Strengthening partnership and networks in agricultural research for development

a learning module

(Version 1.0)
Strengthening partnerships and networks in agricultural research for development

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Session 2: Challenges of the R&D systems and changing paradigms

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Trainer’s guide

Session 2: Challenges of the R&D systems and changing paradigms

Purpose
To enhance the capacity of agricultural researchers to forge effective and efficient partnerships with other relevant stakeholders in the agricultural innovation system for achieving greater impacts.

Objectives
At the end of this session participants will be able to:
- List and explain the changing paradigms in research for development
- Identify and describe the emerging challenges of agricultural research for development systems

Resources
- Flipcharts
- White board
- Blank transparencies
- Flipchart and white board markers
- Copies of handouts 2.1, 2.2, 2.3 and 2.4 for each participant
- Computer and LCD projector
- Overhead projector

Time needed
Two hours and 15 minutes

Method of facilitation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
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<tbody>
<tr>
<td>Presentation</td>
<td>45 minutes</td>
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<tr>
<td>Time to distribute handout 2.1 (presentation slides) before you start your presentation</td>
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<tr>
<td>Give a presentation on challenges of the R&amp;D systems and changing paradigms</td>
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<td>Allow some time for questions to make sure that participants understand what is presented</td>
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<td>Distribute handout 2.2 (presentation text) to supplement your presentation</td>
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<tr>
<td>Exercise</td>
<td>85 minutes</td>
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<tr>
<td>Distributed handouts 2.3 and 2.4 for exercise 2 Reflecting on contemporary scenario of agricultural research for development</td>
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<td>Ask a volunteer to read the exercise</td>
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<td>Ask participants to answer the questions in groups</td>
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<td>Remind them the time allotted to the exercise</td>
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<td>Remind them that there will be a presentation and discussion session of the group discussion</td>
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<td>Transition</td>
<td>5 minutes</td>
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<tr>
<td>Make closing remarks and transit to the next session</td>
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Session 2: Challenges of the R&D systems and changing paradigms: Summary of overheads

2.1

Challenges of the R&D systems and changing paradigms

2.2

Objectives of the session

- List and explain the changing paradigms in research for development
- Identify and describe the emerging challenges of agricultural research for development systems

2.3

Major goals of agricultural research

- Produce agricultural technologies to contribute to rapid economic growth
- Provide options for adaptation to changing global economy, changing policies, and emerging environmental concerns
- Contribute to the reduction of poverty by increasing the supply of staples
- Increasing international competitiveness of national economies
2.4 Guiding principles of agricultural research for development

- Innovation Systems Perspective (ISP)
- Value Chain Approach (VCA)
- Impact Orientation (IO)
- Research for Development (R4D)

Complementary and mutually reinforcing

2.5 Changing context

- Ongoing transformations
- Changing paradigms
- Emerging challenges

2.6 Reform agenda within the R&D arena

- Redefinition of role of government in agricultural R&D
- Decentralization/privatization of agricultural R&D activities
- Broader and active stakeholder participation—pluralism in service provision, networks and partnerships
- New funding arrangements
  - Separation of financing from service provision and research execution
  - Changing the funding base to competitive funding
- Orientation of R&D to be more outward looking, client oriented and impact driven
- Embracing ‘Systems’ perspectives
### 2.7 Reform agenda (cont’d...)

- Increased recognition of cross-sectoral linkages
- Globalization of research and emerging regional and continental bodies
- Increased use of networks and partnerships
- Commercialization of smallholder agriculture
- Changing attitude and mindset of change agents

### 2.8 Exogenous trends contributing to the reform process

- Changes in the political and socio-economic context
- Changes in the market context
- Changes in the demand for R&D services
- Changes in research technologies, methodologies and approaches
- Changes in the organizational context

### 2.9 Emerging agri-food systems

- Massive increase in food moving across national borders
- Rapid rise and economic concentration of supermarkets
- Creation of private standards in addition to public standards
- New technologies to extend shelf-life of produce
- Non-price competition among supermarket chains
- Increased differentiation of food products by class
- New forms of relationships between suppliers and buyers
2.10 Paradigm shifts in agricultural R&D

- Led by:
  - Approaches for technology development
  - Framework for organizational analysis
  - Changing expectations

2.11 Approaches to agricultural research

- Traditional linear model for research and extension
- Farming systems perspective (OFR/FSP)
- Participation/participatory research methods
- Action research
- Rural livelihoods
- IAR4D*
- Agrifood systems/value chain*
- Positive deviance

2.12 Approaches to agricultural research (cont’d…)

- Knowledge development, dissemination and use continuum
- Doubly green revolution
- Rainbow revolution
- Knowledge quadrangle—participatory innovations, information, knowledge and education quadrangle with ICT playing a critical role
2.13 Organizational analysis

- NARIs
- NARS (loose conglomerate of agencies and actors involved in agricultural research)
- AKIS (R,E,T in one system; knowledge triangle)
- Innovation systems perspective

2.14 Innovation system

Innovation, innovation system and innovation systems perspective

2.15 Application of systems thinking in agriculture

- Framework for Technology Development and Dissemination (TDD)
- Organizational analysis within R&D

Both are interlinked
2.16 Systems thinking and its application in agriculture

Framework for technology development

- Cropping systems
- Farming systems
- Household production system
- Farming systems research and extension (FSRE) - Focus on research
- Farming systems approach (FSA) - Focus on research, ext. and training
- Farming systems development (FSD)
- National systems framework - Agricultural research for development (AR4D)

Framework for organizational analysis

- National systems framework
  - National agricultural research system (NARS)
  - National agricultural extension system (NAES)
  - National agricultural Education and training systems (NAES)
- Agricultural knowledge and information system (AKIS)

2.17 Factors contributing to adoption of ISA in agriculture

A number of factors contributed to the adoption of AIS:

- Successful application of the concept in the industrial sector
- Inadequacy of the existing framework to be all inclusive in terms of coverage
- Multiple sources of innovation model
- Inadequacy of the linear model to explain the process of innovation
- Increase demand for demonstrated developmental impact—impact orientation

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2.18 Innovation vs. invention

- Invention—delivers new technology/knowledge as solution to a problem—things new to the world
- Innovation—economically successful use of invention is innovation, delivers social and economic change
- Knowledge cannot be regarded as innovation unless it is transformed into products and processes that have social and economic use

ILRI
Innovation

• Innovation
  • In its broadest sense, innovation covers the activities and processes associated with the generation/production, distribution, adaptation and use of new technical, institutional, organizational and managerial knowledge

2.20 Innovation

• Innovation
  • Deals with product innovation, process innovation, management, organizational and institutional innovation and service delivery innovation
  • Two important factors are knowledge and networking
    • Value of knowledge increases with its use, and exchange can only be realised in a cooperative environment

2.21 Organizations and institutions

• Organizations are entities created by individuals to support the collaborative pursuit of specified goals. Formal organization is that kind of cooperation that is conscious, deliberate and purposeful
  • Institutions are the ‘rules of the game’ which prohibit, permit, or require certain actions. Whether formal or informal, they are recognized and generally followed by members of the community
2.22 Innovation system

- An innovation system is:
  - a group of organizations and individuals involved in the generation, diffusion, adoption and use of new knowledge and their actions and interactions
  - the context and institutions that govern the way these interactions and processes take place
  - associated learning
- Not a theory, but an organizing principle
- Can be defined at different levels
- It is an analytical construct

2.23 National Innovation System (NIS) (innovation ecology)

- The network of organizations in the public and private sectors whose activities and interactions initiate, import, modify and diffuse technologies (Freeman 1997)
- Those institutions that affect the process by which innovations are developed, delivered and adopted (laws, regulations, customs, norms)
- Incorporates actors, processes as well as products

2.24 National innovations systems (cont’d...)

- Reveals that R&D organizations are one type of knowledge agents in a larger system
- Need for multiple roles for R&D organizations
- Importance of institutions and framework conditions
2.25 Agricultural Innovation System (innovation ecology)

• A collaborative arrangement bringing together several organizations and individuals working towards a desired change in agriculture can be called agricultural innovation system (AIS)

2.26 Agricultural innovation system

A dynamic processes of interacting embedded in specific institutional and policy contexts

Demand domain
- Consumers of food and food products in rural and urban areas
- Consumers of individual raw materials
- International commodity markets
- Policy-making process and agencies

Enterprise domain
- Users of codified knowledge, producers of mainly tacit knowledge
  - Farmers
  - Commodity traders
  - Input supply agents
  - Companies and industries related to agriculture, particularly agro-processing
  - Transporters

Intermediary domain
- NGOs
- Extension services
- Consultants
- Private companies and other entrepreneurs
- Farmer and trade associations
- Drought

Research domain
- Mainly producing codified knowledge
  - National and international agricultural research organizations
  - Universities and technical colleges
  - Private research foundations
  - Sometimes producing codified knowledge
- Private companies
- NGOs

Support Structures
- Banking and financial system
- Transport and marketing infrastructure
- Professional networks, including trade and farmer associations
- Education system

2.27 Agricultural innovation systems include

• Traditional sources of innovation (ITK)
• Modern actors (NARIs, IARCs)
• Private sector including agro-industrial firms and entrepreneurs (local, national and multinational)
• Civil society organizations (NGOs, farmers and consumer organizations, pressure groups)
2.28

IS of a commodity chain (Innovation Ecology)

![Diagram of commodity chain]

2.29

**Intervention based innovation systems**

- An intervention-based innovation system incorporates
  - the invention system, as well as
  - the complementary economic processes required to turn invention into innovation and subsequent diffusion and utilization
- Intervention-based Innovation systems do not occur automatically
  - it is the problem situation that defines a particular innovation opportunity

2.30

**Intervention based innovation systems (cont’d…)**

- Intervention-based innovation systems are created for a purpose
- they will change in content and patterns of interaction as the problem situation evolves and
- they are constructed at micro- and macro levels
- Although the IS can be defined at different levels (national, sectoral, commodity and problem/intervention), the most relevant innovation system is the one that is constructed to address a particular problem, i.e. intervention-based
2.31 Innovation systems perspective

- Using the innovation lens in analysing critical constraints; identifying, implementing and assessing appropriate interventions and; subsequent utilization of knowledge generated
- Suggests the analysis of three elements
  - Components (organizations and actors)
  - Relationships and interactions (institutions)
  - Competencies, functions and result of such interactions

2.32 Key features of ISP

- Focus on innovation as its organizing principle
- Makes the distinction between ‘organizations’ and ‘institutions’ explicit
- Learning and role of institutions are critical
- Partnership and networks are integral parts
- Escapes the polarized debate ‘demand driven’ vs. ‘supply push’

2.33 IAR4D

- A new approach to help research contribute more effectively and efficiently to poverty reduction and sustainable NR use
- To mainstream a new way of doing business that ensures that research does not only lead to knowledge and publications, but also and most of all contributes to change and innovation for the betterment of people, while also preserving the natural resource base for future generations
The 4 pillars of ARD

- Organizational and Institutional change
- Knowledge management and information sharing
- Capacity Building
- M&E and Impact Assessment

Major thrusts of IAR4D approach

- Set of principles for conducting research for development
- New research agenda that addresses interaction between NRM, production systems and agricultural markets and policies
- Institutional change for new partnerships involving all stakeholders in the agricultural innovation system

Key steps in AR4D procedure

The 4 phases of the ARD procedure:

I. Organizing the Team → Problem

II. Defining the System of Interest
   - Iteration → Iteration

III. Identifying Strategies

IV. Formulating Research Plans → Research Proposals
• A value chain describes the full range of activities which are required to bring about a product or service from design through the different phases of production, delivery to final consumers, and final disposal after use.
• From ‘hoe–fingers’
• From ‘plough–fork’

A simple value chain has four basic links

Design → Production → Marketing → Consumption and recycling

Input and services
Transformation Packaging
Processing actual sale

Agricultural food chain: Value adding

Feedback
Consumer
Distribution, Exporting
Marketing
Processing and packaging
On-Farm Production
Input
Why is value chain analysis important?

- Value chain analysis plays a key role in understanding the need and scope for systemic competitiveness—growing division of labor, global dispersion of production of components
- Efficiency in production is only a necessary condition for successfully penetrating regional and global markets
- Entry into the various markets: national, regional, and global requires an understanding of dynamic factors within the whole value chain
- Commercialization of smallholder production system and market orientation
- To reap the maximum benefit it is important to understand the nature, structure and the dynamics of the value chain

Value chain analysis (cont’d…)

- In the real world, value chains may be much more complex
- Intermediate producers may feed into a number of value chains, e.g. the forestry, timber

The forestry, timber and furniture value chain

Extracted from Kaplinsky and Morris (2000).
2.43 Industry value chain

Primary production (farming) → Transport → Processing → Warehousing and distribution → Retail and marketing → End Consumer

2.44 Industry value chain

Available Margin

Primary production (farming) → Transport → Processing → Warehousing and distribution → Retail and marketing → End Consumer

Efficient retailing streamlines the cost of selling to the end consumer

2.45 Emerging challenges

- Global financial crisis
- Emerging food and energy crisis
- Greater concern for the environment
- Climate change
- Trade, market liberalization and emerging agrifood systems
- Emerging diseases
- Growing need for inter-sectoral linkages
Emerging challenges (cont’d…)

- Changing expectations from science, technology and innovation
- Underinvestment in agriculture and agricultural research
- Technological advances in biotechnology and ICT
- Globalization of private agricultural research and innovation
- Meeting commitments and targets

Main messages

- Approach to research is changing
- What constitutes R4D systems (organizations and institutions) has changed
- Emerging challenges require R4D systems to be dynamic and flexible

Thank you!
Session 2: Challenges of the R&D systems and changing paradigms: Summary of presentation

2.1 Introduction

During much of the 1970s and 1980s, investments in agricultural research were largely motivated by concerns about growing population, a finite resource base, import substitution and food security at both global and national levels that required a clear focus on increased food productivity. In the 1980s, natural resources management and environmental preservation received much higher priority in the research agenda, as well as food safety in the industrialized countries. In the recent past, with the advancement of the Millennium Development Goals (MDGs), poverty alleviation has come to the forefront as one of the developmental goals. At present the major goals of agricultural research are: to produce agricultural technologies to contribute to rapid economic growth; to provide options for effective adaptation to a rapidly changing global economy and changing policies; to address emerging environmental concerns and to contribute to the reduction of poverty (and food and nutritional security) by increasing the supply of staple products and by increasing the international competitiveness of national economies (Rajalahti et al. 2008).

For a considerable period the public sector research investment and research policy has focused on national agricultural research organizations/institutes (NAROs/NARIs). In this paradigm, public funds were provided as a block grant, usually through the Ministry of Agriculture, to a centralized research department or institute who then set research priorities and executed research through a network of research centres under the control of NARO/NARI. In the 1990s, this paradigm has been challenged, since it failed to consider a variety of other public and private organizations that are involved in research policymaking and research execution (Byerlee 1997).

The research approach was also challenged as the traditional approach (often referred to as the top–down approach) to agricultural research and development was not having significant impact on the development of small-scale agriculture. The researchers and development practitioners argued that an appropriate technology could only be developed if it was based on full knowledge of the existing farming system and livelihood system, and technologies should be evaluated not only in terms of their technical performance in specific environments, but also in terms of their conformity with the objectives, capabilities and socio-economic conditions of the target group of farmers. As a response to these challenges, there is a gradual evolution of the central source model of innovation of the 1970s and 1980s to the current agricultural innovation systems approach. This evolution occurred as a result of the identified weaknesses of the predominant paradigm of the time, and the emerging challenges and needs of the society.

Over the years, the agricultural R&D arena has seen a number of paradigm changes and transformations. In this chapter, first we will discuss the reform agenda within the agricultural R&D arena, then the paradigm shifts and the changes in the global food systems. Currently, the knowledge generation, dissemination and the utilization process within the agricultural sector is guided by four complementary and mutually reinforcing principles. They are the innovation systems perspective, value chain approach, impact orientation and research for development. These concepts are briefly discussed so that the reader is familiar with these developments and effectively use this understanding in designing and implementing research. However, it is worth noting that impact orientation and research for development are implicit in the concept of innovation.
2.2 Reform agenda within agricultural R&D

The policy and institutional context within which agricultural research and innovation occurs have changed dramatically over the years. Rapid changes continue to take place in the structure and authority of governments, the global economy, the structure of the farming sector and in the global and local food industries. The institutional landscape is also changing dramatically with the third sector (such as non-governmental organizations, farmer organizations and civil society organizations) playing an important role in agricultural R&D.

The ongoing reform agenda within the agricultural R4D includes:

- Orientation of research to be more systems based, outward looking, client oriented and, impact driven
- Redefinition of the role of government
- Decentralization and privatization of agricultural R4D
- Broader and active stakeholder participation and pluralism in service provision
- Increased recognition of cross-sectoral linkages
- Globalization of research and emergence of regional, continental and global coordinating bodies
- Increased use of networks and partnerships
- New funding arrangements including separation of financing from service provision and research execution
- Commercialization and market orientation of smallholder agriculture and
- Changed attitude and mindset of the change agents (research, extension and other service providers)

Given the sweeping reforms that are taking place, the R&D systems are facing a transition period in which they will need to restructure themselves, confront new demands, and adjust to new political, scientific, institutional and economic environment.

2.3 Emerging agrifood system

The last several decades have also seen a profound change in the nature of the global food system. These changes include:

- Massive increase in the volume of food moved across national borders (both formal and informal)
- Rapid rise in supermarkets globally
- Economic concentration in the super market sector
- Creation of a multiplicity of private standards, often built on top of public standards
- Rise in third party certification of food production and entire supply chain
- Development of new technologies designed to extend shelf life of agricultural products
- Shift towards non-price competition among super market chains
- Greater differentiation of food products by class and
- Development of new forms of (contractual) relationships between suppliers and buyers

These changes offer both challenges and opportunities to the smallholder producers. In some instances they can force small producers to exit certain markets, contributing to greater poverty and inequality. On the other hand if the smallholder farmers respond positively, this can offer new sources of income and a marked improvement in the quality and safety of food.
2.4 Paradigm shifts in agricultural R&D

Agricultural research and development has been undergoing paradigm shifts over the years which is in fact affecting their organizational structure, management style, as well as the way the research is done. We have seen a shift from a single commodity and mono-disciplinary base to an innovation system and a multidisciplinary based approach together with a change from top-down research model to participatory approach to research for development.

The system thinking is not new to agricultural research and development. It has been applied since 1970s when a significant shift in paradigm occurred by moving away from the top–down, linear, technology development and transfer model to the introduction of Farming Systems Approach (FSA). Since then, the application has evolved gradually to the various participatory approaches to the current innovation systems approach. Now the use has been extended to the application in the organizational analysis resulting in the ‘Agricultural Innovation System’ concept. This evolution is traced in Figure 1, and it is the result of the changing needs and expectations of the society.

The origin and application of the Innovation systems perspective (ISP) in agricultural research can be traced to a number of sources. These include: the successful application of the concept in the industrial sector of the developed economies, the multiple source of innovation model for agricultural research and technology promotion as suggested by Biggs (1989); the inadequacy of the linear model to explain the actual process of innovation in the real world; the inadequacy of the existing organizational frameworks to be all inclusive in terms of the coverage of the various actors; and the increasing demand for demonstrated developmental impacts and the expanded mandate and expectations from the R&D communities (Research for Development).

The main attraction of Innovation Systems Framework stems from the fact that: it recognizes innovation as a process of generating, accessing and putting knowledge into use; explicitly recognizes the interactions and knowledge flows among different actors in the process; emphasizes that institutions are vital in shaping the nature of these innovations and learning as a means of evolving new arrangements specific to local contexts (Sulaiman 2008).

2.4.1 Innovation, innovation system (IS) and innovation systems perspective (ISP)

In the literature, different authors have defined the term innovation differently (ECm 1995; Drukker 1998; OECD 1999; Quintas 1977 cited in ISNAR 2001). The simplest definition is ‘anything new introduced into an economic or social process’ (OECD 1999). The most useful definition of innovation in the context of R&D is ‘the economically successful use of invention ‘(Bacon 1998). Here invention is defined ‘as a solution to a problem’. This allows us to make the distinction between knowledge and innovation. Taking a brilliant idea through, on an often painful journey to become something which is widely used, involves many more steps and use of resources and problem solving on the way.
In the past, science and technology generation were equated with innovation. It is crucial to recognize that innovation is strongly embedded in the prevailing economic structure, which largely determines what is going to be learned and where the innovations are going to take place. Moreover, such innovations are not limited to technological (both product and process) innovations, but also include institutional, organizational, managerial and service delivery innovations. This also emphasizes the notion that the responsibility of agricultural research organizations does not end with the production of new technology or knowledge. They can claim success when their ‘innovations’ are being disseminated, adopted and used (Chema et al. 2001).

Source: Anandajayasekeram et al. (2005).

Figure 1. Evolution of systems thinking and its application in agriculture.
Innovations are new creations of economic significance. They relate to the production of new knowledge and/or new combination of existing knowledge. The critical point to note is that this knowledge cannot be regarded as innovation unless it is transformed into products and processes that have social and economic use (Edquist 1997). This transformation does not follow a linear path but rather characterized by complicated feedback mechanisms and interactive relations involving science, technology, learning, production, policy and demand. The use of the term ‘innovation’, in its broadest sense, covers the activities and processes associated with the generation production, distribution, adaptation and use of new technical, institutional and organizational, managerial knowledge and service delivery (Hall et al. 2005).

The thinking up to early 1990s was that innovations were created by knowledge and technology production process and through formal R&D initiatives by firms and technology creating agents such as universities and public–private research institutes. The assumption was that the market would draw upon the technological resources it needs, as and when necessary. The demand for knowledge would be identified by the formal R&D systems, produced and passed down to those who necessarily apply it because of its usefulness (Hartwich and Meijerink 1999). In reality, however, innovations are not only associated with or stem from major scientific discoveries, but also often develop as a fairly minor scientific and technological advances and can occur without any research (e.g. through learning and adaptation process). Therefore innovations can be generated by different organizations, group or individuals and the conventional research institutions is only one such entity amongst them.

**Innovation system**

An innovation system is a group of organizations and individuals involved in the generation, diffusion, adaptation and use of new knowledge and the context that governs the way these interactions and processes take place. In its simplest, an innovation system has three elements: the organization and individuals involved in generating, diffusing, adapting and using new knowledge; the interactive learning that occurs when organizations engage in these processes and the way this leads to new products and processes (innovation); and the institutions (rules, norms and conventions, both formal and informal), that govern how these interactions and processes takes place (Horton 1990). People working on similar issues, be it in a specific commodity sector, at a particular location or in any problem area tend to form a chain or network that can be described as innovation system.

**Agricultural innovation system**

A collaborative arrangement bringing together several organizations working towards technical change in agriculture can be called ‘Agricultural Innovation System’. Such a system may include the traditional sources of innovations (indigenous technical knowledge); modern actors (NARIs, IARCs, Advanced research institutions); private sectors including agro-industrial firms and entrepreneurs (local, national and multinationals); civil society organizations (NGOs, farmers and consumer organizations, pressure groups); and those institutions (laws, regulations, beliefs, customs and norms) that affect the process by which innovations are developed and delivered. Agricultural innovation system can be defined at three levels: national, commodity-based, and intervention-based. A typical national agricultural innovation system is presented in Figure 2. AIS within an agrifood chain is presented in Figure 3. An intervention-based innovation system can be developed based on the nature of the problem and the context in which the innovation is applied.
Linkages to other economic sectors
- Agricultural value chain
  - input suppliers
  - agricultural producers
  - agricultural advisory services
    - public sector
    - private sector
    - third sector
  - integration in value chains
  - agricultural research and education systems
    - agricultural education system
      - primary/secondary
      - post-secondary
      - vocational training
  - agricultural research system
    - public sector
    - private sector
    - third sector

Bridging institutions
- political channels
- stakeholder platforms
- agricultural advisory services
  - different categories
- input suppliers

Agricultural policies and investments
- general agricultural policies and specific agricultural innovation policies

Figure 2. A national agricultural innovation system.

Informal institutions, practices and attitudes
- examples: learning orientation; trust; communications; practices; routines

INNOVATION

Enabling environment
- political stability, law and order, infrastructure,
- governance, favourable micro-macro and sectoral policies, etc.

Agro-industry (input supply) → Agricultural production (farm production) → Agro industry (product marketing)
- processing
- value adding
- marketing

Facilitating institutions
- policies, legal framework, market, information, quality control, research, extension, training, credit, etc.

Facilitating services
- transport, storage, packaging, facilitating, equipment, import and export, communication, promotion, etc.

INNOVATION

Source: Anandajayasekeram et al. (2005).
Figure 3. AIS in an agrifood chain/agri business system.
Intervention-based innovation system

It is important to make sure that the innovation system is not confused with the invention system. Innovation system incorporates the invention system as well as the complementary economic processes required to turn invention into innovation and subsequent diffusion and use. Innovation systems do not occur naturally; it is the problem situation that defines a particular innovation opportunity. Hence, innovation systems are created for a purpose. They will change in content and patterns of interaction as the problem sequence evolves and they can be constructed at micro- and macro levels. Thus, although the innovation systems can be defined at different levels (national, sectoral, commodity and problem/intervention), the most relevant innovation system is the one that is constructed to address a particular problem. As Antonelli (2001, 2005) argues, innovation systems are constructed to solve ‘local’ innovation problems and are constructed around a market problem (along the value chain).

Innovation systems are constructed to address specific problems. These systems are very specific in nature and they deal with the connection between the relevant components of the ecology as well as ensure that the flow of information is directed at a specific purpose. Depending upon the problem at hand, there can be multiple innovation systems supported by the same innovation ecology. Moreover, since the solution of one problem typically leads to different and new problems, we would also expect that as the problem evolves the actors in the system as well as their interconnectedness will also vary. Thus, while the ecologies are more permanent, the problem-focused innovation systems are transient or temporary in nature. Once a particular problem sequence is solved, the associated system can be dissolved. The dynamism of an economy/value chain depends on the adaptability with which innovation systems are created, grow, stabilize and change as problem sequence evolves (Metcalfe 2008, 442). A problem-focused innovation system can be transboundary in nature or cut across national boundaries and may be spatially unconstrained. This problem-focused, transboundary, dynamic nature of the innovation system is the most relevant one for the R&D community.

Innovation systems perspective

Innovation systems perspectives implies the use of innovation lens in the design, implementation and evaluation of the activities of the various actors involved in the innovation process. Innovation systems perspective (ISP) sees the innovative performance of an economy as depending not only on how individual institutions (firms, research institutes, universities etc.) perform in isolation, but on how they interact with each other as elements of a collective system and how they interplay with social institutions such as values, norms and legal frameworks. ISP suggests the analysis of three elements: the components of the system, principally its actors; the relationships and interactions between these components and the competencies, functions, process and results such components generate. Therefore the analytical implications of ISP are that there is a need to consider a range of activities and organizations related to research and development and how these might function collectively and the need to locate R&D planning and implementation in the context of norms and the cultural and political economy in which it takes place i.e. the wider institutional context.

The key features of ISP are (Hall et al. 2005):

- Focus on innovation (rather than research/technology/knowledge) as its organizing principle;
- Helps to identify the scope of the actors involved and the wider set of relationships in which innovation is embedded;
- Escapes the polarized debate between ‘demand driven’ and ‘supply push’ approaches;
- Recognizes that innovation systems are social systems, focusing on connectivity, learning as well as the dynamic nature of the process;
• Leads us to new and more flexible organizations of research and to a new type of policymaking for science, technology and innovation;
• Emphasize that partnerships and linkages are integral part of the innovation system;
• Emphasize that learning and the role of institutions are critical in the innovation process; and
• The dynamics do not depend on the agents ‘expanding the frontier of knowledge’ but on the innovative abilities of a large number of agents. This dynamics depends on the strength of information flows and the absorptive capacity of the individual agents of institutions and of society as a whole. The innovation processes depend on the interactions among physical, social and human capital, but mostly on the absorptive capacity of individual agents (Ekboir 2004).

A good understanding of the concept of innovation, innovation systems and the innovations systems perspective is vital to design and implement successful research; as most of the funding agencies are looking for developmental impacts of research.

2.4.2 Agricultural research for development (AR4D)

Agricultural research for development takes a systems approach that goes beyond integrated natural resources management to encompass the domains of policies and markets and the effects that these have on the productivity, profitability, and sustainability of agriculture. The four pillars of agricultural research for development and their important interactions are presented in Figure 4. The procedure recognizes that the general approach to rural transformation involves intensification of subsistence-oriented smallholder farming systems, better management of natural resources while intensifying their use, developing more efficient markets and enabling policies.

![Figure 4. The 4 pillars of ARD and their important interactions.](image-url)
Agricultural research for development requires additional mechanisms to foster integration of these four dimensions and a new way of doing research and development. Therefore, the support pillars of agricultural research for development include:

- Promotion of organizational and institutional change to enable cross-disciplinary research and development and multi-institutional collaboration.
- Capacity building of the various stakeholders (farmers, scientists, and other relevant stakeholders)
- Information and knowledge management and
- Continuous monitoring and evaluation and systematic approach to impact assessment.

Agricultural research for development in fact utilizes various participatory methods and tools. The four key steps in the agricultural research for development process are team organization, defining the system of interest, identifying strategies, and plan formulation (Figure 5). These steps are discussed in the following sections based on material prepared by International Centre for Development-oriented Research in Agriculture (ICRA).

### The 4 phases of the ARD procedure

<table>
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<td>Formulating Research Plans</td>
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</table>

**Problem**

**Research Proposals**

**Report**

**Figure 5. The 4 pillars of ARD and their important interactions.**

### Phase I—Team organization

The AR4D procedure starts from the assumption that one or more organizations (including your own) and other stakeholders have identified a problem or area of concern, or an idea for intervention. It also assumes that addressing this problem requires concerted action of these organizations and stakeholders. This may require a team of professionals from these organizations, comprising specialists in the various disciplines needed to address the problem. It is assumed that by using the various diagnostic procedures the ‘clients’ and stakeholders have agreed on a sufficiently well-defined specific problem. Clear planning requires that your team develops a good understanding of the problem statement and the output that the client expects at the end of the process.

As the end of this phase the team should have produced the following outputs:

- Team is composed, mandates are defined, and resources are made available (at least for planning)
- Agreed upon team work procedure established
- Problem is clearly stated and the expected output is clearly defined
- Work plan is formulated and approved by all partners
- Mechanism for monitoring is established.

---

*Problem*
Phase II—Define the system of interest

Here, it is necessary that the team looks at policy issues, markets, institutional issues and other macro-development in and outside agriculture that may have an influence on the problem and on attempts to solve it. It is also important to identify the ‘system’ that needs to change in order to address the problem that was defined in phase I. We have to look at all elements needed for the change that are within the mandate of the stakeholders involved. It is of little use to suggest changes that the stakeholders do not have the power to change or influence.

At the end of this phase the following outputs must be in place:

- Description of how the wider ‘macro trends’ influence the problem
- Redefinition or further elaboration of the problem as seen from the different perspectives
- Demarcation of the ‘system of interest’.

Phase III—Identify strategies

Here, it is important to engage all stakeholders involved in the ‘system of interest’ defined in phase II to identify strategies that will bring about the desired changes, under different scenarios based on the external factors influencing the system of interest. There may be also a need to stratify the target group based on resource endowments, capabilities, strategies and vulnerabilities. It is also important to assess the anticipated effect of these alternative strategies on the environment (sustainability), vulnerable groups (social equity) and the competitiveness of the enterprises of the various stakeholders in the system of interest.

If this ‘screening process’ shows that strategies have anticipated negative effects, these need to be addressed through accompanying measures or the strategy should be dropped. Agreeing to some concrete strategies may usually require compromise between different stakeholders. Each strategy should be assessed in terms of their ecological, social and economic implications. These aspects should be considered simultaneously. The relative importance of each of these analytical perspectives is dependent on the problem and the usefulness of each in terms of finding a possible/viable solution. This integrated analysis should result in the following outputs.

- Description of two or more alternative scenarios for future
- Definition of what changes are needed in the system of interest to address the problem under the different scenarios
- Typology of the stakeholders affected differently by the problem who require different strategies
- Collective strategy to achieve changes in the system of interest that address the problem
- Careful documentation of the analysis completed.

Phase IV—Formulate plans

At this stage, it is essential to list the development and research activities needed to realize the strategy. The contribution of each stakeholder of the implementation of the agreed upon strategy that was defined in Phase III is identified. As available resources are usually not enough to implement all activities, there may be a need to prioritize the list of activities/options identified. The criteria for prioritization must deal with the balance between the extent to which each activity is likely to contribute to the solution of the problem, the cost and time needed for the activity as well as the risk of failure of the activity.

The final step is the formulation of convincing development and research proposals for the activities of highest priority and mobilization of resources to implement them. The process of implementation
(based on the operational plan), monitoring, evaluation and the eventual impact assessment of the intervention needs to be worked out as part of the planning process. As most of you are familiar with the participatory approaches to knowledge/technology development and transfer process, it may be possible to easily integrate the missing elements from the AR4D process described in this section. But a clear understanding of the process will certainly assist in the development of convincing/winning project proposals.

It is important to ensure that the innovation system perspective, value chain analysis, research for development and impact orientation are effectively integrated in the research design.

2.4.3 Value chain

A value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production, delivery to final consumers, and final disposal after use (Kaplinsky and Morris 2000). It is worth noting that production is only one of a number of value added links in the agrifood chain (Figure 6). Some people refer to this chain as from hoe (plough) to the finger (fork). A simple value chain has four basic links.

![Figure 6. Value links in the agrifood chain.](image)

In the real world, value chains are much more complex than this simple depiction. In many circumstances, the intermediary producers in a particular value chain may feed into a number of value chains.

Agricultural value chains are defined by a particular finished product or closely related products and includes all firms engaged in input supply, production, transport, processing and marketing of the product, and their associated activities, interactions and institutions governing the activities and interactions. It entails the addition of value as the product progresses from input supply to production to consumption. It includes input suppliers, producers, itinerant collectors, assembly traders, transporters, wholesalers, processors, exporters, and retailers. The key issue addressed in value chain analysis is vertical coordination: the way of coordinating and harmonizing the vertical stages of production, transformation and marketing.

Porter (1985) distinguished two important elements of a modern value chain analysis:

- The various activities which are performed in a particular link in the chain and
- Multilinked value chain or the value system.

Both these elements are subsumed in the modern value chain described in Figure 7.
In many developing countries there is heavy emphasis on the commercialization of smallholder production system; and production is increasingly becoming market oriented. In order to reap the immediate benefit, it is important to understand the nature, structure, and the dynamics of the value chain related to the various enterprises engaged in by the smallholder farmers. Given the new agricultural innovation system perspective, we need not only understand the dynamic but should also focus on the enabling environment, facilitating institutions as well as the facilitating services associated with a given value chain.

2.5 Emerging challenges

In the previous sections, we discussed the organizational and institutional transformations that are taking place within the agricultural research for development and the associated paradigm shifts to address the broadened agricultural agenda. In addition, the system is also confronted with a number of emerging challenges which shapes the priority agenda. Some of the key challenges currently facing the R&D communities are as follows:

2.5.1 Emerging food and energy crisis

In the recent past global food prices are increasing at an unprecedented rate and the analysts say that they will continue to remain high for a considerable period. Both the demand side and supply side factors contributed to the current price crisis. The demand side factors include: the economic growth and the associated changes in life style and eating habits in many countries; diversion of food crops (maize, sugarcane) for making biofuels: declining world stock piles, the financial speculation in commodity markets (a collapse of the financial derivatives market); and of course the increase in population (although at a slower rate). The supply side factors include: increased fuel and fertilizer prices and the associated increase in cost of production (and low input use); biofuel subsidies pushing production towards biofuel rather than food; idle crop land under a conservation program, export bans and tariffs by many grain exporting countries; production shortfalls from natural disasters and the long
term effects of climate change; trade liberalization making many developing nations depend on food imports (subsidized) which are cheaper; loss of crop lands due to mainly soil erosion, water depletion and urbanization and finally declining investments in agriculture.

The continuing increase in fuel prices is pushing countries towards biofuels. As a result of rising energy costs, inputs such as fertilizers become more and more unaffordable for small farmers who are at the centre of response to the world food crisis. The transport costs have become higher and higher once again resulting in higher consumer prices. Thus the rising fuel prices and the emerging food crisis are closely linked.

2.5.2 Environment and climate change

Since the 1992 Earth Summit in Rio, it is generally accepted that the environmental agenda is inseparable from the broader agenda of agriculture for development. Both intensive as well as extensive agriculture lead to environmental consequences. To address the expected climate change challenges and impact, R&D need to play a major role in increasing the adaptive capacity of the most vulnerable groups in different regions. The climate change could create changes in the geographical production patterns, as well as deterioration of natural resource base due to scarcity of water and rising temperature. It will also affect parasites like the tsetse fly and parasitic diseases such as malaria. With the increased risk of droughts and floods due to rising temperatures, crop yield losses are imminent. World agricultural GDP is projected to decrease by 16 percent by 2020 by global warming.

Although SSA produces less than 4% of the world green house gases, the regions diverse climates and ecological systems have already been altered by global warming and will undergo further damage in the years head. Sahel and other arid and semi-arid regions are expected to become even drier. A third of Africa’s people already live in drought-prone regions and climate change could put the lives and livelihoods of an additional 75–250 million people at risk by the end of the next decades (Africa Renewal 2007). Climate change will create new food insecurities in the coming decades. Low income countries with limited adaptive capabilities to climate variability and change are faced with significant threats to food security.

2.5.3 Trade, market liberalization and the emerging agrifood system

The global and national food systems are increasingly being driven by consumer interests, changing consumption patterns, quality and safety concerns and the influence of transnational corporations and civil society organization. The changes in the emerging food systems such as rapid rise and economic concentration in supermarkets need for quality standards; a shift towards non-price competition among supermarket chains, biosafety issues and the development of new forms of (contractual) relationships between suppliers and buyers offer both challenges and opportunities. They can either squeeze small producers out of certain markets contributing greater poverty and inequality or can offer new sources of income and market improvement in the quality and safety of food.

2.5.4 Emerging diseases

The incidence and impacts of diseases such as HIV/AIDS and malaria are well documented. Additional threats and challenges are posed by emerging diseases. Approximately 75% of emerging diseases are transmitted between animals and human beings; the increasing demand for meat increases this risk of
transmission. Serious socio-economic consequences occur when diseases spread widely within human and animal populations.

2.5.5 Growing need for intersectoral linkages

One of the major constraints to getting agriculture moving in SSA is the general lack of comprehensive policies and weak intersectoral linkages. Now there is growing awareness that a number of sectors such as agriculture, education, health, water, and energy are very closely linked. Thus any agenda to transform the smallholder agriculture should follow a multisectoral approach and capture the synergies between technologies (seeds, fertilizer, livestock breeds), sustainable water and soil management, institutional services (extension, insurance, financial services) and human capital development (education and health)—all linked with market development (World Development Report 2008).

2.5.6 Changing expectations of science and technology and innovation

Over the years, there has been a significant change in the expectations of science and technology and innovations, from increasing crop and livestock productivity to creating competitive, responsive and dynamic agriculture, that directly contribute to the Millennium Developmental Goals.

2.5.7 Underinvestment in agriculture and agricultural research

Public spending on agricultural research as a proportion of agricultural GDP in Africa declined from 0.93 to 0.69% between 1980s and 1990s (ECA–OECD Review 2005). The current average level of public expenditure to support agriculture is around 4%. CAADP reports estimate that if the MDGs are to be met, 10% of the national budget should go to the agricultural sector and at least 2% of the GDP should go to national agricultural research and development by 2010.

2.5.8 Technological advances in biotechnology and ICT

Conventional biotechnologies have been around for a very long time, while genetic modification (GM) technologies have emerged more recently. GM technologies are making rapid progress worldwide. Biosafety is a highly technical field, which typically requires high initial investments for building the necessary human resource capacity and institutional infrastructure (including laboratories and green houses for risk assessment or testing and identification of genetically modified organisms).

The revolution in ICT technologies and increased access to them in developing countries is enabling a variety of new approaches to capacity building and knowledge sharing and exploitation of these opportunities require additional investments.

2.5.9 Globalization of private agricultural research and innovation

In the recent past there is a trend towards globalization of private agricultural research. Drivers of globalization of R&D are growing markets for agricultural products and agricultural inputs (reduced restrictions on trade in agricultural inputs), new technological opportunities due to breakthrough in biotechnology; improved ability to appropriate the gains from innovations, improved policy environment for foreign investments and technology transfer (tax breaks); and growth in demand due to increased income and policy changes (Pray 2008). If carefully nurtured and managed, this may offer additional opportunities for public–private partnership to mobilize additional resources and to move the poverty reduction agenda forward.
2.5.10 Meeting commitments and targets

Over the last several years countries in the regions are committed to a number of targets and goals. Under the United Nations Millennium Development Goals targets are set for: reducing hunger and poverty, achieving universal primary education, promoting gender equality, improving maternal health and nutrition, combating HIV/AIDS, malaria and other diseases and ensuring conservation and the enhancement of basic life-support systems including land, water, forests, biodiversity and the atmosphere. There is increasing evidence to show that we will not meet any of the targets set for 2015.

In 2001, African heads of state adopted the strategic framework to develop integrated socio-economic development framework for Africa—the New Partnership for Africa’s Development (NEPAD) under the auspices of the African Union (AU). The agricultural agenda of NEPAD is driven by the comprehensive African Agricultural Development Programme (CAADP). This strategy calls for an annual growth rate of 6.5%. At least 10% of the national budget as defined in the Maputo Declaration (February, 2003) should be allocated to agriculture.

2.5.11 Global financial crisis

The current financial crisis is contributing significantly to the slow down of many countries resulting in reduction in the capital availability at a time when accelerated investment is urgently needed in the agricultural research and development arena. Although the current food and financial crisis developed from different causes, these two crises have fed into each other and could have significant impact on financial and economic stability and political security (von Braun 2008).

The projected low economic growth is likely to have negative second-round effects for investment and productivity with direct ramifications for food prices and food security around the globe. IFPRI (2008) has projected that under slow growth and declines in agricultural investment, the prices of major cereals increase significantly. According to the projections in SSA, the per capita consumption would be 10% lower in 2020 and its share of the number of malnourished children will increase from one fifth in 2005 to one fourth in 2020. The study concluded that if developing countries and investors can maintain agricultural productivity and investment under recession, they can avoid many of the negative effects of slower growth.

To sum up, there is a need for agriculturalists to grow intellectually and operationally from a narrow focus on agriculture and technological research and dissemination to a better understanding of rural societies and their needs. There is a need to seek greater understanding of alternative pathways for rural economic development, placing the role of agriculture in perspective, and redefining the role, mission and strategy of the agricultural institutes and agents as facilitators of rural economic growth. This calls for change in the mind sets of the change agents and greater flexibility and creativity in defining the agenda as well as in defining new public–private–civil society partnerships on the basis of whatever is necessary to improve opportunities, productivity and income generation capacity of poor rural households.

Key references


Sulaiman VR. 2008. Extension from an innovation systems perspective. A paper presented at the IFPRI conference on advancing agriculture in developing countries through knowledge and innovation. Addis Ababa, Ethiopia, April 7, 2008


Wycoff J. 2004. The big ten innovation killers and how to keep your innovation system alive and well. (www.thinksmart.com)
Session 2: Exercise 2A: Reflecting on contemporary scenario of agricultural 
research for development

(Group exercise)

Group work (60 minutes)
1. Divide into your project teams and have each group elect a rapporteur. (5 minutes)

2. Brainstorm and answer the following questions in your groups:

3. Mention three major changes that have occurred in the agricultural sector in your country during 
   the past 10 years.
   • How did the R&D organizations respond to this changed scenario?
   • Do you feel what is done was enough? If yes, give examples.
   • If no, write two to three actions/interventions that should be taken up to improve the 
     responsiveness of R4D organizations to this changed scenario.

Reporting and discussion (30 minutes)

4. The rapporteurs present the group responses using cards on the soft board or wall (20 minutes).
5. The facilitator asks feedback on this exercise and closes the session (10 minutes)
Session 2: Exercise 2A: Worksheet

(Group responses)

1. Major changes that have occurred in the agricultural sector during the last 10 years

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2. R&D organizations’ response to this changed scenario.

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3. If no, list things that should be done to improve the responsiveness of R&D organizations to the changed scenario

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Session 2: Exercise 2B: Experience in innovation system thinking

(Group exercise)

Phase I. Group work (60 minutes)

1. Divide participants into two groups and ask each group to identify a chairperson and rapporteur. (5 minutes)

2. Each group should identify one familiar project and respond to the following questions.
   a. Was the project planned and implemented using innovation systems perspectives?
      i. If yes, please explain how the concept was used in planning?
      ii. If no, please indicate how you would modify the project design to incorporate innovation systems perspectives?

Phase II. Reporting and discussion (30 minutes)

3. The rapporteurs present the group responses (20 minutes).
4. The facilitator asks feedback on this exercise and closes the session (10 minutes)
   • Note: A case study is included in the Annex for your leisure reading to better understand the concept being discussed.
Session 2: Exercise 2B: Worksheet

(Group responses)

a. Was the project planned and implemented using innovation systems perspectives?

    i. If yes, please explain how the concept was used in planning?

ii. If no, please indicate how you would modify the project design to incorporate innovation systems perspectives?