

The Development and Use of Innovation Systems framework in India

A Southern Perspective

Introduction

The inadequacies of conventional treatment of agricultural science and technology (AS&T) policy issues are becoming increasingly apparent in India. A central issues concerns the need to revisit the institutional underpinning of research and development (R&D) and technology dissemination/extension. Premised on the assumptions of decades old institutional designs, the public sector agricultural research system is out of step with recent institutional and economic developments in the country. At the same time, the persistent social development objectives of the rural/agrarian sector remain unfulfilled. While it is clear to many that current institutional arrangements are not delivering the promise of science and technology, there has been precious little fresh thinking on ways in which this issue can be addressed. It is within this setting that this paper discusses the development and use of the innovation systems framework in a collaborative North-South partnership.

This paper, however, is much more than a reflection on the nature of North-South collaborative projects. Rather it is a reflection on the wider institutional environment in which research and subsequent technical and policy change takes place and the broader (and perhaps more fundamental) implications this has for development research aid (DRA). For this reason, the development and use of the innovation system framework in India is discussed in two contexts.

Firstly a discussion is made of the way the partnership between the Northern and Southern partner emerged, evolved and the dynamics of this relationship. A collaborative policy project on innovation systems provides the illustrative context for this discussion. Secondly, and perhaps more interesting, however, is the discussion of the way that project learning and our growing realisation of the wider implications of the innovation systems concept has caused us to reflect on a much wider set of relationship issues. This has not concerned our North-South partnership *per se*, but the need to view our relationship and its policy change goals, in the context of stimulating behavioural changes within a much wider institutional arena. This has been particularly important in the Indian context where the institutional environment and the policy debate in this context have shown considerable inertia and conservatism.

In practical terms our analysis of AS&T arrangements highlighted the value of developing coalitions of partners to create new capacities to innovate; the need to move beyond technical and policy fixes; and the need for interventions to be rooted in networks of local institutional ownership and support. Our collaborative policy research was certainly intellectually stimulating. We had, however, grossly underestimated the need for policy research projects like ours to form their own coalitions around contending policy positions – in this case an innovations systems perspective on institutional arrangements and institutional reform. The issue for us is therefore not so much the dynamics of the North-South partnership, but a change in perspective related to a much wider capacity building effort. In the case of our policy project, this means knitting together policy researchers and practitioners from diverse institutional affiliations to help build a group of like-minded actors that will gain sufficient momentum for change. Without this wider perspective, discussion of restructuring relationships between Northern and Southern scientists or policy analysts will have little meaning as it will not address the all too apparent need to support the development of broadly based innovation systems capacities firmly rooted in a national institutional context.

The remainder of this paper begins by providing an overview of the Indian agricultural research system and the institutional issues it faces. The emergence, evolution and dynamics of the North South partnership are then discussed. This leads into a discussion of the wider implications that have emerged from project learning on the innovation systems framework and the way this has informed the wider partnership issue. The next section makes a more general discussion of the implications of the innovation systems framework for capacity building and DRA and the way donor assistance could tackle some of these issues. Emphasis is given to the need for a much greater understanding of the prevailing institutional context and the need for evolutionary learning to

underpin policy interventions. It is suggested that this will act as a way of challenging key institutional assumptions concerning the way the system currently works. In conclusion it is recommended that donors pay much greater attention to the implications of the innovation systems framework; and that they focus capacity building efforts in a wider systems purview; that this is supported by human resource development that can promote this perspective on the agricultural innovation process.

The Indian national context to policy research questions on institutional arrangements in agricultural R&D

India has one of the largest and institutionally complex agricultural research systems in the world. At the national level, the Indian Council of Agricultural Research (ICAR) co-ordinates, directs and promotes agricultural research and education in the whole country. It has 4 national institutes, 45 central research institutes, 30 national research centres, 4 bureaux, 10 project directorates, 84 AICRPS/networks and 16 other projects/programmes in the public sector. In addition there are 28 State Agricultural Universities and one Central Agricultural University, which operate through 313 research stations. In addition to this, general universities (about 23 are involved in agricultural research), scientific organisations (CSIR, BARC) other government ministries/ departments (Ministry of Food, DST, DBT) private and voluntary organisations are also involved in agricultural research. ICAR receives most of its budget from the national budget in part financed by external loans and grants. Similarly State Agricultural Universities obtain their bulk funding from state Governments and project specific support from ICAR. The National Agricultural Research System (NARS) over the years has thus grown in terms of institutions, investments and manpower.

From the late eighties and early nineties, the private sector involvement in agricultural research started increasing. This has been associated with the growth of the agro-industrial sector in response to new opportunities in the increasingly liberal policy environment. Private sector has been making significant research contributions in the seed, agro-chemicals and agro-machinery sectors at present. Similarly, potentially important agricultural research and related capability exists in the non-profit sector (NGOs, farmer associations and private research foundations).

The public sector has made significant contributions in making the country self sufficient in food grains and in increasing the production and productivity of major crops. Despite its achievements in the past, the Indian agriculture continues to face serious challenges due to ever increasing population, limited

land and water availability, degradation of natural resources and trade related adjustments following WTO. At the same time, NARS has also been facing system problems like unplanned growth, duplication/overlap of institutional mandates, loss of complementarity among institutions, lack of client focus, lack of funds for operating expenses, a need to modernise the research infrastructure and the need for training and upgrading scientist's skills in frontier science and management areas (Mruthyunjaya and Ranjitha, 1998). In response, ICAR has implemented a number of reforms to improve its efficiency and accountability, forge linkage with other partners and mobilise resources. Two key reforms have specifically been introduced with respect to strengthening ICAR's relationship with the private sector. (i) the establishment of mechanism by ICAR to provide its services on a consultancy and contractual basis; (ii) making available germplasm and other technology products of ICAR to the private sector at nominal cost. Initiatives for decentralising powers to the institute and scientist levels for providing more flexibility in decision making and improve its ability to respond quickly were also introduced. To explore productive partnerships with the private sector, ICAR also initiated interface meetings with the private sector and functional groups were constituted under five broad themes with private sector participation. The impact of these reforms has not been as great as initially anticipated (Paroda and Mruthyunjaya, 1999).

Due to its nature of evolution and lack of a systems approach, the public sector has been working in isolation without much interaction with the private sector. ICAR recognised at one level that there was a need to be more integrated and less isolated from the changing institutional and economic environment in the country. However, the discussions on public-private partnerships in the 90's revolved around on what each sector can independently provide to the other. The reform programme seemed circumscribed by longstanding conventions concerning the proper relationship between science and economic development. Against this setting a number of critical questions emerge: the need to find ways in which the country's strong scientific resources can be realigned with national priorities, how these can be arrived at in a more consensual fashion taking into account the divergent needs of diverse stakeholder groups; and the way the complementary resources, skills, perspectives and agendas of these stakeholders can be more effectively networked together. These questions form the contextual setting for the North-South policy research collaboration discussed in this paper.

The Southern Partner

The National Centre for Agricultural Economics and Policy Research (NCAEP), a constituent unit of the ICAR, has a mandate for examining (among other policy issues) the institutional changes in Indian agriculture. The major focus has been on the growing private sector involvement in agricultural research and extension systems in India. By 1998, the Centre has completed two important studies in this line. One of the studies explored options for improving the effectiveness of agricultural research and extension systems (Farrington *et al.*, 1998) and the other examined the potential of private sector agricultural extension in India (Sulaiman and Sadamate 2000). I have been associated with both these studies, as an associate in the first one and as Principal Investigator on the other. Both these studies have clearly shown the nature and extent of private participation in research and extension in the country, and the need to understand the implications of this for the public sector, highlighting the potential of improving the effectiveness of service delivery through public-private partnerships.

Following these studies I began exploring options on ways to carry forward the results of these studies. Since 1999, the Centre has been facilitating the ICAR in its meetings with the private sector. It was also around this time that Dr Andy Hall came up with the idea of a collaborative study with NCAEP on exploring the institutional issues involved in public-private partnerships in Indian agriculture.

The Northern Partner

Dr Andy Hall, who works at ICRTSAT and NRI, had been dealing with the same issues in the context of crop post-harvest programme. He had also realised that technical change was circumscribed by a fairly fundamental set of institutional issues and that these were becoming more critical as alternative institutional groupings emerged in the horticulture and export sector. In other words, in the same way that these issues were starting to become critical to us in the national programme, similarly these same issues associated with the institutional context of R&D in India were impinging on the work of Northern agencies that were trying to both commission and implement DRA. Clearly the way forward was to start and undertake research that gave a greater degree of importance to this institutional context. Andy has a background in science and technology policy and we found this perspective interesting in our earlier interactions with him.

Emergence of the North-South Partnership

The Northern partner first visited NCAP in late 1997. Although the visit was with reference to another study on commodity outlook, discussions with the then Director, Dr Jha, focused on the issue of public and private sector partners in the horticulture /post-harvest sector. Dr Jha was interested in the area because he felt that, for reasons discussed above, ICAR had to give much greater thought to its role and relationship with the emerging private sector. On his suggestion a pilot project was developed. The idea of this was not only to explore the relevant issues in greater detail, but also to use the project as a device to build wider interest in the topic among the relevant stakeholders. The result was that in early 1998, the Northern partner secured funding for a 6-month investigation of the emerging public-private sector relationships. In fact the project had both a technical and institutional element, the idea being that continuing with technical research would be a good way of revealing the nature of institutional arrangements and the implications these had for the research process. The broad issues that emerged were discussed in two workshops held in Delhi in June and September 1998. The main thrust of this work pointed to the fact that potentially important partnership could develop between the public and private sectors, but that this was constrained by the prevailing institutional set-up. This raised questions over the most appropriate institutional grouping, how these new capacities could be developed and sustained, what was the appropriate role of the public sector in this evolving institutional context, and what would be the implications for achieving developmental goals such as poverty reduction.

In shaping thinking on these issues, critical was the decision to involve Norman Clark (ex of Science Policy Research Unit, University of Sussex) as a collaborator /advisor in this work. As a senior science and technology policy specialist and with the benefit of detachment, he recognised that many of the features of innovation systems discussed in the context of the developed, industrial economies was starting to become apparent in the recent developments in India. This prompted the use of the innovation systems framework as an approach for understanding these issues. Its value stems from its ability to help understand *how* and technical change in and as part of a much wider institutional context. As an approach it had not been used in developing country agriculture, although others had suggested similar ideas. As a result further conceptual development would be required and this needed further empirical work. These ideas laid the foundations for the development of the final project proposal.

The development of the collaborative project

Andy Hall (ICRISAT) with NCAP made broad consultations on the project outline. I had been identified by NCAP as the collaborator and Andy wrote the proposal taking into consideration the comments offered by me and other colleagues in the Centre. For the Centre and ICAR, the interest has been primarily on trying to apply a new conceptual framework for exploring partnership issues in agriculture. One of the striking features of the proposal was the use of a conceptual framework, namely the Innovation Systems Framework (ISF) as a means to understand and evaluate institutional developments taking place in the agricultural sector. Since we at NCAP were also interested in institutional issues in technology development, the proposal was attractive. I was personally interested in this area, as the importance of this topic had been revealed in our earlier studies. The project proposal was finally approved in the ICRISAT-ICAR work plan for the period 1999-2003.

The major objectives of the project were stated as (i) to conduct an evaluation of the emerging patterns of institutional partnerships especially in the post harvest sector and (ii) to provide policy and programme guidance on the optimal arrangements for demand-driven post harvest technology generation and transfer involving public and private sector partnerships. Over a period of about two years, we have conducted case studies in the horticulture, sugar and seed sectors and this has yielded new insights into the problems of developing partnerships in Indian agricultural research and development. The team had published the results of these studies in journals and had presented the same in national and international workshops. Interface meetings were also organised with the public and private sector partners for sharing the results. To make these insights available to a wider policy audience within the country, NCAP has also published a Policy Brief on this theme.

NCAP is fully committed to the project and both Dr Hall and myself are jointly conducting the case studies. Dr Hall is taking the lead in the project and myself contributing more towards bringing the country and ICAR perspectives. The partnership has been thus professionally and intellectually stimulating. And this has been the only study that has tried to use the innovation system principles to understand the public-private interactions in agricultural technology development and promotion. The next section attempts to summarise some of the key findings about the Indian public agricultural research system and the emerging agricultural innovation system in the country. Our studies have revealed a lot about the nature of these systems, which has implications for the effectiveness, and relevance of the policy research that we are conducting in our North South partnership.

There exists a broad consensus on the need for the public and private sector (commercial and non-profit) to work together. The two sectors, however, differ significantly in their perception on each other's needs and capabilities. Both sectors need to learn how to access each other's capability for better system performance. Many of the new initiatives introduced to promote partnerships (which have been accepted in the policy rhetoric of ICAR), remain largely unimplemented (or un-performable) due to a lack of wider systems changes. For example contract research arrangements are now permitted, but personnel policies have not been suitably amended to make these attractive for scientists to pursue such collaboration. Competitive research funds have been introduced, but no attention has been given to examining ways in which these can be operated and adapted within the Indian organisational culture. Decentralisation of decision making to encourage flexibility in dealing with new partners has been introduced into an inherently hierarchical system where patterns of authority are both socially and professionally embedded.

Not surprisingly building up broader patterns of partnership between public and private and research and non-research actors has proved difficult. For instance, Jha and Pal (1999) point out that private sector research and development is growing, but in isolation and with few interactions with public sector research. As a result no major public-private collaborative research programme tackling issues in line with national priorities have emerged. Hall *et al.* (1998) suggest that in the horticultural sector, the technology acquisition strategies of many private organisations are shaped by the fact that the public sector lacks the appropriate skills and perspectives to provide quality management technologies required for entry into export markets. In fact it is often more appropriate for the horticultural industry to buy technology from other private organisations (both nationally and internationally) or to develop *in-house* related capacity.

The public sector research institutions, relying on decades old institutional design of centralised science, have professionally isolated themselves to the extent that interactions between various public sector research institutions rarely happen. Due to disciplinary segregation and lack of linkages, the public sector has difficulty in providing integrated technical solutions to individuals, organisations or industry that want this. As research and extension are institutionally separated, generic technologies remain in the shelf with no mechanism to develop into commercially viable technologies in economic production. Often due to lack of experience in commercial application of technology, valuable knowledge and skills in the public sector remains blocked

with no meaningful pathways to flow to other actors for further refinement and value addition to be used in economic production.

Our research using the innovation systems framework has started to reveal the types of innovation system relationship that is emerging, especially around themes led by private and NGO sectors. Moreover it also reveals some of the constraints to better inclusion of the public sector. Our recent analysis of these issues (Hall *et al.* 2001) concluded with the following points.

It is apparent that while many of the elements of an effective agricultural innovation system are emerging, the system is challenged in a number of important respects. There is still a fundamental misunderstanding of the way innovation actually takes place and the appropriate contribution that public sector research can make. This is demonstrated by two important omissions in the ICAR institutional reform process. Firstly, the broad patterns of institutional arrangements in the public sector remain unchallenged. This is demonstrated by the persistence of disciplinary divisions within ICAR as well as the even deeper divisions that exist between institutions from different research councils and government ministries. In contrast many of the research problems that the private sector is dealing with, are embedded in complex production systems. The way the private sector is structuring its own research capability around a more inclusive interpretation of its technology needs is an important lesson for institutional reform.

The second and perhaps fundamental omission in the reform process concerns institutional learning. For example, new policies that make provision for contract research will not be translated into greater interaction with the private sector unless wider systems changes can be made to accommodate the new working practices that this will entail. This relates to changes in administrative systems as well as aspects of the overall institutional set-up of the public-sector research system. The only way that appropriate changes can be made, is to make institutional learning a more explicit part of institutional reform.

We are also exploring possibilities of using the principles of ISF in agricultural extension too (Sulaiman and Hall, 2001). Extension systems also face similar challenges, as in the case of research and this initiative has been one of the outcomes of our work on the research system. In the context of extension, it is apparent that the role of the public sector needs to change from supply of information to facilitating information networks of the innovation system type. One of the case studies that we examined concerned an NGO that was playing precisely this role (Clark *et al.* 2001). There was a technical research component, but the role of the NGO was to link this activity to other actors who had

relationship with technology users and market actors that could help promote the technology.

It is just these types of arrangements that ICAR scientific institutions need to enter into, but for reasons of organisational culture and hierarchy they are not able to do so. The cultural context in which these systems operate has been found to discourage institutional innovations. Lack of appreciation for analysing the process issues and undertaking institutional learning is making the process of applying ISF in agricultural research and development extremely difficult. Capacity building to facilitate this transition needs sincere and concerted efforts.

Partnerships in the wider institutional context

As may be apparent, the present collaborative project using the ISF has generated many meaningful insights in the institutional issues in public-private partnerships in agricultural research and development. However, it would be insincere if we do not admit here that these have had a limited impact. Though awareness on alternate ways of analysing the effectiveness of agricultural research institutions is slowly building up (primarily through our efforts), this has not become an effective force in reforming the way agricultural research and development system operate.

This relates to the dominance of a policy paradigm in public sector agricultural research and development organisations that is highly linear. Changing the way agricultural research and development is planned, executed and evaluated is going to be difficult given the huge institutional inertia and accepted modes of professional endeavour that this dominant paradigm supports. We believe that the innovation system framework should provide the principles for institutional reform of ICAR and the way scientific and technological capability needs to be organised for development purposes. However we also recognise that policy research (albeit academically successful) will not be enough to stimulate wider system changes and to overthrow the dominant policy paradigm that views technical change and associated institutional relationships as stepwise processes. Unless we engage actively in this process of system change, our North-South research partnership remains stuck in part of this wider linear design.

To address this serious limitation, the team has decided to form a policy network to promote innovation system thinking in ICAR. One way of doing it is to share the findings of this study with other scientists and institutions both within and outside ICAR, particularly among those researchers and practitioners pursuing perspectives similar to the innovation system. We hope to create

sufficient momentum through this type of a policy networking so that even after the project life, the insights gained from this project would facilitate promotion and advocacy for the innovation system perspective. The implication of this for North-South partnerships is that what is important is the way the partnership and the knowledge it creates embed in the local institutional environment, and contributes to the locally rooted innovation system. This applies to policy-based coalitions (as in our case) as much as it does to technology-based coalitions. Only by conceiving North-South partnerships as part of these networks of local stakeholders will the wider goal of improved innovation performance be achieved. In our final section practical ways of achieving this are explored.

Lessons for North South Partnerships

Indian agricultural research and extension system in the post independence period was shaped by a series of interventions. Strengthening this requires advice, financial assistance, infrastructure support and training of manpower. The Indian agricultural research system has also benefited greatly through its collaborative research programmes with CGIAR institutions. Compared to many other countries in Africa or Latin America, India has developed considerable capacity in terms of institutions and manpower in addressing its problems. But what is lacking at the moment is its capacity in drawing inputs from all these different agencies (research and non-research nodes in the public and private sectors). Unless the systems' capacity to perform this role is developed, additional strengthening of the capability of individuals and organisations in advanced science or development capability would not lead to any significant contributions from the research and development system.

If agricultural research and development systems have to move forward, coalitions need to be built around technical and policy research projects. Strengthening capacity to promote the use of the innovation systems framework in public sector agricultural research and development organisations could be the focus of North-South partnerships in future. Our experience has shown that the academic field of science policy provides powerful analytical perspectives for understanding issues concerning the institutional context of science and technology, and ways in which scientific and technological capability needs to be organised for rapid economic development. The ICAR lacks professionals having expertise in this area, but it can always hire this expertise for a detailed analysis of its organisation and research management. Application of innovation policy perspectives in analysing institutional issues in agricultural research and development thus needs emphasis.

To strengthen the capacity of the system towards developing an innovation system perspective, the North can make significant contributions. Donor Research Assistance could be potentially tuned to promote innovation system perspective in the country through:

- a. Priority funding to projects that explores institutional issues in research and development, as such studies have been neglected in the past.
- b. Clear articulation in the project guidelines for the need to form coalitions of actors around technical and policy problems.
- c. Assistance to develop an Innovation System Perspective among research and development organisations in the South in a way that it supports consensus building among relevant stakeholders and professional and policy networks.

Conclusions

Traditional North-South partnerships have not addressed adequately the institutional issues in reforming agricultural research and development. Reforms in agricultural research and development should move beyond technical and policy fixes. Interventions need to be rooted firmly in the local institutional and cultural context. Application of ISF in agricultural research offers opportunities for understanding the institutional issues in re-organising agricultural research systems. To operationalise ISF thinking and action, North-South co-operation has to promote contending coalitions around technical, developmental and policy projects.

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Bibliography

- Clark, N. G.; Hall, A. J.; Rasheed Sulaiman V.; Gurus Naik (2001), 'Research as capacity building: the case of an agro-development post-harvest innovation system for the Himalayan Hills', unpublished manuscript.
- Farrington, J.; Rasheed Sulaiman V. and Suresh Pal (1998), 'Improving the Effectiveness of Agricultural Research and Extension in India', Policy Paper 8, National Centre for Agricultural Economics and Policy Research, New Delhi.
- Hall, A. J.; Rasheed Sulaiman V.; Clark, N. G.; Sivamohan, M. V. K. and Yoganand, B. (2001 d), 'Public-private sector interaction in the Indian agricultural research system: An innovation system perspective on institutional reform', Chapter in Byerlee, D. and Echeverria, R. G. (eds.), 'Agricultural Research Policy in an Era of Privatization: Experiences from the Developing World', CAM (in press).

- Hall, A.J.; Sivamohan, M.V.K.; Clark, N.G.; Taylor, S. and Bocket, G. (1998), 'Institutional developments in Indian agricultural R and D systems: The emergence of public and private sector activity', *Science, Technology and Development*, Vol. 16, No. 3, pp. 51-76.
- Jha, D. and Pal, S. (1999), 'Strengthening IIS-Private sector Interface in Agricultural Research', in Pal, S and Joshi, P.K. (eds.) (1999), 'New paradigms of Agricultural Research Management: Institutionalisation of Research Prioritisation, Monitoring and Evaluation and Partnerships with the Private sector', Workshop Proceedings 6, National Centre for Agricultural Economics and Policy Research, New Delhi.
- Mruthyunjaya and Ranjitha, P. (1998), 'The Indian Agricultural Research System: Structure, Current Policy Issues and Future Orientation', *World Development*, Vol. 16, No. 6 pp. 1089-1101, 1998.
- Parida, R.S. and Mruthyunjaya (1999), 'MARS in Asia Pacific Region-a perspective', Asia Pacific Association of Agricultural Research Organisations, IAAO, RAPO, Bangkok.
- Sulaiman, V.R. and Sudamate, V.V. (2000), 'Privatising Agricultural Extension in India', Policy Paper 10, National Centre for Agricultural Economics and Policy Research, New Delhi.
- Sulaiman, V.R. and Hall, A.J. (2004), 'An Innovation System Perspective on the Restructuring of Agricultural Extension: Evidence from India', draft manuscript.