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THEMATIC OVERVIEW Module 029

# Policy Highlights

## Agricultural Technology: Research and Extension Systems

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## Agricultural Technology: Research and Extension Systems

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based on Chapter 5 of *Agricultural Development Policy: Concepts and Experiences* by Roger D. Norton

for the

Food and Agriculture Organization of the United Nations, FAO

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## 1 INTRODUCTION

Agriculture has only two ways of producing more: expanding cultivated areas and improving productivity per unit of area. The former is limited in most countries, where land shortages mean that marginal areas are increasingly being used for agriculture, bringing with it undesirable environmental consequences.

Future agricultural growth will depend vitally on raising productivity, through better yields and moving toward higher-value products. These will require technology development and innovation, along with access to inputs and markets. As most of the world's poor continue to depend on agriculture for their livelihood, technological improvements, and access to it, are also an essential ingredient of any poverty reduction strategy.

FAO estimates that the largest source of increase in world crop production in recent years was through yield improvements, which accounted for some 78% of the total increase between 1961 and 1999.

## 2 RESEARCH AND EXTENSION ROLES

Agricultural *research* is key to technology development and increased productivity. It is however only one element in a complex of processes that lead to innovation and the adoption of new technology. Another is agricultural *extension*, which can affect the way agricultural knowledge and information are diffused.

There has in recent years been a sea change in the way agricultural innovation is seen to come about:

- The traditional view had been that technology development is a sequential process consisting of first undertaking research, followed by technology transfer and extension to farmers.
- Increasingly, the view is shifting to one in which research and extension (along with education) are integral components of a broader agricultural knowledge and information system.

In the latter view, innovation generation and dissemination do not proceed linearly, but are interactive and result from joint efforts among different kinds of participants. An important policy implication of this is the need to seek *convergence* in development activities and goals between actors involved in research, extension, as well as education.

In practice, agricultural research and extension in most countries are generally planned, funded and managed as separate systems, often by different organisations and institutions.

Sector reforms had largely been with respect to the specific approaches and modalities of each system. A consideration of policy issues must first focus on their separate identities, including the roles and shortcomings of each system. This then paves the way

to exploring the scope for convergence, and determining policy directions that could best promote technology development and adoption of agricultural innovations.

“Education and training are no longer seen simply as a process of transferring knowledge or information but rather as a means to empower people to become critical thinkers and problem solvers, who are better able to help themselves but also better able to engage with others in order to learn, share information and address problems and priorities. ”

... a vision on agricultural knowledge and information systems shared by FAO and the World Bank.

## 3 AGRICULTURAL RESEARCH: A PARADOX

Economic studies have shown very high returns to expenditures on agricultural research in the recent past. Statistical evidence indicates rates of return to research consistently in the range of 35- 45% per year or higher in developing countries. On the other hand, studies have also shown productivity declines, even in developing countries where green revolution varieties of wheat and rice have been widely adopted.

A report by IFPRI put agricultural research expenditure growth of 119 developing countries at only around 3.6% in the mid 1990s, compared to 7.0% in the mid 1980s. For 44 sub-Sahara African countries, growth rate between 1986 and 1991 was 0.5%, this became negative in the early 1990s. Among 15 Latin American countries, four spent less than $10 million on agricultural research in 1995.

The paradox of high returns to research but sluggish productivity growth or declining yields may be explained by one or more of the following:

- The secular downward trend in funding for agricultural research in developing countries in the last two decades.
- The heterogeneity of farming conditions in the developing world, which made it difficult for research to address the needs of a wide range of farmers.
- Research had been oriented towards the needs of the more commercial farmers, typically with more uniform growing conditions, but make up a small percentage of all farmers in developing countries.
- Even when results were suitable for varied agronomic conditions, poor farmers had not been able to meet input cost requirements, particularly where agricultural taxes were also high.
- The technological needs and preferences of the large numbers of women farmers, which can differ markedly from male counterparts, as in varietal or labour demand charateristics, were seldom taken into account in research.

These may be summarised as problems of *under-resourcing* (a), *research bias* (b), *relevancy* (c), and *access* (d and e, above). These were likely to have been exacerbated by *pricing policy* that militated against producer incentives.

In the Ivory Coast, it was found that while men prefer short stature rice varieties, women were reluctant to grow them due to difficulties of harvesting them with infants on their back. In response, WARDA shifted research emphasis towards the development of medium to tall statured varieties.

## 4 CHALLENGES IN RESEARCH AND RESPONSES

Challenges facing agricultural research systems of developing countries are many, most significant of which are:

- Reversing the **downward trend** in research funding by harnessing and channeling additional resources to research programmes, along with their cost-effective management;
- Improving the **relevance and appropriateness** of new technologies to the vast majority of farmers, including poor and women farmers.

In addition, there is also a dire need to make technologies generated more environmentally sustainable. Problems of natural resource degradation, such as soil nutrient exhaustion, waterlogging and salinity, and build up of pest complexes from inappropriate pesticides use and mono-cropping practices in high production areas in particular need addressing.

A study on post-green revolution agriculture in India and Pakistan raised serious concerns about the long-term sustainability of intensive irrigated systems used. One conclusion was " ... halting resource degradation will require that research systems which have been oriented toward developing technologies based on modern inputs, place more emphasis on input-efficient and environmentally friendly practices." It also concluded that input subsidies had led to price distortions, resulting in over-capitalisation, inefficient use of inputs, and a shift in cropping patterns toward water and fertiliser intensive crops, to which problems of soil degradation, salinity, and over-exploitation of ground water may be attributed.... *World Bank Research Observer, Vol.16 (2001).*

Agricultural research systems have been responding to these challenges in a number of ways, some of which represented important departures from earlier approaches in agricultural research. Key aspects are:

- Changes in the financing and management of research
- Involving a wider array of institutions in research
- Decentralisation and greater autonomy to local research units
- Producer participation in the research process

The above are not mutually exclusive; they also tend to reinforce one another. Thus, diversifying the sources of research funding also meant tapping into a larger pool of institutional resources hitherto under-used in agricultural research (such as universities,

non-agricultural ministries and departments, research foundations, NGOs and private sector companies).

An important aspect of producer or farmer involvement in research is participatory technology development (PTD). Most farmers in developing countries already undertake small experiments on their own farms as part of their livelihood strategy. PTD helps promote and support this process, but it is complementary, not a substitute for on-station research.

Another aspect of producer involvement is helping set the agendas for research programmes. This is done through formalising the roles of farmer organisations in local, regional and national research committees, including a share in the responsibility for setting research priorities, allocating resources, and in evaluating performance of research programmes.

The Local Agricultural Research Committee(CIAL) model arose from local farmers' wishes to conduct their own research to evaluate innovations. This was initiated in Colombia by CIAT (International Centre for Tropical Agriculture) and have since been adopted by research institutions, NGOs and universities in several Andean and South American countries. Each CIAL has four or more members elected by the local community, all of whom act as researchers on topics agreed by community members. In the early stages CIALs conduct research to improve yields of staples; many CIALs go on to become successful small scale seed enterprises.

## 5 REDIRECTIONS IN EXTENSION

Extension systems of developing countries, many with their origins in the public extension services of colonial administrations, had generally been underpinned by the 'diffusion model' of the 1950s and 1960s. From the late 1970s, the Training and Visit (T&V) system, first piloted in Turkey, began to dominate extension systems for some twenty years. Although the need for better linkages between researchers and extension workers was better recognised under T&V, its 'technology transfer' mode had departed little from the earlier model.

The hierarchical and unidirectional nature of the extension process inherent in the above has since given way to the view of a broader agricultural knowledge and information system, outlined earlier, of which extension is an integral component. Strategic here are effective linkages among farmers, extensionists, researchers, educators, and other stakeholders in knowledge generation and dissemination.

Meanwhile the limitations of productivity-focused technology in meeting the wider livelihood needs of large numbers of the rural poor are also being better appreciated. Knowledge generation is thus seen to encompass livelihood and vulnerability considerations, including the scope for resource-poor people to avail of production and marketing opportunities associated with the technology.

Many pastoral and agricultural communities in arid and semi-arid areas face 'lean' seasons within years as well as serious drought every few years, both of which pose

food security concerns. Productivity enhancement may itself be of limited value to such communities. Whereas, technology in post-harvest operations which allow more efficient processing and storage of crops and forage, and adding value to agricultural products, may go further toward enhancing the capacity of such communities to cope with their vulnerabilities.

## 6 EXTENSION ROLES AND MODALITIES

To play an effective role in addressing productivity and livelihood objectives, extension must move away from simply disseminating standard packages of inputs and practices. Extension systems would in particular need to:

- Offer a range of agriculture–related and non agricultural options, which rural people can select according to their own household and livelihood contexts;
- Adopt institutional forms and arrangements for service delivery that would increase the interface and enhance interactions between stakeholders, including rural people, public agencies, private service providers, producer organisations and NGOs;
- Achieve financial and fiscal sustainability in system operation, through greater accountability for service delivery and by introducing new forms of partnerships and cost apportionment.

Payment by users, even for a proportion of the cost of the service, creates powerful incentives for extension agents to satisfy them rather than their superiors. Besides a sense of ownership and drawing rights on the service for the users, it could also ease the financial pressure off governments, hence are likely to be more sustainable.

Many countries have explored alternative approaches and devised new operating modalities for extension services. Despite contextual differences, these had gravitated around three main beliefs, that:

- Farmers can identify and characterise their own problems better than external advisors, and possess at least some knowledge relevant to finding solutions.
- Key to promoting agricultural and rural development is the strengthening of inherent capacities of farmers to solve their own problems and make appropriate decisions.
- Governments alone are not able to provide fully the necessary extension services, in view of organisational and financial limitations and lack of capacity to interact with producers.

Demand driven technology systems are those in which farmers are involved in problem identification, establishment of needs and priorities, and carrying out research and extension activities.

These have spawned a plethora of new extension perspectives and operating modalities, of which the following have gained currency:

- Pluralistic service provision;
- Cost sharing and apportionment;
- Demand driven and client oriented;
- Farmer led and participatory;
- Gender sensitive, pro-poor; amongst others.

Individually or jointly, the above are meant to engender partnerships between public and private sectors, and with civil society. These also meant strategic emphasis on mutual learning, self appraisal and review, and the evaluation of technological success not only on technical and economic efficiency grounds, but also on human resource, institutional, social and environmental criteria.

## 7 POLICY ISSUES AND IMPLICATIONS

It is apparent that globally the trajectories of research and extension systems are converging on a number of fronts. One important area of convergence is the increasing provision within both systems for substantive stakeholders involvement in technology generation and dissemination, and appreciation of the need for expanding the financial and human resource base to support these. Access to agricultural technology is moreover justified not purely on grounds of social equity but also on the basis of economic efficiency in resource use and, importantly, environmental sustainability.

There is enormous need and scope for national agricultural policy to support these, particularly where synergies between initiatives in research and extension, as well as in agricultural education, could be further enhanced. Specific needs of each country differ, but clear government policy on the following issues would be merited:

- Giving explicit recognition to the multiplicity and heterogeneous nature of users of agricultural technology. 'One size fits all' mentality and standardised technologies should be re-engineered toward technology generation that caters for diversity but targets specifically clearly identified user audiences. The latter may consist of commercial farmers, small marginal farmers, women farmers, and poor farmers whose livelihood context permits little risk-taking. National agricultural research priorities and sectoral programmes may need to be re-tailored accordingly;
- Facilitating the forging of collaborative partnerships among and between researchers, extension service providers, rural farmers and producer organisations. This can reduce transaction costs of knowledge and information dissemination, and also make for greater relevancy in technology generation. Partnerships amongst farmers themselves, in terms of farmer to farmer exchanges, exemplified in farmer field schools, are an important element of this. Formulating a clear national agricultural extension strategy would be a first step toward moving away from traditional modes of top down 'technology transfer';
- Reviewing existing mandates and administrative divides of government institutions responsible for research and extension functions. Technology generation should not be seen as the preserve of government run NARIs (national agricultural research institutions). This may, in some cases, require dismantling of existing 'turf' barriers.

Opening up the field to academic, private sector, non-governmental and farmer-based organisations may require modifying the organisational set-up within agricultural research, extension, as well as education, systems of the country;

- Developing new funding mechanisms to permit cost sharing and greater accountability for resource allocations to research and extension activities, projects and programmes.. This could mean modifying procedures for allocating and disbursement of fiscal expenditures, for instance through competitive bidding for public sector research. This also requires putting in place effective systems for monitoring and evaluation of research and extension expenditures. Marketing of research results, establishing arrangements for producer contributions, and setting up appropriately endowed research foundations are other options;
- Enhancing capacity in the entire agricultural technology arena through appropriate human resource development, manpower and employment, and agricultural education policies. This consists, on the one hand, of building up skills and capabilities of research and extension staff and community leaders in facilitating empowerment of rural people in exploiting technological opportunities for social and economic advancement. Technical skills would need to be integrated with those of a social, economic, and environmental nature to permit inter-disciplinary team work in research and extension. On the other hand, provision of clear career paths and instituting appropriate incentive structures would be essential to attract, motivate and retain skilled and talented personnel in agricultural research and in extension duties.

In Vietnam, local government has control of extension activities, using mainly public funds. But the range of actors in extension is broad, and include not only public extension services but also mass organisations, village organisations, farmers' cooperatives, private entrepreneurs, and state and private input supply companies. The mass organisations operate with considerable independence but are accountable to the local Peoples' Committees.

Public expenditures on education, especially in rural areas can pay rich dividends, as this can have a strong influence on capacity of farmers to absorb and utilise new information.

Last but not least, the creation of a *conducive and enabling environment* is indispensable to technology development and its adoption. Besides macro and sectoral policies that provide appropriate price and market incentives to agricultural producers and service providers, subsumed in such an environment are also the legal, social and political institutions i.e. 'rules of the game' that research and extension systems and the main stakeholders operate within.

Agricultural innovations are seldom socially or environmentally neutral, and may incur externalities that require regulatory frameworks, as in the case of pesticides. Markets are often imperfect and, by themselves may be inadequate to support technology development. Private sector companies will not invest in technological development if there is no legal protection against violation of patent rights or other fraudulent practices. On the other hand, undue regulation could retard introduction of new

technology and restrict access to farmers. Clearly a proper balance between a liberal and regulatory regime is essential.

Governments can play a very important role in the development and fostering of such institutions, especially in enhancing legal and regulatory frameworks relating to agricultural inputs and research outputs. Enlightened policies in such areas as plant varietal regulation, seed system development, fertiliser marketing and quality assurance, pesticide usage, and protection of trade related intellectual property rights would help strengthen the enabling environment in which agricultural technology development takes place.

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