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**Public private sector partnerships in an agricultural system of
innovation: concepts and challenges**

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PUBLIC PRIVATE SECTOR PARTNERSHIPS IN AN AGRICULTURAL SYSTEM OF INNOVATION: CONCEPTS AND CHALLENGES

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Abstract

The potential for public private sector partnerships is likely to grow. However, despite a number of high profile success stories, promoting partnerships has proved more difficult than many assumed. This paper argues that such partnerships need to be viewed in the framework of an innovation system and a development scenario where networks of agro-enterprises and intermediary organisations will underpin rural development and poverty reduction. This view helps reveal the importance of embedding public research organizations within these local networks and highlights that constraint to building partnership is usually institutional in nature – i.e. it relates to habits practices and patterns of trust. The paper concludes by suggesting that efforts should be focused on building social capital in agricultural innovation systems and cautions that this should be done in contextually relevant ways.

Key words: Public private sector partnerships; innovation systems; institutional change; capacity development; social capital.

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TABLE OF CONTENTS

1. INTRODUCTION.....	7
2. UNDERSTANDING THE CONCEPT OF PARTNERSHIP	9
2.1 PARTNERSHIPS: RATIONALE AND EXPECTATIONS	9
2.2. PUBLIC-PRIVATE SECTOR PARTNERSHIPS IN A SYSTEM OF INNOVATION	11
3. AGRICULTURE AND THE PRIVATE SECTOR	13
3.1. TRENDS IN PRIVATE INVESTMENT IN AGRICULTURAL RESEARCH.....	13
3.2. FUTURE RURAL REALITIES AND ROLE OF THE PRIVATE SECTOR	14
4. REVIEW OF RECENT EXPERIENCES WITH PUBLIC PRIVATE SECTOR PARTNERSHIPS.....	19
5. OPTIONS FOR DEVELOPING THE SOCIAL CAPITAL OF AGRICULTURAL INNOVATION SYSTEMS	23
6. CONCLUSIONS	27
REFERENCES.....	29
THE UNU-MERIT WORKING PAPER SERIES.....	33

1. INTRODUCTION

There is widespread recognition of the potential for public private sector partnerships (PPPs) in agricultural research and that this may be an important way of developing the capacity of agricultural innovation systems (Hall, 1998, 2001). Underpinning this potential is the significant and growing investments made by the private sector in agricultural research (Pray, 2002) and, encouraged by market friendly policies arising from a decade or so of economic liberalization and the growing role of the private sector in many developing countries. There are a number of ways in which PPPs in agricultural research could arise based on the complementarity of assets and the overlapping of interest and agenda (Byerlee and Fisher 2002). Attractions of PPPs are widely perceived to include: research being conducted that neither sector may attempt independently; privately owned knowledge and materials may be accessed for public good research; new sources of funding for public sector research; and new delivery mechanisms for public technologies. In the light of renewed calls for a capacity building agenda in development (Fukuda-Parr et al 2002) it has also been argued that where PPP involve alliances with developed country partners in areas of frontier science, partnership may be an important way of developing scientific capabilities (James, 1997).

Yet despite the apparent promise of PPP recent experiences suggest that PPP in agricultural research have been less extensive and more difficult to promote than might have initially been imagined (e.g. Byerlee and Echeverria 2002; Spielman and von Grebmer 2004; Hartwich et al 2003, Velho 2004). Clashes of working styles, complex IPR arrangements, and institutional inertia in public research organizations are among the reasons cited for this. Where successes have occurred there is no obvious blueprint, but instead it depends on initial conditions.

Furthermore the small number of frequently quoted “success” stories of PPP’s involve large life science companies. These sorts of high profile arrangements may have special significance for strategic and complex research problems. However the potential for these sorts of alliance may be limited by the fact that the focus of these life science companies may not necessarily be matched to the crops and constraints of developing country agriculture (Scoones, 2002). In the future most PPPs will probably concern local or regionalised companies with limited research capability. There is less discussion and analysis of these sorts of developments and partnerships within national innovation systems. Critical questions therefore remain about the nature and role of public R&D capacity, how to strengthen it and integrate it with the range of actors from all sectors playing a role in the development process.

The purpose of this paper is to explore current practice, speculate on future patterns of PPP and discuss how partnership can be leveraged in the development process. The paper seeks to view PPP experiences and their potential from two perspectives. The first perspective is that of the innovation systems concept with its emphasis on strengthening capacity in the sense of linkages, multiple sources of innovation, and institutional contexts (norms, routines and habits) that shape knowledge flows and learning. The second is the perspective of what a market-driven agricultural sector might look like in coming years, the way the sector is likely to contribute to poverty reducing economic development, and the important role agro-based firms and companies are likely to play in this scenario.

The paper argues that while **research-based** PPP are important, these are only one of number of types of partnership and other relationships that constitute innovation capacity. And although technical innovation is important, so is institutional, managerial and policy innovation. Partnerships that promote innovation are thus not **only** concerned with frontier research and technology (although these may have a special importance), but also (and more usually) are concerned with incremental problem solving, i.e. the continuous process of minor adjustments and improvements that farmers and firms make to survive, improve profits and compete with other farmers / firms, domestically and internationally. Furthermore rather than thinking about bilateral PPPs, in practice innovation often involves clusters or coalitions of organizations including those from the civil society sector, who together produce, adapt and use the knowledge that drives continuous innovation. These groupings of partners may be linked through formal as well as informal arrangements. It may therefore be useful to think of research-based PPPs as part of coalitions of other actors. In many cases institutional change in public research systems is required so that a new tradition of working in this way can emerge.

The paper illustrates these points with a series of thumb nail case studies of contemporary experiences. Details from all these mini cases confirm the findings of others that while building partnerships has been valuable, it is not straight forward and often counter to deeply held professional norms, particularly on the part of public scientists. But the cases also suggest that these rather mundane and less high profile cases of PPP are going to be of the type that planners and policy makers are going to have to deal with on a day-to-day basis. The paper concludes by suggesting that while reform and institutional change in agricultural research organization is certainly required, interventions need to be thought about at the systems level. The final section suggests that this could be achieved by concentrating on developing the social capital of agricultural innovation systems. Domains where efforts need to be concentrated are highlighted and possible types of intervention are summarized.

2. UNDERSTANDING THE CONCEPT OF PARTNERSHIP

2.1 Partnerships: rationale and expectations

Reviewing developed country experiences, van der Meer (2002) observes that with the growth of private investment in research, the public sector in some countries has reacted by simultaneously reducing funding and taking steps to seek cooperation with the private sector. In explaining the rationale for this sort of partnership van der Meer describes the blurred and changed boundaries between public and private sector roles in agricultural research. He argues that while some goods can be viewed as purely public and produced by the public sector and others purely private and left to the market, increasingly there are goods that have elements of both – hybrid goods. Furthermore the actual definition of these goods will change over time, as the boundary between public and private sectors shifts with the evolution of markets, technology and institutional arrangements such as intellectual property rules.

Defining the private sector as local and multinational companies as well as farmers and their associations, van de Meer (2002) defines PPP as the pooling of public and private resources with the aim of providing value added to both parties and makes the following points

Both parties must bring some resources to the partnership that are valuable for the other party and for the common interest. These may be information, specialized human capital, germplasm, funds or research facilities

Both parties must have an interest that overlaps. This does not mean that goals or outputs need to be the same for each sector – the private sector may seek increased market share while the public sector may want progress in sustainable rural development.

Both parties must expect some net gain – something that they can not achieve as cheaply, as rapidly or as effectively when they operate on their own.

Byerlee and Fisher 2002 explain the way partnerships could arise based on the complementarity of assets and the overlapping of interest and agenda. (Their summary of interests and agendas is summarized in table 1.) So for example in the area of biotechnology, the private sector may have protocols, genes and know-how, and the public sector may have large germplasm collections and networks for multi-location testing and evaluation.

Thus partnerships may be based on: resource and skill synergies; risk sharing in pre-competitive areas of research; or may relate to the wish of private companies to contribute to philanthropic activities. Alternatively partnerships may relate to simpler, though no less important arrangements involving the private sale of public technologies (Tripp and Pal 2001) or private purchase of public research and advisory services (Hall et al 2002).

Table 1. *Assets of public and private sectors in agri-biotechnology research*

National level research Organization	National agricultural research systems (NARS)	Local seed companies
	Local diverse germplasm Local knowledge Breeding and evaluation programmes and associated infrastructure Access to delivery systems including extension Upstream capacity (in more-effective NARS only)	Local knowledge Breeding programmes and infrastructure Seed delivery systems Marketing network
Key assets	CGIAR international centres	Global life science companies
	Diverse germplasm Breeding and evaluation programmes and associated infrastructure Global germplasm exchange and evaluation networks Economies of market size Up-stream capacity in a few centres Mostly positive public image	Biotechnology tools, genes, and know-how Access to capital markets Economies of market size Skills in dealing with regulatory agencies Flexibility and speed in decision making

Source: Byerlee and Fischer 2002

Attractions of PPPs include: research being conducted that neither sector may attempt independently; privately owned knowledge and materials accessed for public good research; new sources of funding for public sector research; and new deliver mechanisms for public technologies. PPP may provide private developed country organizations access to emerging markets in developing countries; give them influence in the development of legal and regulatory regimes; and help them navigate country-specific research systems and regulatory environments (Spielman and von Grebmer 2004). In cases where PPP involve developing country organizations linking with foreign partners in areas of frontier science, partnerships may be an important way of developing national scientific capabilities.

Capitalizing on complementary assets and new types of arrangements will require new capabilities in partnering to help rapidly develop a range of public-private sector partnerships. Fischer (2000) suggests that regional networks of public research organizations may be required to strengthen their bargaining position and skills. These developments also raise a series of questions concerning the changing role of public research organizations and ways of ensuring that the developmental mandate of the international agricultural research centres (IARCs) is

maintained. Tripp and Byerlee (2000) caution that while there is significant pressure to partner with the private sector as a resource mobilization strategy, this in itself will not improve the effectiveness of agricultural research unless it is guided by specific and relevant opportunities that private partners can provide.

2.2. Public-private sector partnerships in a system of innovation

Recent applications of the innovation systems concept in the agricultural sector have viewed PPP and research partnerships as part of a wider set of relationships and processes (Hall et al 2001, 2003). The concept refers to the system of all actors involved in the production, diffusion adoption and use of knowledge. This knowledge may be brand new, but more often innovation involves the new use of existing knowledge and this may involve both product and process innovations. This system is shaped by the habits, routines and practices (institutions) of actors and particularly the way these habits relate to knowledge sharing and acquisition and to learning. In this way the innovation process is viewed as one involving interactive learning, embedded in series of relationships and institutional contexts that (through learning) evolve over time. The attraction of this approach stems firstly from the fact that it deals with the production and use of knowledge (of all kinds) at a time when economic activities and their competitiveness is becoming knowledge intensive – thus knowledge has great economic significance. And secondly the way it recognizes and values the diversity of stakeholders in the innovation process and the institutional factors governing their participation and roles.

This conceptualization provides a number of insights:

Organized science and codified knowledge (from the private or public sector) is only one of a range of types of knowledge. Tacit knowledge from many different sources is also important. Codified knowledge might be agricultural science but also other types from universities, business schools etc.

Science-based technical innovations are important, but so also are process, managerial, institutional and policy innovations.

Innovation requires accessing knowledge in a number of different types of knowledge-bases and hence partnering and other forms of alliances and networking are key innovation strategies.

Knowledge sharing and access can be governed by formal agreements, but is often governed by informal institutions -- trust and traditions and routines of those involved.

Problem solving, accessing new markets and remaining competitive does not only concern the deployment of frontier science (although it may do). More often innovation concerns the small changes associated with incremental learning and problem solving.

To remain competitive or to deal with problems that might be themselves evolutionary, a continuous process of learning and innovation is required.

There is often an interconnectedness and interaction between technical and institutional innovations – new ways of producing knowledge give rise to further innovations that present new possibilities for producing and using knowledge.

One can draw three broad implications from an innovation systems perspective.

Firstly, the capacity of an agricultural innovation system will certainly involve PPP. But these partnerships will not just involve research, but the creation and sharing of other types of knowledge. Furthermore PPP (research and otherwise) will be just one of a range of relationships that are important in agricultural innovation systems capacity --integration of other actors and knowledge-bases such as policy actors and those from civil society will also be important. Often PPP will be part of clusters of partners, local and foreign, forming coalitions and consortia, of a formal and informal type, to deal with challenges and opportunities.

Secondly, a large element of innovation capacity relates to patterns of trust between actors and the habits and routines of actors that relate to sharing information and learning – i.e. a large element of capacity is institutional in nature.

Thirdly, a key capability of an effective innovation system is its ability to continuously evolve and adapt in concert with changing circumstances. These circumstances maybe: the opportunities presented by new technologies; changing development imperatives and agendas of stakeholders; the challenges of evolving pest and disease problems; or competitive pressures particularly in international commodity markets. This capability relates to the skills of different actors and the way habits and routines promote or constrain institutional learning and change. Innovation capacity is thus evolutionary as institutional arrangement and patterns of partnership are continuously adjusting through learning and in response to changing circumstances.

Innovation systems perspective thus situates the discussion of PPP in a broader set of relationships than just research collaboration. Instead it broadens the scope of analysis to include the range of relationship related to knowledge production and helps reveal the institutional factors that govern this process.

3. AGRICULTURE AND THE PRIVATE SECTOR

3.1. Trends in private investment in agricultural research

Encouraged by technological and institutional changes, the private sector has become a major player in agricultural research, with levels of investment grown more rapidly than those of the public sector (Pray 2002). Pardy and Beintema (2001) estimate that in the mid 1990's about US\$ 22.6 billion was spent annually by the public sector, US\$ 11 billion of which was in developing countries. Private sector player expenditure in the same period was US\$ 11.5 billion of which US\$ 10.8 billion was spent in developed countries. While rates of growth by the private sector in developing countries has also increased, the public sector is still by far the dominant player. In addition increases which have taken place in the private sector have been greater in Asia than Africa and often starting from a very low base.

Byerlee and Fischer (2002) suggest that in biotechnology research the private sector is the major player investing US\$ 2.6 billion. However they go on to explain how only a small share of this is directed at developing countries. This is occurring through direct investments of global life science companies, acquisition by these companies of local seed companies, and through alliances of global and local companies. While these global companies have a significant presence in the developing world it is concentrated in a few large countries.

Not only is most private research conducted in developed countries, but also the process of acquisitions and takeovers has meant that this is concentrated in a relatively small number of global life science companies. Furthermore, these investments tend to be in such niche areas as hybrid vegetables and cereals and global commodities such as soybean and cotton. These have less relevance to developing country farmers. Scoones (2002) doubts whether increasing private research investments particularly in biotechnology is like to benefit the poor. So while the private sector will never entirely replace the public sector (Pray and Umali-Deninger,1998), its research does however present possibilities for technological spillovers relevant to poor farmers. Well known examples are research on pest and disease affecting on global commodities that are important developing country crops (for example: rice, wheat, maize) and the identification genes conferring resistance. Table 2 presents some examples of PPP where the private sector has played an important role by virtue of its research capacity.

Table 2. *Examples of public-private sector partnerships resulting from research capability in the private sector*

Focus	Private sector partner(s)	Private sector partner(s)	Observations
Bt maize (insect resistance)	Pioneer Hi-Bred (USA)	Agricultural genetic engineering Institute (AGERI), Egypt	Training for AGERI scientist. Gave pioneer access to evaluate Bt proteins and genes patented by AGERI). IPRs provide for market segmentation
Papaya ring spot virus	Monsanto (USA) Zeneca plant science (now part of Syngenta)	Research organizations in South East Asia Universities in USA and UK	Network of public and private partners. Arrangement brokered by ISAAA. License is free for production for local domestic markets.
Golden rice (vitamin A enhanced)	Many including Greenovation, Zeneca (now part of Syngenta)		Involved 70 patents belonging to 32 companies and universities and difficult IPR negotiations Board established to help deliver to developing countries
Virus resistant sweet potato	Monsanto (USA)	USAID's ABSP Kenyan Agricultural research organization and Vegetable and Ornamental Plants Institute (South Africa)	Brokered by ISAAA. IPR allow unrestricted use in Africa. Yet to be commercialized and concerns exists about weak links to local private sector.
Apomixis	Pioneer Hi-bred (USA) Syngenta (Switzerland) Limagrain (France)	CIMMYT L'Institut d Recherche pour le Development (France)	
Insect resistant maize for Africa	Novartis ? (Switzerland))	Syngenta foundation (Switzerland) Kenyan agricultural research institute, CIMMYT	Use limited to Africa

3.2. Future rural realities and role of the private sector

Much of the debate of PPP in agriculture has focused on the private sector as a source of research expertise. And since this expertise is often based in global life science companies these arrangements have tended to hinge on various types of North-South partnership between these companies and national and international research centres. While these types of partnership are important, one senses that there is a relatively small number of frequently quoted success stories that tends to overplay the role these are currently playing – although there is no denying their potential significance. Other types of PPP are those where local companies need the support of public research organization in order to allow them to overcome problems, access new markets and compete domestically and internationally (Hall et al, 2001, Hartwich et al 2004). Kiggundu

(2006) argues that regionalised companies need just as much support as local ones and that it is not only support from research organisations that is required, but also support from other public agencies as well as other private companies. These sorts of partnership are also important but seem to attract less discussion, analysis and policy interest than the high profile partnerships illustrated in table 2. Moreover these are precisely the sorts of partnerships that are likely to be needed in a market-driven development scenario and which the innovation systems approach places great importance.

The numbers of small and medium scale agro-related enterprises have grown dramatically as countries have pursued policies of economic liberalization (although there are great country to country differences). It is difficult to be definitive about the size of this sector. But it worth reflecting briefly on the likely nature of the agricultural sector in the future, the role of the private sector in relation to agriculture and how this will relate to poverty reduction.

Recent work by Ashley and Maxwell (2001) paint a picture (albeit generic and extreme) of the future agricultural sector in developing countries in which the majority of rural populations will be functionally landless. Income will be non-agricultural but will have strong links to agriculture through employment in agro-related industries. Commercial farmers will be the norm, with few subsistence producers. Factors driving this include:

The shifts in the food chain towards a value added chain, with increasing movements towards industrialized food processing, long distance marketing – the growth of supermarkets and the way they affect food chains by introducing new requirements for timeliness, quality and quantity that small producers have difficulty meeting. (Readon and Swinnet, 2003)

Rural-urban migration. Both as coping strategy, but often as an accumulative strategy (Deshingkar and Start 2003). The poor are often migrating to small urban centres and market towns working in small-scale rural enterprises providing goods and services for farm families or in agro-industries that add value to agricultural produce.

The viability of the agricultural sector and its contributions to poor people will relate to the ability of commercial farms and agro-related industries to compete, domestically and internationally. While staple food crop will remain important, horticultural crops and livestock products will increase in importance. Small and medium scale enterprises involved in value addition and domestic and international trade will play a large role and will need support in areas such as quality improvement, processing, storage and transportation and, for those in international markets, compliance with sanitary and phyto-sanitary regulations. It is likely that private agricultural extension services will play an important role in a more commercially based agricultural sector (for example, Rasheed Sulaiman et al, 2005) . A continuous stream of

innovations based on scientific and managerial knowledge will be important to maintain the competitiveness of these organizations and their clients and this suggests that partnerships with relevant knowledge bases will need to be formed.

This type of scenario (stylized though it is) suggests that much closer relations will be needed between the private sector and local research organisations. This is not to deny that frontier science may also be important for this type of private sector lead scenario. Rather than the local research organisations are likely to be the point of contact with the local private sector and must have the capabilities and networks linking them to sources of science and technology held by other organizations in both the public and private sector in other locations and countries. The caveat being that coordinating types of private organisations/intermediaries such as business associations may become more important in brokering such partnerships. This is consistent with the view of PPP in a systems of innovation outlined earlier. Box 1 provides examples to illustrate the types of PPP and other partnerships that this would involve. These examples also illustrate the different sorts of roles the private sector can play within these arrangements and ways the innovations involved can be both technical and institutional. These cases (and there are many more like them) do not have the headline grabbing profile of PPP involving the global life science companies and frontier areas of agricultural science. However they exemplify the sorts of partnership arrangement that will support market driven development in many developing countries. It will probably be this sort of partnership that will be most common and thus these sorts of arrangement that policy actors will need to nurture and promote.

Box 1 Public private sector partnerships in agricultural innovation systems

The private sector as a source of institutional innovations in the rice sector in Papua New Guinea (PNG). Recent moves to create rice self sufficiency in PNG have triggered an overlap of the interest of government and a large rice importer and distributor, Tricia Industries. The company sees advantages in procuring rice locally and is keen to encourage domestic production. This has led to modest private funding of public research. However this is part of a bigger intersect whereby public and private stakeholders are working together to co-ordinate and integrate research, entrepreneurial activity, with the efforts of NGO's and policy bodies promoting rice production in order to meet both public policy goals related to food security as well as the needs of industry. An institutional innovation to achieve this -- the formation of a Rice Development Association -- is being actively promoted by both Tricia and the Department of Agriculture. Challenges to be faced include, the development of seed distribution systems; varieties testing in different agro-ecological zones; the development of standards for rice; the coordination of advice and support to farmers; the collection of update information on rice production trends, seed demand and so forth.

The use of multiple knowledge bases to build the capability and competitiveness of the medicinal plants industry in India. The Himalaya Company is typical of the new generation of the corporate enterprises emerging in the traditional small-scale craft based herbal drugs industry in India. To compete and prosper it is developing partnerships with a range of scientific and technical knowledge bases. These include the rural-based collectors of medicinal plants with local ethno-botanical knowledge. With increasing demands for raw material, the company

is finding that it is needing to shift from collecting from the wild to cultivation of medicinal plants and is having to work with rural communities to establish new supply bases. This has required research on cultivation techniques and, while the relevant India research institute has not addressed this topic, a partnership has been established to pursue this type of research. Other partnerships have been formed with allopathic research organizations to try and understand the efficacy of herbal preparations in what had otherwise been a craft based industry. Knowledge about efficacy has become important because of the potential edge it gives the company over its competitors in marketing its products.

Technical and institutional innovations to create competitiveness in the grape and wine industry in South Africa. Over the last decade the South Africa grape industry has felt the twin pressures of intense international competition in the sector, as well as social and political changes that are changing patterns of ownership of land. The sector has responded by altering and in some cases developing new partnerships with a range of scientific knowledge bases within South Africa. These have been used to develop the innovations needed to improve productivity and quality. This has been coupled with a series of institutional and policy changes that have built cooperation within the industry and with different knowledge based and thus helped the industry to maintain international competitiveness.

Capacity development through institutional change: partnerships in The Andhra Pradesh Netherlands Biotechnology programme. The APNB is a long term capacity development programme seeking to use biotechnology in rural development in India. The programme was built on a series of partnerships between agricultural research organizations and university departments on the one hand and civil society organizations and rural communities on the other. It has focused on tissue culture and bio-fertilizers and bio-pesticides in the first phase and subsequently on transgenic pest-resistance. Building partnerships with the civil society sector was important in this case as it was important to build an interface between the rather isolated research organizations and those involved in the use of technology. In addition to the technology impacts of the programme a major institutional impact has been the way it has changed the culture of scientists working on the programme, opening their eyes (often slowly and painfully) to the benefits of working in more consultative ways with partners. (See Clark et al 2002 for further details)

Sorghum poultry feed: a public private sector partnership coalition. The international Institute for Crop Research in the Semi- Arid Tropics has developed a series of partnerships (a coalition) on the theme of increasing sorghum use in poultry feed. This includes scientific partners from plant breeding, poultry science and animal nutrition located internationally, national agricultural research organizations and from a national University Department. From the private sector it involves partners from the poultry feed industry and poultry broiler and layer industry, an industry association and sorghum farmers. The theme requires no fundamental research as the nutritional properties of sorghum are well known. Instead what has been important has been for the scientist to undertake trials in ways that industrial partners can accept results, make selections between different varieties and use them in feed manufacture. The process has brought together a coalition of different actors and built relationships which have allowed existing knowledge to be adapted and used. This is starting to build a long term relation between the research and enterprise sector that is opening the possibility for further collaboration. Driving this collaboration is the wish on the one hand of the private sector to reduce production cost in the face of strong domestic and international competition and rising feed costs, and on the other hand the wish of the scientific partners to find new markets for a crop important to poor producers.

4. REVIEW OF RECENT EXPERIENCES WITH PUBLIC PRIVATE SECTOR PARTNERSHIPS

There is now a growing number of cases - some systematically documented - PPP relating to developing countries. Recent useful reviews include Byerlee and Echeverria (2002), Spielman and von Grebmer (2004), and Hartwich et al (2003, and 2004). Hall et al (2001 and 2002) provide case studies of PPP in India. Ekboir and Parellada (2002) provide a useful case study from Argentina. Velho (2004) reviews partnerships in general relating to agricultural biotechnology research in sub-Saharan Africa. These cases suggest that successful PPPs are certainly emerging. Overall however the picture is much more mixed and the prevalence of these arrangements is less than might be expected. A number of generic problems emerge that relate, first, to forming partnerships between public and private actors, and secondly, operating together in a partnership framework. Reasons include the following

- Bureaucratic procedure on the part of the public sector

- Different working styles and reward structures

- Lack of business culture in the public sector and limited experience of working in commercial settings.

- No tradition or experience of working with the private sector or even in partnership more generally

- Lack of trust

- Complex IPR issues, especially where multiple public and private partners are involved operating in a number of countries

- Weak negotiating and IPR skills in the public sector.

- Private sector concerns that unpredictable policy changes may affect partnership agreements

- Fragmentation of public scientific resources across different ministries and weak communication channels even within the public sector.

- PPP that involve Northern partner collaborating with public research partners in the South often do not lead to useful outcomes because of a failure to partner with the local private sector

Spielman and von Grebmer (2004) exploring PPPs in the CGIAR system conclude that while incentives and perceptions do differ between the two sectors, sufficient common space exists or can be created through incentive structuring to facilitate greater partnership. However partnership development is constrained by insufficient accounting of the actual and hidden cost of partnerships; persistent negative perceptions across the two sectors; undue competition over financial and intellectual resources and partners discount the need for brokers and third-party actors to manage collaborations and reduce competition between sectors; and PPP are operating without sufficient information on existing partnership experiences and lessons.

A recent conference convened to share experience of partnerships and new architectures of innovation in agricultural research (ICRISAT 2003) highlight the following points associated with more successful cases.

Partnership arrangements arose in very context specific ways, each with its own individual history of why the problem was considered important and why particular partners came together.

Critical in successful partnership was the issue of shared values and the development of trust between partners.

As a consequence it was seen to be better to partner with organization that there were already known and there was an existing relationship. This underlines the importance of courting partners.

Complementary resources and skills are certainly important in building partnerships, but complimentary values and cultures are also required.

Not just about raising cash but also about partners achieving goals, e.g. impact, new markets, new products

Using private sector actors as part of public advisory committees and other governance structures is a way of starting to build bridges.

Successful cases have often involved explicit efforts to change culture of science

Successful cases have often involved explicit efforts to learn and learn about learning

Change is constant and on-going.

Emerging from these experiences are a number of broad points.

Firstly, there is no blueprint for partnership. There is a great diversity of arrangements and these relate to the historical and location specific contexts in which partnerships arise and the

factors that trigger the need for partnership. While models will therefore probably be of limited use, developing principles will be helpful.

Secondly developing and operating within partnership arrangements often has high transaction costs precisely because there is no history of working together, no informal agreements between parties exist and thus lengthy negotiations and complex formal agreements have to be developed.

Thirdly, the main constraints to promoting partnerships are of an institutional nature. That is to say that they relate to the habits and traditions of partner organizations and the way these inhibit the development of trust between partners and prevents organizations learning to work in new ways.

While this suggests that institutional development is required by all actors within the agricultural innovation systems, it is probably most desperately needed in national agricultural research organization. Byerlee and Echeverria (2002) suggest reform of such organisations is probably a prerequisite for pursuing partnership approaches. These public research organizations are critical as they will be the point of contact for partnering (often Northern) organizations with expertise in and ownership of frontier areas of science and technology. But also it will be these organizations that will form the critical scientific-knowledge bases supporting the competitiveness of the local companies and farmers. Reform and institutional change of public research organizations needs to be such that it allows them to operate as part of a dynamic agricultural innovation system.

5. OPTIONS FOR DEVELOPING THE SOCIAL CAPITAL OF AGRICULTURAL INNOVATION SYSTEMS

This paper has made the following points: In the literature on PPP greater attention has been given to partnerships associated with biotechnology and with the global life science companies. There are good reasons for this as the emergence of private research capacity in this area presents potentially important opportunities to leverage frontier science in new ways. Less attention has been given to cases where the private sector has limited scientific resources, but is never-the-less an important player and is partnering with (usually local) research organizations. The paper argues that both an innovation systems perspective and predictions about the role of agro-industries in future agriculture sector scenario, suggest it will be the latter type of partnership that will be most frequently encountered, often as part of cluster or coalition of partners. And even where this involves partners -- domestic and foreign -- in frontier areas of science, partnerships with local private organizations will be critical. Finally the paper has argued that for partnerships to be used as a way of developing the capacity of agricultural innovation systems, institutional change, particularly in public research organisations is important.

However thinking about interventions to deal with this from an innovation systems perspective suggests that while there are things that can be done to help agricultural research organizations (and these are included below), it is more useful to think about system level interventions. One way to go about this, suggested by Lal (2002), is to think about this in terms of strengthening the social capital of the system as a whole and then identify the different intervention points needed to achieve this overall goal. Lal (2002) (following Putnam (1995) suggests that social capital comprises the ability of individuals in a group to form relationships of trust, cooperation and common purpose. It is thus intimately related to the co-operative and interactive relationship so fundamental to effective operation of innovation systems. And as the earlier analysis of PPP suggest it is aspects of social capital and the need for institutional change that is usually the central weakness of innovation systems. It relates to strengthening networks, trust, information flows. And it involves new skills, new groupings, but often these are only tools towards changing the organizational culture of those involved.

Table 2 summarises the domains in which social capital needs to be strengthened in agricultural innovation systems. It also presents some of the sorts of interventions that can be used. This is certainly not a definitive list of options, rather it is examples of the sorts of things that can be used. It should be stressed that these will need to be applied flexibly to suit local institutional

contexts, customs and arrangements and that the analysis of specific country contexts will suggest that greater emphasis will need to be given to some sorts of activity. It also needs to be noted that some of these interventions have both product and process outcomes in the sense that the activities have a sub-agenda of intensifying interaction between potential partners with a long term goal of building trust and better patterns of communication. It should be remembered that ways of building social capital and indeed ways of strengthening partnerships and systems of innovation needs to be viewed as an experimental task. That is to say that no one intervention or even set of interventions is likely to achieve this objective immediately or fully. Instead approaches and interventions need to be tried out and incrementally improved through a learning-by-doing approach. It can not be stressed enough that incremental learning and change rather than radical reforms are likely to be at the heart of these processes and that these processes will need to be on-going.

While the need to build social capital would certainly seem to be an important way forward a priority over and above this is to develop the capacity of policy and research actors to engage in this sort of process. In particular capacities need to be built so that these actors can conduct the sort of analysis needed to identify gaps and develop interventions in local systems and develop interventions that are relevant to local contexts and which are informed by the political and institutional realities of these contexts. Building the capacity of policy and research actors in these areas would be complimentary to others forms of capacity development in innovation systems that might be focusing on strengthening research organizations or supporting private sector development.

Table 2. *Domains in which social capital needs to be strengthened in agricultural innovation systems and some options for intervention.*

Domain	Intervention options
Within agricultural research organizations	Team building across disciplines; developing reflection and learning skills; institutional learning and change programmes.
Within local private companies	Training in problem solving, quality management and information management, double loop learning skills (learning to learn)
Among farmers	Farmer field schools; farmer to farmer visits; creation of farmer associations
Within civil society organizations	Strengthen research skills;
Between agricultural research organizations	Stipulation of competitive grant schemes; membership of governing boards.
Between local companies	Industry associations; stipulation of competitive grant schemes
Between research organizations and farmers	Training in participatory methods; development of partnering, reflection and learning skills; professional incentives that relate to developmental objectives as well as scientific ones; institutional learning and change programmes.
Between research organization and local private companies	Stipulation of competitive grant schemes; joint supervision of students; sandwich degree courses; industrial placement for research personnel.
Between agricultural research organization, local companies	The use of third party agencies; membership of governing board; change programs and stipulations of competitive grant schemes

and international life science companies	
Within government	Cross ministerial consultations
Between government, private companies, research organizations and civil society organizations	Foresight exercises (consultative priority visioning exercises using panels of stakeholders). Policy working groups. Taskforces

6. CONCLUSIONS

If public private sector partnerships are to fulfil their obvious potential, then new ways must be found to breakdown barriers and increase communication and trust between the two sectors. From a policy perspective, viewing partnerships in the framework of an innovation system gives sharper focus to the need to address institutional dimensions of this task. Strengthening the capacity of policy and research actors so that they could identify ways of building the social capital of local innovation systems would be a useful way of moving this task forward.

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