

Innovation systems: Implications for agricultural policy and practice

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Farmers and businesses need to adapt constantly if they are to survive and compete in the rapidly evolving environment associated with the contemporary agricultural sector. Rethinking agricultural research as part of a dynamic system of innovation could help to design ways of creating and sustaining conditions that will support the process of adaptation and innovation. This approach involves developing the working styles and practices of individuals and organizations and the incentives, support structures and policy environments that encourage innovation. Previous efforts to support agricultural sector innovation largely targeted agricultural policy and research organizations. The systems approach recognizes that innovation takes place through the interaction of a broader set of organizations and activities. These patterns of interaction and working styles and practices – or institutions as they are referred to by social scientists – need to adapt continuously if they are to meet the changing demands of the evolving agricultural sector. Institutional learning is central to this process and will ensure research organizations remain relevant and continue to introduce innovations that impact positively on the livelihoods of the poor.

Introduction

Innovation is essential if farmers and businesses are to survive and compete successfully in the rapidly evolving environment associated with the contemporary agricultural sector. There are several reasons why the current environment is so dynamic:

- agriculture is becoming increasingly interconnected with regional and domestic markets, competitive pressures are rising, and consumer demands and standards are changing;
- rapid social change is occurring, including urbanization and changing food preferences and systems;
- intensification of agriculture is associated with rising pest and disease problems; and
- environmental degradation is on the increase.

Many poor people rely on agriculture for their livelihoods and a continuous process of innovation is essential if the goal of poverty alleviation is to be achieved. Although agricultural research plays a vital role in the complex process of innovation, there is growing concern that its contribution is not increasing in line with demand. Routine assessments, such as analysis of the economic impact of research, provide little guidance on how to improve performance (Hall et al., 2003). There are, however, signs that the dynamic and multi-faceted role of contemporary agricultural science and the need to address the institutional dimensions of its performance are being increasingly recognized (see box on page 2). Drawing together these types of concerns has led to recent attempts to apply the concept of an innovation system as a framework to help understand and improve the contribution of research to development. This has prompted new thinking on this topic.

The origins of this framework lie in the notion of a national innovation system (Freeman, 1987; Lundvall, 1992). This concept emerged because conventional economic models had limited power to explain innovation, which was viewed conventionally as a linear process driven by research. The innovation systems concept sees innovation in a more systemic, interactive and evolutionary way, whereby networks of

organizations, together with the institutions and policies that affect their innovative behaviour and performance, bring new products and processes into economic and social use (Freeman, 1987; Lundvall, 1992). The concept is now being used as a framework to understand and strengthen innovation at national, regional and sectoral levels (OECD, 1997; Mytelka, 2000), including agriculture (Hall et al., 2001).

Key insights from the innovation systems concept

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 framework 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. Agricultural research organizations with technologies that are 'on the shelf', please take note! 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 governmental or non-governmental organizations (NGOs), whilst institutions are the sets of common habits, routines, practices, rules or laws that regulate the relationships and interactions between individuals and groups (Edquist, 1997).

ILAC Brief 2

Policies also influence the way people behave. An environment that supports or encourages innovation is not the outcome of a single policy but relies on a set of policies that work together to shape innovative behaviour. Furthermore, habits and practices interact with policies, so when designing effective policies, the habits and practices of the people affected need to be taken into account (Mytelka, 2000). For example, the introduction of a more participatory approach to research is often ineffective unless scientists change their habits and working practices.

Stakeholder involvement and demands

The framework stresses the importance of including stakeholders and making organizations and policies sensitive to stakeholder agendas and demands. Demand shapes the focus and direction of innovation. It is not articulated simply by the market, but includes non-market drivers, such as collaborative relationships between the users and producers of knowledge. Demand for certain kinds of innovation can also be stimulated by policy, for instance by providing incentives to adopt a certain technology or management practice. This can be especially important when key stakeholders are poor and have limited social and economic power or when the negative environmental impact of development needs to be addressed.

The dynamic nature of innovation systems

The habits and practices that are critical to innovation are learned behaviours that may change gradually or suddenly. They are often enshrined in institutional innovations, such as farmer field schools or participatory plant breeding, that emerge through scientists' experimentation and learning. Such new approaches to research and development often need new partners in addition to new ways of working.

Changing to cope with change

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 needed for rapid formation of new patterns of partnership dictated by new or changing circumstances.

Implications for policy and practice

Institutions and policies matter

Planners and researchers need to pay much greater attention to policies and institutions, recognizing their dynamic interactions and the need to include them as critical variables in analyses. This involves thinking more broadly about the range of policies relating to innovation and how different policy domains can be coordinated. It is no longer sufficient to focus on research policy alone as the driver of innovation; instead, policy has to address the incentives, triggers and support structures needed to stimulate and sustain creativity. It is also important to recognize that policy imperatives, such as the need to reduce poverty, will only be met if habits,

Signs of change

Some of the more obvious changes in our thinking about agricultural innovation:

- The growing realization that the old national agricultural research system model is obsolete as an organizational focus for capacity development, and that while financial resources have declined, many of the constraints faced by research systems are institutional in nature (Byerlee and Alex, 1998).
- Acknowledgement of the need for a greater role for the private sector in agricultural research, and of the challenges of building public-private partnerships to achieve this (Spielman and von Grebmer, 2004).
- A recognition that civil society organizations and other non-research organizations (including farmer groups) are valuable sources of technical and institutional innovation (Biggs, 1990).
- Changing paradigms in development practice, whereby participation, diversity and reflection are becoming the expected modes of professional behaviour (Chambers, 1983).
- The broadening of the policy agenda of agricultural research to include poverty reduction and environmental sustainability (Hall et al., 2000).
- Concerns about the impact of agricultural research and conventional economic impact assessment as a way of capturing impact and the recognition that institutional learning could be an important tool for improving performance (Watts et al., 2003).
- Greater awareness of the opportunities presented by rapid technology development and how this is reconfiguring disciplinary groupings (Hall et al., 2004).
- Greater awareness of a rapidly evolving development scenario characterized by changing relationships between agriculture and the poor, industrialization of the food chain, rapid urbanization and increasing competitive pressure in global agricultural commodity markets (Ashley and Maxwell, 2001).

practices and institutions are in place to pursue such goals, probably at the expense of other competing agendas.

Importance of relationships

The composite, multi-faceted knowledge needed for sustainable, equitable development cannot be generated by single organizations working alone, nor can market mechanisms alone deliver the goods and services needed by the poor. The logical response is to create new relationships through linking, networking and building consortia. It is therefore essential that all agricultural research organizations should have sufficient skills and incentives to pursue this strategy. A further implication is that research organizations need to expand their role beyond that of research to one of broker, bridge and catalyst within the wider innovation system.

Development of flexible adaptive systems

The capacity to innovate can no longer be thought of in terms of the creation of human and physical scientific and technological resources alone. Instead, it must be thought of in terms of the policies and prac-

tices that promote learning and innovation in networks of organizations. While agricultural research organizations will remain important players, they are not sufficient on their own. Furthermore, policies and practices must be put in place to promote the flexibility and adaptability of innovation systems.

Building the social capital of agricultural innovation systems

Pursuing a partnership-based approach to promoting innovation requires working practices and institutions that encourage individuals and organizations to form relationships of trust and cooperation in pursuit of a common purpose – in other words, social capital. This can be achieved by designing policies and programs that intensify the level of interaction between important stakeholder groups. This is not to suggest that everybody should be partners with everybody else in a mechanistic way. The main objective is to build trust and confidence, so when a new situation prompts a change in groupings or alignments of partners, the barriers to partnership are lowered and responses are rapid.

Learning-orientated monitoring and evaluation

Assessing the economic impact of investment in research can make only a limited contribution to developing better ways of achieving such goals

as reducing poverty. Instead, a continuous process of institutional learning and change is needed. In this process, scientists and their partners will need to reflect continuously on the reasons for both success and failure – especially the latter, since learning from failure is the key to doing better next time. Practices, institutions and incentives will need to be adapted to encourage research organizations to learn in this way. These practices might be purposeful reflective exercises, ranging from workshops to staff appraisal procedures. More important, perhaps, is the development of an organizational culture that legitimizes and encourages this type of reflective activity.

Conclusion

Table I summarizes the differences and similarities between an agricultural research system and an agricultural innovation system. The aim here is not to downplay the importance of research systems, but to highlight the essential characteristics of an agricultural innovation system and to draw attention to the need for institutional change if agricultural research organizations are to contribute more effectively to innovation.

A final word of caution. The agricultural innovation system should not take an administrative and bureaucratic form – although there are implications for existing bureaucracies. The intention here is not to sug-

Table I. Comparison of agricultural research systems and agricultural innovation systems in developing countries

Institutional features	Agricultural research systems	Agricultural innovation systems
Guiding agenda	Scientific	Sustainable and equitable development
Role of actors	Researchers only	Multiple and evolving
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 and development workers from 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 knowledge and sensitive to differing agendas
Knowledge produced	Codified Technical/scientific	All forms of codified and tacit knowledge: scientific, technical, organizational, institutional, marketing and managerial
Indicators of performance	Short-term: scientific publications, technologies and patents Long-term: patterns of technology adoption	Short-term: institutional development and change/new behaviours, habits and practices/links Long-term: social and economic transformation
Responsibility for achieving impact	Other agencies dedicated to extension and technology promotion	All partners
Capacity development	Trained scientists and research infrastructure	Training and infrastructure development related to a range of research and economic activities and people Policies, practices and institutions that encourage knowledge flows, learning and innovation among all participants

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

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gest that a national agricultural innovation organization or council should be established – although coordination (probably by public bodies) is clearly an element of the capacity of a sector or country to innovate. The innovation system should be viewed as a policy tool, i.e. a way to organize policymakers' thinking about how innovation can be nurtured and how appropriate capacities can be built.

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