East Coast Fever Vaccine research |
| International Maize and Wheat Improvement Center (CIMMYT), Nairobi, Kenya | *Striga*-resistant maize research |

Source: Authors.
Note: For a list of the partners in each focal partnership, see the online database accompanying this study, at http://ifpri.catalog.cgiar.org/pppdbase.htm.

Semi-structured interviews were conducted with key informants drawn from the public, private, and civil society sectors (Table 5). The interviews were conducted based on a list of questions that were pre-tested at ICRISAT in Patencheru, India, in early 2006 (Appendix A). Questions were conducted as reflective "conversations" with key informants and focused on project objectives, partner goals, operations and management, interaction processes, organizational change, and poverty impacts.

**Table 5. Semi-structured interview subjects, by affiliation**

| Affiliation | Number of interviews |
|---|---|
| International agricultural research organizations | 40 |
| Private firms | 21 |
| Government agencies[a] | 3 |
| Nonprofit/nongovernmental organizations[b] | 7 |
| Charitable foundations and donor agencies | 4 |
| Total | 75 |

Source: Authors.
[a] Government agencies include national agricultural research organizations and ministries of agriculture.
[b] Nonprofit/nongovernmental organizations include independent entities established to manage a public–private partnership, organizations engaged in international technology transfer activities, and conventionally defined nongovernmental or community-based organizations.

## CGIAR Center Survey

Supplementary data were gathered from an email survey sent to the director generals of the 15 CGIAR centers in May 2006 (Appendix B). A total of 12 centers responded to the

survey and follow-up queries, and where responses were incomplete alternative sources of information were used. Survey questions were designed to assemble basic information on the purpose, partners, outcomes, duration, and budgets of center PPPs. Centers were asked to describe the purpose of the partnership in terms of the five functional categories described earlier, as well as its goals based on the following four categories:

1. to access new scientific knowledge from the private sector,
2. to reduce research costs by partnering with the private sector,
3. to translate research outputs into products for the poor, and
4. to bring the center into closer contact with the poor.

While the survey was designed to capture PPPs according to the narrow definition described earlier, centers were allowed to submit data on interactions with the private sector that might fall under the wider definition. This includes, for instance, funding relationships with private foundations, research subcontracted to the private sector, and research outsourced by the private sector to a center.

## A Functional Typology

Finally, the study team developed a rudimentary classification of partnerships to capture the specific roles played by each partner, the distribution of risk across partners, and the overall goals of the partnership (Table 6). This classification can be described in five functional categories:

1. *Resourcing partnerships.* CGIAR centers receive funding from philanthropic foundations associated with private firms, or they receive scientific expertise from private firms.
2. *Contracting partnerships.* CGIAR center facilities or expertise are contracted to private firms, or CGIAR centers contract private firms to conduct research.
3. *Commercializing partnerships.* CGIAR centers transfer research findings and materials to private firms for commercialization, marketing, and distribution.
4. *Frontier research partnerships.* CGIAR centers jointly undertake research activities characterized by some unknown probability of success.
5. *Sector/value chain development partnerships.* CGIAR centers collaborate with networks of public, private, and civil society partners to develop a commodity subsector or its associated value chain.

**Table 6. A typology of public–private partnership**

| Type of partnership | Role | | | Main risk bearer | Hypothetical impact of different public–private partnership goals | | |
|---|---|---|---|---|---|---|---|
| | Private sector | Public sector | Civil society | | Cost reduction | Agricultural innovation | Poverty reduction |
| Resourcing | Financing | R&D | | Public | +++ | + | + |
| Contracting | R&D | Facilities, expertise, funding | | Private | +++ | + | + |
| Commercial-ization | Product deployment | R&D | Product deployment, monitoring and evaluation | Private | +++ | + | ++ |
| Frontier research | R&D, financing | R&D, financing | | Private, Public | ++ | +++ | + |
| Sectoral/ value-chain development | R&D, planning, financing, product deployment | R&D, planning, financing | Planning, financing, product deployment, monitoring and evaluation | Public, private, civil society | + | +++ | +++ |

Source: Authors.
Note: + indicates the hypothetical degree of positive impact that the public–private partnership may generate in relation to the three goals identified in this study.

The typology set forth above helps to address the research questions posed by this study and sheds light on the policy, institutional, and organizational environment underlying PPPs in the CGIAR. This includes topics such as risk management solutions; financial incentives; organization and management options; legal, contractual, and regulatory guidelines; means of generating interest and political will; and documentation of lessons learned from demonstrable successes. Implicitly, these answers can provide evidence in the CGIAR on where the system stands with respect to the private sector, and how it should direct its priorities in the future.[11]

[11] The priorities of the CGIAR system are (1) sustaining biodiversity for current and future generations; (2) producing more and better food at lower cost through genetic improvements; (3) reducing rural poverty through agricultural diversification and emerging opportunities for high-value commodities and products; (4) promoting poverty alleviation and sustainable management of water, land, and forest resources; and (5) improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger (CGIAR 2006a).

## 5. KEY FINDINGS AND RESULTS

With the parameters of the study defined, data and information assembled can now be presented, specifically in terms of the level and size of PPPs in the CGIAR; their types and characteristics; and the extent to which they contribute to reducing research costs, fostering innovation, or enhancing outreach to the poor. (For further details, see the online database at http://ifpri.catalog.cgiar.org/pppdbase.htm.)

### Survey Results and General Descriptors

The study identified 75 PPPs in the CGIAR that were active in 2004 or later. Of these, 47 partnerships (63 percent) are concentrated in four of the CGIAR's larger or older commodity centers: CIAT, CIMMYT, ICRISAT, and IRRI (Table 7).

Findings show that 43 of the partnerships (57 percent) are collaborations that include *foreign* entities, a category that includes foreign (industrialized-country) firms, multinational firms, or international/regional industry associations and charitable foundations. An equal number and proportion of partnerships are collaborations that include *domestic* entities, that is, developing-country firms, private research organizations, producer associations, and local industry associations and charitable foundations (Figure 3). The overlap between these two categories is relatively small: only four partnerships engage both foreign and domestic entities (5 percent).

Moreover, only 30 PPPs (40 percent) engaged public-sector partners, either foreign or domestic. Only 18 PPPs (24 percent) engaged national agricultural research organizations in developing countries, organizations that represent the CGIAR's traditional partners.

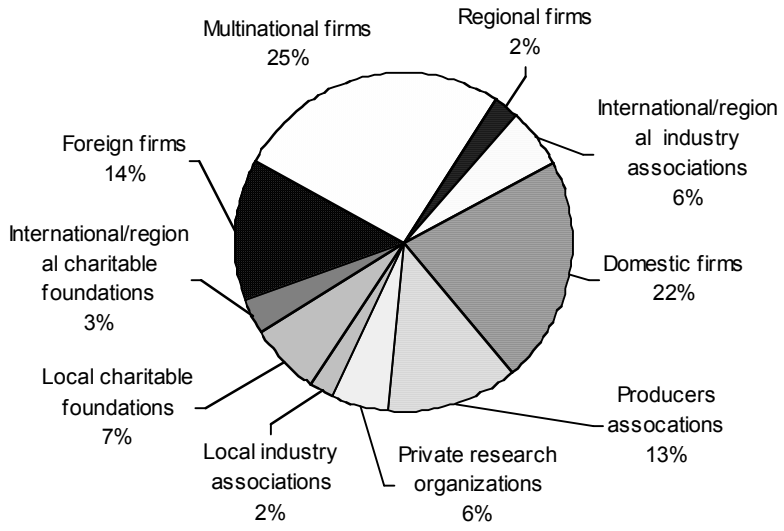
**Table 7. Distribution of public–private partnerships in the CGIAR, by center since 2004**

| Center | Number | Share of total |
|---|---|---|
| International Rice Research Institute (IRRI) | 17 | 23 |
| International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) | 11 | 15 |
| International Center for Tropical Agriculture (CIAT) | 10 | 13 |
| International Maize and Wheat Improvement Center (CIMMYT) | 9 | 12 |
| Bioversity International[a] | 8 | 11 |
| International Center for Agricultural Research in the Dry Areas (ICARDA) | 6 | 8 |
| International Institute of Tropical Agriculture (IITA) | 5 | 7 |
| International Livestock Research Institute (ILRI) | 4 | 5 |
| International Water Management Institute (IWMI) | 3 | 4 |
| World Agroforestry Centre | 3 | 4 |
| International Potato Center (CIP) | 1 | 1 |
| International Food Policy Research Center (IFPRI) | 1 | 1 |
| Africa Rice Center (WARDA) | 1 | 1 |
| WorldFish Center | 0 | 0 |
| Center for International Forestry Research (CIFOR) | 0 | 0 |
| Total | 75 | 100 |

Source: Authors.
Notes: A total of 75 partnerships were identified through the survey and other sources; four of these are multicenter partnerships. CIFOR, IITA, and the World Agroforestry Centre did not provide survey responses. For CIFOR, information on public–private partnerships could not be obtained by any method; for IITA, information was obtained through document analysis; for the World Agroforestry Centre, information was obtained through document analysis and key informant interviews.
[a] Formerly the International Plant Genetic Resources Institute (IPGRI).

Findings further show that a high proportion of PPPs in the CGIAR are exclusive collaborations. A total of 45 partnerships (60 percent of the total) involve exclusive relationships with the private sector that do not involve other public-sector or civil society organizations. Further, 32 of these exclusive partnerships (43 percent of the total) are also "monogamous," meaning they involve just one center and one private-sector partner. Of these monogamous PPPs, 21 involve foreign entities (66 percent), and, of those, multinational firms accounted for slightly less than half (9 partnerships or 12 percent of the total). The remaining 11 PPPs (34 percent) are collaborations with domestic entities. Relatedly, exclusive PPPs with foreign entities tended to be smaller (three partners on average) than PPPs with domestic entities or a combination of foreign and domestic entities (six partners on average).

**Figure 3. Private-sector partners in the CGIAR system, by type**




Source: Authors.

Project size as measured in terms of annual budget ranges from less than US$5,000 to US$923,000, with a mean budget of approximately US$186,000, based on 45 PPPs for which financial information was provided. Extrapolating from the available data, PPPs represent just 4 percent of the CGIAR's aggregate financing averaged over the period 2001–05.

Note, however, that these data are subject to several limitations that make both system-level analysis and comparisons across PPPs difficult. First, where survey responses provide total rather than annual budget data, the budget is determined by simply dividing the total budget by the project's duration. Second, budget data rarely include the in-kind contributions of private firms to a PPP. Third, while some data are based on the center's portion of a project budget (possibly, but not necessarily, representing outlays for the entire project), others are based on project revenues, that is, the income generated to support project operation (Table 8).

**Table 8. An overview of public–private partnerships in the CGIAR**

| Details of partnership | Statistics | |
|---|---|---|
| Budget and duration | Mean | Standard deviation |
| Annual project budget (U.S. dollars)[a] | 186,152 | 234,039 |
| Project duration (years) | 4.2 | 2.8 |
| Private-sector partners per partnership[b] | 1 | 4.6 |
| Other partners per partnership[b,c] | 0 | 2.7 |
| Total partners per partnership[b] | 2 | 5.6 |
| Exclusivity and monogamy | Number | Percentage |
| Partnerships with foreign private-sector entities only | 40 | 53 |
| Partnerships with domestic private-sector entities only | 31 | 41 |
| Partnerships with both foreign and domestic entities | 4 | 5 |
| Partnerships with 1 private-sector partner only | 45 | 60 |
| Partnerships with 2–10 private-sector partners | 27 | 36 |
| Partnerships with more than 10 private-sector partners | 4 | 5 |
| Partnerships with multinational firms | 23 | 31 |
| Crop-science firms | 15 | 65 |
| Agri-food firms | 6 | 26 |
| Other firms | 2 | 9 |
| Partnerships with the public sector | | |
| Partnerships with public-sector organizations | 19 | 25 |
| Partnerships in agricultural biotechnology | 14 | |
| Multinational firms | 7 | |
| Total number of partnerships | 75 | |

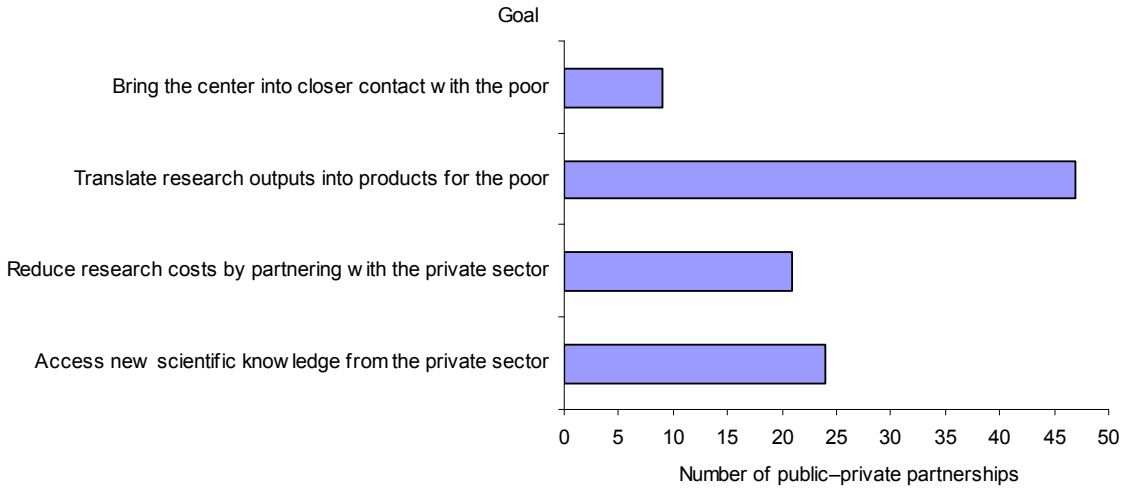
Source: Authors.
[a] Budgets figures cited here refer to total project budgets as reported by the centers surveyed and refer to financial (but not in-kind) contributions. Financing sources may include donor agencies, private foundations, and other sources of funds.
[b] Averages are given as median figures.
[c] This category includes public research organizations, public organizations, international organizations, international development organizations, advanced research institutes, nongovernmental organizations, community-based organizations, and public universities in both industrialized and developing countries (see Table 1).

The mean duration of a PPP in the CGIAR is approximately 4.2 years, ranging from several months to 12 years. In general, low-budget, short-term PPPs were associated with projects such as scientific exchanges with the private sector conducted at the International Food Policy Research Institute (IFPRI) and the International Water Management Institute (IWMI). Big budget, long-term PPPs included both frontier

research projects at CIMMYT, ILRI, and IRRI that involve technology licensing agreements, and well-established multistakeholder platforms such as CLAYUCA and FLAR at CIAT.

More detailed findings show that 28 percent of PPPs reviewed exist for the purpose of sectoral or value-chain development, followed by resourcing (23 percent), contracting (21 percent), commercialization (16 percent), and frontier research (12 percent). Findings further suggest that 47 percent of these PPPs aim to translate research outputs into products for the poor, followed by accessing knowledge from the private sector (24 percent), reducing research costs by partnering with the private sector (21 percent), and bringing the center in closer contact with the poor (9 percent) (see Figure 4).

**Figure 4. The goals of public–private partnerships in the CGIAR**

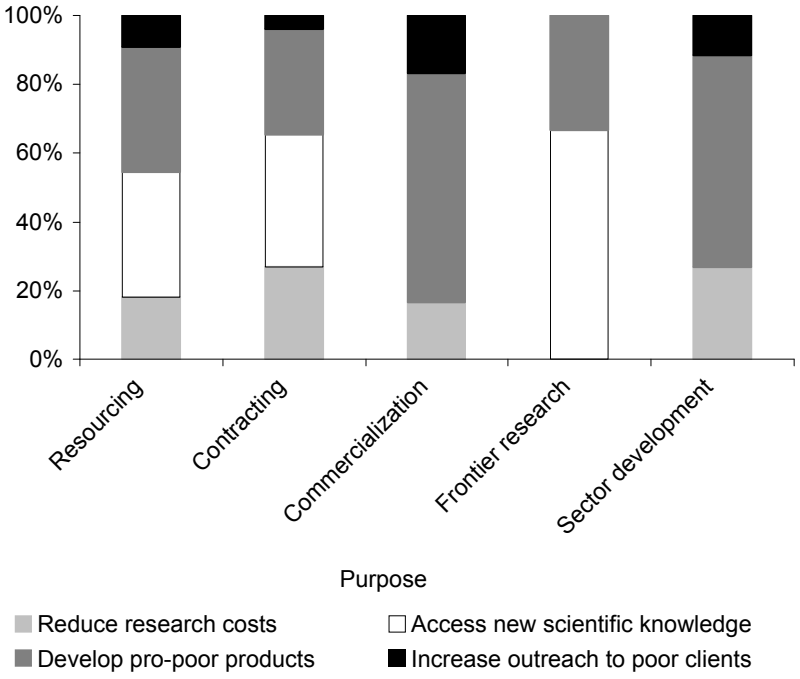



Source: Authors.
Note: Data include reports of multiple goals for a given partnership.

When viewed together, these findings suggest that PPPs in the CGIAR are relatively concentrated in two main areas: pro-poor product development in technologies relating to crop production and value addition, and accessing knowledge from the private sector to further center research. These findings offer several additional insights that are summarized here and examined in detail below (see Figure 5).

- While centers partner with both foreign and domestic entities, PPPs with foreign entities tend to be exclusive or monogamous, while PPPs with domestic entities tend to be larger, multistakeholder undertakings.
- The number of partners in a given PPP where domestic entities are key players suggests that some centers are playing a strategic role in private-sector development.
- Centers are generally collaborating with the private sector to generate additional resources for research, contract for scientific services and materials, and commercialize existing research outputs. However, centers are generally not using PPPs as a vehicle for jointly conducting cutting-edge science with the private sector.
- Centers are involving relatively few national agricultural research organizations in developing countries in their PPPs.

**Figure 5. Goals and purposes of surveyed public–private partnerships in the CGIAR**




Source: Authors.
Note: Data include multiple responses on public–private partnership goals.

## Domestic and Foreign Partners

*Partnerships with Domestic Entities*

As shown above, centers partner with a range of national and local private-sector entities in developing countries, including small firms, industry associations, producer associations, and private research organizations. Alternative partners may exist in the private sector, but they are rarely structured or organized to take advantage of small market opportunities or low-income clients. State-owned seed monopolies, for instance, have little or no incentive to exploit new markets or develop innovative products given their control over supply or price. Multinational firms, on the other hand, have limited interest in serving clients with limited purchasing power or market access, selling products for which they cannot recoup their R&D costs under weak regulatory regimes, or investing in the long-term—but uncertain—potential of emerging markets in many developing countries. The study identifies three modalities of partnering with domestic firms:

1. *Commercialization of improved varieties,* where domestic seed companies partner with centers to commercialize improved plant varieties or hybrids. While such firms may have varying capacity to conduct plant breeding, they generally bring market information and distribution networks to the partnership, thus assisting in moving center materials to end-users. Examples include ICRISAT's Hybrid Parents Research Consortia.
2. *Private-sector incubation,* where centers operate programs, facilities, or support services to strengthen private-sector investment in agricultural research. Examples include ICRISAT's Agri-Business Incubator (ABI) and CIAT's AGRONATURA science park.
3. *Multistakeholder platforms,* where centers collaborate with domestic agroprocessing companies, producer associations, industry associations, and other entities to add value to a given agricultural commodity or develop its agricultural value chain. While many centers contribute to these platforms through plant breeding and related research, the centers' main role is often one of convener or facilitator. Examples include CLAYUCA and FLAR at CIAT, or the Sustainable Tree Crop Program in IITA.

These types of partnerships play a role in moving center research into commercial products and stimulating private-sector development. Each of these is examined below.

First, these types of partnerships can play a vital role in strengthening the ability of centers to move research outputs into deployable products more rapidly, while simultaneously providing domestic firms with materials and expertise that contribute to their market competitiveness. This is particularly important for commodity-based centers such as ICRISAT. In India, ICRISAT's Hybrid Parents Research Consortia brings together 34 small- and medium-sized domestic firms for the purpose of commercializing sorghum, millet, and pigeonpea hybrids, thus contributing to the commercial viability of both domestic seed firms and the wider seed market in India. In Mozambique, ICRISAT's negotiations with Mozambique Leaf Tobacco (MLT) are opening up similar opportunities with a project that is expected to supply domestic seed companies with the materials and know-how to supply high-quality groundnut seed to smallholder tobacco farmers who are diversifying their farming practices to improve their long-term sustainability.

Second, these partnerships can play a role in stimulating private-sector development, often in countries where agricultural input markets are still emerging from the shadows of state-owned monopolies. By supplying improved materials to private firms, supporting these materials with investments in capacity strengthening, and supporting political advocacy on legal and regulatory issues, centers are ideally contributing to the development of efficient private markets and innovative firms. This issue is nontrivial to the success of the CGIAR.

CIAT, for example, hosts private companies and other research, technology, and development organizations at its AGRONATURA Science Park. Currently the park supports 16 research organizations, including several CGIAR centers, Colombian biotechnology companies, and nongovernmental organizations (NGOs) involved in development. The park not only provides physical space and opportunities for interaction with CIAT researchers, but also aims at building institutional relationships, financing new research projects, and promoting private-sector research by partnering the center with multiple public organizations and privates firms to promote research. Drawing on lessons learned from both FLAR and CLAYUCA, the AGRONATURA venture has

emerged as an important new means of promoting partnerships between CIAT research and the private sector. However, several issues are worth noting with respect to CGIAR partnerships with domestic firms, all of which are based on insights shared by key informants.

First, centers' close relationships with small firms sometimes circumvent national research programs. The argument and its counter-argument—that many national research organizations are incapable of translating research into deliverable products of desirable and consistent quality for farmers—are old refrains among centers and their national partners in the public sector (see, for instance, World Bank 2004). While the findings presented here are unlikely to shed light on this continuing debate, it is worth noting that some centers are far more engaged with domestic firms (at the expense of their national public-sector partners) through their PPPs than others, suggesting that the degree of "circumventing" behavior varies across centers.

Second, the size and impact of PPPs that rely on domestic firms are often constrained by firm-level capacity and limited market infrastructure in developing countries. Consider CIMMYT's *Striga*-Resistant Maize project, designed to develop and commercialize improve maize seed coated with an herbicide that provides the seed with resistance to a prolific weed found in East Africa. Only one of the three small domestic firms engaged in the project actually operates a breeding program, while all three are struggling to compete against the Kenya Seed Company, a company closely associated with government interests (though not directly state-owned) that still controls 86 percent of the Kenya maize seed market.

Third, centers have widely varying strategies on the extent to which they engage in the wider issue of local private-sector development. Centers such as ICRISAT and CIAT argue that the need to commercialize their own research and generate impacts on their target beneficiaries *necessitates* their investment in private-sector development at the domestic level. ILRI, on the other hand, chooses to play a relatively minor role in building private-sector capacity *directly*, instead focusing on its comparative advantage in

scientific research, while allocating private-sector development to its national partners.[12] This arms-length approach to private-sector development differs from the approach taken by CIAT and ICRISAT and is significantly based on differences in organizational cultures and histories.

### *Partnerships with Foreign Entities*

Centers also partner with many of the leading multinational firms in the crop-science sector—primarily industry leaders such as Syngenta, Pioneer Hi-Bred International, and Monsanto. Of the 22 PPPs that involve multinational firms, 64 percent are collaborations with crop-science firms; 23 percent with agri-food firms; and 14 percent with other, largely biomedical, firms (Table 9). Of the 14 PPPs that involve some application of advanced agricultural biotechnology, just half involve multinational crop-science and biomedical firms. Findings further suggest four modalities of engagement with multinational firms:

1. *Financing,* where multinational firms and their charitable foundations provide funding to center research projects.
2. *Technology transfers,* where multinational firms license or donate proprietary knowledge to center research projects.
3. *Frontier research,* where multinational firms engage in joint research activities with a center that may include, but extend beyond, technology transfers.
4. *Multistakeholder platforms,* where multinational firms play active and often multiple roles in large platform projects to conduct research or develop value chains.

Partnerships between centers and foreign entities are often fraught with difficulties stemming from differences in organizational practice and behavior, and from the complexity associated with exchanges of proprietary knowledge and IPR. These issues are examined below, based on responses from key informant interviews.

[12] Note, however, that ILRI does play a role in promoting private-sector development through evidence-based research and policy advocacy. ILRI's project on Process and Partnerships for Pro-Poor Policy Change, for example, maintains close links to private-sector dairy development in East Africa and has been successful in effecting pro-poor policy change in Kenya.

**Table 9. Public–private partnerships with the "Big 10s" in the crop-science and agri-food sectors, c. 2004**

| Sector/firm/country of headquarters[a] | Sales (million U.S. dollars) | Number of partnerships with CGIAR center[b] | Center |
|---|---|---|---|
| *Crop-science sector* | | | |
| Syngenta, Switzerland | 7,270 | 7 | CIMMYT, ICRISAT, Bioversity International, and IRRI |
| Pioneer Hi-Bred International, United States | 4,830 | 5 | CIMMYT, ICRISAT, and Bioversity Int'l |
| Bayer Crop-Science, Germany | 7,390 | 4 | ICARDA, IFPRI, IRRI, and ICRISAT |
| Monsanto, United States | 5,220 | 2 | IRRI |
| BASF, Germany | 4,170 | 2 | CIMMYT |
| Grupo Limagrain, France | 965 | 1 | CIMMYT |
| Dow AgroSciences, United States | 3,370 | 0 | |
| Savia, Mexico | 611 | 0 | |
| Advanta, the Netherlands | 398 | 0 | |
| *Agrifood sector* | | | |
| Unilever, United Kingdom/Netherlands | 25,670 | 3 | World Agroforestry Centre, IWMI |
| Mars, United States | 17,000 | 1 | IITA |
| Coca Cola, United States | 19,564 | 1 | ICRISAT |
| Nestlé, Switzerland | 54,254 | 0 | |
| Kraft Foods, United States | 29,723 | 0 | |
| Pepsico, United States | 25,112 | 0 | |
| ADM, United States | 23,454 | 0 | |
| Tyson Foods, United States | 23,367 | 0 | |
| Cargill, United States | 21,500 | 0 | |
| ConAgra, United States | 19,839 | 0 | |

Sources: Corporate and industry publications, personal communications, authors.
Notes: CIMMYT is the International Maize and Wheat Improvement Center; ICARDA, the International Center for Agricultural Research in the Dry Areas; ICRISAT, the International Crops Research Institute for the Semi-Arid Tropics; IFPRI, the International Food Policy Research Institute; IITA, the International Institute of Tropical Agriculture; IRRI, the International Livestock Research Institute; and IWMI, the International Water Management Institute.
[a] Includes local subsidiaries and affiliates.
[b] Excludes partnerships with a charitable foundation directly associated with the firm.

Differences in organizational practice and behavior are often confounding issues in planning and execution of a PPP. Multinational firms are often skilled at project

development, that is, figuring out what they want, what they can get, and under what terms they are willing to make an exchange, while centers are rarely as coherent in identifying or communicating their own needs. Although this may be partly attributable to information asymmetries—for example, the fact that centers rarely have information on technologies held by their private-sector counterparts, whereas the firm can probe center assets more easily through the public domain—the cultural differences are often a significant barrier to the partnership process. Furthermore, in terms of PPP execution, multinational firms are often more accustomed to making difficult project management decisions, for instance, terminating a project that fails to show results. Centers rarely take similar initiatives, nor do they face incentives to do so. These stark cultural differences make PPPs with multinational firms all the more challenging for centers.

IPR and proprietary knowledge exchanges are also confounding issues for the CGIAR system and centers. Approximately 38 of the partnerships reviewed (51 percent of the total) involve the use or exchange of proprietary knowledge, suggesting that IPR is an important issue for consideration in the design and implementation of PPP projects. However, very few key informants suggest that the exchange of IPR between the public and private sectors is, in and of itself, a barrier to successful PPPs. Rather, the problem stems from issues of safe stewardship, asymmetrical information, and organizational experience.

First, the exchange of IPR is often tied to the private firm's concern with ensuring safe stewardship of their proprietary technologies and materials. The misuse or abuse of a private firm's IPR by a center or a third party potentially exposes the firm—as the source of the IPR—to financial and reputational liabilities. Very few policy interventions or organizational mechanisms exist to manage or mitigate the risks associated with stewardship.

Second, IPR exchanges are often constrained by a center's limited ability to access information on a firm's propriety knowledge assets. Few centers have extensive intellectual property management systems that allow them to search out secondary sources of information—patent filings, for instance—to identify useful proprietary

knowledge assets available in the private sector. Other centers have entered into agreements with private firms that inhibit their ability to obtain such information from the firm's competitor. This is the case in ILRI's relationships with Merial, a private-sector partner participating in the East Coast Fever Vaccine project that is discussed further below.

Third, IPR exchanges are often a function of the center's ability to successfully negotiate with the private sector. To be sure, few centers have accumulated sufficient experience in the art of IPR negotiation. This may be partly because centers' requests for proprietary assets are often marginalized by the private sector: the value of IP transferred from the private to the public sector is small (and of nominal value to the private sector) relative to the value of exchanges between private-sector entities, or relative to the importance of these exchanges to corporate strategies. This may also be due in part to the relatively undeveloped intellectual property management systems in some centers—systems that limit a center's ability to identify and evaluate its own proprietary assets, and thus negotiate more successfully with the private sector.

Yet despite these issues, many of the older commodity centers, such as CIMMYT, ICRISAT and IRRI, continue to explore new relationships with foreign entities. Implicitly, these centers recognize that the materials, technologies, and expertise that these firms bring to the research process are invaluable to enhancing the CGIAR's long-term impact on agricultural productivity and poverty reduction.

### Public–Private Partnerships and Research Costs

PPPs often reflect funding realities in the CGIAR. Pressure to forge creative relationships with new funding sources is a commonly recognized incentive underlying many PPPs in the CGIAR. However, findings also show that PPPs are widely used as a means of reducing research costs across a range of different types of PPPs. Findings specifically suggest that centers engage in three different types of cost-reduction modalities:

1. *Making the prohibitive possible.* Many PPPs are designed to overcome the prohibitive costs of conducting research in isolation by using the private

sector to provide access knowledge and technology, commercialize center research outputs, or engage in synergistic innovation processes.

2. *Foundation funding.* Of the 75 surveyed PPPs in the CGIAR, 9 (12 percent) include charitable foundations associated with corporate interests, including the Syngenta Foundation for Sustainable Agriculture, the Monsanto Fund, the Barwale Foundation, and the Sir Ratan Tata Trust. By and large, these PPPs are designed to raise funds only.
3. *Outsourcing and subcontracting.* Five PPPs (7 percent) are largely collaborations that revolve around subcontracting information management systems tasks to the private sector. Examples include several IRRI projects designed to improve access to IRRI's research through various software applications.

The cost issue, however, is not just about sustaining research and operations. Cost issues also figure into calculations of the firm's need to minimize costs, maximize profits, and remain competitive; and the coordination costs incurred in the PPP itself. These issues are examined below based on responses from key informant interviews.

### *Cost Reductions and the Domestic Firm*

Findings suggest that small domestic firms typically engage in PPPs to reduce costs and maximize profits. In such cases, the PPP provides them with opportunities to access new technologies that can significantly enhance their product lines, often within relatively short time horizons. For the multinational firm, PPPs are too small relative to their overall portfolios, or they are designed for a much longer time period to be relevant to the short-term bottom line. Thus, the focus here is how PPPs contribute to reducing costs for the domestic firm by providing access to CGIAR materials that can give them an edge over the competition in the form of, say, a variety or hybrid with unique market value.

A key issue is whether firms are reducing costs or maximizing profits by gaining market power through exclusive access to CGIAR materials. Across the board, centers are adamant about their commitment to nonexclusivity. However, market structure, firm-level capacity, or PPP design can provide private firms with de facto exclusivity and thus market power. For example, in regions where local seed markets are characterized by high levels of firm concentration, barriers to entry, and weak breeding capacity in the private sector could make it possible for a single firm with greater capacity in breeding or

marketing to build its market power using CGIAR materials more effectively than its competitors. According to a number of respondents to this study, these issues are potentially relevant in the context of several CIMMYT projects on maize improvement in eastern and southern Africa and ICRISAT's Hybrid Parents Research Consortia for millet, sorghum, and pigeonpeas. While the centers maintain strict policies to ensure nonexclusive access, both market structure and project design may increase the chances of any one firm gaining implicit exclusivity over CGIAR material.[13]

Having said that, these examples should not suggest that centers are knowingly providing exclusive access to the private sector, thereby reducing firm-level costs, increasing profits, and providing selected firms with an edge over the competition. Such conclusions would require further analysis of market structure and firm performance. However, these examples do suggest the CGIAR's nonexclusivity mantra may be up for closer scrutiny, particularly given the growing importance of plant variety protection (PVP) regulations and other forms of IPR in some developing-country markets (for example, India or Kenya).

The possibility for partially exclusive licensing is entertained, albeit under a limited set of conditions, in several PPPs in the CGIAR. Documents describing the newly established Technology Innovation Center (a nonprofit foundation of ICRISAT designed to interface with the private sector, promote commercialization of ICRISAT technologies, and generate revenues for the center) suggest that the foundation will consider partially exclusive licensing to move ICRISAT research into commercialization, provided that the center's mandate is not compromised. Documents describing CIAT's alliance with Papalotla (a private firm operating in North America and Latin America) show that the firm receives exclusive rights for commercialization, multiplication, and marketing of a forage hybrid developed by CIAT in exchange for a 2 percent royalty on sales for CIAT (though only in countries where viable markets exist and only for the duration of the

[13] For example, several key informants to this study argued that ICRISAT consortia membership fees (US$10,000 per year plus $500 per material transfer for certain lines) represented a potential entry barrier for smaller startup firms.

plant breeders' rights conferred by those countries). In short, exclusive licensing is not unknown within the CGIAR and may become increasingly common.

### *Cost Reductions and the Coordination Cost Offset*

Whereas the cost reductions described above are largely external to the PPP itself—accruing directly to the firm or center—coordination costs are internal to the PPP as a whole. And while there is no easy way to quantify the costs of PPP coordination, that is, the costs incurred in searching for partners, maintaining partner commitment, and resolving conflicts among partners, findings strongly suggest that within-partnership coordination costs are a major challenge to successful PPPs.

The nature of these coordination problems differs across PPPs and can be illustrated by several examples. First, consider ILRI's above-mentioned East Coast Fever Vaccine project, a PPP designed to develop a vaccine that could reduce livestock productivity losses in the order of US$300 million per year, thereby curbing the disease's negative impact on the incomes and nutrition of African smallholders and pastoralists. According to the current terms of agreement between ILRI and its private-sector partner, Merial, the center's contact with other firms with respect to vaccine research is subject to prior discussion with Merial. Given that the animal health sector comprises far more players than the crop-science sector, the agreement terms generate prohibitively high search costs for ILRI to identify new research partners with potentially useful technologies.

Next, consider the case of CIMMYT's *Striga*-Resistant Maize project. According to key informants, the project was temporarily beset by deep coordination problems arising from the poorly defined roles and responsibilities assigned to the African Agricultural Technology Foundation (AATF). AATF, a latecomer to the project, was the subject of several misunderstandings, miscommunications, and conflicts that generated a significant level of tension within the project. Although AATF's role and responsibilities have since been clarified, several partners remain skeptical of the organization, unclear of its position in the project (is it a donor, a researcher, a service provider, or simply a free-rider?), and resentful of its initial missteps (for example, releasing maize seed for farmer

trials under the AATF name). The mistrust and misperceptions generated by these events represent significant coordination costs for the PPP.

In the case of FLAR and CLAYUCA at CIAT, coordination costs relate more to the time and effort needed to organize and administer these multistakeholder platforms. Both initiatives are independent legal entities established on the basis of agreements between CIAT and producers associations and private firms in Latin America. CIAT performs R&D based on requests from their governing boards and plays a central role in the management and administration. But the coordination costs associated with these roles are substantial. Costs include representational functions, administering funds, managing relationships and financial contributions from existing partners, identifying and acquiring new partners and funding opportunities, and, importantly, reviewing and approving all administrative decisions made by the initiatives' members. At present, 4 of the 14 staff employed by CLAYUCA work on administrative and communications issues, while 5 of the 28 staff do so for FLAR.

## Public–Private Partnerships and Innovation

The CGIAR's contribution to agricultural development rests partly on its ability to foster innovation, that is, the successful introduction of knowledge and technology into an economically or socially relevant process (OECD 1997, 1999). Close examination of the CGIAR's PPPs suggests that the overwhelming majority is designed to reduce costs, raise funds, or transfer knowledge and technology from the private sector, but not to innovate in partnership with the private sector. In short, centers are generally not using PPPs as a vehicle for *joint* processes of technological innovation wherein partners collaborate on the planning and execution of project activities. Having said this, centers are generally benefiting from PPPs as a result of the *organizational* innovations they foster, and as a result of increased engagement in critical *downstream* innovation activities. These issues are discussed in detail below.

### *Co-Innovation*

Findings suggest that 12 percent of PPPs in the CGIAR (a total of nine projects) revolve around technology donations or licensing *from* private firms *to* centers for the purposes of scientific research. Examples include ICARDA's projects on stress-resistance in chickpeas and lentils, and IRRI's work on *Bt* rice, beta carotene-enhanced ("golden") rice, and rice genomics.

While technology transfers are important to the centers' work, the question is whether they truly bring public- and private-sector expertise to bear on a given research challenge. Several examples demonstrate how PPPs extend beyond technology transfers to include joint planning and execution of research through repeated and durable interactions, that is, joint processes of technological innovation or "co-innovation." CIMMYT's apomixis research project is a classic example of a joint innovation process, as is ILRI's East Coast Fever Vaccine project, as is discussed below.

ILRI's East Coast Fever Vaccine partnership specifically demonstrates the value of shifting from technology transfer to joint innovation. The project began in 1999 with partners from the public sector and advanced research institutes: Merial only joined later after a period of observation and negotiation. But since joining, Merial's contribution to the project has evolved into a mutually beneficial process of exchange and learning for both the center and company. The back-and-forth exchange of knowledge and technology between the partners has accelerated the pace of research and made outcomes possible that the center could not have achieved in isolation. It has also changed the way ILRI does business with the private sector, a point explored further below. Moreover, partners on both sides of the table believe that the project is on track to deliver a vaccine that could significantly reduce smallholder losses to East Coast Fever in East Africa.

Given the limited number of PPPs designed to facilitate joint innovation processes and outcomes, findings suggest that the CGIAR's interactions with the private sector are generally *not* combining explicit knowledge exchange (for example, donated or licensed technologies) with more tacit forms of knowledge exchange. Examples of tacit knowledge exchanges include experiential learning approaches to research in which

knowledge is transferred through modalities such as learning by doing or learning through face-to-face interaction, hands-on collaboration, scientific exchange programs, and so on.

### *Organizational Innovation*

Whatever impact PPPs have on technological innovation in the CGIAR, findings suggest that their effect on organizational innovation is significant. PPPs are changing the way some centers do business, specifically, their structures, practices, and models of conducting research. PPPs are providing centers with useful insight into industry perspectives—the shortest route to launching an end product, the need to terminate projects when they fail to perform, and the importance of demand-side or market analysis—and how center research can incorporate such perspectives. Experiences at ICRISAT and ILRI are particularly telling in this respect.

These insights are helping centers keep research projects on track, meet donors' short-term project horizons, and ultimately contribute to real impacts among target beneficiaries. More importantly, these insights are helping centers learn and transform themselves beyond original conceptions of brick-and-mortar research facilities into key players within dynamic innovation networks.

CIAT and ICRISAT, among many other centers, have demonstrated significant progress in this regard, while staying true to their mandate. ICRISAT, for example, has learned the importance of building relationships with the private sector. Funding pressures in the 1990s caused the center to seek new ways of sustaining itself, leading to a variety of relationships with the private sector. Over time, ICRISAT's portfolio has come to include activities (many of which are discussed in this study) that support private-sector incubation and capacity strengthening, funding from charitable foundations associated with the private sector, and wide-ranging programs to commercialize its technologies through the private sector.

*Downstream Innovation*

Part of this transformation process includes recognition among some centers that their research should contribute more to enhancing the performance of agricultural value chains that move commodities from production to consumption. Of the 22 PPPs on sectoral/value-chain development, 14 (67 percent) focus specifically on value chain development.[14] Activities include increasing smallholder participation and competitiveness in high-value markets, strengthening the role of producer associations and other collective action institutions, developing and deploying technologies that respond to identified market opportunities, and building market linkages and infrastructure. Examples include projects such as Papa Andina at CIP, watershed innovations at ICRISAT, CLAYUCA at CIAT, and Allanblackia development from smallholder cultivation at the World Agroforestry Centre.

Another useful example of this type of PPP is CIAT's Diversity Agriculture Project Alliance (DAPA), a program that aims to improve the competitiveness of smallholders and their involvement in specialty coffee and other high-value markets, such as medicinal plants, forage crops, and horticulture. DAPA's industry partners include, for example, international coffee buyers interested in addressing development-related aspects of the crop, including environmental sustainability, product quality, and returns to smallholders. The project provides smallholders with access to specialty markets and buyers, and provides buyers with information about the origin and quality of coffees that can return premium prices in high-value foreign markets. While the private sector's financial contributions have been largely in kind, their technical assistance on such issues as quality analysis has been a substantial contribution to smallholders. CIAT's contribution focuses on strengthening smallholder participation in value-chain opportunities, a priority research area for the center and the CGIAR as a whole.

PPPs along the value chain are often complex undertakings. They require contributions of extensive tacit knowledge from multiple actors across both time and

[14] The remaining 7 percent of PPPs involving sectoral/value chain development focus on input and seed sector development.

space, contributions that are often difficult to manage and evaluate. They require public-sector partners to relinquish their control over the traditional modalities of research and extension, and instead seek to understand and collaborate with private-sector concerns. They also draw centers into activities that may make little use of their research capabilities or into activities where centers have a limited comparative advantage. However, it may be the case that such issues are offset by the benefits accruing from greater understanding of the demand-side of agricultural research, more immediate or visible impact, new funding sources, and more relevant participation in national development dialogues. Still, the tension between the CGIAR's system-level research priorities, on the one hand, and the center-level desire to move into more downstream activities with less research orientation (but possibly more visible impact and attribution of success to the center), on the other, was a commonly articulated concern throughout the key informant interviews.

### Public–Private Partnerships and Risk

The majority of research projects, whether conducted in the public or the private sector, is beset by certain types of risks. Covariate risk, for instance, emerges from the wider social and political environment in which research is conducted, or beneficiaries and end-users are targeted, or the economic and financial climate in which research investments are made. The heated global discourse over agricultural biotechnology and especially genetically modified organisms in crops and livestock, for example, poses risks for many of the CGIAR's PPPs in agbiotech. The long decline in donor funding for agricultural research beginning in the late 1980s suggested similar risks.

In the context of research, however, emphasis is typically placed on idiosyncratic risks—those associated with the probability that the research process will not yield a successful output or product, will yield a success along a time horizon that is too long for continued private investment, or will yield a product that cannot pass through legal and regulatory hurdles associated with moving from proof of concept to commercial

deployment. Necessarily, these types of risks are part of the culture underlying research and are often justified by the potential returns to a successful research process.

Several types of idiosyncratic risks are unique to PPPs. They include the risks associated with weak financial infrastructure, coordination among diverse partners, and exchanges of proprietary knowledge assets. These risks are discussed in detail below.

### *Transferring Risk*

Research that is characterized by some uncertain outcome requires a means of sharing or transferring risk from those who are least able to those who are most able to bear it. Both the formal financial sector and the government play a role in transferring risk by financing private research either through private investment (for example, venture capital) or through public expenditures (for example, programs designed to commercialize research).

Often, such formal private financing and public-sector programs are weak—if not nonexistent—in the agricultural research sector in developing countries. For example, domestic seed firms that invest in breeding programs may have limited access to financial markets or public programs (relative, say, to firms in the manufacturing or service sectors) and thus limited means to transfer the risks of a breeding project to others.

Consider, for example, the Western Seed Company, a small firm in Kenya with in-house breeding capacity that plays an active role in several PPPs with CIMMYT, such as the *Striga*-Resistant Maize and Quality Protein Maize projects. The firm's participation in these projects is partly or wholly financed by the firm's own resources and includes testing, releasing, and producing breeder seed. As a small firm in a competitive market where formal financing for seed firms is uncommon, the Western Seed Company assumes an extensive level of risk by engaging in these PPPs. In the absence of formal (private or public) mechanisms to transfer risk, the Western Seed Company must fully absorb the risks posed by difficult regulatory barriers, adverse climatic shocks, and other vagaries that affect the seed business. These types of risk are of considerable importance to smaller domestic firms partnering with the CGIAR.

### *Risk and Coordination*

The failure to sustain commitment between partners—whether through formal mechanisms, such as contract adherence and execution, or informal commitment mechanisms, such as trust-building activities and communication—is another major risk facing PPPs in the CGIAR.

Consider, for example, the Drought Tolerant Crop Initiative, a PPP–based platform organized to develop and deliver new technological innovations to drought-prone, food-insecure farmers in developing countries. Despite the platform's strong focus on product development and deployment, the initial interest of key players in both the public and the private sectors, and some well-planned efforts to launch the initiative, evidence suggests that the PPP has failed to take off.[15]

What went wrong? Published proceedings of discussions among key parties suggest that stumbling blocks included distrust of private-sector motivations and incentives, recognition that regulatory regimes and market infrastructure in many countries were insufficiently developed to attract private participation in the delivery of end-products to smallholders, and concerns over the specific technologies under consideration. But possibly the most important stumbling block was the lack of resources—in terms of people, time, money, and energy—needed to organize and coordinate the initiative. Here, as in many PPPs, coordination costs and system-level failure contributed significantly to the probability of success.

### *Risk and Knowledge Assets*

Risk issues in CGIAR partnerships often relate to the exchange and use of improved germplasm, hybrid parent lines, transgenic constructs, and other such assets held by centers or their private partners. For the center, the issue of risk is often associated with attempts by private firms to assert control over assets held in trust for the public good. For the multinational firm, the issue of risk is more about the transfer and use of IPR to the public sector and the possibility that materials and technologies may fall into the

[15] See Doering, 2005a,b,c. Note, however, that other drought-tolerance research projects have operated in parallel with this initiative or have subsequently been initiated (for example, CGIAR 2006b).

hands of competitors or parties who might misuse or abuse the materials and technologies. This can potentially damage the firm's reputation or brand, incur legal or criminal liability for the firm, and do harm to the firm's public-sector and civil society partners as well.

Consider, for instance, CIMMYT's project on Insect-Resistant Maize for Africa (IRMA). The project aims to introduce pest resistance traits conferred by *Bacillus thuringiensis* (*Bt*) into maize varieties and hybrids commonly cultivated in East Africa. While the Syngenta Foundation for Sustainable Agriculture provides considerable funding for the project, the project makes use of *Bt* events available in the public domain only—in this case, a transgenic event from a Canadian university. The choice to use a public event rather than one developed by the foundation's parent company, Syngenta, reduces the exposure of public-sector partners to reputational risk resulting from possible associations with corporate interests being drawn by third-party observers.

But even the best-laid plans for mitigating risk can fail, as experiences from this same project illustrate. In August 2005, a technician at the Kenya Institute of Agricultural Research accidentally treated a test plot containing *Bt* maize with pesticide, thus ruining the experiment. Press reports followed soon after with allegations from the chair of Kenya's National Biosafety Committee that the project had succumbed to pressure from international organizations to sidestep regulatory procedures (see, for example, Sunday Nation 2005). While the allegations proved to be untrue, the project partners' slow response to the public and political damage caused by press reports suggests that the absence of an effective communications (and damage control) strategy was a setback for the project.

To be fair, CIMMYT's experience is not unique in the CGIAR. The global discourse surrounding such controversial topics as agricultural biotechnology, genetically modified organisms, globalization, and litigation against multinational firms has exposed centers and their partners to multiple risks, primarily with regard to safe stewardship. Risks posed to the CGIAR's reputational integrity result from PPPs with crop-science firms such as Bayer Crop-Science, Monsanto, and Syngenta manifest in ongoing

criticism from watchdog organizations and by the disengagement of the CGIAR's own NGO Partnership Committee.[16] Similar risks may also emerge from PPPs that engage companies representing controversial products, such as tobacco (IITA and the British American Tobacco Foundation, or ICRISAT and MLT, a subsidiary of Universal Leaf and a major supplier to Philip Morris).[17]

### *Risk Management and Mitigation Tools*

This is not to say that risks make the PPP approach expendable: rather, centers need to have effective risk assessment, management and mitigation strategies in place to safeguard their research, financing, and reputational integrity should a worst-case scenario materialize. Risk management and mitigation strategies for both individual partners and the PPP as a whole are discussed below.

*Precautionary strategies.* The default strategy for the CGIAR is one of caution: transfer materials to traditional public-sector partners only, and minimize contact and exchanges with the private sector. However, this strategy may be difficult to sustain in light of centers' commitments to the Food and Agriculture Organization of the United Nations (FAO) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), which stipulate that materials held in the public trust will be made available to both public and private parties.

The default strategy for the private sector—particularly foreign entities such as multinational firms—is similarly cautious. Many firms choose to disengage from the development-through-partnership agenda and limit their interactions with centers, or they only share technologies and materials of relatively low commercial value or that pose relatively low risk should they fall into the hands of competitors or be misuse by third parties. However, this precautionary strategy may also limit the ability of such firms to

[16] See, for example, criticism of the CGIAR from GRAIN (2001) and deGrassi and Rosset (2003); and an account of the CGIAR NGO Partnership Committee's disengagement in NGOC (2002) and Bezanson, Narain, and Prante (2004).

[17] In 2003, the British American Tobacco Foundation (BATF) committed 7.0 million Nigerian naira (approximately US$ 52,000) to fund the AGo-Are Development Project in Nigeria, in which IITA was a stakeholder (IITA 2003).

gain access to emerging markets in developing countries, breeding materials from centers, or other valuable information or assets. In the case of CIMMYT's Insect-Resistant Maize for Africa project, for example, application of the precautionary strategy was implicit in the decision to use a transgenic event available in the public domain. However, several respondents noted that this choice may have also affected the pace of R&D under the project.

*Legal and contractual strategies.* Legal and contractual strategies offer the next-best option to risk management. Such strategies are common in PPPs where the operative relationship is based on technology licensing and material transfers or requires strong measures to ensure safe stewardship of proprietary technologies and materials. In these types of partnerships, explicit contractual agreements formalize the roles and relationships among parties; ensure that parties jointly plan and execute activities to accomplish agreed objectives; and distribute costs, risks, and benefits equitably. Provisions such as indemnifications and warranty disclaimers may be included to provide partial protection to the licensor or seller or a technology from the actions of the licensee or buyer.

The recent creation of organizations designed to facilitate legal and contractual agreements in partnership-based research projects illustrates this strategy. The African Agricultural Technology Foundation, for example, is mandated to facilitate the transfer of technologies (including, but not limited to, advanced biotechnologies) between research organizations in the public and private sectors. In doing so, AATF provides the expertise—individuals with significant experience in agricultural science, communications, legal affairs, and regulatory affairs—needed to design and negotiate formal agreements that address the risks associated with PPPs.

Still, it is important to recognize that regardless of how skilled organizations such AATF are at mitigating risk through legal recourse, or how well the centers' own legal capabilities are developed, they are still likely to be limited relative to those of the multinational firms with which they partner. Thus, several respondents argued the need to bolster legal expertise at the system- or center-level sufficiently for the CGIAR to

confidentially navigate protracted litigation or negotiate with batteries of lawyers from the private sector. Most others, however, felt that legal recourse offered little benefit to any of the parties to a partnership: rather, they argued that legal recourse would only lead to costly litigation and the loss of good faith among partners, thus harming project implementation and the long-term growth of public–private partnerships. Moreover, many argued that legal recourse is difficult to pursue in developing countries, where legal and regulatory regimes are rarely equipped to address the complex issues underlying PPPs and technology development.

Yet there is some evidence to suggest that the legal context within which the CGIAR operates is changing, thus necessitating greater legal expertise in centers and the system. New regimes governing IPR exchange, biosafety regulation, and agricultural trade are emerging in many developing countries where the CGIAR conducts research, while some centers are finding themselves more exposed to host-country regulations that govern R&D than in past decades. This changing context has led ICRISAT, for example, to establish a separate entity—the Technology Innovation Centre (TIC), a U.S.–registered foundation operating in India—to commercialize new technologies with the private sector and absorb some of the associated risks (see TIC 2005).

*Financial strategies.* Missing in many PPP projects are financial strategies to transfer the risks borne by small domestic firms, as described above. Financial mechanisms, such as commercial loan guarantees from public sector partners, small grants administered through competitive schemes, or credit programs managed by charitable foundations could play a role in mitigating some of these risks. Several programs along these lines are being developed (for instance, under the Forum for Agricultural Research in Africa [FARA]), but it remains to be seen whether the programs will be open to small firms, entrepreneurs, and other private-sector actors operating in markets where the formal financial infrastructure needed to transfer and share risk remains weak or nonexistent.

*Communications strategies.* Formal risk management strategies, such as those described above, are only as strong as the communications strategies behind them.

Communications strategies are designed to manage and mitigate risk through efforts that include building social and political support for a given PPP, educating end-users on proper product stewardship practices, informing beneficiaries and observers of the potential benefits of the PPP through appropriate media channels, and preparing provisions to mitigate damage caused by worst-case scenarios.

Illustrative of a proactive risk-management strategy is ICRISAT's efforts to mainstream its Agri-Science Park (of which the Agri-Business Incubator is a part) into Andhra Pradesh's wider "Genome Valley" initiative. ICRISAT's strategic efforts to gain political endorsement and support from the government as part of the state's own strategic initiative in research and innovation can potentially insulate the center from political risk, even in the volatile environment of state-level politics in India.

*Platform-building strategies.* A critical risk-management strategy for the successful PPP—like any investment project—is proper design and funding. This often requires that the PPP be established on a solid platform that allows the relevant parties to come to agreement on a common objective and to commit resources to achieve that objective. The platform may be an informal coalition of organizations, a coalition headed and managed by a lead organization, or a legal entity established to manage the project with some degree of decisionmaking independence from the partners themselves.

Elements of a successful platform include clear definition of the problem, its solution, and the resources needed to achieve the solution; establishment of benchmarks to gauge progress and decide on next steps; and effective communication channels to all key stakeholders through which to exchange knowledge, resolve conflicts, and change course as needed. While many PPPs in the CGIAR attempt to build such platforms, findings suggest that the absence of a solid platform, as illustrated earlier with the Drought-Tolerant Crop Initiative, is the single-most important determinant of success.

The importance of platform-building is also seen in the case in CIAT, which operates a separate PPP unit designed to catalyze partnerships by assisting in the promotion of collaborative undertakings, identification of common interests, and design of the organizational structure. The unit's main functions include identifying possible

business opportunities and partners, organizing roundtables and conferences where potential partners are brought together on topics of mutual interest, and providing advisory services on organizational design to deal with PPP governance, management, and administration issues.

In summary, PPPs are fraught with risk for centers and their private-sector partners. Precautionary, legal, and financial provisions are needed, as are effective communications platform-building strategies, PPP management units, and foresight into the worst-case scenario. By and large, these strategies are not commonly used or available to PPPs in the CGIAR.

## Public–Private Partnerships and Poverty

Do PPPs enhance the impact of research by improving outreach to the poor? The poverty orientation of PPPs is a topic of extensive discussion within the CGIAR. However, this study does not attempt to evaluate the poverty impacts of each PPP examined here: center management and impact evaluators are better positioned to undertake those analyses. Rather, this study suggests different ways of looking at the poverty orientation issue.

### *Impact Pathways*

Poverty orientation is closely related to the issue of impact pathways, that is, the specific channels through which agricultural research contributes to food security and poverty reduction. Impact pathways operate through research that enhances crop yields, output, and quality; improves the sustainable use of natural resources; and fosters the accumulation of physical and human capital in vulnerable households. The impact pathways may also be less direct, operating on a sectoral level by increasing the returns to collective action through producer associations, or by improving nonfarm employment opportunities in agro-processing and other fields. Ultimately, these outcomes translate into impacts in the form of higher incomes, greater food consumption, better nutrition, and favorable changes in the allocation of individual and household assets for small-scale, resource-poor farmers; food-insecure households; and other marginalized social groups.

For instance, the choice of crop in a PPP suggests much about the poverty focus. Certain (largely food staple) crops are prioritized by the CGIAR because cultivar improvements have direct, beneficial impacts on the incomes and nutrition of small-scale producers or food-insecure consumers; thus, they are critical to achieving sustainable food security and reducing poverty. This includes research on the traditional CGIAR focus crops, such as maize, rice, wheat, legumes, and pulses, as well as cattle and small ruminants.

Other (largely specialized commercial) crops may generate similarly direct impacts or indirect impacts, such as growth in the demand for agricultural labor and nonfarm rural labor, or in the application of innovative natural resources management practices. But they may also bear a greater chance of generating direct or indirect benefits for large farmers, large-scale farming operations, or corporate agriculture, depending on the particular country or region. This includes research on crops such as oil palm, ornamentals, bananas, coffee, and cotton, all of which are covered by PPPs in the CGIAR.

### *Choice of Partners, Level of Partnership*

The choice of crop is only part of the story. Of equal importance is the choice of partners and the level at which the partners operate. Many PPPs operate at relatively high level of aggregation—for example, multistakeholder platforms that operate around a particular crop or value chain. Examples include CIAT's role in CLAYUCA or FLAR, where the center plays an important convening role, the World Agroforestry Centre's role in the development of the Allanblackia value chain, or IITA's role in the Sustainable Tree Crop Program. These PPPs yield indirect impacts by mobilizing large numbers of key actors around the improvement a single crop or its value chain. To the extent that center participation extends beyond a convening or supportive role to these platforms, then such PPPs can have significant impacts on poverty. But where the center's role aggregates at a higher, more formal level, or where mission creep diverts the center from its comparative advantage in research, then further analysis of real poverty impact might be warranted.

PPPs aggregating at a lower level can incur some of the same problems. For example, the science parks at ICRISAT and CIAT, while designed to promote small-scale entrepreneurship and private investment in agricultural research, aggregate among a number of small firms that may simply be benefiting from the facilities and expertise offered by the center. The poverty impacts of their operations are largely indirect and unevaluated, suggesting the need for further analysis.

Findings suggest that PPPs operate through three different impact pathways, as follows:

1. *Household impacts* result from PPPs that focus on research and dissemination of crops, traits, and technologies that are directly relevant to the incomes and nutrition of small-scale producers, agricultural laborers, or food-insecure consumers. Included in this are the vast majority of PPPs designed to commercialize center research.
2. *Sectoral impacts* result from PPPs that focus on research that benefits other agents in agriculture and agricultural research by enhancing competitiveness in specific value chains, creating employment opportunities, and generating public revenues through the taxation of private-sector activities. This includes the science parks and private-sector development initiatives described above.
3. *Intergenerational impacts* result from PPPs that are designed to preserve and unlock genetic diversity and natural resources for future generations. Centers conducting genetic improvement are acutely aware of the tradeoff between protecting local endowments of indigenous genetic resources, publicly improved varieties, and natural resources, and the need to exploit the information and knowledge embodied in these assets for use by future generations.

The key issue with respect to PPPs and poverty is the identification of the right interventions—crops, traits, and technologies—specifically targeting the poor, and the right partners—public, private, and civil society—to conduct the project. Best practices are captured in projects where partners clearly identify and document the pro-poor potential of a given intervention. Less desirable practices might include

- exclusive licensing of technologies for seed that may affect market structure and the availability of seed to smallholders without sufficient ex ante assessment of the poverty impacts generated by the research;
- allocation of center facilities and expertise to conduct research on high-value cash crops outside the CGIAR mandate (for example, cotton, flowers, and oil

palm) for which alternative suppliers of research may exist, or from which cross-subsidies for more poverty-oriented research are not forthcoming; and

- ad hoc proposals to sell potential technologies in segregated markets (subsidized rates for poor clients, market rates for others) without ex ante evaluation of market size, structure, infrastructure, and the effects that segregation will have on the technology's price and market performance.

These examples are not meant to spotlight particular centers or projects. They do, however, point out the critical importance of conducting ex ante analysis of the poverty impact pathways through which a PPP operates.

# 6. CONCLUSIONS

Findings from this study suggest that PPPs in the CGIAR are serving a wide variety of research objectives, ranging from the system's traditional emphasis on increasing food security by increasing yield and output, to new pathways through which to reduce poverty such as value-chain development. This trend further suggests that centers are widening their focus from research for technological innovation, to innovation at both a systemic/societal level and an internal/organizational level. Implicit in this shift is a greater awareness of the demand for research derived from markets for both food staple and high-value agricultural commodities.

Nevertheless, findings also suggest that, while the CGIAR's interactions with the private sector are generally designed to overcome some of the market failures and institutional constraints described earlier, they are not addressing many of the wider systemic weaknesses associated with knowledge exchange. Specifically, few PPPs in the CGIAR are combining explicit knowledge exchange, such as technology donations or experiential learning approaches in which knowledge is transferred via learning by doing, learning through face-to-face interaction, hands-on collaboration, and public–private scientific exchange programs.

Nevertheless, these findings are far from universal for the CGIAR. Specific findings from this study paint a more nuanced picture of PPPs in the CGIAR and their influence on system and center performance and output:

- PPPs in the CGIAR are concentrated in the development of pro-poor technologies and products relating to crop production and value addition, and in the transfer of knowledge and technology from the private sector to further center research.
- Centers are partnering with both foreign (that is, industrialized-country) firms and domestic (that is, developing-country) firms. A significantly larger proportion of PPPs involving foreign firms are either exclusive (limited to the agreed set partners) or "monogamous" (involving only one partner) arrangements, whereas PPPs involving domestic firms are typically larger multistakeholder undertakings.
- The cost reductions afforded by PPPs translate into competitive advantages for domestic firms and provide centers with the ability to conduct research

that otherwise would be prohibitively costly. Nevertheless, in some instances, cost reductions may be offset by the costs of coordinating the PPP itself.

- While centers are using PPPs effectively to commercialize and deploy new technologies and products with local relevance, concerns that PPPs may supplant the role of their national partners persist.
- PPPs are contributing significantly to changing the way centers do business, both in terms of internal practices and behaviors and in terms of external trust-building and networking with the private sector.
- PPPs are generally not vehicles through which centers engage in joint processes of technological innovation where partners collaborate on the planning and execution of project activities.
- PPPs are generally not designed with risk assessment, management, and mitigation strategies in mind, thereby exposing both the partnership and its partners to significant challenges and threats.
- PPPs are rarely designed with sufficient analysis of the direct and indirect pathways through which the research will affect the poor.

The findings suggest that successful PPPs are predicated on several conditions that have implications for how centers and their private-sector partners organize, govern, and implement partnership-based projects—that is, how they overcome market failure, institutional constraints, and systemic weaknesses. While these conditions are not universally applicable to all centers and projects in all instances, they do provide insight into key areas where partnership-strengthening activities could be focused. Specific recommendations include the need for the following:

- a platform on which to assemble relevant partners, identify incentive compatibility, agree on mutual objectives, and assign roles and responsibilities appropriately;
- resource commitments from all partners, not only to a project's research activities, but also to the coordination activities needed to manage and sustain partners' commitment;
- organizational mechanisms to facilitate the exchange of knowledge and resolve conflicts arising from the process;
- benchmarks and decision-points that allow partners to evaluate progress, revise the course of a project, and terminate the project as necessary;
- strategies to manage and mitigate the risks associated with projects, including both formal legal and financial strategies and informal strategies that emphasize external communications and political support; and

- explicit ex ante and ex post analysis of the impact pathways through which projects affect the marginalized social groups that it targets.

It is important to note that these elements are useful not only for generating additional resources for research, contracting scientific services and materials, or commercializing center research, but also in promoting greater *joint* innovation by the public and private sectors, from which may emerge many innovative solutions to agricultural production and productivity constraints. In short, using PPPs to fund research is beneficial, but not enough to contribute to agricultural development and poverty reduction.

It is also important to note that a "one size fits all" approach to PPPs is counterproductive to the goal of increasing food security and reducing poverty in developing countries. The deployment of pro-poor knowledge and technology requires different—and often creative—approaches to R&D. Creativity itself requires that both public- and the private-sector organizations become more innovative in the ways they conduct business and build strategic relationships with each other. Without organizational innovation within the CGIAR and among its partners, pro-poor technological innovation would largely be impossible.

These findings represent an attempt to close the gap between the popular rhetoric in support of PPPs and the general absence of rigorous analysis. However, the findings also suggest the need for further study of PPPs in agricultural research. Further analysis is recommended specifically with respect to research partnerships between national agricultural research organizations and the private sector, partnerships intended to combat neglected diseases in developing countries, and other areas where PPPs are being used to promote economic growth and poverty reduction in developing countries.

This final recommendation is not meant to simply generate new research on PPPs; rather, new research is viewed as a necessity in light of the high expectations of the development community on the one hand, and the low level of interest and effort among key partners on the other. These realities suggest a real risk that policymakers, research managers, and private-sector leaders will become dissatisfied with the PPP approach. Such dissatisfaction would be detrimental to the research, development, and

dissemination of pro-poor knowledge and technology. What is needed, then, is greater financial and intellectual investment in harvesting the potential of PPPs, and transforming them into tools that support small-scale farmers, food-insecure households, and other marginalized social groups in developing countries.

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## APPENDIX A. SEMI-STRUCTURED INTERVIEW QUESTIONS

1. What is your organization's primary mission and main activities?
2. What are your organizations' main competencies or skills?
3. Please give a brief description of the partnership project that your organization is participating in. Who do you collaborate with in this project?
4. How is this project helping to reduce poverty and/or improve smallholder livelihoods?
5. What is the project duration and its annual budget? What are the main contributions to this project by your organization?
6. What are the main benefits from the project for your organization?
7. How is the project governed and managed, and what role does your organization play?
8. How much time, effort, and resources are required to coordinate the project and its partners?
9. What types of risks has your organization faced in this project
10. Has the project undergone any changes since implementation began, and what has been the response to these changes in (a) the project itself, and (b) your organization?
11. Have project partners faced any conflicts since implementation began, and how have conflicts been resolved among partners?
12. What lessons have you learned from this project, and how would you improve it?
13. Is it necessary to improve the relationships in this project? How would you improve the relationships between/among partners?

## APPENDIX B. EMAIL SURVEY

For each of your center's public–private partnership projects, we would kindly ask you to answer a few short questions, as follows.

1. Project title
2. Date established
3. Project location
4. Project duration
5. Names of partner organizations/companies
6. Total project budget (a rough estimate is sufficient)
7. Main project outputs
8. Which of the following would most appropriately describe the purpose of the partnership?

____ Resourcing partnerships in which CGIAR centers receive funding from philanthropic foundations associated with private firms or receive scientific expertise from private firms.

____ Contracting partnerships in which CGIAR facilities or expertise are contracted to private firms or CGIAR centers contract private firms to conduct research.

____ Commercialization partnerships in which CGIAR centers transfer research findings and materials to private firms for commercialization and distribution.

____ Frontier research partnerships in which CGIAR centers jointly undertake research activities characterized by some unknown probability of success.

____ Sector and value-chain development partnerships in which CGIAR centers work with a networks of public, private, and civil society partners.

9. Which of the following would most appropriately describe the immediate goal of the project:

____ The project was designed to access new scientific knowledge from the private sector.

____ The project was designed to reduce research costs by partnering with the private sector.

____ The project was designed to translate research outputs into products for the poor.

____ The project was designed to bring your center into closer contact with the poor.

10. Optional: what lessons has your center learned from this project?

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