

Public-private Partnerships and Developing-country Agriculture: Evidence from the International Agricultural Research System

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Abstract

This study examines the role of public–private partnerships in international agricultural research. It is intended to provide policymakers, researchers, and business decisionmakers with an understanding of how such partnerships operate, how they promote the exchange of knowledge and technology, and how they contribute to poverty reduction. In doing so, 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. 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 for this study were obtained during the first half of 2006 from an analysis of documents, semi-structured interviews with key informants, and a 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.

Keywords: Public-private partnership, research and development, agricultural technology, innovation incentives

I. Introduction

Public–private partnerships (PPPs) in agricultural R&D are increasingly viewed as an effective means of conducting advanced research, developing new technologies, and deploying new products for the benefit of small-scale, resource-poor farmers and other marginalized social groups in developing countries. There are, however, few studies that empirically establish whether public-private partnerships fulfill this role effectively.

This paper attempts to fill this knowledge gap by examining how PPPs in agricultural research stimulate greater investment in pro-poor innovation in developing-country agriculture. The paper is meant to provide policymakers, researchers, and business decisionmakers with a better understanding of how such partnerships operate, what types of challenges they face, and how their operation can be improved to contribute more to food security and poverty reduction.

We define PPPs as any research collaboration between public- and private-sector entities in which partners jointly plan and execute activities with a view to accomplishing agreed-upon objectives while sharing the costs, risks, and benefits incurred in the process. We examine three specific issues with respect to PPPs: (1) whether public–private partnerships contribute to reducing the costs of research, (2) whether they promote innovative research, and (3) whether they enhance the impact of research on smallholders and other marginalized groups.

To do so, 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.^{iv} Data for this study were obtained during the first half of 2006 from an analysis of project, center and corporate documents; semi-structured interviews with 75 key informants involved in PPPs; and

an email survey of CGIAR centers to which 12 of the CGIAR's 15 centers responded. See Spielman et al. (2007) for further details on the study's concepts, methodology, and findings.

II. Background

Conceptually, PPPs represent a means of organizing the production of some output—in this case, agricultural knowledge and technology. Thus, the production process is subject to the usual constraints imposed by the costs of physical and human capital. The production process is also subject to constraints associated with imperfections in the market for knowledge. In other words, certain barriers impede the otherwise smooth process of exchanging and using knowledge necessary to the innovation process.

These barriers might be attributable to market failure, wherein the social benefits of research exceed the private benefits, resulting in a chronic undersupply of research and the need for public intervention (Dalrymple, 2006; Sandler, 2003; Martin and Scott, 2000; Pray and Umali-Deininger, 1998). Market failures in the exchange of knowledge emerge from 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, or poor market infrastructure.

The barriers might also be attributable to institutional constraints, or the absence of effective institutions to bridge these market failures and promote efficient knowledge exchanges. Where instruments such as intellectual property rights regimes, contract enforcement norms or the intra-firm organizational structure are insufficiently robust, knowledge exchange may incur prohibitive transaction costs, thus impeding market-based knowledge exchanges (Naseem et al., 2006; Alfranca and Huffman, 2001; Williamson, 1991).

Finally, the barriers might also be described in terms of systemic weaknesses inherent in the exchange and use of knowledge (Nelson and Winter, 1982; Lundvall, 1988; Metcalfe, 1988; Revilla et al., 2005). Systemic weaknesses could be 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.

Since their emergence, PPPs have been the focus of extensive study in a variety of disciplines, including economics, public administration, and management science. The literature on research partnerships can be divided into at least four analytical categories (see Hagedoorn et al., 2000; Hall 2006; Hall et al., 2003, 2002):

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;
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; and
4. innovation systems approaches that examine 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.

In general, these studies conventionally define PPPs in terms of joint planning, joint execution and the sharing of costs, risks and benefits. However, this definition is occasionally too narrow to capture the richness of experience gained from other types of public-private interactions in the international agricultural research system. Hence, we expand the definition of PPPs 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.

Thus, for the purposes of this study, we can classify PPPs into five functional categories, each with a unique assignment of roles, allocation of risk, and potential impact on cost, innovation, and poverty (Table 1):

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

This typology 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.

Table 1. 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	+++	+	+
Commercialization	Product deployment	R&D	Product deployment, monitoring, 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, 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.

III. An overview of findings

Findings 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 also greater awareness of the demand for research derived from markets for both food staple and high-value agricultural commodities—a change from the historic tendency towards a more supply-side technology push approach.

The study identified a total of 75 PPPs in the CGIAR that were active in 2004 or later.^v Of these, 47 partnerships (63 percent) are concentrated in four of the CGIAR’s larger or older commodity centers: the International Rice Research Institute (IRRI), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Center for Tropical Agriculture (CIAT), and the International Maize and Wheat Improvement Center (CIMMYT) (Table 2).

Table 2. 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.

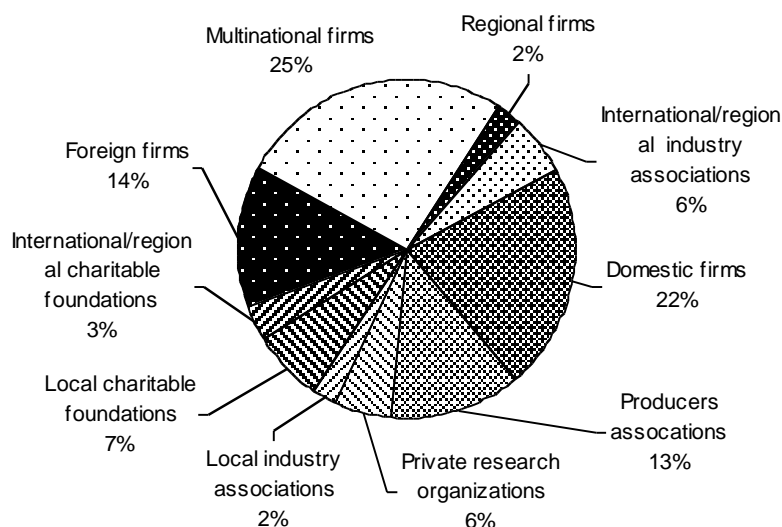
Notes: A total of 75 partnerships were identified through the survey and other sources; four of these are multicenter partnerships. CIFOR, IITA, and the World Agroforestry Centre did not provide survey responses. For CIFOR, information on public–private partnerships could not be obtained by any method; 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).

Additional findings from this study 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 1).

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.

Figure 1. Private-sector partners in the CGIAR system, by type



Source: Authors

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. 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).

Of these exclusive partnerships, 32 (43 percent of the total) are also “monogamous,” meaning they involve just one center and one private-sector partner. And 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.

Findings also show that 28 percent of all surveyed PPPs 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) (Figure 2).

When viewed together, these findings suggest that PPPs in the CGIAR are relatively concentrated in three main areas: pro-poor product development via private domestic entities based on technologies relating to crop production and value addition; knowledge acquisitions from private foreign entities to further center research; and private funding from private entities to support public research.

III. Reducing costs through partnership

The study goes on to ask whether PPPs reduce the costs of research. Conceptually, public-private partnerships are often thought to improve the management of scarce resources by capitalizing on economies of scale and scope in research, exploiting complementary resources and capacities across the public and private sectors, and reducing transaction costs in the exchange of knowledge and

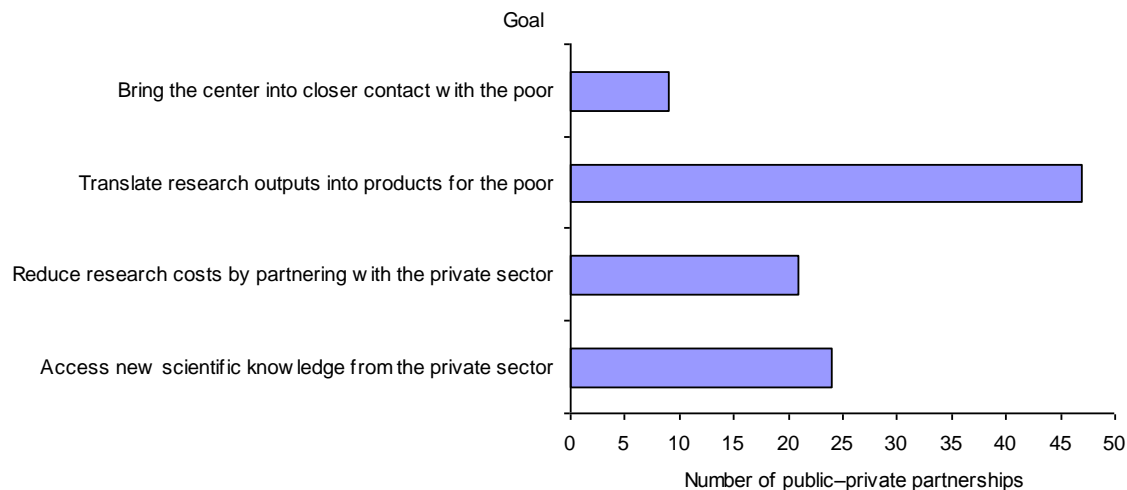
technology. Findings from this study suggest that centers leverage PPPs to pursue several types of cost-reduction strategies including:

- *Outsourcing research activities.* Of the 75 surveyed PPPs in the CGIAR, five (7 percent) are collaborations in which centers subcontract research tasks to lower-cost providers in the private sector. Examples include several IRRI projects designed to improve access to research conducted by the International Rice Research Institute (IRRI) through various software applications.
- *Securing alternative financing.* Nine (12 percent) of the surveyed PPPs are designed to raise funds from private firms or from charitable foundations associated with the private sector. Examples include several ICRISAT projects supported by the Monsanto Fund, the Barwale Foundation, and the Sir Ratan Tata Trust; and a CIMMYT project supported by the Syngenta Foundation for Sustainable Agriculture.
- *Making the prohibitive possible.* Twenty-nine (39 percent) of the surveyed PPPs are designed to help public research organizations to overcome the prohibitive costs of conducting research or deploying products independently. Through these types of PPPs, public research centers leverage valuable private resources, expertise, or marketing networks that they otherwise lack. Examples include several ICRISAT and CIMMYT projects designed to commercialize improved crop varieties.

Findings from the study also suggest that firms—particularly small, domestic firms in developing countries—leverage PPPs to secure an edge over their competitors, or to carve out their own niche in an emerging market. This is particularly the case with local seed firms, where PPPs provide access to centers' improved breeding materials that can expand a firm's product line and generate profits over a relatively short time horizon.

But while these cost reductions make partnerships an attractive strategy for both the public and private sectors, findings also suggest that the hidden costs of PPPs are not insignificant. Though difficult to quantify, the transactions costs incurred in searching for appropriate partners, maintaining partner commitment, and resolving conflicts among partners are often non-trivial.

Figure 2. The goals of public–private partnerships in the CGIAR



Source: Authors.

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

IV. Promoting innovation through partnership

Apart from reducing research costs, public-private partnerships are also designed to promote innovation—to transform knowledge and technology into an application of social or economic relevance. Thus, we ask whether PPPs promote the creation of new knowledge or technology otherwise unattainable by agents acting independently, and whether synergies result from doing so.

Findings suggest that PPPs in the CGIAR are generally not being leveraged to promote innovation. Some centers do use PPPs to move research from proof of concept to product deployment—an important goal in itself. However, few centers use PPPs as a vehicle for joint processes of technological innovation—as opportunities to interact repeatedly with the private sector and leverage their expertise and assets as a means of enhancing the value of the center’s work. Notable exceptions include CIMMYT’s apomixis research and East Coast Fever Vaccine research project headed by the International Livestock Research Institute (ILRI).

Having said this, many centers are benefiting from PPPs in terms of the internal processes of organizational innovations they foster. Centers such as ICRISAT, ILRI and the International Center for Tropical Agriculture (CIAT) have used PPPs to link their research with critical downstream innovation activities and, in doing so, to reorganize their organizational structures, practices and cultures for greater impact orientation.

V. Reducing poverty through partnership

Ultimately, public-private partnerships in developing-country agriculture are about reducing poverty by providing smallholders and other vulnerable social groups with new technological options. Thus, we ask whether PPPs are effectively targeting the poor in developing countries.

Two immediate issues arise from this question. First, are PPPs identifying the right interventions—the right crops, traits, and technologies—that specifically target the poor? Second, are PPPs convening the right partners—public, private, and civil society—to generate impacts on poverty?

While this study does not attempt to evaluate the poverty impacts of each partnership in the CGIAR, it does find that few PPPs are based on clear analyses of their impact pathways. Thus, several examples of less desirable practice emerge, including

- exclusive licensing of technologies for improved 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 (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 sufficient evaluation of market size, structure, infrastructure, and the effects that segregation will have on the product's price and market performance.

VI. Managing the inherent risks of partnership

Before concluding, it is necessary to raise the issue of risk, an underlying challenge that is often overlooked in both the rhetoric and execution of PPPs in agricultural research.

PPP are beset by the same risks found in most research projects, including the possibility that (1) the research investment will not yield a successful product that is acceptable to its end-users; (2) the product cannot be developed within a time period that attracts sufficient investment; (3) the product cannot pass through the legal and regulatory hurdles needed to move from proof of concept to commercial deployment; or (4) the investment will fail due to changes in the wider social, political or economic environment in which the research is conducted.

But PPPs are also different than other research investments in that they carry some very unique risks. They include the risks associated with coordinating diverse partners and interests; protecting the distinct mandates, missions and reputations of centers and firms; and exchanging proprietary knowledge assets between the public and private sectors. These risks are particularly relevant with respect to agricultural biotechnology research undertaken by centers in partnership with leading multinational firms in the cropscience industry (Table 3).

Findings suggest that few PPP-based projects have adequate risk management or mitigation strategies in place to address the possibility of a worst-case scenario emerging from the project. Few centers and firms have invested adequately in platforms on which to assemble partners, assign roles and responsibilities, and resolve internal conflicts as they emerge. Fewer still have adequate legal, financial and communication strategies in place to manage external threats. CIMMYT's experiences in two maize improvement investments in East Africa where both internal and external threats came to bear on the PPP-based projects, demonstrate just how necessary a good risk management and mitigation strategy can be.

VII. Conclusions

This study suggests that while PPPs are serving a wide variety of research objectives, the CGIAR's partnerships with the private sector are still at a very nascent stage. Few partnerships are explicitly designed to facilitate joint innovation, an important justification for the use of PPPs. Still fewer provide for effective management of the risks inherent in PPPs, or provide effective analysis of their poverty-targeting

strategies. Thus, the international agricultural research system and its private partners could do more in the future to

- Combine explicit knowledge exchanges (for example, straightforward technology transfers) with experiential learning approaches in which knowledge is transferred via learning by doing, learning through face-to-face interaction, hands-on collaboration, and scientific exchange programs;
- Commit resources to building platforms on which to assemble relevant partners, identify incentive compatibility, agree on mutual objectives, and assign roles and responsibilities appropriately;
- Devise comprehensive strategies to manage and mitigate risks associated with projects that include recognition of the complex legal, financial, and political elements that underlie a successful PPP; and
- Improve the quality of analysis of the impact pathways through which PPPs improve the well-being and livelihoods of the marginalized social groups they target.

In conclusion, public-private partnerships are a viable approach to conducting research for development. However, it is important to note that a “one size fits all” approach to PPPs is counterproductive: The deployment of pro-poor knowledge and technology requires different—and often creative—approaches to research and partnership. And 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.

Table 3. 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
<i>Crop-science sector</i>			
Syngenta, Switzerland	7,270	7	CIMMYT, ICRISAT, Bioversity Int'l, 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	
<i>Agri-food sector</i>			
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.

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David J. Spielman, a U.S. national, joined IFPRI in 2004 as a postdoctoral fellow. He is now working as a research fellow at the institute's office in Addis Ababa, Ethiopia, where his research examines a range of topics including science, technology and innovation policy in the context of developing-country-agriculture. Prior to this, David worked on agriculture and rural development issues for the World Bank (Washington, D.C.), the Aga Khan Development Network (Pakistan), and several other organizations. His research interests include rural innovation systems, community-based development, and agricultural biotechnology, with a regional emphasis on East Africa and South Asia. He received a Ph.D. in Economics from American University in 2003, an M.Sc. in Development Studies from the London School of Economics in 1993, and a B.A. in International Relations from Tufts University in 1992.

Frank Hartwich joined IFPRI's new ISNAR division in 2004 continuing work in the Costa Rica office on the project Public-private Partnerships for Agro-industrial Research in Latin America. Before he was working at ISNAR and the University of Hohenheim, Germany. His current research focuses on public-private partnerships and how they can be used for developing pro-poor innovations in agriculture. He also works on evaluation of agricultural research and has dealt with theories and methods for institutional innovation in agricultural innovation systems. Before, in the frame ISNAR projects, he has worked in research performance assessment in Africa and impact pathway analysis. He has also worked on different consultancies, among others for the Natural Resources Institute, on project evaluations in Africa and South-East Asia. Dr. Hartwich has a M.S. in Agricultural Science from the University of Bonn, a M.S. (French DAA) in Management of Agro-enterprises from ENSA Toulouse, and a PhD in Agricultural Economics from the University of Hohenheim, Stuttgart.

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^{iv} 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.

^v Details of these PPP projects are also available in a searchable online database at <http://ifpri.catalog.cgiar.org/pppbase.htm>.