

Draft Note

Consultative Group on International Agricultural Research
Science Forum
Strengthening Research-For-Development Capacities

**EMBEDDING AGRICULTURAL RESEARCH
IN A SYSTEM OF INNOVATION**

Andy Hall¹

December 6, 2005
Marrakech, Morocco

Contemporary thinking about the production and effective use of knowledge demands a fundamental rethink about the way agricultural research organisations relate to the process of agricultural development and efforts to use it to reduce poverty in sustainable ways. At the heart of this change is the recognition that it is not only knowledge production (by research) that is important. What is also important is making this knowledge available and enabling its effective use. This process of producing, accessing and using knowledge in new ways, innovation – not to be confused with invention – creates wealth and social wellbeing by adding value to existing knowledge, resources and skills. Furthermore this view suggests that innovation does not arise solely from a simple process of transferring knowledge from research to knowledge users. But instead arises through a process of interaction and learning where knowledge from diverse sources is shared and integrated in ways that allow its novel use. This view situates research organisations in a wider set of relationships with a more diverse group of actors than was previously considered necessary. These ideas are increasingly discussed in terms of an innovation system.

Yet this perspective is at odds with most development interventions in the agricultural sector. Here investments in research coupled with technology transfer mechanisms

¹ United Nations University, Institute for New Technologies, Maastricht, The Netherlands, email: hall@intech.unu.edu

Draft Note

were, and continue to be the main policy instrument for generating and diffusing the knowledge needed to develop the sector. After decades of investments premised on the idea that research was central to innovation, the innovation systems concept suggests that agricultural research organisations need to be thought of as part of a much larger constellation of sources of knowledge, players and processes. And that the relationship between research organisations and these other players needs to change substantially. However, just as the suggestion of Copernicus that the earth was not the centre of the solar system, the innovation systems concept seems counterintuitive to many who believe in the centrality of research. Indeed for those whose views of the organisation and role of agricultural research and extension has been informed by the iconic success of the apparently research driven Green Revolution in South Asia, to suggest that research is not the central player does indeed seem like heresy.

This paper introduces the innovation systems concept and explains its relevance to contemporary agricultural development challenges. A discussion is then made of the implications of this perspective for agricultural research organisations and the way they work.

New agriculture and the changing agricultural scenario

The majority of poor people in developing countries live in rural areas with livelihoods related directly and indirectly to agriculture. Yet the development landscape in these regions is changing rapidly offering both constraints and opportunities to reduce poverty that include but go beyond old strategies of transferring productivity enhancing agricultural technologies. This has been referred to as New Agriculture and its emergence is being driven by an interrelated set of changes: the rural sector is becoming more connected to domestic, but also international markets; private sector organisations as well as NGOs are starting to become more important players in rural areas; political and administrative decentralisation and a changing role of the State in many countries has created new opportunities and roles of different actors; urbanisation and changing consumers demands are presenting new opportunities for agro-processing and in doing so creating value chains with a diverse range of employment opportunities for poor people; and, in turn, greater participation in markets is exposing farmers and companies to rapidly changing market and regulatory environments and often very strong competitive pressures and the need to innovate continuously and at unprecedented rates.

The corollary to these changes being that as production and processes in value chains become more knowledge intensive, innovation requires linkages to a diversity of stocks of knowledge located in organisations in the public and private sectors, both locally and internationally. At the same time new technological paradigms are emerging – information technology, biotechnology; nano-technology – bring new challenges

Draft Note

relating to how to make these technologies available and the type of policy and institutional environment needed to make productive use of them².

Systems perspectives on innovation and development

Why Innovation systems?

The relevance of the innovation systems concept is not just that the old research driven framework is out of step with what is now known about knowledge production and use. But also the contemporary agricultural development scenario has properties that require a different more dynamic and evolutionary approach.

This is not the first time that there have been calls to revisit the frameworks in which the relationship between research and the process of social and economic changes is considered³. Biggs⁴ pointed out that there are multiple sources of innovation, not just research. Chambers and others made much of the fact that poor people have important stocks of knowledge and that if they participated in research and developmental processes, equitable development would proceed much faster. Roling and others developed the idea of an agricultural knowledge and information system, recognising the range of actors in the rural sector and the importance of their interaction as a way of promoting knowledge use.

The innovation system idea was a parallel conceptual development coming not from agriculture and rural development, but from science and technology policy studies from the industrial world. Freeman⁵ and later Lundval (1991) noticed that the more successful economies had what they described as an effective National System of Innovation. Earlier work had recognised that innovation rather than research investments per se were the key to economic growth. And that innovation was a social process of interacting and learning.

The contention was that for innovation to take place, knowledge from codified and tacit sources, from the public and private sectors and from local and global sources needs to be successfully integrated through partnerships and networks. This requires nurturing policy environments; routines and cultures accustomed to learning and handling and sharing knowledge from multiple sources and using them effectively in a particular context; and the ability to learn and adapt to changing surroundings. This last point was

² Hall, A.J. (2005) Capacity development for agricultural biotechnology in developing countries: an innovation systems view of what it is and how to develop it. *Journal of International Development*. Vol 19, No.5:pp 611-630

³ Byerlee, D., (1998) "The Search for a New Paradigm for the Development of National Agricultural Research Systems", *World Development Vol.26*, No.6, pp.1049-1055, 1998.

⁴ Biggs, S.D., (1990). "A multiple source of innovation model of agricultural research and technology promotion" *World Development* 18 (11), pp 1481-1499.

⁵ Freeman C (1987) *Technology and Economic Performance: Lessons from Japan*. Pinter, London.

Draft Note

particularly important as it recognised that social and economic change takes place in an evolving context and that a successful innovation process needs to cope with that.

These sorts of perspectives are captured by the concept of an innovation system and this is increasingly being applied to agriculture in developing countries⁶. Its relevance to agriculture was that:

- it situated the analysis and planning of agricultural research in a very broad set of relationships including those beyond the rural sector – particularly important given the increasing importance of different actors including those beyond the rural sector and particularly the private sector;
- it gave very high importance to institutional setting—the habits, practices and routines that create patterns of behaviour important to innovation – these had been recognised as a bottleneck for a long time but most frameworks struggled to handle these; and
- it placed very strong emphasis on the dynamic interaction of the networks, processes and institutions with the evolving context in which they were located – a phenomena that most commonly used frameworks could not handle.

The contrast between an agricultural research system and an agricultural innovation system is summarized in Table 1. Rather than give a detailed description of the properties of an innovation system and the conceptual underpinnings of this, four key features and implications need to be highlighted.

Focus on innovation

In contrast to most economic frameworks, which focus on production (output), the new framework focuses on innovation processes. Innovation is often confused with research and measured in terms of scientific or technical outputs. However, the innovation systems concept stresses that innovation is neither research nor science and technology, but rather the application of knowledge (of all types) to achieve desired social and/or economic outcomes. This knowledge may be acquired through learning, research or experience, but it cannot be considered as an innovation until it is applied. The processes of learning and acquiring knowledge are interactive, often requiring extensive links between different sources of knowledge.

The role of institutions

Institutional settings play a central role in shaping the processes that are critical to innovation: interaction, learning, and sharing knowledge. The innovation systems framework distinguishes institutions from organizations. Organizations are bodies such as enterprises, research institutes, farmer cooperatives and government or non-government organizations (NGOs), whilst institutions are the sets of common habits,

⁶ Hall A.J., , M.V.K. Sivamohan, N. Clark, S. Taylor and G. Bockett. (2001) Why Research Partnerships Really Matter: Innovation Theory, Institutional Arrangements and Implications for the Developing New Technology for the Poor. World Development Vol. 29, No 5 pp783-797

Draft Note

routines, practices, rules or laws that regulate the relationships and interactions between individuals and groups⁷.

Coping with dynamic environments

One of the characteristics of successful innovation systems is that their component organizations tend to create new partnerships and alliances when facing external shocks. Examples of external shocks include new pest problems that require collaboration between a different set of scientific disciplines; new technologies, such as biotechnology, that need partnerships between the public and private sectors; or new trade rules and competitive pressures in international markets that force a change in relationships between local companies and research organizations. It is not possible to determine the kinds of networks, links and partnerships that will be needed in the future, as the nature of future shocks is, by definition, unknown. Dealing with future shocks could be made easier if organizations had both the flexibility and the types of networks necessary to rapidly form the new patterns of partnership dictated by new or changing circumstances.

Change in emphasis to capacity development and the nature of capacity development.

The innovation systems concept focuses on the change process, rather than the inputs such as technology needed to bring about change. This has a very important implication, because in terms of intervention it shifts emphasis toward improving processes rather than increasing inputs and is therefore much more concerned with capacity development. The logic here being that building the capacity of an innovation system would strengthen both the process by which inputs (technology) are produced and the processes involved in making these inputs available and ensuring that they are used. But capacity development in relationship to innovation does not just mean training – although it includes that. Instead it also places great emphasis on developing networks that support interaction and learning. Equally important is the development of institutional setting -- norms that pattern behaviour – that play such an important role in innovation, shaping patterns of interaction and learning.

Table 1. Comparison of an agricultural research system and an agricultural innovation system.

Institutional features	Agricultural research system	Agricultural innovation system
Guiding agenda	Scientific	Sustainable and equitable development
Role of actors	Researchers only	Multiple and evolving

⁷ Edquist C (ed.) (1997) Systems of Innovation Approaches – Their Emergence and Characteristics. Cassell Academic, London.

Draft Note

Assumptions on how impact is achieved	Diffusion through extension and through the market	Interactive learning leads to novel action
Relationships involved	Narrow, hierarchical	Diverse, interactive
Partners	Scientists in agricultural research organizations and other public agencies such as universities	Evolving coalitions of interest. Various combinations of scientists, entrepreneurs, farmers, development workers and planners from the public and private sectors
Policy focus	Narrow, related to agricultural research and agriculture and food policy Disconnected from other policy domains	Broad, also inclusive of trade, rural development, industry, environment, education Integration and coordination between many policy domains
Policy process	Disconnected from stakeholders and knowledge	Integrated with stakeholders and sensitive to differing agendas
Knowledge produced	Codified Technical/scientific	All forms of codified and tacit knowledge: scientific, technical, organizational, institutional, marketing and managerial

Draft Note

Indicators of performance	<p>Short term: scientific publications, technologies and patents</p> <p>Long term: patterns of technology adoption</p>	<p>Short term: institutional development and change/new behaviours, habits and practices/links</p> <p>Long term: social and economic transformation</p>
Responsibility for achieving impact	Other agencies dedicated to extension and technology promotion	All partners
Capacity development	Trained scientists and research infrastructure	<p>Training and infrastructure development related to a range of research and economic activities and people</p> <p>Policies, practices and institutions that encourage knowledge flows, learning and innovation among all participants</p>

Note: This table polarizes the differences between these two paradigms and has been exaggerated for illustrative purposes.

Implications for agricultural research organisations.

It is important to begin by stressing that the innovation systems concept does not reject scientific research and its power to generate new knowledge. Instead what the concept does is to situate research within a set of relationships necessary to make knowledge available to others and which allow that knowledge to be put into effective use. The corollary being that part of the notion of “putting knowledge into effective use” -- i.e. innovation – involves interactive learning. The research process can therefore no longer act autonomously from those who it intends to use its products. Furthermore, situating research in this wide set of relationships places it in a much more dynamic context as it brings it closer to organisations that need to respond to changing production conditions, market fluctuations and trends, and changing policy and regulatory environments.

In practical terms, situating a research organisation in an innovation system implies that it becomes just one among many organisations contributing towards a particular social

Draft Note

or economic objective -- for example, creating rural employment; combating livestock diseases; improving the competitiveness of an export horticulture industry. Driving this might be a particular policy measure and / or initiative of a developmental agency or a private company or a research organisation.

As research organisations start to situate themselves in these networks, and because the relationships needed are interactive – a mixture of supply push and demand pull – the priorities, approaches, roles and measures of performance become increasingly determined by the networks in which they sit.

Embedding research organisations in a system of innovation therefore has important implications for how they operate. The broad implications discussed below apply equally to national research organisations.

Centrality of partnerships

Partnerships and other forms of collaboration with other research organisations and more importantly with organisations from the enterprise, development and policy sectors need to be used extensively. This should not be interpreted as meaning that everybody should partner with everybody, but should be used to contribute to specific networks of action.

Network development

Beyond partnering on distinct projects or programmes a related implication is that research organisations need to build the sorts of relationship that bind them to a diverse network of organisations. The importance of this is that these networks provide access to knowledge about the changing contexts and possible future states – policies, markets, technological contexts etc. Also, the network is a pool of potential partners that can be linked up with when needed.

Developing a stakeholder dialogue

A further element of embedding research organisations in a system of innovation is the need to develop relationships and networks that supports a dialogue between research organisation and stakeholders about the evolving nature of challenges and opportunities and potential ways of address these. This is important as it not only builds the trust needed as a foundation for future partnerships. But in addition it helps deal with controversies and where there are a number of alternative trajectories that can be followed – for example about how biotechnology can be used in development or about how the agendas of the poor can be promoted in scenarios where the private sector is driving innovation.

Draft Note

New governance mechanisms

Situating research organisations in a network brings with it an expectation of participation in initiatives to address the concerns of the network – clearly an important element of achieving impact. Working as part of an innovation system therefore means recognising that this network is an important mechanism for setting priorities and that these are likely to be dynamic and evolving and relate to specific stakeholder domains. Centralised priority setting and evaluation process such as those in the CGIAR have a role to play. However the habits, practices and values of centralised mechanisms inevitably circumscribe what is ultimately viewed as a priority and what types of outcome are judged as a success. Consultation is not sufficient to fully overcome this tendency. Embedding research in a system of innovation implies a shift from a centralised, static approach to priorities to an approach that will allow stakeholder networks and their value judgements to drive a dynamic process of priority setting and evaluation.

New agenda of systems capacity development

Traditionally research organisations have contributed knowledge embodied as technology, policy recommendations or conceptual insights. The rationale being that these types of knowledge inputs were missing and that they could be formulated in sufficiently generic ways to make them applicable in multiple contexts. Embedding research in a system of innovation recognises that it is not just knowledge inputs that are missing, but also the processes necessary to make knowledge available and to enable its use are also missing. Research organisations need to contribute to the strengthening these processes. This sort of capacity development might involve new linkages, new institutions (i.e. new forms of behaviour, routines and norms) as well as new enabling environments⁸.

New research focus associated with systems capacity development agenda.

The systems capacity development agenda that accompanies embedding research organisations in a system of innovation has implications for the types of research conducted, and how that research is conducted. Firstly, investigating the nature of the innovation processes and how to create innovation systems capacity emerges as a major generic area of research. But not as a specialist social science endeavour, but as core element of research in different technological sectors seeking to understand the institutional and policy regime needed to bring about innovation. Secondly the main way of investigating this is through an action research methodology whereby new capacities are developed experimentally and lessons learnt. These lessons are international public goods and as such this is also a relevant area of research for CGIAR centres.

⁸ Hall, A.J, N.G. Clark, Rasheed Sulaiman V., MVK Sivamohan and B Yoganand. (2000). New agendas for agricultural research in developing countries: policy analysis and institutional implications. *Knowledge, Policy and Technology* Vol 13 No1 pp 70-91

Draft Note

New roles associated with systems capacity development agenda.

The systems capacity development agenda that accompanies embedding research organisations in a system of innovation has implications for the role of these organisations. The research role will remain important, although this will have to contribute to institutional change as well as technological change. In other cases research organisations will have to play the role of knowledge brokers ensuring that reliable knowledge and information is available where it is needed. In other cases it will be necessary to play the role of a catalyst stimulating networking where it is needed. At other times it will be necessary to participate in networks either to ensure access to knowledge or to ensure that knowledge produced is accessible by others. These roles are determined by particular contexts and fields of action and all are legitimate roles for research organisation, contributing to developing the capacity of the innovation system in which they are embedded.

Explicit efforts to reassess roles.

Embedding research organisations in a system of innovation means having dynamic and often multiple roles. However these will not happen automatically and an implication is that research organisations will have to make explicit efforts to continuously reassess their most appropriate roles in the network of the organisation that they are situated in.

New organisational cultures and institutional learning and change.

Embedding research organisations in innovation systems demands a different organisational culture. Elements of this culture include: openness to partnership, consensus and dialogue; a willingness to respect the views of stakeholders; a willingness to participate in knowledge sharing and exchange; a recognition that ways of working and institutional arrangements are inherently experimental with the scope for continuous improvement; the reorganisation of innovation can involve technology transfer; participatory development; and interactive learning. Finally that institutional learning, i.e. incrementally changing habits and practices to better achieve a goal is an incremental process of reflection and learning and is central to building the capacity of organisations to innovate and the systems in which they are situated.

New skills and disciplinary mixes.

The new organisational cultures that have been discussed above suggest that soft skills will be required to work in new ways – partnering skills; facilitation skills; reflection and learning skills; networking skills. But it also suggests new disciplinary mixes are required. Embedding research organisations in systems of innovation and the new research agenda that comes with it means that institutional analysis and research will become a much more important topic. The number of scientists with these sorts of research skills will need to be increased substantially.

Conclusion.

Embedding agricultural research organisations in system of innovation offers a potentially powerful way of making more effective use of science and technology in the development process. The principles inherent in the innovation systems concept are particularly appropriate to the contemporary situation in the agricultural sector characterized as it is by multiple players, complicated institutional, policy and economic environments and the increasingly rapid rate of change seen in these environments. However to move ahead in this new direction research organisations need to substantially rethink the way they work. Of particular important is a renewed emphasis on capacity development that accompanied this approach. The contribution of international agricultural research organisations to developing the capacity to produce and use knowledge more effectively would create major developmental into the future.