From:

Integration of Agricultural Research and Extension

©APO 2003, ISBN: 92-833-7017-1

Report of the APO Study Meeting on Integration of Agricultural Research and Extension
Philippines, 18–22 March 2002

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Published by the Asian Productivity Organization
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INTEGRATION OF AGRICULTURAL RESEARCH AND EXTENSION

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ISBN: 92-833-7017-1

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FOREWORD

Research and extension play important roles in the enhancement of agricultural productivity. Research, on one hand, generates improved technologies and practices that help to raise crop yields and incomes, particularly of small farmers. Extension, on the other hand, provides the mechanism by which those technologies and practices are disseminated for adoption by farmers. For the technology transfer process to be successful, however, these two vital support services need to be effectively linked.

The integration of agricultural research and extension is not a simple task. In fact, The Study Meeting on Integration of Agricultural Research and Extension held in March 2002 in the Philippines pointed out that there was no single, ideal, easy recipe for improving agricultural research and extension linkages. The strategies and mix of mechanisms employed depend on the policy, institutional, and resource context of a particular country. In this regard, the study meeting noted that several factors are important: 1) viewing research and extension as an integrated knowledge and technology system; 2) focusing on research and extension functions, rather than simply on organizational structures, to broaden dialogues among all stakeholders; 3) strengthening crucial linkages under a pluralistic approach/system; 4) promoting informal networking at many levels with an incentive system for improving linkages; and 5) empowering farmers' groups for more demand- and farmer- driven research and extension services. The study meeting also concluded that the coordination of research and extension functions/activities between and among the agencies involvedconcerned willould continue to be an enormous challenge.

This volume is a compilation of the papers and proceedings of the study meeting. I hope that it will serve as a useful reference on the subject in APO member countries.

The APO is grateful to the Government of the Philippines for hosting the study meeting, in particular to the Development Academy of the Philippines for implementing the program in cooperation with the Department of Agriculture, and to the resource speakers for their valuable contributions. Special thanks are due to Dr. Rita Sharma for editing the present volume.

TAKASHI TAJIMA
Secretary-General

Tokyo
October 2003

SUMMARY OF FINDINGS

INTRODUCTION

The Study Meeting on Integration of Agricultural Research and Extension which was organized by the Asian Productivity Organization (APO) and implemented by the Productivity and Development Center – Development Academy of the Philippines (PDC-DAP) in cooperation with the Department of Agriculture (DA), Philippines was held in Manila from 18 to 22 March 2002. Sixteen participants from 13 member countries and five resource speakers from the International Service for National Agricultural Research (ISNAR), Food and Agriculture Organization (FAO), Ministry of Agriculture, India and Philippines participated in the study meeting.

The objectives of the seminar were: 1) to review recent developments in agricultural research and extension in member countries; and 2) to suggest ways of integrating them for more efficient dissemination and adoption of new/improved technologies/practices.

The study meeting started with the presentation of resource papers by the selected experts. The papers focused on the following specific topics: 1) Recent Developments in Agricultural Research and Extension Systems in Asia and the Pacific; 2) Agriculture and Fishery Research and Extension Systems: Organizational Linkages; 3) Human Resources Development for Agricultural Research and Extension in the Philippines; 4) Mechanisms for the Transfer of Agricultural Technology Among Countries in Asia and the Pacific; and 5) Effective Networking of Research and Extension through Information Technology. This was followed by the presentation of country reports wherein the participants reviewed the recent developments in the integration of agricultural research and extension in their respective countries, and the conduct of field studies.

The following summary presents the highlights of the study meeting.

HIGHLIGHTS OF RESOURCE PAPERS

Recent Developments in Agricultural Research and Extension Systems in Asia and the Pacific (Dr. Md. M. Rahman)

Organized growth of agricultural research and extension systems took place in the 1960s and 1970s with the establishment of agricultural research institutes and councils of different forms in most Asian countries. These institutions aimed to consolidate, guide and coordinate the national research efforts. Linkage was established with the international research centers, especially with International Rice Research Institute (IRRI) and Centro Investigacion para la Mejoramiento Mais Y Trig (CIMMYT). Agricultural extension services were also organized during this period as separate entities. Innovative approaches like the Training and Visit (T&V) extension system, farming systems research, farming systems research and extension, and lab to land program to strengthen research-extension-farmers linkages at the field level were pursued. This transformation paid handsomely. Agricultural growth jumped and surpassed the population growth so that the period between the mid-1960s and 1970s came to be referred to as the "Green Revolution" stage in Asia.

In the post-Green Revolution period starting early 1980s, however, agricultural growth slowed. The annual growth rate for cereals fell sharply from 3.2 percent during 1963-72 to less than 2.0 percent during 1983-92. This was accompanied by a new set of problems such as soil degradation, salinization, pest incidence, groundwater shortage, and others. Another set of challenges emerged from the rapid changes in the external environment. Climate change, globalization, trade liberalization, intellectual property rights, appearance of many players in agricultural Research and Development (R&D) including the private sector, NGOs and civil societies had changed the perspective on agriculture. Agriculture had turned more competitive with product quality improvement becoming equally important as production increase.

1. ***Emerging Trends in the Agriculture Sector***

In agricultural research and extension the clients are now becoming partners. Market and environment considerations are driving the innovation process and development potentials are being defined in the international arena. Information science and biotechnology are also greatly influencing agricultural research and extension. Research and extension, for instance, are depending more and more on communication and information tools. Innovations are being generated in networks. What is emerging is a public-private co-innovation system.

2. ***Issues and Concerns***

Concerns have been expressed that the institutions designed to address the pre-Green Revolution problems are not well geared nowadays to face the new challenges and accordingly, they need to change. The centralized institutions with centralized decision-making authority are unlikely to meet the local needs. There is no system of accountability to stakeholders. Linear research-extension-farmer linkage is no longer effective in a field where multiple actors are involved. There is, therefore, a need for partnerships and alliances with farmers, private sector, NGOs and civil society. This could be achieved through decentralization, devolution of certain research and extension functions to the private sector, and partnerships and collaboration with the key actors.

3. ***Transformation in Research and Extension***

The post-Green Revolution transformation of public agricultural research and extension systems started in many countries of Asia about a decade ago. The process is continuing. The purpose is to: (1) improve institutional responsiveness and accountability; (2) decentralize to share costs; and (3) involve farmers in the decision-making and management. The changes primarily relate to: (1) decentralization and privatization of research and extension; (2) market-oriented demand-driven research and extension; and (3) partnerships with producers, private sector and civil society. In this regard, a number of examples from different countries were cited. The new focus on regional collaboration involving international agricultural research centers (IARCs), regional organizations, NGOs and the private sector was also highlighted.

4. ***Organizational and Management Issues***

The new direction of research and extension demands considerable improvements in governance and management of the new systems, partnerships and networks. Decentralization does not automatically ensure farmer empowerment and their participation in research planning, implementation and evaluation of results. It does not automatically enhance partnerships with farmers and actors without building a constituency among farmers and different actors. Strong central institutions to create the policy framework and strong

local institutions and mechanisms to govern and manage decentralized development efforts are required. It also requires strong local government leadership and a pool of administratively and technically skilled people. Decentralization also has transition problems related to resource allocation, staff deployment, development and management. Partnership building requires role definition and mechanisms of sharing costs and responsibilities. Increased investment and fiscal decentralization policy are essential requirements for decentralization. Information networking and management is also an important component of a decentralized operation.

To effectively deal with future research and extension challenges, institutional innovation in system organization and management will be critical to the success of Asian research and extension systems.

Agriculture and Fishery Research and Extension Systems: Organizational Linkages (Dr. Eliseo R. Ponce)

The early 1980s highlighted the issue of research-extension linkage as a major obstacle in developing more responsive and efficient research and extension systems. It was noted, for instance, that the farming community had not been optimally using new knowledge and technologies generated from agriculture research. Several studies on farming systems research had dealt with the continuing issue of research-extension linkage. Likewise, several reviews on the research and extension system of the country, from the start of the Aquino Government in the mid-1980s up to the present, had consistently pointed out the long-standing problem on research-extension linkage in the country. In 1997, the Congressional Commission on Agricultural Modernization (Agricom) identified research-extension linkage as a critical part of the total structural reforms required in the agriculture bureaucracy. This view largely remained unchanged to the present.

1. ***Research-Extension Linkage***

In developing the research-extension linkage, the following assumptions are made. First, in a client-oriented and industry-responsive agricultural research system, the R&D agenda must focus on the needs of farming and fishing communities. Second, the information and technologies generated by research should be able to reach the greatest number of farmers if the extension system is to effectively disseminate them as an integral part of its program of activities. Third, the ability of the extension service to provide timely feedback to research and the ability of the research system to transfer new knowledge to the extension system depend on the research-extension linkage. The following efficiency considerations should also be noted: 1) the organizational structure of both the R&E systems; 2) the organization's orientation and quality of human resource; and 3) the effective functioning of the transfer mechanism.

2. ***The Philippine Research Reality***

The research system, despite the progress achieved by the Agriculture and Fisheries Modernization Act (AFMA) of 1997 continues to face problems in the development of a dynamic and mutually reinforcing research-extension linkage.

The research issues and problems consist of: 1) inadequate structure of the R&D system; 2) lack of strong research centers; and 3) weak research extension linkages especially between the research institutions and the extension system which have affected the transfer of knowledge to the farming/fishing community and the latter's feedback to research.

3. ***The Extension Reality***

The National Extension System for Agriculture and Fisheries (NESAF) consists of three sub-systems, namely: 1) the local government sub-system – this consists of the provinces and the municipalities that are tasked by law to deliver direct extension support services to the farming and fishing communities, as per the Local Government Code of 1991; 2) the national government sub-system – the Department of Agriculture (DA) and its attached agencies and corporations, the Department of Agrarian Reform (DAR), the Department of Environment and Natural Resources (DENR), and the state colleges and universities (SCUs) undertake various types of extension services in selected municipalities and provinces; and 3) the non-governmental sub-system – this consists of agribusiness firms that perform extension services for their clients in connection with their products or services (major players are seed, fertilizer and chemical companies, feed and farm machinery dealers, and banks).

The extension issues and problems are: 1) overlapping of extension functions between the national and local governments; 2) weak capacity of local government units (LGUs) to plan and implement extension programs; 3) lack of mechanism for regular communication between research and extension agencies; 4) weak partnership with farmer organizations, NGOs and the private sector for service delivery; 5) failure to recognize research and extension as closely interdependent activities; and 6) over-politicization of agricultural extension services at the municipal level which has stifled professional growth and development of the extension staff.

While AFMA affirms the local government's role in the delivery of extension services to the farming and fishing communities, the law also mandates the DA to play a catalytic role in improving the overall quality and effectiveness of the extension services. The Implementing Rules and Regulations (IRR) designated the Agricultural Training Institute (ATI) as the focal agency in the department to provide national leadership in the integration and strengthening of the national extension system. The ATI's responsibilities include, among others, the development of a national extension agenda and program, the setting up of a national standard for extension and farmer's training, and the provision of counterpart funds to support LGU extension facilities development and program implementation. The ATI, however, has been unable to fully discharge its functions because of funding constraints and the inability of the DA to push through with its structural reforms that would reorganize ATI into a Bureau of Agricultural and Fishery Extension.

4. ***Bridging the Gap between Research and Extension***

As a major step towards bridging the national research and extension systems, AFMA created the Council for Extension, Research and Development for Agriculture and Fisheries (CERDAF). AFMA also changed the orientation of both the research and extension systems by treating research and extension activities as part of a development continuum that begins and ends with the farmers/fisherfolk.

The Bureau of Agricultural Research (BAR) employed three major strategies to operationalize the organizational linkages between research and extension. These are:

1) formation of regional Research, Development and Extension (RDE) networks to bring together major research and extension players to develop the regional agenda and program for agriculture and fisheries research and extension.
2) crafting of on-farm-research (OFR) program based on the principle of community participatory action research (CPAR) as a major vehicle to accelerate the transfer of technologies to the countryside.

3) development of a funding facility for the development of provincial research-extension centers (PRECs). Through its Institutional Development Grant (IDG), BAR has assisted the provincial governments in strengthening their PRECs.

5. ***Lessons Learned***

1) In a national situation where research and extension belong to separate administrative structures, a **major national policy** is important to develop institutionalized mechanisms to link research and extension.
2) While national policies are important, **resources will have to be invested** to develop and nurture organizational linkages between research and extension.
3) To further nurture organizational linkages, **rewards** need to be instituted to provide incentives to players, especially, to those involved in interfacing activities.

Human Resources Development for Agricultural Research and Extension in the Philippines (Dr. Aida R. Librero)

In the Philippines, agricultural research and extension may be viewed as a system involving various agencies in the public and private sectors. In the public sector, institutional functions or mandates on agricultural research may be categorized into either research management or research implementation. The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) which is under the Department of Science and Technology (DOST) and the Bureau of Agricultural Research (BAR) which is under the Department of Agriculture (DA) are the primary research management agencies. These agencies plan, coordinate, monitor and evaluate R&D activities in agriculture. As the stewards of the R&D system, these agencies have their respective programs designed to develop the technical manpower in agricultural research to ensure excellence in the conduct of research in this sector.

Research implementing agencies constitute the largest number of public institutions in the research system. These include, among others, state colleges and universities (SCUs), line and commodity specific agencies under and attached to the DA. Under the leadership of PCARRD, these agencies have been organized into a National Agriculture and Resources Research and Development Network (NARRDN), a network of national single and multi-commodity R&D centers, regional commodity R&D centers and cooperating stations. To better respond to their mandated tasks, each of these institutions has its own technical manpower development program.

The extension service in the country, on the other hand, is primarily in the hands of the local government units (LGUs) following the Local Government Act of 1991. Prior to this, there were two parallel systems of extension, one under the DA and the other under the LGUs. Devolution shifted the main responsibility of agricultural extension to the LGUs. Consequently, human resource development for extension service has been decentralized and the intensity and seriousness by which this is carried out considerably vary by LGU depending on local priorities, resources and political support.

At the national level, the Agricultural Training Institute (ATI) under the DA has the mandate to cater to the training needs of extension workers and the farmers as well. Capability building for LGU extension personnel is given highest priority in the program thrusts of this agency. The resources of the institute however, remain limited to fully meet the training needs of all extension workers in the country.

The SCUs also have their own extension service as part of the trilogy of functions of these institutions, i.e., research, instruction and extension. The common goal of the extension

program of the SCUs is to support national and regional priorities in agriculture and rural development.

1. ***Major Problems/Issues Related to HRD***

Based on a study on research extension linkage in 1998, the following problems/issues related to human resource development (HRD) were identified:

1) Over-politicization of agricultural extension services at the municipal level stifled professional growth and development of extension staff. Extension services operated within the municipality, hence, the chance for promotion and growth of agricultural extension employees is almost absent.
2) Financial difficulty and poor quality of agricultural extension confronted many of the LGUs. There had not been any organized training program for upgrading the competencies of LGU extensionists except those associated with national programs. The training components of the programs were usually aimed at improving the implementation of national programs which might have priorities different from those of LGUs. The ATI did not have national training programs aimed at upgrading the managerial capabilities of the municipal and provincial agricultural officers. Its training programs generally complemented the DA national commodity programs.

Another study showed that while local governments had started to explore innovative ways in organizational development, they had so far not invested enough in comprehensive HRD. When the financial pinch hits, their HRD and training activities/concerns were usually the first to be sacrificed.

In assessing the effect of devolution in Nueva Ecija province, another study reported that before devolution, promotion and scholarship were "inadequate", recognition was "moderately adequate", while trainings and seminars were "adequate". After the devolution, there was no change in promotion. On the other hand, the effect of devolution was noticeable among recognition, trainings, seminars and scholarship. This could be attributed to the fact that personnel development was not in the list of priority programs of the LGUs.

2. ***Policies with Direct Bearing on HRD***

Enacted in 1998, the Agriculture and Fisheries Modernization Act (AFMA) or Republic Act 8435 declares that it is the policy of state to "provide for a program of human resources development in science and technology (S&T) to achieve and maintain the necessary reservoir of talent and manpower that will sustain its drive for total S&T mastering". To implement this policy, a number of relevant programs has been established.

The Magna Carta for Scientists, Engineers, Researchers and Other Science and Technology Personnel in Government or Republic Act 8430, on the other hand, states that the State shall "establish, promote, and support programs such as science and engineering scholarship programs, improvement of the quality of science and engineering education, popularization of science culture, and provision of incentives for pursuing career in S&T".

Mechanisms for the Transfer of Technology among Countries in Asia and the Pacific
(Ph.Dr. Tito E Contado)

Technology is understood as the practical use of scientific knowledge in industry and everyday life. It consists of methods, devises or techniques including methods that humans have used to adapt materials in nature to their own use and to invent new ones. Technology transfer has a technology source and a technology receiver-user. Available technology should be transferred to the end-user in order that it becomes beneficial. The means of

transfer of technology may be referred to as the mechanism of technology transfer. Mechanisms are identifiable set-up and means of making technology transfer from the source to the end-user.

Several mechanisms of technology transfer from one country to another have been identified. These mechanisms could be classified into informal mechanisms and formal mechanisms. The informal mechanisms are *ad hoc* ways and means in which agricultural technology from one country has taken root in another. There are no formal arrangements or organized means of transfer of technology in the case of informal technology transfer mechanisms. An example of agricultural technology that has been transferred informally is salmon fish culture from the Northern Hemisphere (Alaska, U.S.A.) to the Southern Hemisphere (Chile). Another example is the transfer of ostrich culture from Africa to America. Other examples are kiwi fruit from China to New Zealand, tropical ornamental plants from tropical countries to Italy, fruit trees from one country in Asia to another and a Japanese special squash to Tonga.

The formal mechanisms involve three kinds of technology transfer mechanisms, namely: 1) Technology Source-Provider Mechanism; b) Technology Transfer Brokerage Mechanism (TTBM); and c) Technology Receiving and Disseminating Mechanism. In Asia and the Pacific, there are several national and international source-provider mechanisms for technology transfer. These include the International Rice Research Institute (IRRI), the Centro International de la Papa (CIT), the Asian Vegetable Research and Development Center (AVRDC), Australian Center for International Agricultural Research (ACIAR), the ASEAN Regional Center for Biodiversity Conservation (ARCBC), Plant Resources of Southeast Asia (PROSEA), Agricultural Multi-nationals, etc.

TTBMs are international and regional institutions and networks that promote transfer of existing technology from one country or institution to another. Some examples of these TTBMs are: the Food and Agriculture Organization of the United Nations (FAO), the Economic and Social Council for Asia and the Pacific (ESCAP), the Southeast Asia Regional Center for Research and Graduate Education in Agriculture (SEARCA), the International Service for the Acquisition of Agri-biotech Application (ISAAA), the Southeast Asia Sustainable Knowledge Network (SEASAKNet), Southeast Asia Network for Agricultural Extension (SEANAE), and the private business networks such as the Asia and Pacific Seed Association (APSA).

The Technology Receiving and Disseminating Mechanisms are institutions which have the mandate and capacity to receive, disseminate and apply technologies from other countries. Examples of this kind of mechanism are the national agricultural extension systems such as the Department of Agricultural Extension of Thailand in the case of the adoption of green grapes suitable to the tropics, the Indian Agricultural Research and Extension Systems in the adoption of high-yielding variety (HYV) wheat from Mexico, and in the case of HYV rice from IRRI, the national research and extension systems in rice growing countries of Asia and the Pacific. National private organizations have also been identified as effective receiving mechanisms of technologies from other countries such as the Bangladesh Rural Advancement Center (BRAC), the Philippines Rural Reconstruction Movement (PRRM) in the Philippines, the Allied Botanicals, Inc. and the Alliaga Nueva Ecija Cooperative, also in the Philippines.

Several issues/problems affecting the technology transfer mechanism were identified including: 1) lack of awareness and appreciation of existing useful technologies in different countries of Asia and the Pacific; 2) risk aversion among the leaders of these countries; 3) absence of acceptable technology transfer mechanism or lack of appreciation of the

benefits from technology transfer and consequently lack of money to establish and operate an economically viable technology transfer mechanism; 4) strong culture that believes narrowly on local specificity of agricultural technology that lead to low priority given to well-known technologies in other countries; 5) protectionism and nationalism on the part of the source of high quality technology; 6) the emerging proprietary ownership of emerging high technology; 7) infrastructure and economic problems on the part of the potential receiving country; and 8) restrictive policies of technology source countries which oftentimes do not allow exportation of technology to other countries or policies that prevent potential receiving country from allowing the importation or transfer of technology from other countries.

The undertaking of further studies was suggested such as an inventory of agricultural technologies that have been effectively transferred from one country to another and an assessment of the effectiveness/benefits of different technology transfer mechanisms.

Effective Networking of Research and Extension through Information Technology
(Dr. Rita Sharma)

In the 21st century agriculture will continue to be the engine of economic growth for many developing countries and it will provide sustainable livelihoods to the majority of rural populations. However, the nature and scope of the demands of the rural community to improve their quality of life – social, economic and political – are undergoing significant changes. No longer are the farmers today content with production technologies of food grain crops embodied in the Green Revolution era, as technologies for these crops are already well-known to farmers, who are well-served by seed and input suppliers. More varied research and extension services are demanded by farmers to remain competitive and profitable, diversify production, and produce for niche markets, and move to higher-value products and more value-added production. Effective linkages of production systems with marketing, agro-processing and other value-added activities have acquired greater importance. In this competitive environment, research and extension services must be oriented to markets and must overcome the exclusive focus on production that ignored market demand and profitability in the past.

1. ***Focus on Knowledge and Information***

Agricultural growth in the new millennium would largely accrue from improvements in productivity of diversified farming systems with regional specialization and sustainable management of natural resources, especially land and water. Furthermore, increases in productivity are likely to come from more efficient use of inputs. Technology recommendations will be tailored to specific groups of farmers and more narrowly defined production environments. Innovation will require more knowledge and information input from research and extension services which will have to respond to specific farmer requests for information in demand-driven mode.

2. ***Multi-agency Research and Extension Providers***

The diversified nature of farming demands, against a background of economic liberalization and globalization, is radically changing the spectrum of service providers to the rural community. No longer are public research and extension systems the sole providers of agricultural services to the farming community. Indeed, the private sector, farmers' organizations, cooperatives, self-help groups, para-professionals, NGOs, input suppliers and small agribusinesses are engaged in both the generation and dissemination of technologies, information and services.

3. ***Research-Extension-Farmer Linkages***

Differences in objectives and motivations between public and private research and extension organizations mean that one or the other may be more appropriate for certain kinds of extension activities and clients. Pluralistic research extension systems seem to make sense not only in terms of flexibility and complementarity, but also in terms of the range and number of farmers served as well as their different technological needs (e.g., commercial agribusiness technologies compared to low external input technologies). Pluralistic approaches explicitly underscore the need for integrating mechanisms. No longer is it sufficient to address research-extension integration which served the purpose under a supply-driven regime wherein predetermined technology packages were marketed across large recommendation domains. With the focus now shifted to demand-driven, location-specific, customized and tailor-made technologies and services to serve different categories of farmers, a vital link in the integration process, missing from the earlier dispensation, namely, the "farmer", needs to be included in the integration process.

4. ***Research and Extension Reforms***

Research and extension reforms are being undertaken by various governments to meet the changing needs of the farming community. In India, radical policy reforms and institutional restructuring is taking place to modernize the National Agriculture Research Systems (NARS) and the National Agriculture Extension Systems (NAES) to make the technology generation and technology dissemination system more farmer-driven and farmer-accountable. Under the National Agriculture Technology Project (NATP) supported by the World Bank, one of the objectives is to strengthen research-extension-farmer linkages. Using both the traditional inter-personal mode, group mechanism, as well as the modern instrument of Information Technology (IT), effective linkages are being forged between research, extension and farmers.

5. ***Importance of Information Technology***

In the new regime "farmer" integration in the research-extension-farmer triangle has become vital not only because the farmer as a client/recipient of technology, knowledge and information provides crucial feedback to the service providers, but also because in his own capacity as an individual as well as a member of community-based organizations, cooperatives, farmer interest groups, self-help groups, he is the keeper and developer of indigenous technical knowledge as well as an extension agent. While research-extension linkages were theoretically possible in the inter-personal mode because there were limited number of research and extension personnel, the task becomes almost gigantic if "farmers" are to be included. To reach farmers on such a large scale in an interactive mode, the need to harness IT becomes imperative. IT is the only mechanism which has the potential to reach out with technologies, knowledge and information extensively and rapidly. It is also the only instrument that can keep pace with information regarding changing market prices, arrivals in markets, global market scenario, weather, etc.

6. ***Lessons from Pilot Projects***

Pilot projects on harnessing IT for strengthening research-extension-farmer linkages have demonstrated that IT has enormous potential for effective networking between research, extension and farmers. Instruments of IT such as the telephone, video-conferencing, *e*-mail, Internet connectivity, satellite communication, etc. are being used by researchers, extension agents and more recently by farmers with very positive results. But these efforts have yet remained primarily in the domain of isolated pilots. IT is yet to be extensively integrated into the research-extension systems and for making information available to clients.

7. ***Large-scale Applications of IT***

Several factors need to be addressed if IT is to be harnessed on an extensive scale to bring about effective research-extension-farmer linkages. The major factors are: 1) creation of enabling environment for IT; 2) development of infrastructure; 3) development of software and information content; 4) making IT sustainable; 5) building capacities; 6) combining strengths of "old with new"; and 7) learning from success stories and compiling Best Practices.

HIGHLIGHTS OF COUNTRY REPORTS

The country reports highlighted the recent developments in agricultural research and extension in the various participating countries. In general, it was found that the countries were on a path towards greater responsiveness to farmers needs as well as to meeting the changing requirements emerging from a more liberalized and globalized world order. In regard to research-extension integration it was noted that integration had taken on various forms and had been pursued at different levels. A common form had been organizational integration where the research and extension organizations had been put together under one department or ministry. This type exemplified the centralized system/top-down approach in rendering research and extension services. It had been criticized, primarily because it entailed a very demanding task of coordination and it afforded only the limited participation of stakeholders, particularly, the farmers, in the technology transfer process. As a consequence, an advocacy for a more demand-driven research and extension system which was centered on the farmer as client or beneficiary had been promoted in many of the countries.

To address the problems of an overly centralized system, some countries, for instance, had decentralized their research and extension system. These efforts were aimed in large part at strengthening functional and institutional linkages. The devolution, particularly, of extension to lower/lowest level administrative units, however, had generated its own set of problems, primarily arising from the lack of preparedness of the local governments to fully take over the responsibility of extension and the low priority many municipalities/towns were giving to agriculture. What appeared to be a much more successful model was that adopted by East Asian countries whereby research and extension were integrated at a more intermediate level of the government administrative hierarchy (i.e., region, district or prefecture) where more applied and participatory types of research were undertaken. In general, also, integration at project level had been demonstrated to be feasible in many of the countries.

Functional or operational integration of research and extension had been pursued, particularly, where research and extension were administratively under separate departments/ agencies, through the establishment of coordinating mechanisms at various levels. These mechanisms aimed to administer and coordinate all research and extension activities, including in some cases, those being undertaken by the private sector. Under this modality, councils or committees represented the typical mechanisms for strengthening linkages.

One important conclusion from the country presentations was that there was no one right or correct model for integrating agricultural research and extension. The model that a particular country adopted very much depended on its stage of development. In this regard it was noted that selecting best practices of each country was probably an ideal approach to enhancing research-extension linkages.

Major Issues and Problems affecting the Integration of Agricultural Research and Extension

The common issues and problems that the participating countries face included: 1) policy and structural considerations (e.g., lack of clear specification of organizational responsibilities and/or absence of unified policy framework); 2) inadequate incentives or government support (i.e., lack of sufficient funds); 3) compartmentalized structure of research and extension (e.g., existence of institutional boundaries); 4) internal organizational pressures and cultures; 5) lack of adequate access to quality information; and 6) lack of efficient and effective strategies to strengthen the linkage(s) between research and extension.

Most of the countries pointed out that linkages were facilitated when research institutions, extension agencies and education organizations recognized the value of shared or complementary information and promoted group or team approaches to problem-solving.

Effective Measures for Enhancement of Linkage(s) Between Agricultural Research and Extension

A number of measures had been adopted by the participating countries to enhance linkage(s) between agricultural research and extension. These included, among others: 1) shifting to a more farmer-driven, farmer-accountable research-extension system; 2) decentralization of research and extension networks to lower level administrative units; 3) adopting the "group approach" to address farmers needs; 4) increasing investment in research and extension; 5) provision of national government to support local governments in terms of financial and technical inputs; and 6) promotion of more research-extension networks by international organizations.

FIELD STUDIES

For their field studies the participants visited five places, namely: 1) Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna; 2) International Rice Research Institute (IRRI), Los Baños, Laguna; 3) Philippine Business for Social Progress – Center for Rural Technology Development (PBSP-CRTD), Calauan, Laguna; 4) Southern Tagalog Integrated Agricultural Research Center (STIARC), Marauoy, Lipa City; and 5) Magsasaka Siyentista Demo Farm, Tipakan, Lipa City. The highlights of these visits are presented below:

Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)

PCARRD is a sectoral council under the Department of Science and Technology (DOST). Established in 1972, PCARRD formulates policies, plans and programs for S&T development. It is a government arm that coordinates, evaluates and monitors the national agriculture and forestry R&D program. Its mandates also include allocation of government and external funds for R&D and the generation of resources to support these programs.

PCARRD pursues an active partnership with international, regional and national agencies. It maintains and evolves linkages with international agricultural centers and funding institutions for joint R&D, HRD and training, technical assistance and exchange of scientists, information and technologies. The Council supports and manages the National Agriculture and Resources Research and Development Network (NARRDN) comprising of national multi- and single-commodity, and regional R&D centers, cooperating stations and

specialized agencies. It has been a potent arm in catalyzing the Philippine agriculture and natural resources sector toward self-sufficiency and global competitiveness.

Dr. Bessie Burgos of the Technology Outreach and Promotion Division welcomed the participants. They were given a brief orientation on how the Council started and its operations/programs. The participants were received at the Techno Gabay Center. The *Techno Gabay Program* is an integration of PCARRD initiatives such as the Farmers' Information and Technology Services; Farmer-Scientist Bureau (FSB); Information, Education and Communication Strategies; and Information and Communications Technology. The participants had an opportunity to look around on their own and check the one-stop shop database system.

International Rice Research Institute (IRRI)

IRRI is an autonomous, non-profit agricultural research and training organization with offices in more than 10 nations. The institute's main goal is to find sustainable ways to improve the well-being of present and future generations of poor rice farmers and consumers while at the same time protecting the environment. Most of IRRI's research is done in cooperation with national agricultural research and development institutions, farming communities and other organizations of the world's rice-producing nations.

IRRI was established in 1960 by the Ford and Rockefeller Foundations in cooperation with the Government of the Philippines. Its research activities began in 1962 and are now estimated to have touched the lives of almost half the world's population. Besides doing research, it is also very active in local communities – providing educational scholarships, organizing income-generating training activities and arranging other community projects that will help improve living conditions in the poor communities that neighbor the institute.

Philippine Business for Social Progress – Center for Rural Technology Development (PBSP-CRTD)

The Philippine Business for Social Progress (PBSP) established the Center for Rural Technology Development (CRTD) in Calauan, Laguna in 1979 to serve as a laboratory for testing, validating and disseminating technologies appropriate for lowland farming. CRTD developed farming systems designed to optimize the use of land, providing ample yield so that the farmers' economic well-being can be improved. The Center had developed the following farming systems: 1) BUKHAY 1 and BUKHAY 5000 (*Bukid ng Buhay* or Farm Life); and 2) SAPAT 2000 (*Sama-samang Pagsasaka at Angkop na Teknolohiya* or Diversified Farming and Appropriate Technology).

The Training Supervisor, Mr. Ralph Perez, received the participants and gave the group a 40-minute orientation on the center.

Department of Agriculture – Southern Tagalog Integrated Agricultural Research Center (DA-STIARC)

DA-STIARC was established in 1930 as the Southern Luzon Experiment Station, one of the experiment stations of the Bureau of Plant Industry (BPI). In 1983, the station was integrated with the DA Region IV and became the seat of the Regional Integrated Agricultural Research Systems (RIARS) Office. In 1989, through Executive Order No. 116, the station was again renamed as Dr. Manuel L. Roxas Regional Integrated Agricultural Research Station. Two years later, by virtue of DA Administrative Order Nos. 6 and 19 series of 1991, it became the R&D Center of the DA Region IV.

DA-STIARC is a center effectively responding to agricultural technology needs for development of agriculture in Region iv in support of the goals and objectives of the AFMA. It is responsible for strengthening the Regional Research and Development/Extension Systems in agriculture for greater effectiveness and efficiency and for promoting the region's agricultural growth through R&D. Its efforts are focused on the upliftment of the quality of life of small farmers and on sustainability of the resource-base over a longer term.

Ms. Digna Narvacan, Assistant Center Chief of DA-STIARC welcomed the participants. The Center staff provided a briefing on the operations and activities of the center.

Magsasaka Siyentista Demo Farm

As noted earlier, the FSB or *Magsasaka-Siyentista* (MS) is one of the major information and technology delivery modalities of the Techno Gabay Program of PCARRD. MS is composed of outstanding farmers who have demonstrated successful application of S&T-based and indigenous technologies. These farmers are active participants, enablers, facilitators or initiators of technology development and transfer practices. Participating outstanding farmers are identified, evaluated and selected as MS based on a set of criteria. As a farmer-to-farmer advisory service, the FSB provides technical assistance to the LGUs and farmer cooperatives or organizations.

Each Techno Gabay Center is complemented by acknowledged farmer-leaders or MS to collaborate with PCARRD's regional consortium in demonstrating, experimenting and promoting technologies in agriculture and natural resources. The MS has the following functions: 1) acts as resource person during trainings, seminars, field days, investment clinics, cross-visits, etc.; 2) provides technical assistance and hands-on training and shares experimental insights to farm visitors and other FSB trainees; 3) devotes a certain portion of his/her farm as demonstration plot for his/her own farm trials; 4) tests/applies technological information learned from the seminars and cross-visits attended; and 5) influences other farmers in adopting his outstanding farm practices by sharing information, experiences, resources and ideas.

The group visited the FSB or MS Demo Farm in Tipakan, Lipa City, a 34-ha coffee plantation owned by retired Col. Nicetas Katigbak.

WORKSHOP OUTPUT

A workshop was conducted to provide an opportunity for further discussion and sharing of views and experiences among the participants. Specifically, two discussion points were taken up, namely:

1) major issues/problems affecting the integration of agricultural research and extension
2) specific measures that address these issues/problems so that the linkage(s) between agricultural research and extension can be enhanced.

To facilitate the discussions the participants were divided into two small groups. The outputs of the two groups were presented in a plenary session. The outputs are summarized below as follows:

Group I: Mr. Md. Nurul Amin (Bangladesh), Mr. An-Long Chiou (Republic of China), Mr. Aliki Turagakula (Fiji), Dr. Baldeo Singh (India), Dr. Behzad Ghareyazie (Islamic Republic of Iran), Mr. Dhrub N. Manandhar (Nepal), Dr. Danilo C. Cardenas (Philippines), Dr. W. G. Somaratne (Sri Lanka) and Dr. Md. M. Rahman (Facilitator)

1. ***Common Definition of Integration***

- A mixture of bottom-up and top-down approach
- Uniting vision/plans (shared vision)
- Integration of research and extension linkage between government and private sectors
- Integration includes research, extension and farming sector (under one umbrella organization)

2. ***Nature of Integration***

- Structural/functional/institutional): functional (field level); structural (whenever possible); and policy (coordination mechanism).

3. ***Goals/Objectives of Integration***

- Enhancement of agricultural growth
- Finalization of research and extension agenda
- Balancing of research and extension concerns
- Strengthening of linkage with other services providers/receivers

Areas	Problems/Issues	Solutions
Policy	- Top-down (dominant approach) - No clear policy on integration - Kept integration among public agencies and ignoring importance of private sector contribution - No clear role identified, no clear direction among the players	- Bottom-up approach is desirable as long as possible - Put integration policy in place as an important component of national agricultural policy - Promote multi-agency approach (public sector playing central role)
Institutional/ Management/ Organization	- Problem identification - Type of integration desired/ possible - Exploitation of group approach - Decentralization of extension is highly desired - Decentralization in research is not recommended except in some downstream research	- Most critical research and extension linkage is at municipality/ district level - Promote group and encourage farmers' association - Decentralization to consider national priorities - Promote decentralization of downstream research only as much as possible
Financial	- Low priority/funding	- Increased/higher priority on funding; recommended funding to at least 1 percent of GDP

... To be continued

Continuation

Areas	Problems/Issues	Solutions
Financial	C Decentralization requires more financial resources but is often not possible C Inadequate financial management/ administration	C Tapping private sector resources for augmentation of funding C Adopt innovative strategies such as cost sharing and contracting arrangements
Others	C Lack of impact indicators/ measures of integration C Lack of acceptable standards of outcome C Harnessing technology development to facilitate integration and linkages C Very little agricultural orientation in extension	C Develop appropriate measures and train people how to use and interpret them C Set up universally accepted and comparable standards of performance C Use Information and Communication Technology (ICT) for dissemination for information and knowledge ex-change and construction C Agricultural extension workers time should only be allocated for agricultural activities

Group II: Dr. Ming-Teh Huang *(Republic of China)*, Mr. Idrus Kadir *(Indonesia),* Dr. Gholam Ali Ranjbar *(Islamic Republic of Iran)*, Mr. Tomohide Sugino *(Japan)*, Dr. Seung IL Na *(Republic of Korea)*, Mr. Md. Nazri Abas *(Malaysia)*, Dr. Shirchin Demberel *(Mongolia)*, Mr. Rolando Labios *(Philippines)* and Dr. Tito Contado (Facilitator)

Linkages between research systems and extension systems at the national/regional level could be enhanced through establishment of a Ministry of Agriculture Council with supporting committees and technical groups. The Council would have a coordinating or orchestrating role.

Integration of three major components (viz., applied research, training and dissemination) at the provincial/field level could be achieved if managed by one center or placed under the same institution. Under this set-up the farmer and the community should actively participate in the R&D activities.

Areas	Problems/Issues	Solutions
Policy	C Lack of clear policy for extension and research functions/roles/working relationship at the national, regional, local levels	C Formulate state/national policy framework for R&D based on a law C Develop linkages at national and regional level, and integration at local level

... To be continued

Continuation

Areas	Problems/Issues	Solutions
Institutional	C Overemphasis on research group vs. extension; bias for research group vs. extension; high qualification of research group compared to that of extension group; lack of opportunity for professional growth of extension workers; low quality/salary scale of extension workers C Underutilization/lack of facility or equipment to support research and extension program C Centralization/decentralization issue	C Identify accountable officer C Provide additional budget/incentives C Encourage private group participation in research and extension program C Research to continue its centralized activities while extension may be decentralized but linked to research
Operational	C Lack of leadership; frequent changes of management leaders/ politicians C Lack of integration of research and extension program at the field level C Lack of mechanism for integration of research and extension C Research and extension have different programs (agencies have different priority programs)	C Develop career or professionalized research and extension leadership C Establish effective functional structure for integration of research and extension like research, training and extension center C Develop a unified program at local level managed by the center
Others: Funding	C Insufficient/lack of funding	C Increase fund allocation for research and extension C Set up joint cooperative funding (e.g., 40 percent from national and 60 percent from province)
Quality of manpower	C Lack of incentive for research and extension workers at the field level	C Provide incentives from national and private groups
Technical sources	C Limited exchange of technical information for research and extension due to individual government restriction/laws	C Signing of bilateral agreements

The above outputs were summarized and integrated by Dr. R. Sharma as follows:

1. ***Policy***

1) There is no choice but to move towards a farmer-driven, farmer-accountable research-extension system that is demand-driven rather than supply-driven and is "bottom-up" rather than "top-down". The farmer should be the center of all research and extension activities.
2) This would mean decentralization of research and extension networks to provincial and further down to district/municipal level.
3) It is agreed that while linkages need to be forged and strengthened at the national level, more operational/functional integration of research-extension with farmers at the center is likely to come at the district/municipal level under a single umbrella rather than at national level.
4) However, the local governments should not be allowed to work in isolation. They should be supported by the national government through both financial as well as technical inputs. In doing so the national government can also ensure that national priorities and essential reforms also get built-in into the process. The national government should retain the role of coordinator and capacity builder.
5) In the scenario of economic liberalization and globalization, there is need to promote a multi-agency extension system drawing upon the resources and strength of the private sector. Yet at the same time strengthening the public sector to meet the requirements of those in the farming community not served by a competitive private sector. There is also a need for partnership between public and private sector.
6) At all decision-making levels, both research and extension representatives must be involved. A planning process, which involves participatory rural appraisal (PRA) exercise, should be conducted by both research and extension workers. Joint review and finalization of the plan is likely to bring about greater integration.
7) Government should play the role of enabler, facilitator and coordinator and retain monitoring and evaluation function.

2. ***Programs***

1) A need was felt to develop appropriate indicators that could measure the strength of research-extension linkages.
2) While it was agreed that returns to research and extension were very high, there was need to close the gap between technologies developed and technologies adopted by farmers. This gap was found to be of the order of more than 60 percent in most countries.
3) A research-extension agenda based on farmers' needs would, perhaps, reduce this gap to some extent.

3. ***Institutional Arrangements***

1) It was agreed that the "group approach" to address farmers' needs appears to be the most effective approach.
2) Community-based organizations and farmers' associations need to be strengthened to partner with public agencies in input provision as well as in marketing.
3) Capacity building of extension functionaries together with an appropriate system of rewards and incentives is essential.
4) IT networking to integrate knowledge systems should be promoted in order to provide essential information to the farmers.

4. ***Financial Support***

1) Investment in research and extension should be increased to 1 percent of GDP.
2) Almost all countries reported resource constraints in financing their research and extension systems. It was felt that one way to address this issue was to expand the services of research and extension providers by facilitating the entry of private, cooperative and farmer organizations and promoting private extension.
3) Other ways include establishing cost recovery and cost-sharing mechanisms and undertaking contractual arrangements for research and extension services.

5. ***International Cooperation***

1) Forums such as the present one which provide an opportunity for nations to learn from the success stories and failures of one another need to be strengthened. More research-extension networks need to be developed and promoted by international organizations such as FAO and APO, wherein issues of inter-country technology transfer can be discussed and debated.

CONCLUSION

There is no single, ideal and easy recipe for improving agricultural research and extension linkages. The strategies and mix of mechanisms employed depend on the policy, institutional and resource context of a particular country. The complexity of national agricultural technology systems requires, however, that governments foster linkage mechanisms and play a coordinating role.

To improve linkages, and thereby improve the effectiveness of agricultural technology systems, several elements seem to stand out as particularly important:

1) It helps to view research and extension as an integrated agricultural knowledge and technology system.
2) A focus on research and extension functions, instead of just organizational structures, might broaden the dialogue to include other partners and thereby lead to improved integration.
3) A pluralistic approach is likely to have advantages, but to be effective linkages must be formed and strengthened.
4) Linkages may be best improved through the promotion of informal networking at many levels with an incentive system that rewards collaboration.
5) Strengthening and empowering "client groups" especially typically hard to reach groups can result in more demand-driven research and extension services and put pressure on the system to improve linkages.

Many strategies and programs to strengthen the linkage(s) between agricultural research and extension have been formulated in the various countries. The coordination of these functions/activities between and among concerned agencies continues to be an enormous challenge. The integration of research and extension activities is, therefore, important for ensuring that research remains relevant to the needs of the farmer-clientele and effective in terms of its impact on their livelihood.

The study meeting provided the participants an opportunity to review the present situation and recent developments in agricultural research and extension in their respective countries, as well as to discuss measures on how the linkage(s) between research and

extension could be strengthened and improved. In this regard, the participants felt that through their participation in the study meeting they have gained a better appreciation of the importance of the integration of agricultural research and extension and the value of shared or complementary information and promotion of group or team approaches to problem-solving for the enhancement of agricultural productivity.

1. RECENT DEVELOPMENTS IN AGRICULTURAL RESEARCH AND EXTENSION SYSTEMS IN ASIA AND THE PACIFIC

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INTRODUCTION

In mid-1950s, increasing population pressure, widespread poverty, chronic food shortages, and attendant economic uncertainties and social upheavals stimulated the thinking of national leaders for restructuring the agricultural services. This resulted in the growth of organized national agricultural research and extension systems with emphasis on major food commodities. In 1960s, Asian countries started widening the research base by creating new research institutions. Agricultural research departments/divisions were, in some cases, transformed into semi-autonomous research institutes. Agricultural research councils/ agencies of different forms were established in many Asian countries to consolidate, guide and coordinate the national research efforts. Linkage was established with the International Agricultural Research Centres (IARC), especially with International Rice Research Institute (IRRI) and Centro Investigacion para la Mejoramiento Mais Y Trig (CIMMYT). The success of Green Revolution in rice and wheat triggered further expansion of the research networks. Over the last three decades, national agricultural research systems (NARS) in Asia have grown rapidly in size and maturity.

Agricultural extension services were also transformed during this period. Extension services were decoupled from research and strengthened as separate entities. Training and Visit (T&V) extension system was introduced in many countries to expand extension services up to village level, and link it up more closely with the research service. Innovative approaches such as farming systems research (FSR), farming systems research and extension (FSRE), and lab to land program (India) were designed to involve farmers in testing, selecting and disseminating relevant technologies. The purpose was to facilitate convergence of research, extension and farmers in the field.

Transformation of agricultural research and extension in 1960s and 1970s paid handsomely. Technological change coupled with market forces has greatly influenced Asian agriculture. From a relatively stagnant sector in the pre-Green Revolution period, Asian agriculture emerged as a dynamic sector in the Green Revolution period. During this period, agriculture sector went through a Revolutionary Phase and made remarkable progress. Growth of institutional infrastructure, positive shift in public policy, market forces, and

technological change have brought phenomenal change in agriculture. The period between mid-1960s and 1970s witnessed the Green Revolution in Asia. Food grain production grew at 2.3 percent for rice, 3 percent for wheat and 4 percent for maize per annum. This growth rate was higher as compared to other regions of the world. Fruits and vegetables production increased in many countries. Cotton production in India and Pakistan; palm-oil production in Malaysia; sugar production in India; and banana production in the Philippines and Thailand also increased. Overall agricultural output increased by more than 4 percent per annum in China, by 3.6 percent per annum in Southeast Asia and by 2.9 percent per annum in South Asia during the period between 1970 to 1990. On average, the rate of agricultural growth was higher than the rate of population growth.

This trend has reversed. Growth in agricultural production has slowed, especially in cereals. Evidence shows that total factor productivity growth is slower in the post-Green Revolution period. In some cases, it has registered negative growth. Byerlee reported in 1994 that the growth rate for cereals has fallen sharply from 3.2 percent per annum during 1963-72 to less than 2.0 percent per annum during 1983-92.

CHALLENGES FACING ASIAN AGRICULTURE

Besides stagnant growth, agriculture is facing new challenges resulting from rapid changes in external environment. Climate change, globalization, trade liberalization and urbanization associated with changing food habits are rapidly changing the pattern and nature of agriculture. Changes in global and regional trade regimes and Intellectual Property Rights (IPR) have turned agriculture more competitive. While production increase in terms of total volume is critical for poverty alleviation, improvements in quality of the produce and product diversification has become equally important for increasing incomes and reducing the level of malnutrition, satisfying consumer needs, and for competing in the export market. In the past, agricultural research and extension focused on increasing the quantity of production. With market liberalization, the need is to focus on improving the quality of both the primary and the secondary agricultural products.

Public research institutions are no longer the only source of innovation. A large share of the innovations in the agriculture sector is now originating from sources other the public research institutions. Many actors in the private sector have entered into agricultural research and development (R&D). The role of universities, NGOs, community-based organizations (CBOs), and farmer organizations are expanding. Innovations can now be generated in networks, where the farmers and people from different organizations, different disciplines, and different professions meet. Combining collective wisdom and knowledge of potential actors, with hands-on experience, is becoming a new way of generating innovation. These developments have changed the context of agricultural research and extension.

EMERGING TRENDS IN THE AGRICULTURE SECTOR

Within the agriculture sector, four major trends are emerging. First, the users are becoming more central in innovation and technical change. In the past, farmers were considered the “clients” of research. Now they are increasingly becoming major “partners”. Second, market and environment considerations are increasingly driving innovation processes. Adding value rather than producing more is becoming increasingly important to improving incomes and reducing poverty. Managing rather than using the resources is a key

to sustainable gains. Third, the development potential of the agriculture sector is increasingly defined in the international arena. Agricultural development in isolation of the international markets is becoming difficult to achieve. Fourth, new fields of science such as information science and biotechnology are greatly influencing agricultural research and innovation systems.

The role of private sector organizations and non-agricultural research institutions, including universities is growing. As a result, innovation systems are currently looking fuzzier than 10 or 20 years ago and have become highly dependent on communication and information tools. The primary functions of public research institutions are being defined in relation to what the private sector can offer. What seems to be emerging is a public-private co-innovation system in which both partners share research and development responsibilities and contribute to costs. Public sector research organizations are still the key actors in agricultural innovation, but to cope with the new challenges, they need to develop effective partnerships and linkages with universities, private sector, NGOs and CBOs.

ISSUES AND CONCERNS

Given the new context, there is concern about the ability of the Asian agricultural research and extension systems with the existing institutional set-up to meet the new challenges, and to ensure efficiency and relevance of research and extension. Institutional structure and organization that were evolved during the 1960s and 1970s were primarily tailored to work on the development of seed-fertilizer-irrigation technologies, and associated problems by consolidating the limited and scattered resources and human capital. How far these centralized institutional settings are appropriate for addressing today's complex problems that characterize crop, livestock and natural resource management are under scrutiny. The question is also raised about the future role and effectiveness of many research and extension systems. Research councils that have been established to coordinate the financing of research, and give some freedom to the research systems from rigid civil service regulations have, in practice, become large centralized research organizations in themselves. These councils have not been able to come out of the strict government civil service rules and regulations that are mostly incompatible with what is needed to do science. Consequently, many research systems are suffering from a serious research management crisis, with top-heavy bureaucracy and centralization of decision-making authority. Similarly, centralized extension systems are seen to have been ineffective in a changing context. Research-extension linkages have weakened in most countries.

It is increasingly recognized that the centralized research and extension systems have not been very successful in dealing with site-specific problems. Generalized package of practices and technologies, developed by the centralized research institutes, did not work very well in diverse field, season and farmer circumstances. Site-specific problems, particularly of the marginal and vulnerable areas, require local treatments. There is a growing feeling that well developed decentralized system of adaptive research linked to a dynamic extension system, and skilled farmers and agribusiness might improve the relevance and efficiency of research and enhance wider adoption of technologies.

Public sector research and extension organizations are an important component of agricultural R&D system. But the new context demands adjustments in their structure and roles. There is a need to develop effective partnerships and linkages with universities, private sector and NGOs. Commercial enterprises, NGOs, universities and public sector research

organizations are real and definable entities of innovation systems. A focus on only one or group of public or private sector institutions will not necessarily guarantee impacts on poverty reduction and sustainable resource use. New ways and mechanisms need to be established to facilitate agricultural innovation that impacts positively on the poor and contributes to sustainable development.

CHANGING TREND IN ASIAN AGRICULTURAL RESEARCH AND EXTENSION

Public Research Institutions

The second phase of transformation in public agricultural research and extension systems has started more than a decade ago for greater efficiency and quality in achieving global competitiveness in agricultural production and marketing. The purpose of undergoing structural and organizational reform is to improve institutional responsiveness and accountability, fiscal decentralization to share costs, and farmer participatory involvement in decision-making and management. The emerging trend relates to: (i) decentralization and privatization of agricultural research and extension; (ii) market-oriented demand-driven research and extension; and (iii) partnerships with producers, universities, agribusiness, NGOs, and CBOs in technology generation and dissemination. Decentralization of research and extension has been done many years ago in countries such as India, China, Bangladesh and Pakistan. The focus was more on testing new technologies in different agro-ecological zones to verify adaptability, and not so much on greater involvement of farmers and other actors in technology development and dissemination. The current focus of decentralization is to deepen the involvement of producers, private sector, universities, NGOs, and civil societies as partners in agricultural research and development.

In 1995, Indonesia has decentralized downstream research by creating 17 Agricultural Technology Assessment Institutes (BPTP) to improve research-extension-agribusiness linkages. Research, extension and training specialists have been brought under the umbrella of BPTP to assess new technologies under farmer conditions. This is a paradigm shift from "linear research-extension-farmer relationship" to "working partnership". One of the objectives of these institutes is to involve farmers, district extension services, agribusiness and NGOs in on-farm research planning, and technology testing, evaluation and dissemination. The institutes have prepared their strategic plan to focus on on-farm adaptive research and technology testing; and development of partnership and collaboration with the district extension services, farmers/farmer organizations, agribusiness, NGOs and CBOs for bottom-up research planning and priority setting to address site-specific problems.

Philippines has devolved downstream research and extension services to Local Government Units (LAUs). A law was enacted in 1993 to transfer the extension services to local government. The local government provides funds for their salary and programs. Central government pays only for specific national programs. Extension workers are located at the municipality, and they work in the *Barios* in collaboration with farmers, farmer associations, private cooperatives and NGOs in a partnership mode. Municipal extension services have no organic link with sources of new technology. Research institutes, universities and NGOs themselves link up with the extension groups and provide new technologies for on-farm testing and dissemination. Farmers are involved in the design phase of the study and participate in implementing the program. At the national level, the national research institutes are working on programs of national importance. PHILRICE conducts

basic and applied research for improving rice production. Plant Breeding Institute works on other important crops and biotechnology. Bureau of Plant Industries, Bureau of Soils and Water, Bureau of Animal Industries, Bureau of Statistics and National Research Station under the Department of Agriculture have their own research programs in specific areas. Bureau of Agricultural Research (BAR) and Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) primarily promote and coordinate the national research efforts. The Philippine system is open and provides opportunities for entrepreneurships.

Thailand has recently (2000-01) reviewed the structure and role of the Ministry of Agriculture and Cooperative, including its research system, and bracing for a change to: (i) make Thai agricultural production more competitive on world markets; and (ii) sustain production systems, conserve natural resource base, protect environment and reduce rural poverty. Agricultural research is being reorganized to make it more effective in contributing to these objectives. The major changes recommended for research include:

- formation of a National Agricultural Research Council (NARC) in the form of a committee with limited functions such as to provide oversight, formulate national research policies and priorities, and facilitate funding for agricultural research.
- establishment of a National Agricultural Research Institute (NARI) to serve as a secretariat to the NARC. The secretariat will gather and analyze information needed by the Council to make policy decisions and set priorities. It will implement the Council's policies in areas such as funding of agricultural research programs and projects, monitoring and evaluation, and facilitate research coordination.
- establishment of a fund to support high priority agricultural research and promote inter-institutional and inter-sector cooperation.
- building of inter-institutional and inter-sector linkages (crops, livestock, fisheries, forestry).
- transforming some of the current satellite experiment stations into Agricultural Research and Development Centres (ARDCs) and devolving downstream research functions to ARDCs to pay greater attention to the needs and problems of farmers.
- create a Commercial Technology Development Fund (CTDF) to promote commercialization of technology.

Emphasis is given on vertical integration by ensuring that the technology generated in the research institutes is tested in farmers' fields and herds, and that information on its performance and farmers needs and traditional knowledge are passed on to the research institutes to formulate new research agenda. Emphasis is also given on horizontal integration between public and private sector research. Greater emphasis is given on farmer participatory technology development (FPTD) by all research units. Sub-district level Technology Transfer Centres (TTC) and CBOs are given the primary tasks to restructure the agricultural extension system at the local level (district, sub-district) according to local needs.

A special feature of the reorganization is to ensure research-extension-farmer linkage through participatory adaptive research and technology development at the local level. The ARDCs will maintain strong upstream technical linkages with the appropriate research centers and universities, and downstream linkages with the district extension offices and TTCs. ARDCs will be responsible to the respective regional Office of Agricultural Research Department (OARD), and governed and managed by an advisory committee that will include

representatives of farmers group/association, NGOs, agribusiness, universities and appropriate departments of the Ministry of Agriculture and Cooperatives.

To facilitate the flow of inputs from the farm communities, NARI will be provided information on farmers' needs and traditional knowledge by the TTCs of the Department of Agriculture. This information flow will be enhanced through linkages with the Agriculture and Resource System Information Network (ARSIN). Demands from other end-users will influence the agricultural research policies by their representatives on NARC. In addition, arrangements will be made for interactions between NARS and the National Agricultural Products Standards Institute (NAPSI) to identify research needs in relation to quality standards for agricultural products.

In 1999, Sri Lanka has reviewed the structure and functions of the Council for Agricultural Research Policy (CARP) and suggested changes in its structure, role and governance system to respond to new requirements and challenges. The major changes include:

- make CARP an inter-ministerial organization with greater representation of farmers/ farmers' organizations and private sector in the Council.
- provide demand-driven services in the area of: (i) policy and strategy analysis, including human resource development; (ii) information services; and (iii) research planning, project appraisal, monitoring and evaluation services, including competitive funding and external reviews.
- develop contract research program into a competitive grant scheme to fund research topics of strategic importance.
- provide methodological and technical inputs for decision-making.
- establish alliances with a broader range of actors in the field of agriculture, rural development and agribusiness.

Greater emphasis is given to facilitation and inter-institutional and inter-sector linkages and coordination.

Nepal is in the process of preparing a new strategic plan for agricultural research to incorporate structural and functional changes for strengthening ties with farmers, extension service, NGOs and private sector, and meeting environmental, market and gender concerns. No major structural change has taken place in Bangladesh agricultural research and extension systems in recent years. Decentralization of research and extension took place many years ago. The system is now focusing on building partnerships with NGOs and private research entities through competitive funding for research and development.

Vietnam has completed a Master Plan for Agricultural Research in 2001. The Plan includes reorganization of agricultural research to reduce fragmentation, functional overlap and complexity of the system; and to pursue decentralization to make the system more responsive to the needs of different economic regions, to build effective linkages with farmers, local extension services and agro-industries, and to create synergy by building closer links with universities, commodity organizations and international knowledge centers. Government's overarching emphasis is on decentralization of research to strengthen research-extension-producer linkages. In 1996, the government handed down a decision with the following directives: (i) dissolve the ineffective institutes; (ii) make three institutes self-accounting and 100 percent self-funding; (iii) transfer the research institutes for coffee, sugarcane, rubber, tea and fruits and vegetables to the State Owned Enterprises (SOEs); and

(iv) retain nine institutes under the Ministry of Agriculture and Rural Development (MARD) with government funding. The decision could not be implemented due to incompatibility of mandates and staff of the institutes and SOEs and financial, social and legal implications. MARD suggested two alternative options. Option 1 suggests retention of 16 institutes under MARD and option 2 suggests 18 institutes under MARD. Other institutes were recommended for transfer to the relevant SOEs. The third option under the Master Plan proposed two central research institutes, five special research institutes and six regional institutes under MARD. All other institutes should go to the relevant SOEs. Reorganization of the system is still under study. Meanwhile, the government is going ahead with the implementation of new research and development projects in a decentralized mode at the district level. Research, extension, IARCs and NGOs are working together in these projects to increase crop, livestock and forestry production and improve natural resource management.

In 1996, Papua New Guinea established an autonomous National Agricultural Research Institute (NARI). The idea was to create an independent research organization for food and livestock sector in the country with the objective of building appropriate research infrastructure, and strengthening institutional linkages with extension services, farmers and development agencies. After intensive consultations with farmers, policy-makers, donors, NGOs, private and public sector national, regional and international research and development organizations, the Ministry of Agriculture and Livestock approve the establishment of a NARI in the country.

NARI's vision is to improve food security and enhance income level through efficient and sustainable production of high quality agricultural products based on improved scientific technology and information. NARI's primary focus is on:

- applied and adaptive research based on agro-ecological zones;
- research agenda directed to improve smallholders production and income;
- research-development integration (linking research with development);
- stakeholder participation in research and implementation; and
- partnerships and alliances.

In China, decentralized agricultural research system was in existence even before the socialist takeover in 1949. The system was disrupted during the Cultural Revolution. The research network at the national, provincial, prefectural and county levels was restored after the Revolution. Chinese Academy of Agricultural Sciences deals with basic and applied research of national significance. Provincial institutes work on applied research, based on ecological conditions of the province. Prefectural institutes are mainly engaged in selection and adaptive research. County research institutes are primarily responsible for extension work. China has taken a major drive to privatize agricultural research and extension services as part of rural reform that started in early 1980s. The government has asked the research institutes and extension entities to develop self-financing projects and sell research and extension services to producers. Practices show that in China, free extension services are not only too expensive to be funded by the government and create more bureaucracy in the extension system, but also, even with strict discipline, such services cannot guarantee success. The general policy is that those receiving benefits should pay. This new paradigm is developing fast in China, particularly in extension service.

In the first reform, research, extension, training and input supplies were combined. The priority of reorganization was to set up County Agricultural Technology Extension

Centers (CATEC) by merging different stations of crop cultivation, plant protection and soil/fertilizer, and research stations of county agricultural sciences and others. Township Agricultural Extension Stations (TATES) and Agricultural Demonstration Household (ATDH) at the village level were also established during this reform period. In some developed villages, service organizations have been created. The second reform was designed to implement payment for extension services. The third reform is a shift from government-monopolized extension to cooperative extension. Cooperative extension is organized at the grassroots level. The government encourages this system to share service costs by townships, villages and farmers. The whole system is run under the leadership of government agricultural departments/bureaus. The system is managed by State extension personnel and technicians paid by farmers and townships and villages. It is operated through "technology contracts". Once a contract is signed between extension agencies and farmers (sometimes townships, villages, cooperatives), the extension agencies are responsible for technical guidance, input supply and the yield. Farmers pay the service fee to the extension agencies, and extension agencies pay for the loss due to technical failure. This extension approach of technology contracts is unique to China, and is popularly applied nation-wide, especially in high value crops. The system is accelerating the transfer of new technology. Under the current system, extension agencies at the county level are also running agriculture-related business enterprises themselves to support their operations. Through these essential methodological and management reforms, China's extension services have gradually shifted from being administrative or instruction-oriented to motivation- or service-oriented and from directing to influencing or advising farmers to adopt new technologies. However, the government still largely funds the research and extension systems in China.

Private Sector

Agricultural research and extension is no longer an exclusive domain of the public sector. Private sector, NGOs, CBOs and farmer organizations are coming in a significant way in many countries such as China, India, Indonesia, Malaysia and Philippines. Over the last two decades, research interventions by the private sector significantly stimulated the production of industrial and high-value commodities like fruits and vegetables and livestock. It also stimulated the growth of floriculture industry in Asia. Recent policy changes and greater emphasis on privatization have further provoked private sector participation in agricultural research. Investment by the private sector in maize breeding is almost close to the magnitude of public sector investments. According to Byerlee (1996), private investment in sorghum and millet in India is also of comparable magnitude to public sector investments. Greater involvement of the private sector with the introduction of IRP, and liberalization and globalization of markets under GATT and ASEAN Free Trade Area (AFTA) are likely to induce further changes and adjustments in Asian agriculture.

Trade liberalization and introduction of IPR are inducing greater private sector participation in agricultural research and extension. The governments are also promoting private sector participation as a national policy. As a result, private participation is increasing in Asia, but the pace is slow. Public research and extension systems are still playing the dominant role. Seed, fertilizer and pesticide companies have always had roles in agricultural research and extension. Their activities are expanding, particularly where public research system is weak. NGOs are all over the place. Two important examples of national NGOs are Bangladesh Rural Advancement Committee (BRAC) and PROSHIKHA in Bangladesh. They are extensively involved in downstream research and extension work. The private

sector has been involved in high value crops, livestock and fisheries research for a long time. In recent years, they have initiated research in some of the important cereal crops that have so long been a public sector domain. Private sector has entered mostly in seed production, including hybrid seeds. In India, millets and maize hybrids are being produced by private enterprises. Private firms in Bangladesh are also engaged in providing maize hybrid seeds to farmers. More and more private entrepreneurs are getting engaged in producing seeds and seedlings of high value crops like vegetables and fruits. Many small farmers are engaged in raising fruits, vegetables and forest nurseries.

In recent years, the private sector is seen to have been intensively involved in biotechnology works. Private tissue culture laboratories have been established in many countries to provide disease free seeds and plantlets. There are bilateral and multilateral biotechnology programs established in many countries. In Indonesia, ICI Seeds and Central Research Institute for Food Crops are working on Bt (*Bacillus thuringiensis*) tropical corn. Monsanto and International Service for Agri-biotechnology acquisition (ISAAA) are working with Research Institute for Food Crops on virus resistance and delayed ripening of papaya. ISAAA is also working on viral diagnostics in tomato. PT Bright and PT Tanido Subur Prima are working on hybrid corn. PT Fitotek Unggul is working with flowers and ornamentals, and East-West Seeds is working on vegetable crops.

In Malaysia, Malaysian Agricultural Research and Development Institute (MARDI), ISAAA and Monsanto are working on virus resistance and delayed ripening in papaya. This work is also being carried out in collaboration with the Institute of Biotechnology in Vietnam; with the Institute of Plant Breeding in the Philippines; and with National Center for Genetic Engineering and Biotechnology (BIOTEC) in Thailand. This is part of Papaya Biotechnology Network in Southeast Asia. Golden Hope Company is working on oil palm, rubber, cacao and fruits in Malaysia. There is a large program on bio-fertilizers and bio-pesticides in India being carried out by Swiss research institutes/universities, Indian public research institutes and private companies. Monsanto and Tata Energy Research Institute (TERI) in India are working on high beta-carotene mustard oil; Mahyco on cotton; ProAgro on mustard, tomato, egg plant, cauliflower and cabbage; and Rallis India Ltd. on chili, bell paper and tomato. ISAAA and Asian Vegetable Research and Development Center (AVRDC) are working on black rot disease on crucifers.

A number of private companies are involved in biotechnology work in Thailand. Monsanto, BIOTEC and ISAAA are involved in Southeast Papaya Network program. Charoen Seeds is engaged in corn, sorghum and orchid breeding program. Industry consortium and BIOTEC are engaged in molecular diagnostics for the control of shrimp viral diseases. Charoen Seeds and Uniseeds are engaged in corn breeding. In Bangladesh, private tissue culture laboratories are working on production of disease-free Irish potato and banana planting materials. In Pakistan, private companies are working on potato, date palm and banana planting materials, new hybrid variety trials and bio-fertilizers in collaboration with the public research institutes. This list is not inclusive. Much more works on this front is being done in Asia, particularly in China and India.

Private sector participation in agricultural research and extension is growing, but development of public-private partnership with cost and responsibility sharing in research and extension beyond biotechnology is taking much longer than expected. Meaningful and sustainable partnership is yet to come about in areas that will enhance incomes of the rural poor.

Revolution in information technology has opened new opportunities for integrating agricultural knowledge and information system (AKIS) to facilitate rural access to information. India is using information technology to help reduce the development gap at the village level. M.S. Swaminathan Research Foundation in Chennai is carrying out an experimental project in villages in Pondicherry. The project, known as "Knowledge Centre for Sustainable Food Security", is designed to provide information to local rural people according to their needs and demands. In Beijing, a computer network project called "BJ-FARMKNOW" has been established to provide information service to farmers in vegetable production. FAO Communication for Development Group, in collaboration with FAO's World Agricultural Information Centre (WAICENT), is developing an innovative tool called "FARMnets" – farmer-operated electronic networks that facilitate local access to marketing, price, weather and other essential agricultural production information. This is a new trend being pursued in many countries to facilitate exchange of information at the farm level and link farmers with the market through information network.

Regional Collaboration

A new trend has been set to accelerate regional and sub-regional collaboration in agricultural research. Donors are pressing for regional focus of Consultative Group on International Agricultural Research (CGIAR) activities. Given the circumstances, neither the public sector nor the private sector research has the capacity to single-handedly address the new technological demands. Therefore, the current initiative is to forge institutional alliances among the national, regional and international research centers and the private sector institutions to make efficient use of globally available research resources and to exploit the complementarities of all efforts in reducing poverty, and improving food security and natural resources sustainability.

At International Centers' Week (ICW) 2000, the national, regional and international research and development partners, including the NGOs agreed to adopt a regional approach for research planning, priority setting and implementation that would involve a broad spectrum of stakeholders from both the public and the private sectors. Accordingly, the international research centers of the CGIAR are expected to collaborate more closely with the regional and sub-regional organizations (ROs, SROs) and other development partners, and adopt an inter-center collaborative regional approach to research through programmatic integration and harmonization of administrative operation for increasing the effectiveness and efficiency of CGIAR research.

Normally, ROs, SROs, and the CGIAR centers set their regional research agenda independently. The ROs and SROs determine their priorities at the regional fora. There is very little formal interaction between the ROs and the CG centers; and between the CG centers working in the same country or region. Neither the ROs/SROs nor the CG centers involve development partners in the private sector in setting their research agenda. In accordance with the agreement at ICW 2000, Asia-Pacific Association of Agricultural Research Institute (APAARI) has taken the lead in initiating a new approach to setting regional research agenda. They have involved the CG centers and other development partners in the process. Meanwhile, the CG centers are engaged in forging inter-center alliances and strengthening collaborative partnerships with their stakeholders. The objective has been to harmonize CG regional priorities with those of ROs and SROs. For the first time the ROs, SROs and the CG centers have come together to initiate a joint process for setting the regional research agenda. This may eventually lead to a regional programmatic approach

for agricultural research. Sub-regional and regional workshops have been conducted for identifying priority research areas for future collaboration. The process is ongoing.

ORGANIZATIONAL AND MANAGEMENT ISSUES

Given the magnitude and nature of the problems, Asian agricultural research and extension systems are facing formidable tasks to deal with the emerging challenges. The new direction of research and extension will demand considerable improvement in governance and management of the new systems, partnerships and networks. Decentralization does not automatically ensure farmer empowerment and their participation in research and extension planning, implementation and evaluation of results and impacts. It does not automatically enhance partnerships among clients and actors without building a constituency among farmers and different actors. It requires strong central institutions to create policy framework and strong local institutions and mechanisms to govern and manage decentralized development efforts. It also requires strong local government leadership and a pool of administrative and technical skills. It is important to monitor how the relationships with other services for rural development are taken into account in supporting research and extension services when they are decentralized to local government.

Decentralization has transition problems. Essentially, they relate to staff management and allocation and channeling of funds to local governments. Devising and implementing new allocation procedures is complex and rarely a smooth process, as expectations relating to the use of funds are bound to differ between local and central levels. For the staff devolved to lower government levels, a simple hierarchical structure and uniform status gives way to a complex line of command, typically involving both the line ministry and the local government, and to regional differentiation of status. Devolution to a lower government level can be a source of disincentive for the staff. Indonesia and the Philippines are experiencing this problem after decentralization of research and extension services. Improving resource allocation and management is an issue that will require specific attention to make decentralization work.

Decentralization requires increased investment by both the central and the provincial governments with improved resource allocation procedures. Unfortunately, investments in agricultural research and extension by national governments and donors in real terms have declined. This slowdown of funding has already made it difficult for many research and extension systems to commit necessary human and financial resources for addressing long-term strategic issues that are critical for sustaining productivity growth. The pressing issue for the public research and extension systems is to develop alternative funding mechanisms for research and extension, and to establish improved management systems by which the available resources can be used more efficiently and the research and extension programs can be rationalized and managed more effectively.

The development of alternative funding mechanisms and their management is a major concern in many Asian NARS. Some countries like China and Malaysia have established new funding mechanisms. China has created Core Funds for salaries, and Project Funds for priority research programs, specified in the national five-year plan. Funds for other research programs are generated through commercial activities. This has, of course, created conflicts of interest between the research responsibilities and the income-generating activities of research institutes. Malaysia has established a competitive funding scheme by creating a special fund for R&D under a program of Intensification of Research in Priority Areas

(IRPA). Some NARS have established Contract Research Funds under donor-funded projects; and some are collecting research levy from industrial crops. These and other mechanisms will require further study for designing better option(s), and improving management of these funds.

The information need for planning and managing the new research and extension systems are overwhelming. The systems are required to increasingly use Management Information System (MIS) for resource planning and management. Some emerging problems, particularly related to eco-regional issues, have regional dimension and will require rapid exchange of information. Similarly, public research system linkages with the regional research networks/councils/consortia and global research system demand improved information and communication links. There is a need to establish electronic technology information network to have access to information on regional and international scientific and technological development.

New institutional dimension of research and extension and the emphasis on production increase in the less productive marginal and risk-prone area will require well-trained research staff with specialized knowledge and skills. Program shift will also demand appropriate planning for redeployment and readjustment of staff and training for work conversions. There will be a need to improve the competence of program/project leaders through training on project and resource management with emphasis on planning, monitoring, evaluation, and impact analysis to enhance their skills of adapting to changing requirements.

The emerging organizational and management issues explain that to effectively deal with the future research and extension challenges, institutional innovation in system organization and management will be critical to the success of Asian research and extension systems in the 21st century. There is high probability of achieving potential gains from introducing governance, organizational and management changes. Most systems do not have appropriate methods, tools and guidelines to address the governance and management issues, particularly at the local level.

2. AGRICULTURE AND FISHERY RESEARCH AND EXTENSION SYSTEMS: ORGANIZATIONAL LINKAGES

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INTRODUCTION

The early 1980s highlighted the issue of research-extension linkage as a major obstacle in developing more responsive and efficient research and extension systems. It has been noted that the farming community has not optimally used new knowledge and technologies generated from agriculture research. Several studies on farming systems research have dealt with the continuing issue of research-extension linkage. Likewise, several reviews on the research and extension system of the country, from the start of the Aquino Government in the mid-1980s up to the present, have consistently pointed out the long-standing problem on research-extension linkage in the country (Philippine Agricultural Extension Study Team [PAEST], 1987; Ponce, *et al*., 1989; David, Intal, and Ponce, 1992; and David, 1996). In 1997, the Congressional Commission on Agricultural Modernization (Agricom) identified research-extension linkage as a critical part of the total structural reforms required in the agriculture bureaucracy. This view has largely remained unchanged up to the present.

RESEARCH-EXTENSION LINKAGE: ASSUMPTIONS AND EFFICIENCY CONSIDERATIONS

Assumption 1

In a client-oriented and industry-responsive agriculture research system, the research and development (R&D) agenda must focus on the needs of farming and fishing communities. While the R&D system has mechanisms to collect data and information from farmers, the extension system still presents the best alternative in terms of cost efficiency and speed. The extension system, having a direct and more extensive contact with farmers, can theoretically provide up-to-date data and information to help improve the relevance of research.

Assumption 2

The information and technologies generated by research can quickly reach the greatest number of farmers if the extension system makes a conscious and determined effort to disseminate them as an integral part of its program of activities. A systematic effort on the part of the extension system can accelerate the transfer and utilization of research outputs.

Assumption 3

The ability of the extension service to provide timely feedback to research and the ability of the research system to transfer new knowledge to the extension system depend on research-extension linkage. The efficiency and effectiveness of this linkage depend on: (1) the internal efficiency of both the research and extension systems; (2) the organizational orientation of both systems; (3) the structure of mechanism; and (4) the resources made available for the mechanism to function effectively. The quality of governance of the research and extension systems determines their internal efficiencies, which, in turn, influence the efficiency of the research extension linkages.

THE PHILIPPINE RESEARCH REALITY

The research system, despite the progress achieved by the Agriculture and Fisheries Modernization Act (AFMA) of 1997, continues to face problems in the development of a dynamic and mutually reinforcing research-extension linkage. The structure and the management of the research system affect its ability in building a strong research-extension interface. The principal reasons are as follows:

1. ***The Presence of Three Orchestrating Agencies***

In the agriculture sector, the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA), by virtue of the AFMA, has the national mandate to coordinate the National Research and Development System in Agriculture and Fisheries (NaRDSAF). However, the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) orchestrates the R&D institutions involved in upstream research on agriculture. On the other hand, the Philippine Council for Marine and Aquatic Research and Development (PCMARD) orchestrates the marine and fisheries research. While the three coordinating agencies have agreed to work together under the principle of "one system, one program approach," the coordination between BAR and PCMARD has been more solid and integrated than between BAR and PCARRD, which brought difficulty in defining its complementary orchestrating role under AFMA because of its historical role.

2. ***The Loose Structure of the National Research System***

The R&D institutions in the country can be divided into three major sub-systems:

- *The state colleges and universities (SCUs) of agriculture* – Selected SCUs of agriculture and fisheries receive regular annual government budget for research. Some of these institutions have specialized research institutes and centers. The SCUs are autonomous, therefore, they are independent from each other. Despite the hierarchical designations of the SCUs as national, regional, and provincial, there exist no formal or institutionalized mechanisms for linkage. The four national multi-commodity research universities of the country do not have institutionalized linkage to the regional research universities as well as the DA regional R&D centers and institutes.
- *The DA and its attached agencies' network of research centers and institutes* – The DA R&D sub-system consists of national and regional research centers, institutes, and stations. There are 13 national agencies with mandates to undertake total research. These are:
  - <u>*Seven agencies directly under the department*</u>: Bureau of Plant Industry, Bureau of Animal Industry, Philippine Carabao Center, Bureau of Soils and Water

Management, Fiber Industry Development Authority, National Fisheries Research and Development Institute, and Bureau of Postharvest Research and Extension.

- N *Six corporations attached to the DA*: Philippine Rice Research Institute, Philippine Coconut Authority, Sugar Regulatory Administration, National Tobacco Administration, National Dairy Authority, and Cotton Development Authority.
- N The regional stations consist of the Regional Integrated Agriculture Research Centers (RIARCs) and the Regional Fisheries Research and Development Centers (RFRDCs) of DA. Before the AFMA, there was no clear functional delineation between the national stations and the regional experiment stations, and between the region and the stations operated by the provincial governments. The station existed independently of each other even within the DA proper.

C *Private research laboratories* – Major agribusiness firms created research laboratories principally to meet their needs. A few of these provide services to the public with fee.

3. ***The Funding Approach and the Lack of Accountability***

The present funding approach, despite funding reforms as a result of the AFMA, continues to present problems for program integration. Besides budget for core activities, the Department of Budget and Management (DBM) continues to provide budgets for non-core activities as part of the annual agency appropriations of R&D institutions. While the DA has the responsibility to endorse all the R&D budgets for agriculture, monitoring of implementation is difficult. After budgets have been approved, compliance monitoring presents serious problems due to logistical and administrative factors.

To promote linkage and partnership among the three sub-systems, the DA through BAR, created Research, Development and Extension (RDE) networks with lead institutions both at the national and regional levels. Under the principle of "one system, one program approach" the national networks (Table 1) provide the technical leadership in the development of national agenda and programs, which serve as guides to research planning and implementation among the various agencies that make up the national networks. The objective was to promote better partnerships, use resources, knowledge management, and undue duplication of efforts.

BAR provides funding support to both national and regional networks to enable them to undertake networking activities. The lead partner institutions, in return, provided release time for National Team Leaders (NTLs), administrative support personnel, and offices. One major impediment is the time available for the NTLs to perform their leadership role. Many of the university research leaders have also teaching and administrative responsibilities.

It should, however, be noted that AFMA provided the increased funding for R&D, setting a minimum annual investment of 1 percent of the gross value-added in agriculture and fisheries. In 1999, BAR received an additional budget of ₱400 million or US$10 million. The additional funds for research provided an incentive for research institutions to get involved in the networks and to align their institutional R&D priorities to the national agenda and programs.

THE EXTENSION REALITY

The National Extension System for Agriculture and Fisheries (NESAF) consists of three sub-systems:

Table 1. List of National RDE Networks and Lead Institutions

Network	Lead Institution
Crops:	
Rice	Philippine Rice Research Institute
Corn	Institute of Plant Breeding, University of the Philippines at Los Baños (UPLB)
Vegetables	Institute of Plant Breeding, UPLB
Fruits	Bureau of Plant Industry
Coconut	Philippine Coconut Authority
Sugarcane	Sugar Regulatory Administration
Ornamentals	Department of Horticulture, UPLB
Plantation crops	University of Southern Mindanao
Fiber crops	Fiber Industry Development Authority
Legumes	Institute of Plant Breeding, UPLB
Root crops	Visayas State College of Agriculture
Livestock and Poultry	Institute of Animal Science, UPLB
Fisheries:	
Aquaculture	Institute of Aquaculture, University of the Philippines in the Visayas
Capture fishery	Institute of Marine Fisheries and Oceanology University of the Philippines in the Visayas
Discipline-based:	
Biotechnology	National Institute of Molecular Biology and Biotechnology (BIOTECH)
Soil and water	Bureau of Soils and Water Management
Social science and policy	Philippine Institute of Development Studies
Crop protection	Department of Entomology, UPLB
Urban agriculture	Cavite State University
Agricultural engineering	Agricultural Machinery Testing and Evaluation Center (AMTEC), UPLB
Post-harvest, food and	Bureau of Agricultural Fishery Products Standards (BAFPS)
Irrigation	UPLB
Plant genetic resources	Bureau of Plant Industry

1. ***The Local Government Sub-system***

These consist of the provinces and the municipalities that are tasked by law to deliver direct extension support services to the farming and fishing communities, as a result of the Local Government Code of 1991. The municipalities independently plan and implement the delivery of their agriculture and fishery extension services. The provincial government in paper, is mandated to provide the leadership to plan and orchestrate the implementation of all the municipalities in their respective provinces. However, they do not have real authority and power over the municipal agricultural extension services, which make linkage difficult if the executives belong to opposing political parties.

2. ***The National Government Sub-system***

The DA and its attached agencies and corporations, the Department of Agrarian Reform (DAR), the Department of Environment and Natural Resources (DENR), and the SCUs undertake various types of extension services in selected municipalities and provinces.

3. ***The Non-governmental Sub-system***

This consists of agribusiness firms that perform extension services for their clients in connection with their products or services. The major players are seed, fertilizer, and chemical companies, feed and farm machinery dealers, and banks. They also include NGOs such as foundations and cooperatives, both secular and non-secular, which perform extension services for clients in specific locations of the country, usually as part of special projects.

While AFMA affirms the local government's role in the delivery of extension services to the farming and fishing communities, the law also mandates the DA to play a catalytic role in improving the overall quality and effectiveness of the extension services. The Implementing Rules and Regulations (IRR) designated the Agricultural Training Institute (ATI) as the focal agency in the department to provide national leadership in the integration and strengthening of the national extension system. The ATI's responsibilities include, among other things, the development of a national extension agenda and program, the setting up of a national standard for extension and farmer's training, and the provisions of counterpart funds to support LGU extension facilities development and program implementation. ATI has been unable to fully discharge its functions because of funding constraints and the inability of DA to push through with its structural reforms that would reorganize ATI into a Bureau of Agricultural and Fishery Extension.

BRIDGING THE GAP BETWEEN RESEARCH AND EXTENSION

As a major step towards bridging the national research and extension systems, AFMA created the Council for Extension, Research and Development for Agriculture and Fisheries (CERDAF). It was the argument of the proponent of the law that by having only one policy-making body for both research and extension, the linkages between the two systems could be reinforced. The DA secretary chairs the CERDAF; while members include the Department of Science and Technology (DOST) and representatives of farmers and fisherfolk organizations, local governments, SCUs, and the private sector.

AFMA also changed the orientation of both the research and extension systems by treating research and extension activities as part of a development continuum that begins and ends with the farmers/fisherfolk (Figure 1).

The figure shows the interdependence of research and extension; the major players and their roles, clients, and outputs; and the various levels of implementation. The figure shows the complementary roles of the various players in the hierarchy. BAR used the illustration in its orientation program to the players of both research and extension systems; thus, they need to work together. Another presentation of the concept is shown in Figure 2.

BAR employed three major strategies to operationalize the organizational linkages between research and extension. These are:

1. formation of regional RDE networks to bring together major research and extension players to develop regional agenda and program for agriculture and fisheries research and extension. The common agenda and program allow the research and extension

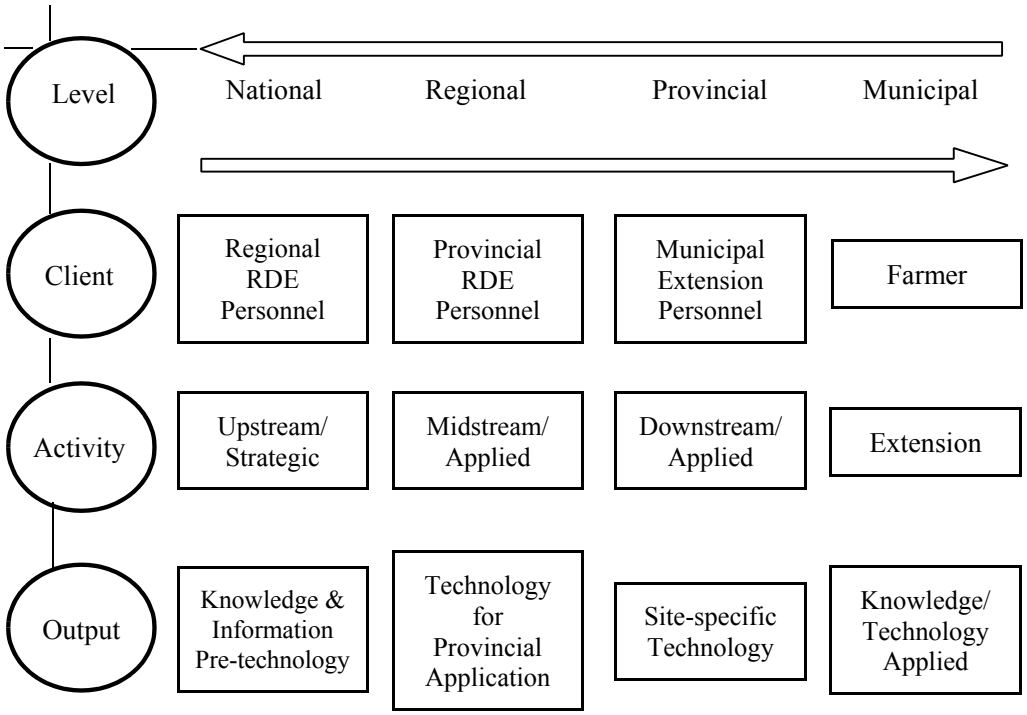

Figure 1. The RDE Continuum

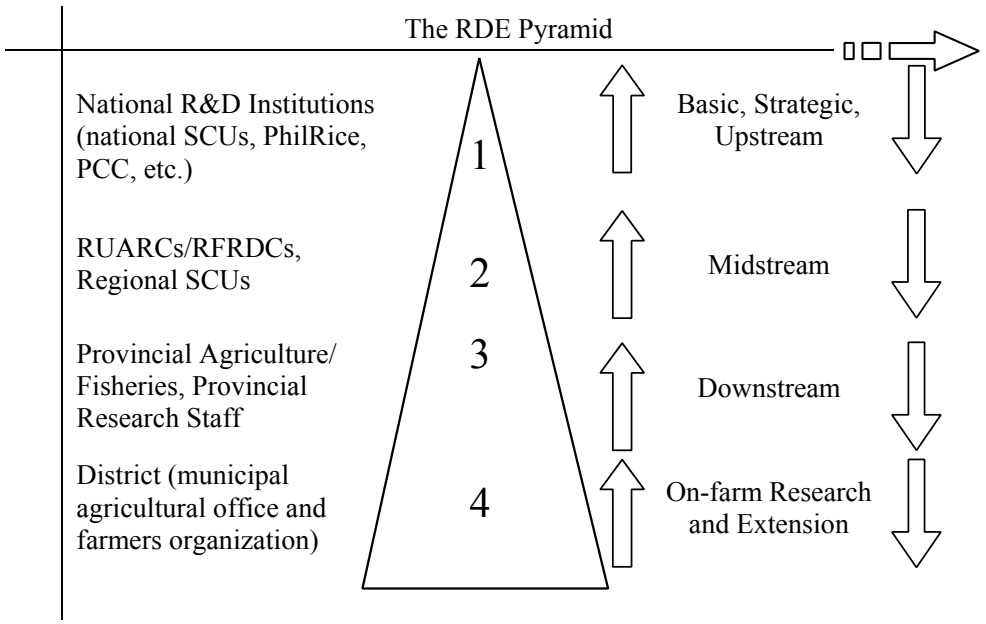

Figure 2. The RDE Pyramid

agencies to define their common vision and objectives towards the development of the crops, livestock and poultry, and fisheries sector. Likewise, it allows research and extension to define cooperative activities such as planning, monitoring, and evaluation.

2. Crafting on-farm research (OFR) program based on the principle of community participatory action research (CPAR) as a major vehicle to accelerate the transfer of technologies to the countryside. The goal is to have at least one OFR per congressional district in the country. OFR allows the DA through its regional research staff, the LGUs, and farmers to work together in a common project. The OFR works through a counterpart resource scheme.
3. Developing a funding facility for the development of Provincial Research-Extension Centers (PRECs). Through its Institutional Development Grant (IDG), BAR has assisted the provincial government in strengthening their provincial rural development committee.

Lessons Learned

1. In a national situation where research and extension belong to separate administrative structures, a major national policy is important to develop institutionalized mechanisms to link research and extension. No doubt, the promulgation of the historic AFMA in 1997 provided structural reforms that hasten the development of new mechanisms and organizational linkages between research and extension.
2. While national policies are important, resources will have to be invested to develop and nurture organizational linkages between research and extension. No doubt, the additional resources made available from AFMA enabled the research system make a major investment on activities and program that brought together research and extension.
3. To further nurture organizational linkages, rewards need to be instituted to provide incentives to players especially to those involved in interfacing activities.

REFERENCES

Agbamu, Joseph U., 2000. "Agricultural Research-Extension Linkage Systems: An International Perspective", AgREN Network Paper No. 106.

Andrew, Chris O. and J. Kenneth Mcdermott. *Farmer Linkages to Agriculture Extension and Research*.

Commission on Agriculture Modernization, 1997. "Human Resource Development", a Committee Report, Agricom.

Compton, Lin J. "The Integration of Research and Extension" (mimeograph, undated).

Cornick, Tulley R., *et al*., 1987. *Institutionalizing Farming System's Research and Extension: Cornell University's Experience in Ecuador and the Philippines*, Cornell University Press, New York.

David, Cristina C., Ponciano S. Intal, Jr. and Eliseo R. Ponce, 1992. "Organizing for Results: The Philippine Agriculture Sector", Philippine Institute for Development Studies (PIDS).

David, Cristina C., 1996. "Philippine Agriculture's Structure of Governance: A Critique", xerox copy, PIDS.

de Vries, James, 1981. *Agriculture Extension and Farming System's Research*, Tanzania.

Eponou, Thomas. "Linkages Between Research and Technology Users: Some Issues from South Africa", ISNAR Briefing Paper No. 30, International Service for National Agricultural Research (ISNAR).

----------, 1996. "Linkages Between Research and Technology Users in Africa: The Situation and How to Improve It", ISNAR Briefing Paper No. 31.

FAO, 1995. *Understanding Farmers' Communication Networks: An Experience in the Philippines*.

Fuglie, Keith, *et al*. (no date). "Agricultural Research and Development", Agricultural Economic Report No. 735, USDA, Washington, D.C.

Halos, Saturnina, 1997. "Technology Development for Agricultural Modernization: Unleashing the Filipino Creativity for Competitive, Sustainable Agriculture", a report submitted to the Agriculture Commission.

ISNAR, 1986. "Review of the Research System of the Ministry of Agriculture and Food in the Philippines", ISNAR Report, the Hague.

Kaimowitz, David and Deborah Merill-Sands, 1989. "Making the Between Agriculture Research and Technology Users", ISNAR Discussion Paper.

PAEST, 1987. *Agenda for the Rural Sector*, Department of Agriculture, Manila.

PCARRD, 1996. *Strengthening Research and Extension Linkage*, Los Baños.

Ponce, E. R., 1989. "Enhancing Extension and Research Linkage in Farming Systems Development", Proceedings of National Expert's Workshop on Farming Systems, Los Baños, Laguna.

Ponce, E. R., O. F. Sison, G. Minguez, and J. D. Gerochi, 1989. *Philippines Agriculture Extension Study*, Access Asia (Philippines), Volume 1.

Sto. Tomas, Patricia, 1996. "Catching Up With the Competition: The Case of the Philippine Agriculture Bureaucracy" (mimeograph).

Umali, D. and Lisa Schwartz, 1994. "Public and Private Agriculture Extension: Beyond Traditional Frontiers", World Bank Discussion Paper, World Bank, Washington, D.C.

3. HUMAN RESOURCES DEVELOPMENT FOR AGRICULTURAL RESEARCH AND EXTENSION IN THE PHILIPPINES

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Philippines

INTRODUCTION

In the Philippines, agricultural research and extension may be viewed as a system involving various agencies in the public and private sectors. In the public sector, institutional functions or mandates on agricultural research may be categorized into either research management or research implementation. The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) which is under the Department of Science and Technology (DOST) and the Bureau of Agricultural Research (BAR) under the Department of Agriculture (DA) are the primary research management agencies. These agencies plan, coordinate, monitor and evaluate research and development (R&D) activities in agriculture. As the stewards of the R&D system, these agencies have their respective programs designed to develop the technical manpower in agricultural research to ensure excellence in the conduct of research in this sector.

Research implementing agencies constitute the largest number of public institutions in the research system. These include state colleges and universities (SCUs), line agencies under and attached to the DA such as the Regional Field Units (RFUs), the Bureau of Plant Industry (BPI), the Bureau of Animal Industry (BAI), the Philippine Rice Research Institute (PhilRice), the Philippine Coconut Authority (PCA), National Tobacco Administration (NTA), Sugar Regulatory Administration (SRA), Philippine Carabao Center (PCC), among others. Under the leadership of PCARRD, these agencies have been organized into a National Agriculture and Resources Research and Development Network (NARRDN), a network of national single and multi-commodity R&D centers, regional commodity R&D centers and cooperating stations. At present, the NARRDN is composed of 132 institutions.

* The author acknowledges the assistance of Mr. Ernesto Brown, Socio-economic Research Division, PCARRD and Ms. Leonora V. Tulon, Office of the Deputy Executive Director for Institution Development and Resource Management, PCARRD. She also would like to express appreciation to the Institution Development Division, PCARRD, Department of Agriculture – Bureau of Agricultural Research and the Agricultural Training Institute, for providing some of the data used in this paper.

At the regional level, these agencies are organized into regional consortia primarily to be able to put their acts together in responding to regional needs. There are 14 such consortia, one each of the 14 administrative regions in the country. To better respond to their mandated tasks, each of these institutions has its own technical manpower development program.

The extension service in the country is primarily in the hands of the Local Government Units (LGUs) following the Local Government Act of 1991. Prior to this, there were two parallel systems of extension, one under the DA and the other (which is a relatively small portion) under the LGUs. When the extension service was centralized under the DA, human resource development (HRD) for extension workers was carried out as an integral component of programs being pursued by the Department designed to develop the rural sector in general and agriculture in particular. Devolution placed the responsibility of agricultural extension to the LGUs. Consequently, HRD for extension service has been decentralized and the intensity and seriousness by which this is carried out considerably vary by LGU depending on local priorities, resources and political support.

The local government system is composed of 78 provinces, 95 cities, 1,514 municipalities, 42 of *barangays* (villages), one metropolitan government, and two autonomous regions, one in the North in the Cordillera Mountains and one in the Muslim South.

At the national level, the Agricultural Training Institute (ATI) under the DA has the mandate to cater to the training needs of extension workers and the farmers as well. Capability building for LGU extension personnel is given highest priority in the program thrusts of this agency (ATI Corporate Plan, 2002-05). The resources of the institute however, remain limited to fully meet the training needs of all extension workers in the country. Under the ATI are the regional and provincial training centers which cater to extension workers and farmers in their respective geographical locations.

The SCUs also have their own extension service as part of the trilogy of functions of these institutions, i.e., research, instruction and extension. The common goal of the extension program of the SCUs is to support national and regional priorities in agriculture and rural development. Each SCU, particularly the larger ones, have various constituent units of R&D institutes, each pursuing both research and extension functions. Each unit may have its own manpower development program, though they are very much dependent on the support provided by the central administration.

PROFILE OF AGRICULTURAL RESEARCH AND EXTENSION PERSONNEL

Research Personnel

1. ***By Sector***

As of 1998, the total number of researchers in agriculture and natural resources (but excluding fisheries) in the NARRDN with M.S. and Ph.D. degrees was estimated at 1,418 or a little more than one-third of the total (Table 1). Being the largest agriculture sector in the country, the crops sector constitutes the bulk (36 percent) of the R&D manpower. Socio-economics and management account for 28 percent of the total manpower as these disciplines cut across various sectors and disciplines in agricultural research. Those in agri-ecosystems account for 10 percent while those on livestock account for 8 percent. Six percent of NARRDN researchers are in the basic sciences such as chemistry, biology and math, among others.

Table 1. Distribution of NARRDN Researchers by Sector and Degree, CY1998

Sector	Ph.D.		M.S.		Total	
	Number	Percent	Number	Percent	Number	Percent
Crops	125	25	385	75	510	36
Agri-ecosystems	41	28	107	72	148	10
Forestry	52	32	111	68	163	12
Livestock	41	35	75	65	116	8
Socio-economics[a] and management	161	41	235	59	396	28
Others						
Chemistry	8	33	16	67	24	2
Biological science	8	42	11	58	19	1
Math	4	33	8	67	12	1
Others	11	37	19	63	30	2
Total	451	32	967	68	1,418	100

Source: PCARRD.

Note: [a] May include personnel not actually doing research, especially those in public administration, management, etc.

2. ***By Degree***

Table 2 presents the number of researchers by highest degree completed. Note that here, we have lumped together those who have graduated with their Ph.D. (or M.S.) degree and those who have taken postgraduate units in Ph.D. (or M.S.) although they have not yet graduated.

Table 2. Distribution of NARRDN Researchers by Degree, CY1998

Degree	Number	Percent
Ph.D.	451	11
M.S.	967	23
B.S.	2,751	66
Total	4,169	100

Eleven percent of all researchers have Ph.D. degrees or have Ph.D. units while 23 percent have M.S./M.A. or masteral units. This means that slightly more than one-third have gone to postgraduate studies in various fields of specialization. The socio-economics and management sector has the largest proportion with Ph.Ds., 41 percent. This is followed by the livestock sector with 35 percent.

The largest proportion of M.S. degree holders is in the crops sector with 75 percent, followed by agricultural ecosystems with 72 percent. Socio-economics and management have a large number of researchers as well as a large proportion of postgraduate degrees (or with units), however, many of them are involved almost full-time in administrative or teaching work such as those in public administration, management, development education, etc.

Profile of R&D Personnel in Major R&D Institutions

The proportion of personnel by highest degree obtained may somehow indicate the relative strength of R&D institutions in the conduct of research in agriculture. In SCUs, while there are still a good number of R&D personnel with only B.S. degree, majority have already completed either M.S. or Ph.D. As the premiere agricultural university in the country, University of the Philippines Los Baños (UPLB) has 379 personnel with Ph.D. and 373 with M.S. degree. The picture is somewhat different among the various R&D institutes (RDIs) such as those attached to the DA. In these institutions, majority of R&D personnel have B.S. degree followed by those with M.S. and finally those with Ph.D. Among the agencies (which constitute a large portion of researchers in the country) the highest number of personnel with advanced degree can be found in PhilRice, which, since its inception, has been recruiting staff with advanced degree and has been pursuing an intensive technical HRD program. The HRD program of each SCU and RDI is generally tailored to meet the specific requirements of the agency to effectively carry out their respective mandates. It is difficult to identify the proportions of Ph.D., M.S., and B.S. that would be optimal for each agency. In general, however, agencies strive to achieve a high number of personnel with advanced degree which their limited resources may allow.

Extension Personnel

1. ***Local Government Units***

The country's extension service consists of a highly decentralized set of operating units headed by the LGUs which draw support from other government agencies in terms of technologies, manpower (technical assistance) and other resources. At the provincial level, agricultural operation is headed by the provincial agriculturist which is middle level management directly under the office for the provincial governor. In many provinces, however, there exists a Provincial Veterinary Office (PVO) which is separate from the Office of the Provincial Agriculturist (OPA). The OPA is composed of various operating divisions, handling agriculture-related functions, research (mainly applied, on-field trials, and the like), institutional development, and planning and monitoring. Similarly, the municipal/city agriculturist under the direct supervision of the mayor, heads the municipal/city agriculture. Recent studies however, covering Mindanao and four regions in Luzon pointed out the absence of divisions or operating units indicative of the lack of focus of agricultural programs at the municipal level (Central Luzon State University [CLSU], undated; and Hondrade, 2001).

As of the year 2001, there were an estimated 12,069 extension workers in the LGUs, almost 80 percent of which are appointed at the municipal level while the rest are at the provincial level (Table 3.) The ratio of farmers to agricultural technicians ranges from 231 (Central Luzon) to as high as 732 (Western Mindanao). Higher class (income) municipalities have more agricultural personnel than low class municipalities. On the average, first class municipalities have 20 personnel compared with only four in fifth class municipalities.

Two recently completed studies (Vargas, *et al*., 2001; and Hondrade, 2001), one examining the structure and conduct of LGU agricultural extension in Luzon and the other one which examined the same in Mindanao, provide sample data from which the profile of agricultural extension workers in the country may be gleaned (*Note*: Examination of some documents indicate that simultaneous studies were conducted in all regions but copies of some studies could not be found). At the provincial agricultural office (PAO)/PVET, about 76 percent of agricultural extension personnel have college degree/units, about 15 percent

have masteral degree/units while 1 percent have doctoral degree/units (Table 4). At the municipal agricultural office (MAO), about 83 percent of the extension personnel have college degree/units, while 14 percent have masteral degree/units. The rest of the staff have completed secondary education some of whom may have completed vocational or diploma courses. They are mostly assigned, however, as administrative or technical support staff. Extension personnel, regardless of whether at the provincial or municipal levels are mostly (about 46 percent) at the middle age bracket (41-50 years old). However, a considerable number (about 21 percent) are relatively old and are close to retiring age (Table 5).

Table 3. Number of Agricultural Extension Workers

	Number	Percent
Province	2,456	20.3
Municipality	9,613	79.7
Total	12,069	100.0

Table 4. Highest Degree Obtained by Agricultural Extension Personnel in Provincial, Municipal and City LGUs

Agricultural Office	Provincial		Municipal		City		Total	
Ph.D.	16	(0.7)	4	(0.3)	1	(0.2)	21	(0.5)
M.S.	339	(14.9)	222	(14.3)	62	(10.6)	623	(14.1)
B.S./B.A.	1,734	(76.3)	1,280	(82.6)	475	(81.0)	3,489	(79.2)
Below B.S.	183	(8.1)	43	(2.8)	48	(8.2)	274	(106.2)
Total	2,272	(51.6)	1,549	(35.1)	586	(13.3)	4,407	(100.0)

Note: Figures in parentheses are percent.

Table 5. Number of Agricultural Personnel by Age Bracket, Luzon and Mindanao

Region/Agricultural Office	Age				
	21-30	31-40	41-50	51-66	All
Luzon (CAR*, I, II and III)					
PAO/PVET	102	378	615	307	1,402
MAO/CAO	95	177	593	277	1,142
Sub-total	197	555	1,208	584	2,544
	(8)	(22)	(47)	(23)	(100)
Mindanao (X, XI, XII and XIII)					
PAO/PVET	97	305	448	199	1,049
MAO/CAO	75	259	443	191	968
Sub-total	172	564	891	390	2,017
	(9)	(28)	(44)	(19)	(100)
All regions					
PAO/PVET	199	683	1,063	506	2,451
MAO/CAO	170	436	1,036	468	2,110
Total	369	1,119	2,099	974	4,561
	(8)	(25)	(46)	(21)	(100)

Note: * Cordillera Autonomous Region.
Figures in parentheses are percent.

2. ***Agricultural Training Institute***

The ATI of DA is the major government institution mandated to train extension workers and farmers. ATI maintains a network of 34 training centers, namely; International Center on Pig Husbandry (ITCPH), four national training centers, 13 regional training centers (RTCs), and 16 provincial training centers (PTCs). The Institute extends more services through the 18 satellite training centers (STCs) nationwide. These include seven regional fishermen's training centers (RFTCs) that were formerly part of the ATI network of training centers but are now under the Bureau of Fisheries and Aquatic Resources and those that are situated in SCUs.

The ATI has a total manpower complement of 804 of which 318 are technical and 486 are administrative. Of these, 653 are assigned in the training centers distributed around the country while 151 are in the Central Office.

To augment its manpower complement, the ATI maintains a pool of training faculty and resource persons on-call in training centers. The pool comes from SCUs, DA-Regional Field Offices, LGUs and other GAs and NGOs.

HUMAN RESOURCES DEVELOPMENT

Prior to the creation of PCARRD in 1972, the R&D system in the country was plagued with a number of constraints, one of which was the dearth of technical manpower to do R&D activities in agriculture and natural resources. To address this, the Council embarked on a manpower development program consisting of graduate scholarship grants and support to non-degree training programs. Funds were obtained from foreign sources (e.g., USAID) as well as from government appropriations. As of 2002, PCARRD has provided degree scholarships to 195 Ph.D. and 614 M.S./M.A. scholars.

Conceptual Framework (adapted from a PCARRD proposal on impact of HRD)

Analysis of HRD can be cast within the input-process-output-outcome framework (Figure 1). HRD necessitates the employment of certain inputs, which are translated to output through distinct processes. The output translates to outcome, which refers to the objectives of the HRD program.

Investment in HRD constitutes the inputs to pursue the program. Direct investment consists of stipend, tuition fees and other allowances of the scholars while indirect investment consists of the costs of running the program which include the facilities and materials used as well as the salaries of those employed to operate the program. On the broader sense however, the total costs of the HRD goes beyond the costs incurred by the sponsor, e.g., PCARRD, but also those incurred by the scholar's mother agency specifically the salaries paid to the scholars while on official study leave of absence and other costs incurred by the scholar himself.

The investments or inputs are then translated to outputs through certain processes. These processes include the selection procedures, rules, and guidelines governing the program, monitoring and evaluation and other relevant policies. On the other hand, the outputs may consist of graduates in specific fields and improvement in the technical knowledge and skills of the scholars. There could also be important spill-over effects. For example, an agency with more trained manpower may be able to attract more research funds. On the other hand, there could also be external dysfunctionalities such as better saleability of the scholar to more attractive positions outside the agency.

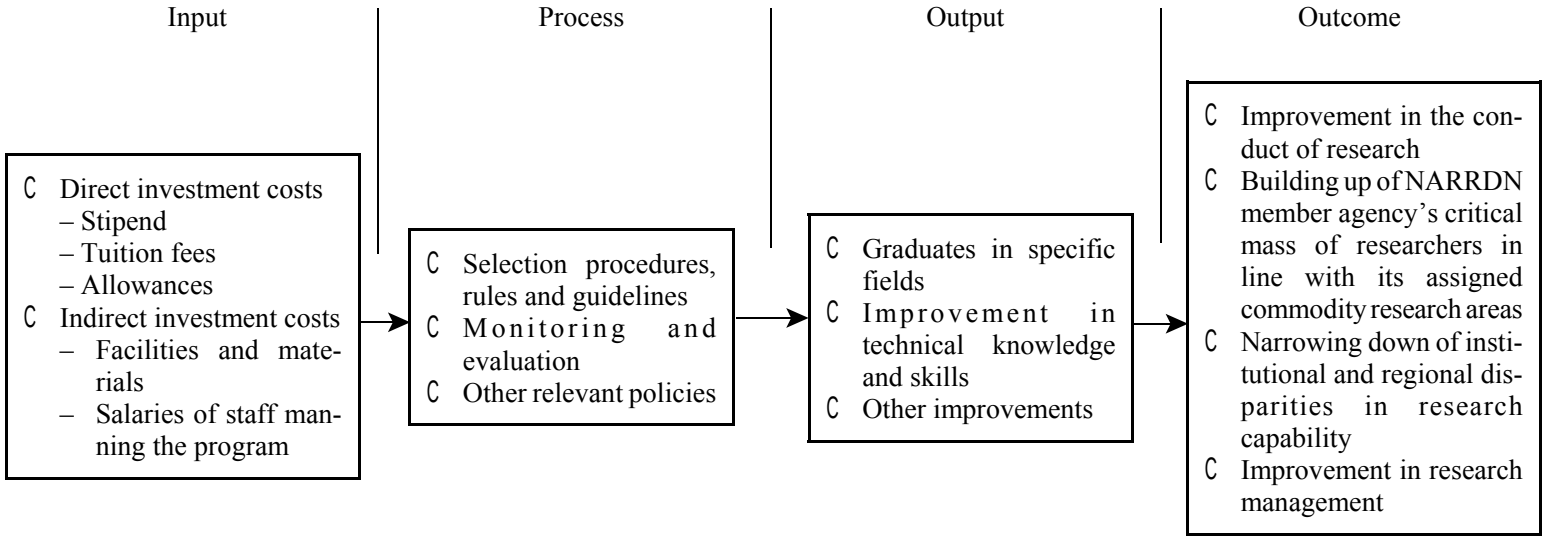

Figure 1. Analytical Framework

Outputs or outcomes, which refer to the very objectives in pursuing the program include improvement in the conduct of research, the building up of agency's critical mass of researchers in line with its assigned commodity research areas, the narrowing down of institutional and regional disparities in research capability, and improvement in research management, among others. In the long-run, these outcomes are envisioned to translate to social impact such as improved technologies for agriculture, improvement in yield of agricultural commodities, efficiency improvement in agricultural enterprises, better farm household income, etc. (a preliminary study done by Librero and Brown indicated a rate of return on HRD investment of 27 percent) (Librero and Brown, 1995).

Other forms/inputs in HRD include awards and incentives to researchers/scientists and research managers. The policy environment surrounding HRD would also affect the extent of implementation of HRD programs.

Human Resource Development for Researchers

1. ***PCARRD Scholarship Program***

It is PCARRD's policy to continuously enhance the human resource capability of the research agencies in the country, especially those belonging to the NARRDN. The PCARRD HRD program consists of four types, namely:

1) Graduate Degree (Ph.D., M.S./M.A.);
2) Thesis Assistance Program;
3) Non-degree Programs such as short courses, study tours and participation in conferences, symposia, diploma courses or similar development-oriented courses; and
4) Research and Development Fellows Program.

Accredited schools for degree program include the University of the Philippines System, and the CLSU. CLSU is accredited in the fields of animal science, agricultural engineering and crop science. Other accredited schools are private universities such as Ateneo de Manila and De La Salle University (Metro Manila) for information technology and social sciences. PCARRD is now in the process of accrediting additional schools particularly in the regions.

The fields of specialization must be supportive of the PCARRD Medium Term Plan and the Regional R&D Plan. At present, these fields are focused on high-end sciences (e.g., biotechnology, information technology, agricultural economics, environmental science, etc.) Selection of scholars has also been based on the commodity/discipline assignment of the institution.

Eighty percent of the scholarship slots for degree program per year is allocated to the NARRDN and the remaining 20 percent to the PCARRD Secretariat.

The Thesis/Dissertation Assistance Program is geared towards providing financial assistance to other graduate students (but also from the NARRDN) who may not have scholarship or lack thesis support.

The Research and Development Fellows Program aims to:

- beef up an agency's/organization's capability in R&D management through the posting of an expert from another agency;
- optimize human resource sharing;
- promote networking and cross-posting of R&D expertise; and
- provide opportunities for personnel growth, for exposure to other agencies' R&D environment and experiences.

Assignment to and from government agency or private sector/industry may be in the form of technical assistance or consultancy by cross-posting or scientist exchange. A person may be on detail, i.e., where the mother agency pays the salaries and attendant incentives and the requesting unit pays the additional incentives where appropriate as a result of the service agreement. Or he/she may be on secondment where the requesting unit pays the salaries and attendant incentives.

2. ***The Department of Agriculture – Bureau of Agricultural Research Scholarship Program***

The program aims to develop the skills and knowledge of scientists, researchers, and technical and support staff of the DA and agencies under the National Research and Development System in Agriculture and Fisheries (NaRDSAF) through continuous education. The program and thesis/dissertation assistance applies to Masters and Doctoral degrees in the following fields:

- *Crops Science*: cropping system, production management, seed technology, breeding, integrated pest management, post-harvest, processing/storage and biotechnology;
- *Animal Science*: poultry and livestock production, feed and nutrition, animal health, breeding, product development and processing;
- *Veterinary Medicine*: small and large animal health management;
- *Fisheries*: inland water, marine water, brackish water, coastal resource management, pest management, post-harvesting/processing;
- *Social Science*: agribusiness, agricultural economics, policy economics, natural resource economics, rural and urban planning, community relations and mobilization, extension, communication and impact assessment;
- *Farm Resources*: irrigation and drainage, water resource development, farm machinery and equipment, farming systems and management, soil and water resources management, environmental science; and
- *Computer Science*: computer technology, information technology, software technology.

Applicants should be qualified for admission at any of the following accredited universities/colleges:

UP system
CLSU
Leyte State University
University of Southern Mindanao
Mindanao State University
De La Salle University, Manila (private)
Ateneo de Manila University, Quezon City (private)
Siliman University, Visayas (private)
University of San Carlos, Visayas (private)

3. ***Fullbright – Department of Agriculture Scholarship Program***

This program provides funding for educational exchanges between the Philippines and the United States. It covers both research and extension workers.

4. ***Requirements for Application***

The usual requirements for applicants are:

1) permanent appointment with recommending agency: have served his/her agency for at least two years of continuous service prior to the recommendation by the agency head;
2) have at least a very satisfactory performance rating during the last two rating periods;

3) not be over 45 years of age for Ph.D. and 35 years for M.S.;
4) not have been a delinquent scholar of a previous scholarship award (whether or not from PCARRD). A delinquent scholar is one who already enjoyed a scholarship but was unable to complete the program;
5) be currently involved in R&D projects or research management responsibilities;
6) apply in the field of specialization that conforms with the commodity/discipline responsibilities and R&D program requirements of his/her agency;
7) have obtained prior admission from the graduate school of an accredited institution where he/she intends to enroll; and
8) submit a re-entry plan, indicating what the scholar intends to accomplish in his/her agency after completion of his graduate program. The plan should have an approval by the head of agency.

5. ***Scholarship Support***

Part of HRD, whether for research, extension or otherwise, is the incentives provided to the scholar. The amount of financial assistance varies according to the sponsor but in general would include the following for a fully funded scholarship:

1) Full basic salary and other benefits provided by the mother agency;
2) Monthly stipend;
3) Matriculation and other school fees (actual);
4) Book and photocopying allowance;
5) Thesis/dissertation support;
6) Graduation fees (actual);
7) Allowance for computerization services; and
8) Reimbursable economy round trip travel fare to and from place of official station.

6. ***Obligations/Responsibilities of the Scholar***

The recipient has the following obligations/responsibilities:

1) Pursue on a full-time basis his/her degree program at the designated university/college and in the filed of specialization indicated in the Memorandum of Agreement;
2) Keep up with the academic standards set by the university/college;
3) Carry a full academic load for each semester/summer;
4) Conduct himself/herself in such a manner that will not disgrace or dishonor his/her agency or institution and the sponsoring agency;
5) Refrain from engaging in any work for pay or accepting other forms of scholarship or fellowship during the scholarship period; and
6) Complete the program of study in 2-2.5 years (depending on the sponsor) for the M.S. and 3-3.5 years for Ph.D. degree (in case the awardee does not finish within the specified period, he/she shall shoulder any additional expenses to complete the program).

7. ***Non-degree Training Programs for Researchers, CY2002***

Not all researchers qualify for admission to graduate schools and therefore would have to be provided with short-term non-degree programs. Even researchers with advanced degrees need training in specific areas. PCARRD continues to conduct or send researchers to non-degree programs. For CY2002, some of the programs cover the following:

A. *For the NARRDN*

(a) <u>GIS for Livestock and Poultry R&D</u>

Create awareness and appreciation on the potential benefits that can be derived from the appreciation of Geographical Information System (GIS) in livestock and

poultry R&D; train workers in livestock and poultry R&D in the development, maintenance; and application of GIS.

b) Environmental Management Concept and Clean Production Technology for Agriculture and Natural Resources
Equip researchers and regional research managers with concepts and approaches to conduct R&D in the environment sector.

c) *Ex-ante* Evaluation of Socio-economic Impact of Projects/Technologies
Equip participants with necessary concepts and skills in conducting *ex-ante* evaluation of R&D projects and technologies.

d) Training on Advanced Desktop and Electronic Publishing
Design and create documents using desktop publishing application and develop skills in electronic publishing.

e) Seminar/Workshop on How to Get Research Articles Published in a Referred Journal
Equip participants with initiatives in getting research articles published in referred journal.

f) Continuing Education Program for Leaders-Managers cum Resource Generation/ Mobilization and Networking and Managing Organizational Change
Enhance the skills of regional research managers in R&D management, change management vis-à-vis strategic planning and resources generation/networking.

g) Training Performance on Research Management Information Service Coordination or Database Content Build-up
Enhance management information service coordinators to backstop the content build-up of databases especially for the Farmers Information Technology Service (or Techno Pinoy) Centers.

h) Training on Technology Assessment Protocol
Hone the participants' skills in the conduct of technology assessment prior to commercialization.

B. *For the Secretariat*

a) Empowering Decisions to Change
To identify the participants' own relations and events that influence decision-making, appreciate the gains in establishing and maintaining relationship and identify and value the core principles that will continually guide them to change for the better.

b) Basic Supervisory Development Program
The supervisor is a vital link between the managerial and non-managerial personnel. It is through him that company policies are understood and enforced. He assists in achieving company goals and objectives by making the rank and file perform effectively and efficiently. Thus, this program is designed to develop and enhance the abilities of supervisors to effectively perform their jobs.

c) Information Technology
To keep abreast with the fast development in information and communication technology (ICT).

d) Effective Business Writing and Basic Technical Writing
Effective written communication is highly valued in businesses. The ability to write clear, accurate, and effective business messages/technical papers are not only necessary but also a definite advantage for the success of both the individual and the organization in general.

e) Work Attitude Program

The program is designed to make the participants understand that functional values when practiced repeatedly, become good habits that incline us to the proper use of our intellect, will and emotion. Participants will become more aware of a framework integrating positive attitudes and necessary skills which enable them to examine their personal situation.

Human Resource Development Program for Agricultural Extension

1. ***Devolution of Agricultural Extension***

Agricultural extension used to be handled by the Bureau of Agricultural Extension of the DA. Republic Act No. 7160, called the Local Government Code of 1991, introduced sweeping changes in the political processes of the Philippines. The code transferred substantial power, functions and responsibilities from the national government to the LGUs. It transferred the responsibilities to the delivery of basic services to the LGUs, including appropriate personnel, assets, equipment, programs and projects. One of these basic services is agricultural extension.

The Local Government Code effectively devolved substantial powers, functions and responsibilities from the national government to the LGUs. In terms of personnel complement, the number of devolved employees from different agencies reached a total of 66,357 as the transfer was completed in October 1993 (URR/LGSP/SANREM CRSP).

C Department of Health (DOH)	–	46,107
C DA	–	17,667
C Department of Environment and Natural Resources (DENR)	–	899
C Department of Budget and Management (DBM)	–	1,650
C Philippine Gamefowl Commission	–	25
C National Meat Inspection Commission (NMIC)	–	9
Total		66,357

For the DA agricultural extension, a total of 17,667 personnel were devolved. This number included extension workers and administrative staff. As of 2001, the estimated number of extension workers of LGUs was 12,069, one-fifth of whom are assigned in the provinces and 80 percent in the municipalities (Table 3). The distribution ranges from about 10 percent with provincial assignment in Region VII (Central Visayas) to 28.8 percent in Region XI (Southern Mindanao). It follows that Central Visayas has the largest proportion of municipality assigned extension workers while Southern Mindanao has the lowest of 71.2 percent. In terms of absolute number of extension workers, Regions III (Central Luzon) and IV (Southern Tagalog) have the largest of more than 1,520 constituting about 12.7 percent of the total number of extension workers in the country. On the other hand, the CAR has the smallest number of 333 extensionists representing 2.8 percent of the national total.

The transfer of personnel to the LGUs posed problems of salary rates in the case of the transferred personnel. Among the major human resources concerns that local government encountered particularly those in low-income areas, include (International Institute of Rural Reconstruction [IIRR]/LGSP/SANREM):

- the clamor by the local employees for salaries comparable to those being received b y their counterpart employees from the national government;
- ceilings on budget for personal services;
- lack of Human Resource Development and Management Office (HRDMO) that shall spearhead human resource planning and implementation in the local government;
- lack of adequate career development plans and capability-building programs including management development;
- outdated job designs and performance review systems; and
- need for changes in recruitment and promotion policies and procedures.

In a study by Ponce (1998) regarding research extension linkage, two major problems/issues related to HRD were cited:

1) Over-politicization of agricultural extension services at the municipal level stifles professional growth and development of extension staff – Extension services operate within the municipality, hence, the chance for promotion and growth of agricultural extension employees is almost absent. The only chance for vertical promotion was the MAO position which was only one.
2) Financial difficulty and quality of agricultural technicians – Since the devolution of the agricultural extension to the LGUs, there has not been any organized training program for upgrading of competencies of LGU extensionists except those associated with national programs. These trainings were usually aimed at improving the implementation of DA national programs which may be different from the priorities of the LGUs.

According to Ponce, the DA's ATI did not have national training programs aimed at upgrading the managerial capabilities of MAOs and PAOs. Its training program generally complemented the DA national commodity programs.

The IIRR, LGSP, SANREM CRSP (2001) report on local governance also states that while local governments have begun to explore innovative ways in organizational development, they have not invested enough in comprehensive HRD concerns. When the financial pinch hits, its HRD and training concerns are usually the first to be sacrificed.

Assessing the effect of devolution in Nueva Ecija province, Vargas and Acoba (1996) made the following conclusions regarding development of LGU extension personnel: "Before devolution, promotion and scholarship were 'inadequate', recognition is 'moderately adequate', while trainings and seminars are 'adequate'. After the devolution, there was no change in the promotion. On the other hand, effect of devolution was noticed among recognition, trainings/seminars and scholarship. This could be attributed to the fact that personnel development is not in the list of priority programs of the local government units".

2. ***Role of the Agricultural Training Institute***

At present, HRD programs for extension personnel may either be through the initiative of national agencies (of which ATI is at the forefront) or the LGUs themselves. In addition, such capability programs may either be in the form of advanced academic degree or short-term non-degree trainings on a wide range of disciplines related to agriculture or rural development.

Among national agencies, ATI is one of the most active in providing support to LGUs on capability building. Each year, the institute targets a certain number of extension workers to be trained on various fields particularly on rice, corn, high value commercial crops, fisheries, livestock, institutional/entrepreneurship development, participatory planning, supervisory management and other concerns (ATI Corporate Plan, 2002-05). In year 2000, ATI has conducted a total of 1,526 training courses for both regular staff and *Agrikulturang*

Maka Masa (Agriculture for the Masses) Program with participants numbering 63,218, about 17 percent of whom were extension workers (Table 6). Apart from these short-term trainings, the institute implements a special scholarship program dubbed "SPREAD", which stands for Scholarship Program for the Revitalization of the Extension System for Agricultural Development. This program was established by ATI to enhance the delivery of agricultural support services among the LGUs. It is designed to provide all agricultural personnel involved in extension and training with access to higher quality education. Since its inception in 1998, the program has benefitted a total of 340 scholars, 266 of whom come from LGUs and 74 from the DA (ATI, 2001).

Table 6. Trainings Conducted by ATI for CY2000

Programs	No. of Training	No. of Persons
Regular		
Grains	228	9,888
HVCC	206	7,635
Livestock	134	6,149
Fisheries	48	1,949
Coconut	8	244
Sugarcane	1	33
Institutional development	161	5,661
Entrepreneurial development	95	4,116
Program planning project	74	3,132
Gender and development	11	425
Communication advocacy	9	493
TSEP-RU	40	1,383
Sub-total	1,015	41,108
Agrikulturang Maka Masa		
Grains	401	17,126
HVCC	64	3,124
Livestock	3	73
Fisheries	9	452
Institutional development	34	1,335
Sub-total	511	22,110
Total	1,526	63,218

The profile of short-term trainings received by LGU extension workers for selected regions in Luzon and Mindanao is shown in Table 7. Bulk of the trainings were on crops (46 percent), 12 percent were on livestock, 6 percent on fisheries while the rest were on a wide variety of topics that are not commodity-based (e.g., cooperatives, agricultural credit, entrepreneurship, marketing, organizational and leadership, etc.)

A long list of agencies provides sponsorship to training attended by LGU extension workers (Table 8). For extension personnel under the PAO, among the DA agencies, ATI is the primary agency having sponsored the most number of trainings. However, foreign agencies, NGOs, and other attached agencies of the DA likewise sponsored appreciable

number of these trainings. On the other hand, private companies, particularly those engaged in the manufacturing and trade of agricultural inputs, sponsored about 15 percent of trainings attended by extension personnel under the MAO.

Table 7. Number of Trainings Attended by Agricultural Personnel by Commodity, Luzon and Mindanao, 1995-99

Agricultural Office/Topic	Luzon		Mindanao		Total	
	Number	Percent	Number	Percent	Number	Percent
MAO/CAO						
Crops	832	45	1,075	52	1,907	49
Fisheries	135	7	103	5	238	6
Livestock	157	8	289	14	446	11
Non-commodity	741	40	610	29	1,351	34
Sub-total	1,865	100	2,077	100	3,942	100
PAO/PVET						
Crops	528	36	633	52	1,161	43
Fisheries	131	9	55	5	186	7
Livestock	154	11	221	18	375	14
Non-commodity	649	44	307	25	956	36
Sub-total	1,462	100	1,216	100	2,678	100
All Agricultural Offices						
Crops	1,360	41	1,708	52	3,068	46
Fisheries	266	8	158	5	424	7
Livestock	311	9	510	15	821	12
Non-commodity	1,390	42	917	28	2,307	35
Sub-total	3,327	100	3,293	100	6,620	100

Table 8. Common Sponsoring Agencies of Trainings Attended by Extension Personnel in Regions I, II, III and CAR

Sponsoring Agency	PAO		MAO		PVET	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Private agencies	5	6.7	19	14.6	3	7.5
NGOs	7	9.3	31	23.8	3	7.5
LGUs	1	1.3	4	3.1	1	2.5
Foreign agencies	13	17.3	17	13.1	7	17.5
DA agencies	32	42.7	39	30.0	12	30.0
DA-attached agencies	7	9.3	9	6.9	4	10.0
DENR	2	2.7	6	4.6	2	5.0
DAR	3	4.0	3	2.3	4	10.0
NAFC[a]	3	4.0	1	0.8	1	2.5
DTI[b]	2	2.7	1	0.8	3	7.5
Total	75	100.0	130	100.0	40	100.0

Notes: [a] National Agricultural and Fishery Council; and [b] Department of Trade and Industry.

3. ***ATI Staff Development***

1) Scholarship Program for the Revitalization of the Extension system of the DA
   - C Extension workers from DA for graduate studies in rural development extension, public administration and other related fields (also included LGUs).
2) Expanded Human Resource Development Program
   - C For master's degree in public management, extension program in rural development and agricultural development, particularly at the Ateneo de Manila University (private).
   - C Master's degree in food systems management at the University of Asia and the Pacific.
3) Fullbright-DA Scholarship Program for Agriculture and Fisheries Modernization
4) Non-degree Staff Development Program
   - C One hundred and seventy ATI staff attended non-degree training programs both in-house and offered by other agencies. Three attended foreign short-term courses.

4. ***Program Thrusts for 2002-05***

In its Corporate Plan for 2002-05, the ATI Capability Building Program encompasses training and education of LGU personnel and their clienteles and various stakeholders (LGUs, farmers, fisherfolk, women, youth, etc.) on the following: rice, corn, high value commercial crops, fisheries, livestock, institutional/entrepreneurial development, participatory planning, supervisory management, and other concerns.

In response to DA commitments on various national programs, training courses on the following will be conducted:

1) Gender and Development (GAD): This involves the mainstreaming of GAD activities, particularly GAD trainings and advocacy, and for formulation of gender-based information and statistics.
2) Scholarship Program:
   - * Revitalization of the Extension System for Agricultural Development (SPREAD)

     This is a distance education program for agriculture and fishery extension workers and training personnel designed to enhance the delivery of agricultural support services among the LGUs. Starting in 1998, some 356 scholars have enrolled in degree courses in various colleges and universities nationwide. At present, 47 have received thesis assistance for the completion of their courses. The program is expected to end by March 2003.
   - * Expanded Human Resource Development Program (EHRDP) for Agriculture and Fisheries Modernization (1999-2004)

     Pursuant to the mandate of the Agriculture and Fisheries Modernization Act (AFMA) to provide quality education and training on science and technology (S&T), the EHRDP covers deserving technical, administrative, academic and scientific staff and extension workers of DA, SCUs and LGUs; and capable and deserving youth, particularly the children of smallholders and fisherfolks.
   - * Fullbright-DA Scholarship Program

     This program provides funding for educational exchanges between the Philippines and the United States.
   - * Non-degree Courses for ATI Staff:
     - % Center managers course on participatory management
     - % Enterprise development
     - % Extension and social mobilization

- % Communication and advocacy
- % Basic and advanced computer applications
- % Enhancing administrative support services

5. ***PCARRD***

PCARRD has collaborated with the LGUs to improve research and extension linkage and to enhance access to research results and technologies generated by research. In effect, this enhances human resource capabilities of extension workers (Brown and Librero, 1996). PCARRD invites extension workers during the annual Regional Symposia on Highlights of Agricultural Research where researchers in each region present technologies generated during the year.

PCARRD continuously works toward sustainable development by bringing R&D milestones, breakthroughs, and major R&D outputs to the awareness and reach of potential users, particularly the resource-poor farmers. This commitment entails active and close coordination with members of the national agriculture and natural resources R&D network, LGUs, NGOs, other government organizations, and stakeholders of S&T outputs.

PCARRD since 1996 has intensified its R&D utilization efforts with the implementation of the Farmers' Information and Technology Services (FITS) Program, particularly the establishment of FITS or Techno Pinoy Centers. To date, there are 67 Techno Pinoy Centers nationwide, established in progressive municipalities strategically located near majority of farmers, processors, traders, and entrepreneurs who are not easily reached by extension services. Information and technology services are made available when needed in print audio/video tapes, and database formats. Techno Pinoy Centers are based or located either at SCUs, LGU offices of the provincial and municipal agricultural officers, or DA field offices. If manned by LGUs, the Techno Pinoy Centers are excellent training grounds for extension workers in getting aware of new technologies and in understanding the needs of farmers and other clientele.

At the moment, PCARRD is requesting President Gloria Macapagal Arroyo to put up, in coordination with LGUs, Techno Pinoy Centers in 50 more municipalities/*barangays*. Technological information will be readily available to the users, our small farmers in the rural areas. This will entail a total cost of ₱10 million, as counterpart fund to LGUs to cover purchase of audiovisual equipment; computers and peripherals; and information, education and communication (IEC) materials.

AWARDS

PCARRD

To provide incentives for researchers, research administrators, institutions, and media practitioners, the following awards are given by PCARRD every year:

1.	UGNAY (Linkage)	– Outstanding regional R&D consortium
2.	PANTAS (Sage)	– Outstanding scientist/researcher
		– Outstanding research administrator
3.	TANGLAW (Light)	– Outstanding R&D institution
4.	SINAG (Ray of Light)	– Outstanding technology commercialization
5.	Best R&D Paper	– Research category and development category
6.	Professional media	– Print, broadcast (radio and television)

DA

The DA gives awards for:

1. Outstanding scientist
2. Best research papers for each sub-sector, e.g., crops, livestock, socio-economics, etc.

National Academy of Science and Technology (NAST)

Established in 1976, the NAST is the highest advisory and recognition body in S&T. It supports scientific and technological pursuits and pays tribute to the achievements of Filipino scientists and various scientific and technological endeavors aimed at advancing the state of Philippine S&T (NAST, 2000). It provides the following awards related to agriculture:

1. National Scientist Rank and Title

The rank and title of National Scientist is the highest honor that is given to a Filipino scientist for exemplary, significant achievements and contributions to S&T. For the period 1978-2000, the NAST has conferred the rank and title to 26 scientists, nine of whom are still active.

2. Membership to the Academy

For the period of 1978 to the present, the NAST has awarded membership to 73 scientists (in all S&T sectors), 24 of whom are in agriculture. Academicians and scientists avail of research fellowship grants.

3. The Outstanding Young Scientist (OYS) Awards
4. Outstanding Scientific Papers Awards
5. Outstanding Book/Monograph Awards
6. The Hugh Greenwood Environmental Science Award

This award recognizes outstanding scientific and technological researches contributing to environmental protection and conservation efforts.

Scientific Career System (SCS)

As part of the government policy to "support and encourage the development of S&T to attract scientific experts into the public service, and to provide a system for the recognition and reward of technological and scientific productivity, efficiency, innovativeness and effectiveness on the job", the SCS was established by the DOST. The SCS is a system of recruitment, career progression, recognition and reward for scientists in the public service as a means of developing a pool of highly qualified and productive scientific personnel.

The System is characterized by:

1. entrance and career progression or advancement based on qualifications, merit and scientific productivity;
2. career paths that shall allow scientists to develop within their respective areas of expertise without leaving their status as scientists; and
3. incentives and rewards to ensure attraction and retention of highly qualified manpower in the S&T sector.

The SCS system applies to scientific personnel with masteral and/or doctoral degree in the natural sciences, agricultural sciences, selected social sciences, and other related disciplines as may be determined by the SCS.

POLICIES WITH DIRECT BEARING ON HRD

Republic Act 8435 – AFMA

Title 2 of AFMA, Human Development, declares that the state shall give priority to education and training on S&T in order to accelerate social progress and promote total human development.

Among the significant provisions of the Act are:

1. ***National Agriculture and Fisheries Education System***

The Commission on Higher Education (CHED), in coordination with the DA and appropriate government agencies, shall establish a National Agriculture and Fisheries Education System (NAFES) which shall have the following objectives:

a) To establish, maintain and support a complete and integrated system of agriculture and fisheries education relevant to the needs of the economy, the community and society;
b) To modernize and rationalize agriculture and fisheries education from the elementary to the tertiary levels;
c) To unify, coordinate and improve the system of implementation of academic programs that are geared toward achieving agriculture and fisheries development in the country; and
d) To upgrade the quality, ensure sustainability and promote global competitiveness, at all levels, of agriculture and fisheries education.

2. ***Education Program for Elementary and Secondary Levels***

The AFMA established an Agriculture and Fisheries Education Program under the NAFES, specially designed for elementary and secondary levels. The program to be formulated, organized and implemented by the Department of Education, Culture and Sports (DECS), has the following objectives:

a) To develop appropriate values that form the foundation for sustained growth in agriculture and fisheries modernization;
b) To increase the attractiveness of agriculture and fisheries education, so that more young and talented persons will look at agriculture and fisheries as an acceptable option for career and livelihood;
c) To promote appreciation of science in agriculture and fisheries development;
d) To develop among students, positive attitudes towards entrepreneurship and global competition in the agriculture and fisheries business;
e) To improve the present curriculum in the elementary and secondary levels by emphasizing the core values necessary for agriculture and fisheries modernization; and
f) To develop an outreach program where students, parents and the schools become instruments in effecting positive changes in the pupils' home and community.

3. ***Post-secondary Education Program***

The AFMA also established a Post-secondary Education Program for Agriculture and Fisheries under the NAFES, which shall be formulated and developed by Technology Education and Employment Authority (TESDA) in coordination with the appropriate government agencies and the private sector. The program shall include, among others, the following:

a) A mechanism for a flexible process of curriculum development;
b) Integration of the dual training system in the various agricultural curricula and training programs;

c) Integration of entrepreneurship and global competitiveness in the agro-fisheries curricula;
d) Institutionalizing agriculture and fisheries skills, standards and technician testing and certification;
e) Regular upgrading of learning/training facilities, school buildings, laboratory equipment; and
f) Development of a system for the strict enforcement of school regulation regarding standards and requirements.

4. ***Network of National Centers of Excellence for Tertiary Education***

A network of national centers of excellence in agriculture and fisheries education, composed of qualified public and private colleges and universities, duly accredited as National Centers of Excellence (NCE) in the field of agriculture and fisheries will be established.

For this purpose, the CHED shall formulate and implement a system of accreditation based on:

a) institutional accessibility, population, economic contribution of agriculture and fisheries in the community, and the needs or unique requirements of the area;
b) quantity and quality of research studies conducted;
c) degree of utilization of research results;
d) quantity and quality of faculty members;
e) type of facilities; and
f) linkage with international organizations.

5. ***National Integrated Human Resource Development Plan in Agriculture and Fisheries***

The CHED, in coordination with the DA and appropriate government agencies, shall formulate, develop and implement an integrated HRD plan in agriculture and fisheries which shall serve as an instrument that will provide overall direction in setting priorities in curricular programs, enrollment, performance targets, and investment programs.

6. ***National Scholarship Program***

The CHED in coordination with public and private universities and colleges, TESDA and DBM, shall develop a National Scholarship Program that provides opportunities for deserving academic staff to pursue advanced degrees in agriculture and fisheries.

Where appropriate, such scholarship program shall also provide opportunities for graduate work in foreign universities.

7. ***On Extension Services***

On extension services, the AFMA also "supports the development of a national extension system that will help accelerate the transformation of Philippine agriculture and fisheries from a resource-based to a technology-based industry". There shall be a national merit and promotion system governing all extension personnel, regardless of source of funding, to promote professionalism and achieve excellence and productivity in the provision of the government extension services.

Republic Act No. 8439 – Magna Carta for Scientists, Engineers, Researchers and Other Science and Technology Personnel in the Government

Enacted in 1998, the Act declares that it is the policy of the state to "provide for a program of HRD in S&T to achieve and maintain the necessary reservoir of talent and manpower that will sustain its drive for total S&T mastering". The State shall "establish, promote, and support programs such as science and engineering scholarship programs,

improvement of the quality of science and engineering education, popularization of science culture, and provision of incentives for pursuing careers in S&T" (RA8439).

Among the provisions of this Law are:

1. ***Science and Technology Career System***

A career system for S&T personnel in government which is patterned after the SCS shall be formulated by the DOST in coordination with the Civil Service Commission.

2. ***Benefits of S&T Personnel***

a. *Honorarium*

S&T personnel who rendered services beyond the established workload of scientists, technologists, researchers and technicians.

b. *Share in Royalties*

The share in royalties shall be on a 60-40 basis in favor of the government. Royalties are defined as a share in the proceeds of royalty payments arising from patents, copyrights and all intellectual property rights.

If the researcher works with a private company and the activities have been mutually agreed upon by the parties concerned, any royalty arising therefore shall be divided according to the equity share in the research project.

c. *Hazard Allowance*

This is paid to S&T personnel involved in hazardous undertakings or assigned in a hazardous workplace. Amount ranges from 10 percent to 30 percent of monthly basic salary depending on the nature and extent of the hazard. Hazardous workplace includes:

- radiation exposed laboratories and service workshop
- remote/depressed areas
- areas declared under a state of calamity or emergency
- strife-torn or embattled areas
- laboratories and other disease-infested areas

d. *Laundry Allowance*

This is paid to S&T personnel required to wear a prescribed uniform.

e. *Longevity Pay*

Paid monthly, this amounts to 5 percent of the monthly basic salary for every five years of continuous and meritorious service as determined by the DOST Secretary.

f. *Free Medical Examination Once a Year*

3. ***Detail to the Private Sector***

Government S&T personnel employed on a regular basis are allowed secondment to a private entity whenever such services are required; provided that:

a. the duration of such service shall not exceed one year;
b. the secondment will not adversely affect the operations of the originating office; and
c. the agency head approves such secondment.

4. ***Hiring of Retired Scientists and Technical Personnel***

A retired employee, who in the judgement of the governing board or agency head, possesses technical qualifications and the capability to undertake specific scientific research, may be rehired on contractual basis, provided that no qualified S&T expert is available to undertake scientific activities.

5. ***Science and Technology Awards***

Four outstanding achievements and excellence in S&T.

REFERENCES

Agricultural Training Institute. *Corporate Plan, CY2002-05*.

----------. *Annual Report*, 2000 and 2001.

Congress of the Philippines, 1997. Republic Act Nos. 8435 and 8349, December 1997.

Department of Science and Technology, undated. Scientific Career Council Rules and Regulations Implementing the Merit System for Scientific Career System.

Hondrade, R. F. D., 2001. *The Structure and Conduct of Local Government Units' Agricultural Extension – The Mindanao Case*, University of Southern Mindanao.

Librero, A. R. and E. O. Brown, 1995. *Rates of Returns to Technical Manpower Development: The Case of PCARRD*.

Librero, A. R., E. O. Brown, and R. A. O. Parducho (ed.), 1996. *Strengthening Research and Extension Linkages*, PCARRD Book Series No. 157.

National Academy of Science and Technology. *Annual Report 2000*.

PCARRD-DOST, 2000. *Bringing S&T to the Masses: Medium Term Plan (2000-04*), Los Baños, Laguna, PCARRD.

Ponce, E. R., 1998. "Research Extension Linkage and the Philippine Agriculture and Fishery Research and Extension System", lecture delivered during the Policy Seminar Series of the Department of Agriculture, Quezon City, 17 February 1998.

Vargas, D. S. and T. T. Acoba, 1996. "Effect of Devolution on Selected Agricultural Development Project and Extension Services in Nueva Ecija Province", Central Luzon State University (unpublished).

Vargas, D. S., *et al*., 2001. *The Structure and Conduct of Agricultural Extension Services of LGUs in Regions I, II, III and CAR*, Central Luzon State University.

4. MECHANISMS FOR THE TRANSFER OF AGRICULTURAL TECHNOLOGY AMONG COUNTRIES IN ASIA AND THE PACIFIC

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INTRODUCTION

Since the United Nations discussed appropriate technology needs of developing countries in the late 1960s, there may have been very few discussion on the issue of Technology Transfer Among Countries (TTAC). What followed was the concept of Technical Cooperation among Developing Countries (TCDC) to enhance exchange of information and expertise among developing countries and to facilitate transfer of appropriate technology. In the general topic of Technology Transfer (TT), the most common discussion has been in the area of agricultural technology transfer from research to the farmers within a given country.

In my literature search, data and information on the mechanisms for transfer of agricultural technology among countries is hard to find. Therefore, the Asian Productivity Organization (APO) deserves the credit of studying (for the first time?) *Mechanisms for the Transfer of Agricultural Technology among Countries in Asia and the Pacific* in the context of integration of agricultural research and extension. In my opinion, while mechanisms for technology transfer have developed many years ago, the interest on these mechanisms was not considered important for whatever reason. In fact when I was approached and given the assignment to prepare and present a resource paper on the subject, I did not think I could produce a two-page paper because of my unfamiliarity with the subject. My professional field of interest has been Agricultural Extension which is one of the most effective mechanisms of technology transfer in agriculture from its source (research and development organizations) to the local farmers. Even when I was still with the FAO, my interest and work did not include the general subject of TTAC. We conducted inter-country meetings and consultations in agricultural extension but the topics were how national extension services could be more effective in enhancing TT to farmers within the country, with special emphasis on TT to small-scale farmers.

Given my professional background, I accepted this assignment with the attitude that I am in for a new field of study. I used to be fascinated with anecdotal reports of how plants

and animals have spread from the place of origin to countries that significantly benefitted from them. What came to mind were the transfer of kiwi fruits from China to New Zealand, then to Italy, the United States, etc. Did you know that until the late 1970s there were no salmon in the southern hemisphere? Today, salmon is a multi-million dollar industry in Chile brought about by an innovative and systematic physical transfer of salmon technology from the northern hemisphere to the southern hemisphere. My curiosity on this topic led me to discover a wealth of information on "mechanism" of TTAC in Asia and the Pacific.

The organizers of this Study Meeting are to be commended for including this new topic, not because there is so much known about it but to bring center-stage a significant but neglected area of study in the broad field of research and extension for agricultural productivity and development. While many examples can be cited of TT between countries (between developed and developing countries and among the developing countries) the mechanisms and processes of this form of technology transfer is not well studied and documented. Traditional knowledge tells us that major crops in European countries such as tomatoes, tobacco and maize came from Mexico and potatoes from Peru. They were brought by the returning colonial people. Both the rubber plant and oil palm wherever they are grown in Asia and Africa today are said to have been brought by the colonial people from Brazil. *Baca* and *cabayo* (caballo) are not native to the Philippines, they must have been brought in from other lands.

Therefore, the nature of this paper is exploratory and the scope is limited to discussion of basic typology of the subject, identifying and discussing issues and principles that influence useful mechanisms, identifying mechanisms and giving examples of TT between or among countries under an identified mechanism. Attempt is being made to identify and cite common problems of TTAC and to identify areas for possible study on the subject of mechanisms for TTAC in Asia and the Pacific.

TRANSFER OF TECHNOLOGY AMONG COUNTRIES: BENEFITS, ISSUES AND PROSPECTS

Technology and Technology Transfer: A Definition

Technology – "with superior brain, human being has become dominant species on earth. With a superior brain, they have been able to devise methods or techniques to overcome their relative puniness and generally improve their lives. These techniques together are called technology and include all the different methods human have used to adapt materials in nature to their own use and to invent new ones" (Encyclopedia Britanica).

Technology is the practical use of scientific knowledge in industry and everyday life. Every technology has an information aspect, a set of techniques, methods and procedures and a concrete object (Chambers 21st Century Dictionary).

There are many kinds of technologies in general and in agriculture in particular. But for purposes of this paper, the kinds of technology that are referred to are known as: a) conventional technology provided by the public; and b) proprietary technology, owned primarily by private sector corporations (International Service for Agri-biotechnology acquisition [ISAAA]).

Technology Transfer

Known cases of successful technology transfer from one country to another suggest that the world is made more productive and richer because wider application of technology

when transferred from one country to another increased tremendously the efficiency, quality and quantity of production. Technically approved technology has inherent qualities to improve product quality, increase production efficiency and heighten productivity. This implies that the potential benefits of technology are actualized only when it is successfully transferred to a large number of end-users. A highly beneficial technology in one country cannot benefit the people of another country unless it is successfully transferred and properly used or adopted by many people in another country. Therefore, in development, technology generation or creation is one important thing but the transfer and correct and widespread application of that technology is still another thing. Hence the ultimate measure of the usefulness and benefits of an existing technology can contribute to economic growth and development only when it is correctly and successfully transferred and correctly applied by a large number of the intended end-users.

Therefore, the fundamental parameters of TTAC in Asia and the Pacific in the field of agriculture include: a) technology source provider; b) technology transfer mechanism; c) technology receiver-user; and d) impact of TT and adoption.

ISSUES OF TTAC IN ASIA AND THE PACIFIC

In spite of the overwhelming benefits and tremendous contribution of TTAC to the growth and development of nations in Asia and the Pacific, there are a number of issues that hinder faster rate of TTAC in Asia and the Pacific. The issues of TT between developed and developing countries are different from the issues of TTDC. For purposes of this paper the issues will be identified according to the four parameters mentioned above.

Technology Source-provider Issues

There are issues from technology source-provider which can hinder a freer transfer of technology to another country. These could include:

- fear of losing its market
- fear of losing its competitive edge
- undefined policy on technology transfer to other countries
- proprietary rights could discourage or delay transfer of technology and its application could mean added cost of technology transfer.

Transfer Mechanism Issues

Conceivably and in some cases, there are issues associated with the transfer mechanisms itself in achieving a more efficient TTAC in Asia and the Pacific:

- Lack of TT mechanism for some agricultural sub-sector
- In cases where there is a mechanism, such mechanism may have inadequate capacity to enhance technology transfer
- There are cases where the mechanism is not mutually acceptable by both the technology source-provider and technology receiver-user
- In other cases, the issues concerns the strategy, approaches and methods of TT being used by TT mechanism
- There are issues related to funding in the operation of the mechanism
- There is also the issue of linkages among related mechanisms.

Technology Receiver-User Issues

Based on some observations of failed and successful TT experiences among countries, some issues found among the technology receiver-user countries could be identified. This would include the following:

- the awareness issue of useful and available technologies in other countries
- there is the policy issue on the part of the receiving-user country on TT from other countries
- the issue of appropriateness of agricultural technology from another country to the local specific requirements of the different parts of the country
- fear and suspicion of foreign technology
- risk aversion and the issue of capacity to adopt foreign technology
- economics in the use of technology from other countries is locally developed technology
- the political issues of importing foreign agricultural technology
- infrastructure to receive the technology issues
- technical standards issue of the technology receiving country.

Technology Impact Issues

Technology transfer is resorted to for actual or perceived impact, on the part of the receiving country. When the perceived impact is positive, i.e., economically positive and environmentally non-destructive, TT is likely to be desired and enhanced.

Therefore the issues related to technology impact could include the following:

- fear of negative environmental impact (local, national and international)
- fear of a negative social and economic impact
- fear of displacement effect: of local technology, of labor, etc.
- the fear of economic dislocation of adopting foreign technology.

Future Prospects

There is a bright and favorable prospect for more TTAC for reasons of "buying time" and favorable economic gains by importing appropriate available technology from other countries. Because of many positive experiences in TT from one country to the other in the world, there is an increasing awareness and greater appreciation of the immediate benefits of TT across countries. As a consequence there is an increasing willingness and capacity to pay for imported technology. There is a noticeable increase in the number and capacity of TT mechanisms which are a part of the new realization of the greater benefits of interdependence among nations in many spheres including TT. Furthermore, there is an increasing openness for new technologies from other countries and there is an increasing quantity and quality of appropriate agricultural technology developed in more and more countries. Lastly, there is an increasing quality and sophistication of the infrastructure and facilities used in the transfer of technology across countries and continents.

MECHANISMS FOR TRANSFER OF AGRICULTURAL TECHNOLOGY AMONG COUNTRIES: AN OPERATIONAL DEFINITION

Mechanisms are an identifiable and definable set-up and means of making observable events to happen. It could be physical, technical/technological, economic, political and social

mechanism or a combination of two or more of these categories of mechanisms. Mechanisms for TTAC in the Asia and Pacific region social, economic and political arrangements and organizations that make possible the successful transfer of agricultural technology successfully from one country to another.

In this exploratory study, there were several mechanisms of TT for agricultural and rural development. The first categorization of mechanisms for the transfer of agricultural technology may be referred to as: a) informal mechanisms; and b) formal mechanisms. Using a systems framework, this exploratory study identified three kinds of mechanism, namely: a) Technology Source-provider Mechanisms; b) Technology Transfer Broker Mechanism; and c) Technology Receiving and Disseminating Mechanism.

Informal Mechanisms

These are *ad hoc* ways and means in which agricultural technology happen to be transferred from one country to another. There are no formal organizations or arrangements involved. The following are largely anecdotal stories which will serve as illustration of the informal or non-formal transfer of agricultural technologies from one country to another:

1. ***The Spread of Salmon Culture to the Southern Hemisphere***

It was known the world over, that there were no salmon fish in the southern hemisphere until around the 1970s. It was told that when there was a change of government in Chile, several multinational companies left the country and their bank accounts were confiscated by the government. The President decreed that that money should be used solely for innovative applied research with immediate high returns. The money was entrusted to a group of high level research scientists. Discovering that there were no salmon in the southern hemisphere, specifically in the southern part of Chile, the applied research scientists decided to study if salmon fish from the northern hemisphere could survive and grow in the southern hemisphere. And if it survived, would it multiply? The group decided to use the special fund to charter a plane to Alaska, study how salmon were growing there and then brought some fingerlings back to Chile and grew them in cages. The Chilean researchers concluded and were happy to discover that salmon from the northern hemisphere could grow normally in the southern hemisphere.

To find out if salmon could breed and multiply in the southern hemisphere, the Chilean researchers went back to Alaska on a chartered plane and transported thousands of salmon male and female fingerlings and "seeded" them in the mouths of the rivers in southern Chile which had similar conditions where they collected the salmon fingerlings. Lo and behold, the researchers found the salmon they brought to the southern hemisphere behave in the manner that salmon do in the northern hemisphere: they went back to the river where they were originally placed during the breeding season. The salmon bred and multiplied as though these salmon fish were in the northern hemisphere.

Today, Chile is producing tons and tons of salmon fish and boasts a multimillion dollar salmon industry which did not exist before the 1970s. It may be noted that the mechanism that made it possible for the transfer of salmon culture from the northern to the southern hemisphere was a small group of applied research scientists which was creative to produce something innovative with immediate economic impact. The mechanism became operational with a special applied research fund.

2. ***Ostrich from Africa to America***

In the 1980s an American working with USAID in Swaziland became fascinated and familiar with the ostrich, the largest living bird found in the dry plains in eastern and southern

Africa. He left his job, bought hundreds of cheap male and female ostrich birds from Namibia and brought them to Swaziland for quarantine and clearance (Namibia did not have an accredited quarantine infrastructure for these birds). Then he chartered a plane to transport his ostrich birds from Swaziland to Texas. The former USAID man became a major source of eggs and breeding ostrich in southern U.S.A. It should be noted that the transfer of this technology (ostrich culture) was made possible by one enterprising man who had adequate funds and who used two accessories: the quarantine facilities in Swaziland and an airplane.

3. ***KIWI Fruit from China to New Zealand***

Kiwi plant is a native to China. It is called Chinese gooseberry but was never considered a fruit of commercial value by the Chinese. As of this writing, literature on the mechanism on the transfer of Chinese gooseberry from China to New Zealand could not be found. It is said that when the Chinese gooseberry was brought to New Zealand, it thrived well and was popularized by a fruit company as a New Zealand kiwi fruit, named after a nocturnal flightless bird found only in the forests of New Zealand. Whether it was brought from China to New Zealand by the fruit company or brought by another agent is not also known as of this date of writing. It is recorded though that kiwi fruit was first exported to Europe by the New Zealanders in 1960s. Today kiwi fruit is a multimillion dollar commodity sold in the fruit markets of many countries of the world. Kiwi is now also grown in Italy and the United States.

4. ***Tropical Ornamental Plants and Vegetables from Tropical Countries of Africa and Asia to Italy***

This writer lived and worked in Rome, Italy for more than 20 years. He noted that Italy has enriched its biodiversity through an open door policy in the transfer of any attractive ornamental plants and vegetables from the tropics. As a receiving-user country, Italy seemed not to have a formal regulation in the informal importation of plants to the country which encourage its citizens to bring in interesting plants wherever they visited. Bringing in plants had no control, not even a plant quarantine questionnaire. It should be noted that under such open door policy the informal mechanisms of transfer of tropical ornamental and vegetable plants developed spontaneously. The individual travelers (Italian and expatriates) who have interest and initiative studied the culture, collected and brought the planting materials to Italy.

5. ***Transfer of Tropical Fruit Trees Among Asian Countries***

Rambotan is likely to have originated in Indonesia. In Bahasa Indonesia, *rambot* means hair and rambotan means hairy. That name of this fruit tree, rambotan is the same in the Asean countries. It seems that the transfer of rambotan from Indonesia has been largely informal and the mechanism could have been individual travelers who visited Indonesia. It would be interesting to find out if there are formal inter-governmental mechanisms for the transfer of tropical fruit trees such as rambotan, Bangkok durian, guava, mangoes, bananas, etc. Such study could include the transfer of orchid and other flowering plants.

Formal Mechanisms

This brief exploratory study of mechanisms for TTAC in Asia and the Pacific has led to the identification of three kinds of technology transfer mechanisms. They are: a) Technology Source-provider Mechanisms; b) Technology Transfer Brokerage Mechanisms; and c) Technology Receiving and Disseminating Mechanisms. The nature of each kind and the example of each are given below.

1. ***Technology Source-provider Mechanisms***

Before any technology could be transferred to another country, that technology must exist somewhere. The country or institution where the technology exists through discovery

or through research and development is the source-provider which would have a mechanism that would make possible the transfer of the existing technology to another country. In Asia and the Pacific region, there are several national and international source-provider mechanisms for TT.

National technology source-provider mechanisms for TT to other countries include research institutions of the country's agricultural research system. In addition, several countries in Asia have universities which serve as TT mechanism for other countries in the region. In some countries, there are private research organization and universities that belong to the technology source-provider category.

In the past, some 40 years ago, there were few countries which had technology source-provider mechanism and there were no international organization that served this purpose either. But today, there are no less than 20 international institutions that serve as technology source-provider mechanism for the TTAC in the region. These international institutions in Asia and the Pacific region include:

1) The International Rice Research Institute (IRRI) is located in the Philippines. In addition to its research and development program, it has information and training functions which facilitate rice technology transfer among the countries in Asia and the Pacific. Its network with national rice research institutes facilitate the transfer of rice technology from one country to another.
2) The International Crops Research Institute for Semi-Arid Tropics (ICRISAT) is located in the semi-arid region of India. Like IRRI, ICRISAT has an information and training function that enhances knowledge and TTAC that have semi-arid agriculture in southern Asia. It also has a network of national research institutions of countries with semi-arid agriculture, including those in Africa.
3) The Centro International de la Papa (CIP) is located in Peru, Latin America. But CIP has a potato research branch in a number of countries in Asia. Those branches which have the information, training and joint research projects enhance the transfer of potato technologies of some countries in Asia.
4) The Asian Vegetable Research and Development Center (AVRDC) is located in Taiwan. A big proportion of its programs are in information and training in vegetable production that facilitate vegetables TTAC in the region.
5) Australian Center for International Agricultural Research (ACIAR) is a new comer of the technology source-provider mechanism in Asia. It may now have a strong information and training program that facilitates TT among participating countries.
6) Multinational companies are considered source-provider mechanisms because of their strong research programs and TT work with countries where they have permit to conduct business. TT mechanisms include direct and indirect marketing of technological products, franchising in interested countries and making available information and training. The multinationals that facilitate technology transfer include: Dole Company, the Monsanto Group, Argil and Bayer.
7) In Asia and the Pacific, there are regional inter-governmental organizations or agencies which function as technology source-provider mechanisms. These include:
   - The ASEAN Regional Center for Biodiversity Conservation (ARCBC)
   - Plant Resources of Southeast Asia (PROSEA)

2. ***Technology Transfer Brokerage Mechanism***

These are international and regional institutions and networks that promote TTAC which have not generated the technology, but transfer technologies produced by other

national or international research and development organizations in different countries. These institutions' TT brokerage mechanisms include stimulating information exchange, training and meetings and the use of projects.

1) The FAO is an appropriate example. Part of its program is stimulating TCDC and South-South Cooperation (SSC). The activities under these technical cooperation programs include: a) exchange of experts; b) exchange of information; c) training; and d) knowledge and TT. FAO's Technical Cooperation Program (TCP) funds are used to support inter-country TCDC and SSC activities. One interesting example is the case of transfer of hybrid rice technology from China to Vietnam. When Vietnam on its own could not obtain hybrid rice technology from China, FAO through a TCP project was able to provide Vietnam with Chinese rice hybrid experts who went to Vietnam for training Vietnamese in the hybrid rice technology.
2) The Economic and Social Council of Asia and the Pacific (ESCAP) is another international agency that has a technology transfer brokerage mechanism function. It coordinates with other international organizations such as FAO as well as with private companies in the transfer and management of fertilizer technology in the Asia and Pacific region.
3) Regional inter-governmental mechanisms such as the Southeast Asia Regional Center for Research and Graduate Education in Agriculture (SEARCA) promote TT among its member countries through exchange of information, training and the use of projects to transfer agricultural knowledge and technology.
4) There are several other regional inter-governmental organizations which serve as mechanism for TT in their respective areas of competence. Like SEARCA the approaches used are to promote TT are information exchange, training and the use of inter-country projects. Among these inter-governmental bodies in the region are:
   - Southeast Asia Sustainable Knowledge Network (SEASAKNet)
   - Southeast Asian Network for Agricultural Extension (SEANAE)
5) NGOs also serve as TT brokerage mechanism. Examples are the International Institute of Rural Reconstruction (IIRR) and the Asia and Pacific Seeds Association (APSA).
6) The lone example of a public-private partnership in TT from developed to developing countries is the International Service for the Acquisition of Agri-biotech Applications. ISAAA is a non-profit international organization co-sponsored by public and private sector institutions. The organization seeks to facilitate the acquisition and transfer of agricultural biotechnology applications – particularly proprietary technology in the private sector – from industrial to developing countries. ISAAA operates by building partnership between the private and public sector institutions in the North and the South.
7) Private business networks that serve as mechanism for TTAC are fast developing in the region. One example is the S&G Seeds, Inc. This is operating in several countries in Asia. Another example is APSA. It has 300 member seed companies from network members who actively participate in inter-country activities such as the annual trade and professional meetings.

3. ***Technology Receiving and Disseminating Mechanism***

This refers to the organization and capacity in a given country to receive technologies from another country. This is often referred to as the infrastructure for TT. This exploratory study observed that there are technology receiving and disseminating mechanisms which are in the public and the private sectors.

1) In the public sector, the government agricultural extension organizations are the most common mechanism. For example, the initial transfer and spread of tilapia fish in the Philippines was carried out by the Bureau of Agricultural Extension in 1950s. Another example is the transfer and spread of the green table-grapes in Thailand. This was the work of the Department of Agricultural Extension of Thailand in 1960s. Still another example is the high-yielding variety (HYV) of wheat in India which was made possible by the work of the national research system and the Agricultural Extension Commission of India and the State Agricultural Extension Services in the early 1970s. The transfer of the rice HYV from IRRI was made possible by the joint effort of the national research institutes and the National Agricultural Extension Services. The Assessment Institute of Agricultural Technology (AIAT) in Indonesia is a new example of a local technology receiving mechanism.
2) The Bangladesh Rural Advancement Center (BRAC) which has branches located in every municipality in that country is a good example of a local NGO TT receiving mechanism.
3) In the Philippines, the Allied Botanicals, Inc. is a local private company that imports, develops and disseminate seeds. The S&G Seeds, Inc. is also a private company that has the local capacity to import seeds and disseminate them. This company operates in a number of countries in Asia.
4) Alliaga Nueva Ecija Cooperative is a local private organization. It imports machinery from Japan and uses it to provide mechanization service to the rice farmers in land preparation, transplanting and harvesting. Without this cooperative, the available Japanese farm machineries could not be transferred to the local town in Nueva Ecija.

PROBLEMS AND POTENTIALS

The potential benefits of agricultural TTAC in Asia and the Pacific are conceptually tremendous and significant as has been illustrated by the known examples of kiwi, salmon, rice, wheat, oil palm, rubber and other technologies. Past experience shows that there are overwhelming advantages and benefits from TTAC than disadvantages and negative effects of this kind of TT.

The problems that must be recognized and overcome are many. These may include:

1. lack of awareness and appreciation of existing useful technologies in different countries in Asia and the Pacific
2. risk aversion among the leaders of countries
3. absence of acceptable TT mechanism or lack of appreciation of the benefits from TTAC and consequently lack of money to establish and operate an economically viable TT mechanism
4. protectionism and nationalism on the part of the source of high quality technology
5. proprietary ownership of emerging high technology
6. infrastructure and economic problems on the part of the potential receiving country
7. policies of the country often time do not allow exportation of technology from other countries on the part of technology source countries or policies that prevent potential receiving country from allowing the importation or TT from other countries.

IMPLICATIONS FOR FURTHER STUDY

This exploratory study of mechanisms for TTAC indicates that TTAC is taking place informally and formally. Furthermore, TTAC seems highly developmental because it expands the economy of the receiving country and improves the return to investment in research and development of the technology providing country. Therefore, globally TTAC is highly beneficial to the societies involved. Given these values and as a result of this exploratory study of mechanisms for TTAC, five further studies could be recommended for the immediate term.

1. ***A Systematic Inventory of Agricultural Technology that has Transferred from One Country to Another*** (during the past 25 years)

   What are the inherent qualities of the agricultural technologies that have been widely transferred? Of technologies that failed to be transferred widely across countries in Asia and the Pacific, what are their inherent qualities?
2. ***Mapping of Mechanisms for Technology Transfer Among Countries in Asia and the Pacific***

   Mapping of mechanisms for technology source-provider, TT brokerage and for technology receiver and disseminator. This should lead into the publication of a directory of mechanisms for TTAC in Asia and the Pacific. A network of mechanisms for TTAC could develop from this mapping initiative.
3. ***Assessment of the Effectiveness of the different Mechanisms for TTAC in Asia and the Pacific***
4. ***Study of the Economics and Socio-economic Benefits of TTAC in Asia and the Pacific***
5. ***Review and Assessment of Policies and Programs that Enhance or Restraint TTAC in Asia and the Pacific***

Finally, it is recommended that a Study Meeting be organized to discuss the findings and implications of the five studies above. The Study Meeting should be devoted entirely to this new field of study in agricultural development – the functions of TTAC in accelerating global agricultural productivity and development.

REFERENCES AND INFORMANTS

Alexandratos, Nikos (ed.), 1995. *The World Agriculture: Towards 2010 – An FAO Study*.

APO, 1996. *Agriculture Trade Policy in Asia-Pacific: A Study Meeting Report*, APO Study Meeting held in Seoul, Rep. of Korea, 24-31 October 1995, APO, Tokyo.

Bonifacio, Manuel F., 1997. "Technology Transfer and the Situation of Resource Poor Farmers: A Mission Report" submitted to FAO, Bangkok, Thailand, January 1997.

FAO, 1981. *Technical Consultation on the Promotion of an Asian Network for Technology Transfer in Agro-Industries*, a report of a Technical Consultation in Bangkok, 24-28 August 1981.

----------, 1998. *Expert Consultation on Rural Women and Technology Transfer: A Report*, FAO Bangkok, Thailand.

ISAAA, 2000. *International Service for the Acquisition of Agri-biotec Applications*, April 2000.

Kwaschik, Ed. R., R. B. Singh and R. S. Paroda. *Technology Assessment and Transfer for Sustainable Agricultural and Rural Development in Asia and Pacific Region: A Research Management Perspective*.

Nickel, John (team leader), Fernando Bernardo, Tito E. Contado, Prabhakar Tamboli, Gunardi and Supri Bashdabella. *External Review of the Agency for Agricultural Research and Development (AARD): A Report by a Review Panel*.

SEARCA, ACIAR, *et al*., 1998. "Enhancing Farmer Adoption of Simple Conservation Practices: Land-care in the Philippines and Australia", Final Working Copy, 1998.

SEARCA, *et al*., 1999. *Strengthening Marketability and Transfer of Technology for Sustained Food Processing at a Village Level in Vietnam*, a Technical Report, September 1999.

----------. *Annual Report 2000-2001*.

----------, 2001. *Financing Technology Transfer in the Agricultural Sector*, Policy Forum Series No. 4, November 2001.

Syngenta Philippines, Inc., 2001. Farmers Support Team, a brochure and newsletter.

Dr. Noel Mamicpic, retired Director of the Asia and Pacific Seed Association (APSA), Bangkok, Thailand.

Mr. Jose Soriano, Consultant, Syngenta Foundation Inc., Syngenta Philippines, Inc.

Dr. Manny Logronio, S&G Seeds, Inc. (local importing of seeds).

Dr. Randy Hautea, International Service for Acquisition of Agri-Biotech Applications (ISAAA).

5. EFFECTIVE NETWORKING OF RESEARCH AND EXTENSION THROUGH INFORMATION TECHNOLOGY

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INTRODUCTION

Asia-Pacific region accounts for nearly half the world population. India and China together are home to 70 percent of the region's population. Majority of the Asian people depend upon land and agriculture for their livelihood. Agriculture continues to be the engine of economic growth in most developing countries of the region. In India, it accounts for one-fourth of the GDP but provides livelihood to two-thirds of the population. Mid-1960s onwards, as a result of the Green Revolution the agriculture sector in India registered spectacular growth transforming the scenario of food deficiency into one of self-sufficiency. In addition to food grains, oilseeds, fruits, vegetables, sugarcane, milk, fisheries and poultry recorded impressive gains. The success of the Green Revolution was experienced in several Asian countries where the rapid adoption of modern agricultural technology resulted in dramatic gains in productivity. Public research and extension played a major role in bringing about the Green Revolution.

Constraints of the T&V System

The Training &Visit (T&V) system of extension profoundly influenced extension practices and registered impressive gains in irrigated areas, because of the similarity between the agro-ecological conditions where technologies were generated and where they were ultimately used and the favorable socio-economic situations and developmental infrastructure for their wider uptake. However, the T&V system suffered from several constraints, it operated largely in the inter-personal mode without planned and optimum utilization of information support and with low level of involvement of farmers. The "top-down" approach generated uniformity rather than specificity and lacked focus on location specific needs of regions, disadvantaged areas, target groups enterprises, etc. Individual and institutional issues under Human Resource Development (HRD), the training of researchers, subject-matter specialists and extension functionaries and farmers had not been addressed adequately. The linkages between research-extension and farmer remained weak or non-existent. Media and information management was not suitably addressed. The system was supply-driven with

scarcely any accountability to farmers. Technology generation systems were also largely in a top-down mode with very weak mechanisms for feedback from the client farmers.

Post-Green Revolution Period

The T&V system, well suited to the rapid dissemination of preset agronomic practices for the high yielding wheat and rice varieties, failed to respond to the more location-specific, risk-prone agriculture of the unirrigated tracts. Similarly, extending the system to programs for natural resource management, sustainable agricultural practices such as integrated pest management, integrated nutrient management and to diversified agriculture such as high value horticulture, livestock activities and fisheries did not meet with success. Nor could the T&V system adapt to the more holistic farming systems approach towards which the new thrust of both research and extension had begun to focus.

AGRICULTURE IN THE NEW MILLENNIUM

In the 21st century in an increasing environment of economic liberalization and globalization the old research and extension systems face important challenges in the areas of relevance, accountability and sustainability. The global economy and market forces have great impact on the options for future change in all farming systems and for farmers' ability to use extension and information services.

Serving Commercial Agriculture

Agricultural systems are becoming more commercialized. Increasing productivity is essential to staying in business on the farm, as globalization forces farmers to compete, not just with their neighbors, but with the best global producers. In this competitive environment, extension services must be oriented to markets and overcome the exclusive focus on production that ignored market demand and profitability and was the "Achilles heel" of the past extension programs. More varied extension services are needed to help farmers remain competitive and profitable, diversify production, produce for niche markets, and move to higher-value products and more value-added production. Effective linkages of production systems with marketing, agro-processing and other value-added activities would play an increasingly important role in the diversification of agriculture. In many countries, providing public extension services focused only on staple food crops, as during the "Green Revolution" era, is no longer necessary, as technologies for these crops are already well known to farmers, who are well-served by seed and input suppliers.

Knowledge-intensive Agriculture

It is expected that future agricultural growth would largely accrue from improvements in productivity of diversified farming systems with regional specialization and sustainable management of natural resources, especially land and water. Furthermore, increases in productivity are likely to come from more efficient use of inputs. Technology recommendations will be tailored to specific groups of farmers and more narrowly defined production environments. Innovation will require more knowledge and information input from extension services with information transferred in an educational rather than directive approach, building on formal schooling as an asset and basis for the information services provided. Extension will have to respond to specific farmer requests for information in demand-driven mode rather than pushing predetermined technology packages and must

provide situation-specific (i.e., field-specific) recommendations rather than technology messages marketed across large recommendation domains.

Farmers need up-to-date information on sources, availability and cost of agricultural inputs, also on the potential of different techniques and technologies used for production and processing of agricultural goods. They also require information for livelihood strategies. This includes information about the role and responsibilities of different institutions in the provision of key services, and where to go and who to ask for specific information. Legal issues are important for farmers especially as they relate to land rights and entitlements. Agricultural credit is another. Risk management and crop insurance is yet another. Legal and financial disputes are common because rural people do not have access to basic legal and financial information. Farmers increasingly need information about rural off-farm activities, and about rural development projects supposedly designed to benefit them. It is important that this information is available in an appropriate format and language, and that farmers have the capacity to analyse it and act on it.

Expanding Research-Extension Agendas

Research and extension are being forced to embrace a broadened mandate, such as local organization development, mobilization of farmers into groups, watershed management, micro-enterprise, marketing linkages, post-harvest technologies and value addition, access to credit, risk management, management of agribusinesses, together with environmental and natural resource management issues, rural infrastructure and other non-agricultural issues.

PLURALISTIC APPROACHES TO RESEARCH AND EXTENSION

It is becoming increasingly evident that public research and extension by itself can no longer respond to the multifarious demands of farming systems. Recent shifts in public sector control and the trend towards decentralized services point to the error in expecting one single organization to be able to deal effectively with all farmers – poor semi-subsistence farmers and rich commercial ones alike – and all rural sector issues – from resource conservation to crop production. There is need for reappraisal of the capacity of existing agricultural extension systems to address, effectively, contemporary and future needs of the farming community. Public funding for sustaining the vast extension infrastructure is also under considerable strain. Meanwhile, in response to market demand the existing public extension network is inexorably being complemented supplemented and in some instances replaced by private extension. Conceptual shifts and economic constraints are leading to a greater consideration of pluralistic research extension approaches, i.e., multi-organizational partnerships including non-governmental actors in the broadest sense. As the nature and scope of agricultural extension undergoes fundamental changes, the outlook is for a whole new policy mix nurturing a plurality of institutions.

For example, differences in objectives and motivations between public and private extension organizations mean that one or the other of them may be more appropriate for certain kinds of extension activities and clients. Pluralistic extension systems seem to make sense not only in terms of flexibility and complementarity, but also in terms of the range and number of farmers served as well as their different technological needs (e.g., commercial agribusiness technologies compared to low external input technologies). Pluralistic approaches explicitly underscore the need for integrating mechanisms.

Changing Nature of Extension Providers

1. ***Multi-agency Extension Service***

For many years agricultural extension was considered the monopoly of the public sector and government extension agencies were assumed to have singular research extension skills. However, with the wide range of demands for agricultural technology in the changing scenario there is growing recognition that public extension by itself cannot meet the specific needs of various regions and different classes of farmers. The new extension regime recognizes the role of a multi-agency dispensation comprising different strengths. Development communications strategies are explicitly or implicitly a part of any extension program. Mass media information services, using traditional media or new information/ communications technologies, are important as a complement to or as direct support for a field extension program. Policy environment will promote private extension to operate in roles that complement, supplement, work in partnership and even substitute for public extension. The three arms of the agricultural extension network are shown in Box 1.

Box 1

Public Extension Services

- State government line departments operated extension (Departments of Agriculture, Horticulture and Livestock Development)
- State agriculture universities (SAUs) based extension (Directorates of Extension, *Krishi Vigyan Kendras* [KVKs] and *Krishi Gyan Kendras* [KGKs])
- Indian Council of Agricultural Research (ICAR) extension (Zonal Research Stations/ KVKs, Agriculture Technology Information Centers [ATICs], Institute Village Linkage Program [IVLP], etc.)

Private Extension Services

- Community-based organization (farmers' organizations, farmers' cooperatives, self-help groups [SHGs], farmers' interest groups [FIGs], etc.)
- Para extension workers (contact farmers, link farmers, master farmers, *gopals, mitra kisans, mahila mitra kisans*, etc.)
- Agri-clinics and agribusinesses
- Input suppliers/dealers (pesticides, seeds, nutrients, farm implements, etc.)
- Corporate sector (commercial crops – tobacco, tea, coffee, oilseeds [sunflower]; vegetables – seeds; farm implements – tractors, threshers, sprinklers, drip irrigation, etc.

Mass Media and Information Technology

- Print media – vernacular press
- Radio, television, private cable channels, etc.
- Electronic connectivity through computers, NICNET, internet, V-SAT, etc.
- Farmers Information and Advisory Centers (FIACs)
- Private portals
- Public and private information shops

Changing Nature of Research Providers

The outputs of national agricultural research institutes, the traditional suppliers of formal research in developing countries are increasingly being supplemented by private, cooperative or NGO research efforts (as well as by efforts of farmers who have always been involved in their own research but whose contribution has only recently been recognized. Different types of suppliers of agricultural research can be identified (Box 2).

Box 2

- Multinationals which conduct commodity-specific research for major – often export crops – crops. They tend to be active in plant breeding research although some also work on agronomic issues and conduct extension.
- National companies are primarily engaged in research in herbal and aromatic plants as well as in indigenous technical knowledge the area of operation includes research in plant breeding especially in production of vegetable seeds, hybrids and floriculture.
- Commodity boards can be important sources of research and extension for the key export commodities, e.g., tea, coffee, coconut, spices are considered to be at the forefront of research in their areas. Research is usually paid for by a cess on commodity sales which gives these autonomous institutes a reliable source of funding enabling them to conduct longer term research than some of their private counterparts.
- NGOs and non-profit organizations usually conduct research as part of integrated research/extension and rural support programs. Most NGO research is concentrated at the adaptive end of the research spectrum NGOs take new technologies (often from the public sector) and adapt them to suit local needs. However, there are also examples of NGO research, such as that conducted by Bharatiya Agro-Industries Foundation (BAIF) on artificial insemination (AI) in India, which is both long-term and ground-breaking.
- It is clear that farmers conduct their own research, to varying degrees.

Research can be seen as part of a continuum starting with basic research, followed by strategic research, applied research and finally adaptive research. The more downstream the research, the nearer it is to the market and the more private the research in general. The reason for this is the increase in appropriability of the research results. Different types of research have different degrees of appropriability.

RESEARCH EXTENSION LINKAGES

When research and extension institutions are organized and function in an integrated systems approach, even when physically separate, then linkages among them and with farmers are more likely to receive attention. An integrated approach to research and extension attempts to link all system participants – researchers, extension workers, input suppliers, farmers and others – so that they are jointly involved in the agricultural technology innovation process. The common denominator among these participants is information and knowledge; when linked, they form an agricultural knowledge and information system that draws on both modern science and farmers' indigenous knowledge.

An integrated research extension approach emphasizes the importance of interactive, mutual learning between formal and informal knowledge/technology systems and stresses linkages with farmers so that they actively participate in agricultural technology innovation efforts. While in the traditional technology transfer approach more attention is paid to "trickle down" flows of information from research to extension and from extension to farmers, an integrated research extension approach shifts attention to feedback and upwards communication from farmers and to facilitating research-extension-farmer interactions.

Strengthening Research /Extension Linkages

There is no single, ideal and easy recipe for improving research-extension linkages. The strategies and mix of mechanisms employed depend on the policy, institutional and resource context of a particular country. The complexity of national agricultural technology systems requires, however, that governments foster linkage mechanisms and play a coordinating role. This involves identifying "linkage gaps" and where and how research and extension organizations, both public and private, can overlap with each other and with farmers. It also means establishing vertical and horizontal links at multiple levels – at the field level and at different hierarchical levels between and within research extension institutions. Measures that have been taken to close linkage gaps include:

- allocating staff time and operating funds to linkage activities;
- creating special linkage or liaison positions;
- building linkage responsibilities into job descriptions;
- forming farmer advisory committees and integrated field teams;
- training research-extension managers to support and provide leadership to linkage activities; and
- research-extension joint problem diagnosis, priority-setting and planning.

A key player in most pluralistic research-extension systems is the NGO community. Less attention has been paid, however, to linking NGOs to public-sector research extension institutions so that there is complementarity between their efforts. While NGOs often focus on small, resource-poor farmers, their reach is limited and they often lack a solid technical base. Pluralistic approaches to research-extension should stress the importance of improved collaboration between NGOs and government agencies.

LINKING EXTENSION TO SOURCES OF INNOVATION

Extension services must be able to access a continuous flow of new information and innovation if they are to be of continuing benefit to clients. The subject-matter specialist (SMS) is traditionally the key link in this system, being a specialist within the extension service who maintains contact with state-of-the-art technology and feeds this to extension staff. As extension demands become more varied and extension staff better qualified, extension agents will have to depend – to an increasing extent – on specialists outside of the extension agency in research agencies, universities, and the private sector.

Research will remain an important source of technologies and information. However, national research systems are just one – but perhaps the most important – source of information for extension. Extension programs can have much more to offer clients by organizing to access knowledge and information from all possible sources, including the

private sector, NGOs, indigenous knowledge, and international technology programs. Identifying and facilitating access to innovation is a key part of a national extension strategy.

RESEARCH-EXTENSION NETWORKING IN INDIA

Present Scenario

India has invested heavily in the past in its public agricultural research and extension systems. These investments have been a major contributor to national success in raising food grain production from 51 million mt in 1950-51 to around over 210 million mt in 2001, thereby maintaining food security in the face of a huge increase in population. Green Revolution technology the use of improved crop varieties and modern inputs on relatively well-endowed (usually irrigated) land was the cornerstone of that success. However demands for agricultural technology are now changing and diversifying. Factor productivity growth in India's Green Revolution areas does not match that of some East Asian countries and may be on the decline. New approaches, for instance involving frontier sciences such as biotechnology as well as production systems approaches to breaking through yield plateaus, are needed for these well-endowed areas. At the same time India must – both for economic and social reasons – invest more in technology for less well-endowed areas, particularly the rainfed lands which comprise 63 percent of the cultivated area and where many of the rural poor live. And in all areas, as agricultural demands on the resource base intensify, greater attention is needed to sustainability and the containment of potentially adverse environmental impacts. These trends have set a new agenda for the generation, assessment and dissemination of agricultural technology.

Public sector agricultural research at national level is the responsibility of the ICAR, a semi-autonomous society under the Ministry of Agriculture. ICAR operates a wide range of specialized institutes and programs including agricultural universities. ICAR employs some 5,000 scientists; a further 25,000 or so in agricultural universities work on research for a part of their time. Government funds allocated to agricultural research have risen from 0.1 percent of agricultural GDP at independence to over 0.3 percent at present. Private sector research, especially in plant breeding and inputs, is also increasing steadily. World Bank loans have supported agricultural research, but although administered by ICAR most loan funds went to building the adaptive research capacity of SAUs. Agricultural extension is a state-level responsibility and has been following the T&V extension system since the mid-1970s. States currently employ some 110,000 extension staff of whom around 20 percent are graduates.

Under the National Agriculture Technology Project (NATP) being supported by the World Bank, it is proposed to address the various constraints faced by the research-extension systems, and to shift the balance of programs more towards improvement of whole production systems rather than a commodity or single discipline approach. Very importantly to improve links between research and extension and secure greater farmer participation in their programs. The NATP has three components:

1. ***Development of the ICAR Organization and Management System***

Funding would be provided" to continue with present reforms to ICAR organization and management process including support for a review of selected institutions to enhance their management capabilities; for strategic studies, consultancies and workshops to plan further evolution of ICAR and its role in the Indian National Agricultural Research system

(NARS); for the expansion of data connectivity, information and library systems for socio-economic research; and for a program of HRD in research management.

2. ***Support for Agro-ecosystems Research***

The project would fund location-specific interdisciplinary research programs in a program mode by multiinstitutional teams on 13 priority production systems in five of India's main agro-ecosystems; also time bound crosscutting support to these programs in the mission mode; supporting strategic research, especially involving development of frontier sciences to address production systems problems, the creation of a "Competitive Eco-regional Grant Scheme" to promote entry of private sector; and extensive staff skill development for agro-ecosystems research through study tours, sabbaticals and enhanced interchanges with national and international centers of scientific innovation.

3. ***Innovations in Technologies Dissemination***

Funds would be provided to 28 districts in agro-ecological zones where production systems research is being supported, for pilot exercises to bring together researchers, extensionists, farmers and other stakeholders (including NGOs, the corporate sector and others outside the public services) to make joint diagnostic studies and develop research and extension plans to introduce innovations in technology dissemination matched to local needs and characteristics. Plans would cover in an integrated manner improved stakeholder involvement in technical aspects of adaptive research and extension, closer links between researchers and extensionists, HRD related to technology dissemination, as well as innovations and adjusted responsibilities for information transfer. Stress would be given to building inter-institutional links, decentralization, rehabilitation, redeployment and training/ re-training, and broader HRD intended to change individual behavior and culture in government institutions.

Figure 1 shows the current technology system in the country. The major medium of communication among the research and extension agencies in India is still "Face-to-Face Communication". The Department of Agriculture and Cooperation (DAC)-ICAR interface at the highest level provides the interaction platform for the policy-makers in DAC and the senior scientists of ICAR. At the state level also similar mechanism exists in almost all the states, where the State Departments of Agriculture (DOA) interact with the concerned SAUs, research and extension scientists to prepare plans for extension activities at field level. In some of the States, the SAUs have established extension centers at each districts (Andhra Pradesh and Punjab). There are few other mechanisms in between these systems. These include the interactions among research scientists and extension managers at Zonal Research Station (ZRS) and at KVK at district level. Thus the research-extension communication is mainly interpersonal, which is generally followed by technical literature from the universities and field feedback (in written form) from extension functionaries. This mechanism prevails in most of the States in India. Under the NATP and the Uttar Pradesh Diversified Agriculture Support Project (UPDASP) internet based connectivity has been provided to the major stakeholders in research and extension systems in about 60 pilot districts.

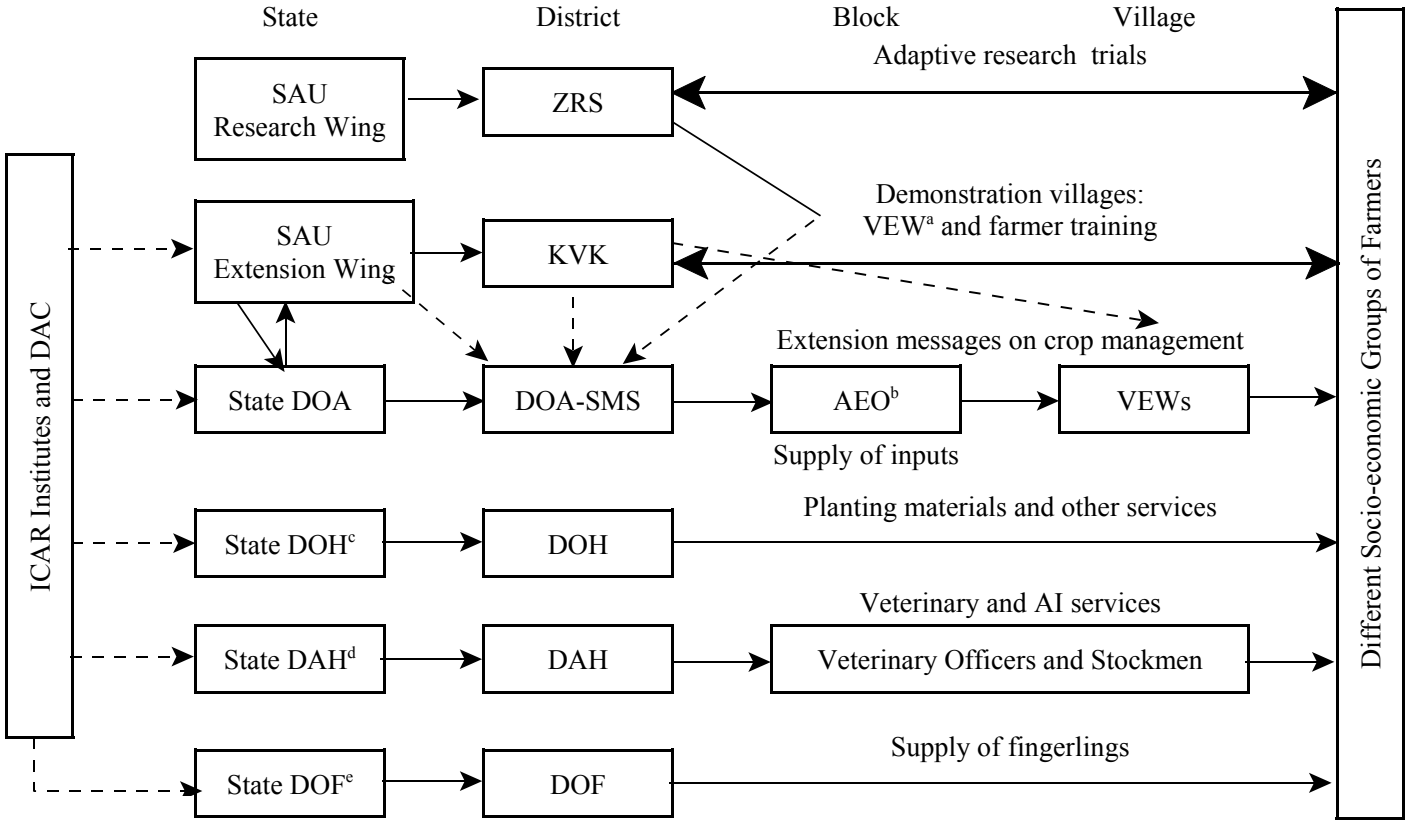

Figure 1. The Current Technology system

Notes: [a] Village extension worker; [b] agriculture extension officer; [c] Department of Horticulture; [d] Department of Animal Husbandry; and [e] Department of Fisheries.

RESEARCH-EXTENSION-FARMER NETWORKING THROUGH INFORMATION TECHNOLOGY

New information technologies and the inventiveness of agricultural scientists and farmers are leading to many new Information Technology (IT) applications in agriculture. Computers and new software development allow farmers, producer organizations, and extension agents to access information on pests and disease, crop and livestock technologies, markets, and more from local or remote databases. Information technologies also facilitate reporting and recording of local information and improvement in accounting and management of the producer organizations that may be key to small farmers access to ITs. At a higher level of sophistication, remote sensing, global positioning systems, and geographic information systems provide opportunities for improved planning and priority setting for extension programs, improved monitoring and evaluation of impacts, and improved presentation of information for use by farmers and extension staff. "Precision farming" which manages crops, inputs, and land use according to the precise needs of the area within field (in large-scale agriculture) or by individual plot (for small farmers), holds promise for significantly increasing productivity.

Figure 2 shows institutional reforms and restructuring of the public sector extension under NATP. The basic communication flow consists of periodical reports to the project agencies and in some cases *e*-mail communication between researchers and extension managers. Half of the 28 project district Agriculture Technology Management Agencies (ATMAs) have hosted their web-sites, which provide basic information about district, the agricultural pattern of the district, the Strategic Research and Extension Plan (SREP) and major initiatives under NATP. The universities have also hosted their web-sites and in some cases the ZRSs and KVKs have also done so. These web-sites are primarily serving as a ready reference for contacting the concerned agencies. They provide contact address, *e*-mail address and telephone number of important scientists. The technical material on the university web-sites is of very general nature. The material is however very useful for the university scientists placed at ZRS and KVK levels and extension personnel at the district level. This can be considered as the phase 1 of using information communication technology for agricultural extension. The phase 2 of this initiative will include *e*-enabling the research extension communication process in dynamic sense. This will involve re-engineering of existing communication mechanism at various levels. A proposed communication mechanism among the key stakeholders in the extension system is depicted in Figure 3.

The use of IT to simply replace the manual communications will not provide optimal solution to the existing problems. The new technology offers new opportunities. The existing methodology of communication among the various stakeholders needs to undergo a thorough review. The researchers at the universities now can involve their district level KVKs, extension functionaries and even the farmers right from the beginning of the project. They can share their objectives, their methodology of research, methodology of analysis and also the observations and intermediate results with the concerned fellow scientists and the interested farmers. In this open system, the other stakeholders can provide feedback and their suggestions to the researchers at every stage of experimentation. In some cases, even the farmers can participate in adaptive research. The validation of research can definitely be undertaken at an appropriate number of locations within the concerned agro-eco-zone, with the results of the same being shared among all stakeholders on-line, at various stages of research.

SREP and Work Plan Implementation Through Block Technology Teams

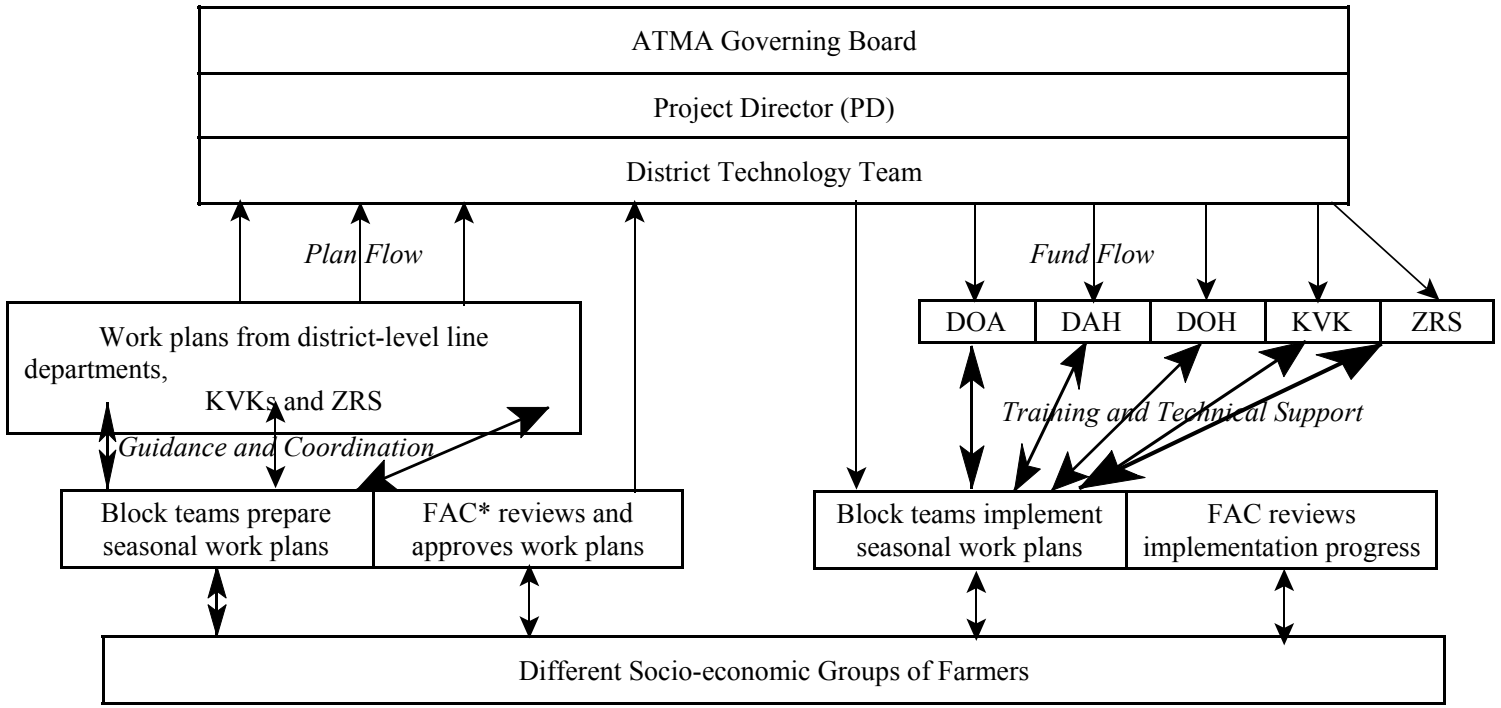

Figure 2. Institutional Reforms in Public Sector Extension

Note: * Farmers' Advisory Committee.

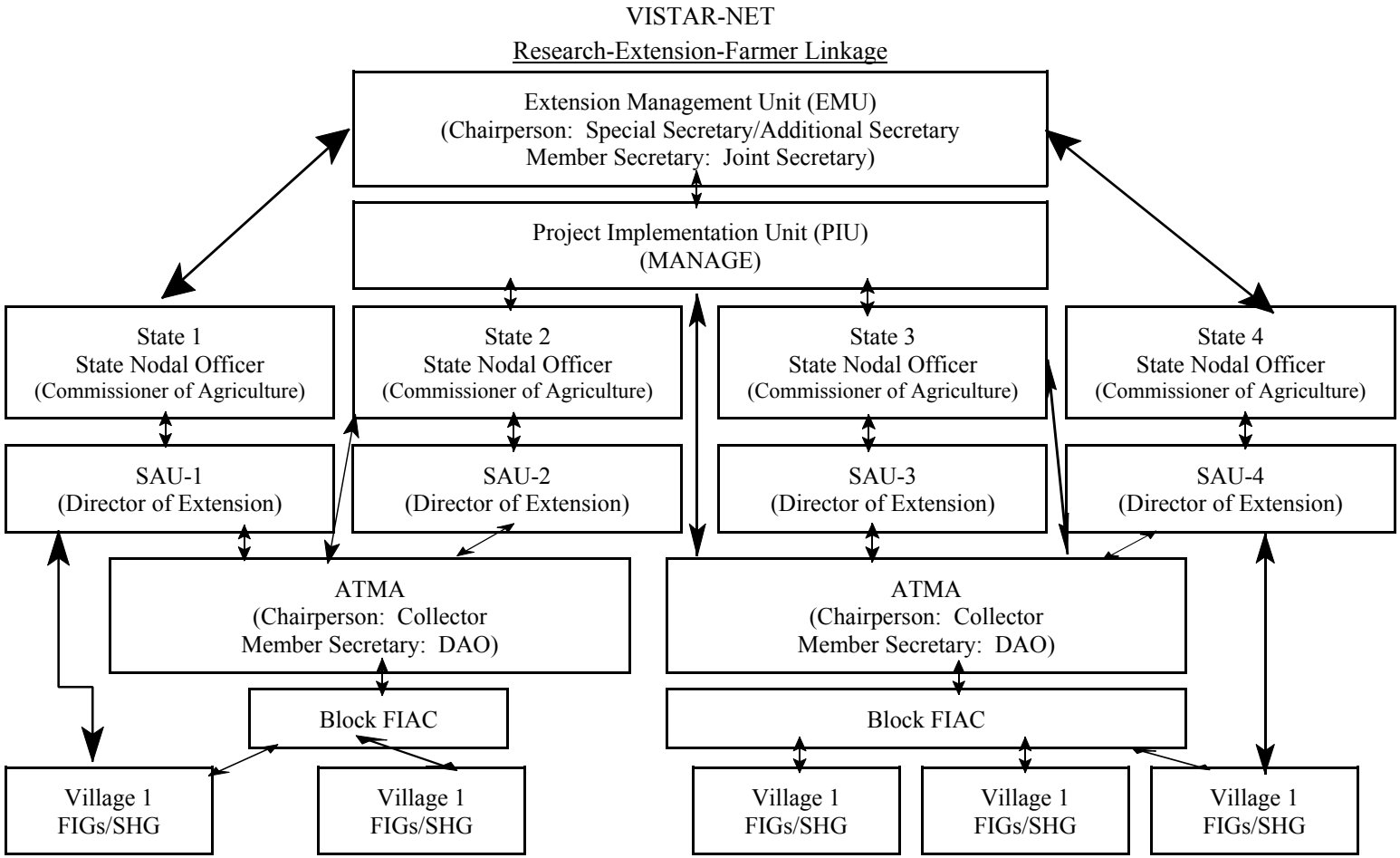

Figure 3. Research Extension Networking with IT

The packaging of research recommendations could also be affected in more participative ways with the help of information and communication technology (ICT). The extension functionaries at the district level could be taken in to confidence before final packaging of the "Practices" for each crop. The experiences and results of various trials could also be indicated in the proposed package of practices. The extension functionaries may then keep the concerned researchers informed on the field, electronically. This way IT can really help both the researchers and farming community to talk to each other on a regular basis. Moreover, IT could serve to increase the efficiency and effectiveness of information transfer. New technologies for desk-top publishing, power-point presentations, digital images, and lower cost audio-visual hardware have varied applications to extension services.

Enabling Research-Extension-Farmer Linkages: Getting Started. The process of ICT enabling the research and extension will require a few important steps to be taken. These include:

1. providing connectivity to all SAUs, ZRSs and KVKs, i.e., providing required hardware and software to all the above institutions;
2. capacity building of all the scientists at SAUs, ZRSs and KVKs in ICTs;
3. one time digitization of all extension literature of SAUs/ZRSs/KVKs in English and local languages;
4. integration of weather related forecasts – short and medium term;
5. integration of agricultural marketing data (including market prices, marketing intelligence and State/district-specific forecasts) with extension information delivery;
6. integration of information on allied subjects like animal husbandry/dairy/fisheries/ horticulture/sericulture, etc. with the extension information (making it holistic for farmers);
7. providing access/links to "*e*-governance" sites in the district/zone/State;
8. providing technical ICT support to all these agencies for a critical period of one year;
9. developing a mechanism for 'face-to-face' or telephonic follow-up of 'knowledge-transactions' on monthly/quarterly basis among research-extension agencies within a district/zone/State; and
10. monitoring of all 'information transactions' among these institutions and also with extension functionaries/farmers for at least one year.

This process has to be complemented by extensive 'on-line' networking of 'extension agencies' up to at least block-level. The experiences of NATP have been very positive in terms of providing connectivity at district level, KVKs and block level. The capacity building experiences of NATP can be particularly helpful in planning and implementation of "IT Enabling of Agricultural Research System". It is proposed to link all agriculture offices in the public sector right down to the district (590) and block (5,600) level with computer (internet) connectivity during the 10th Five-Year Plan (2002-07). Below of the block it is proposed to do away with the public extension functionaries. During the same period, the Agriculture Research Information Service (ARIS) would be ready enabling all extension agents up to the block level to directly access the latest research findings within the ICAR.

Under the ICAR the project ARIS is being implemented to bring information management culture to NARS so that agricultural scientist can carry out research more effectively by having systematic access to research information available in India as well as in other countries, better project management of agricultural research, and modernization of

the office tools. The basic infrastructure required for linking all ICAR institutes has already been created. The *e*-mail connectivity has been established in 72 out of 86 ICAR institutes by linking through dial-up including six institutes with VSAT connectivity using NICNET and ERNET services. ARIS has four information modules, namely: Agricultural Research Personnel Information System (ARPIS); Agricultural Research Financial Information System (ARFIS); Agricultural Research Library Information System (ARLIS); and Agricultural Research Management Information System (ARMIS). The ICAR is also running an Agricultural Research Information Centre (ARIC) as the central source of information on all research projects and schemes financed by the ICAR.

FARMER TECHNOLOGY INTERFACE

Rural telecommunications systems – ranging from the simple pay phone to digital wireless cellular phones and internet systems – are powerful tools for improving rural communications and information systems. Bridging the digital gap between rural and urban areas expands flow of information of all types and facilitates market transactions, changes in employment, globalization, increases in competition, emergence of new industries, and social transformations. Rural tele-cottages, serving rural areas with 5-10,000 population are a proven means of providing services to rural people. These and other communications services may require initial subsidies, but over the longer term the private sector should be expected to exploit them as viable commercial opportunities, as evidenced by the proliferation of video rental and photo-copy shops in many rural towns. Internet promotion and pilot projects, internet policies, and infrastructure investment can stimulate use and creative applications of the internet for rural users.

The concept of "Rural Tele-cottage" or "Village Information Shops" is being discussed, debated and experimented in India at various places. The following case studies are discussed to illustrate the increasing use of ICT in reaching farmers. These case studies provide valuable insight into the information needs and paying capacities of the rural community. Preliminary results indicate that, 'Agricultural Extension' alone is not sufficient to sustain 'Information Shop' at village or even at block level. The concept of "extension" will need to be significantly expanded making it a rural information supply domain which has to encompassing of not only economic but also social content. It needs to be dynamic in nature so as to offer value-adding information like market prices, local topical information like bus and railway timetables, weather forecasts, etc. Five case studies are discussed in the paper.

Case Study 1: The Information Villages Project: Pondicherry

The Information Village project, implemented by the M. S. Swaminathan Research Foundation in collaboration with International Development Research Center (IDRC), is aimed at bringing the benefits of modern ICTs to the rural population. The specific objectives of the project are: (1) to set up Village Knowledge Centers that enable rural families to access modern ICTs; (2) to train educated youth especially women, in rural areas in operating information shops; (3) to train rural youth in the organization and maintenance of a system that generates locally relevant information from generic information; (4) to maintain, update and disseminate information on entitlements to rural

families using a blend of modern and existing channels of communication; (5) to measure the impact of information shops and ICT through surveys, participatory rural appraisal and other methods; and (6) to build models of information dissemination and exchange in rural areas that use advanced ICTs. The Project is located in the Pondicherry region in south India. A Value Addition Center (VAC) has been established at Villianur and is functional since February 1998. It acts as the hub of the communication network in the Project. Four Village Knowledge Centers have been set up at Kizhur, Mangalam, Embalam, and Veerampatinam.

VAC – The premise is that value addition by professionals to networked information is an important step in enabling rural families have access to it. A small office in Villianur serves as a VAC. Villianur is a market center for many hamlets that surround it and is also an administrative node and a road junction. Project staff at VAC scan the WWW for useful contacts and technology. Data gathering and value addition to data are carried out here and information is transformed to suit local queries or needs. This is also an exchange point for a variety of locale-specific information on health, transport, public events, subsidies, prices, weather, etc. Information on developmental programs (entitlements, credit, inputs, etc.) and markets is maintained here. The VAC has two personal computers (PCs), a scanner and a printer; a telephone line for long distance calling facility. This telephone has dial up access to internet provided by VSNL. A LAN based on VHF radio has been established has been established with Villianur office serving as a hub handling voice and data. The strategy is to create a wireless network (VHF) in the local area, which connects to a fixed telephone line through which access to internet is available. From here *e*-mail can be sent online while *e*-mail to other villages can be received at Villianur and forwarded. There is a reading room with a small collection of books and documents in Tamil on various aspects of agricultural production. A collection of government notifications is also maintained in the VAC. A number of locally relevant databases in Tamil have been created to meet the felt-needs of the rural families on families below poverty line; public welfare schemes or entitlements to the rural population.

Village Knowledge Centers – Village Knowledge Centers have been established at Kizhur, Embalam, Mangalam and Veerampatinam and are linked to VAC. Meetings were held with various groups within the community in each village to identify volunteers who would operate the Knowledge Center and to identify the shop's location. This helped in identifying community's information needs. The Centers provide information related to health, credit, input price and availability, transport, market information, meteorological information, information for pest surveillance and agronomic practices, data on entitlements to rural families. Each Center has a Pentium PC with multimedia, VHF transceiver with a workstation-cum-storage box designed by the project staff, and a desk jet printer. The PC can be connected to the wireless network through a modem and a specially designed interface. Each Center also has a board to display bulletins received on *e*-mail from the VAC. The Center also enables a visitor to make voice call within the region. A circulating library of educational CD-ROMs is maintained by VAC for use in the Centers.

C In Kizhur village volunteers were chosen by the general body of the council, which also nominated a 23-member group of 14 men and nine women to guide the shop's operations. The volunteers, one woman and one man, belong to the elected family

which has set aside a portion of their house for the Center. They have been trained on basic operations of PC, handling *e*-mail and use of HTML.

- In Embalam village all volunteers are women. Each of them spends half-a-day at the Center and takes turns to attend work. The Center is located in the premises of the village temple owned by the community. In addition to bulletins by *e*-mail this Center also receives real audio files containing the same information to facilitate its use by illiterate women.
- In Veerampatinam village, where majority are fishermen families, the village has its own *panchayat*, which has allotted space in its own office for the Center to function from. Three volunteers, two women and one man have been identified and trained in handling PCs and data communication. This Center receives data on fish aggregation off the coast of Tamil Nadu and Pondicherry from National Remote Sensing Agency.

Case Study 2: *Gyandoot* – Cyber-café-cum-Cyber-offices

On 1 January 2000, Dhar district, in Madhya Pradesh State in India began the new millennium with a mass-based information revolution. Computers in 21 major centers in five blocks of the district were connected through an intranet network. These computers have been established in *gram panchayats*. They have been called *Soochanalayas*. From the *Soochanalaya*, user-charge-based services are given to the people and at the same time the IT-related developmental needs of government departments and *panchayats* are met free of cost. This intranet has been named *Gyandoot*. Internet web-site is www. GYANDOOT.NET.

The 21 centers where *Soochanalayas* have been established cater not only to the 21-villages but also to surrounding 25-30 villages. *Soochanalayas* have been established in the buildings of such *gram panchayats* which are located either at block headquarters or at prominent *haat bazaar*. The benefits cover wide-ranging information needs of the village community. The *Gyandoot* network benefits over half a million population living in 311 *gram panchayats* and over 600 villages. The *Soochanalayas* are located on the roadside and are central villages where people normally travel. *Soochanalayas* are 21 client sites/nodes working as rural cyber-café-cum-cyber-offices. Server/hub is a Remote Access Server (RAS) housed in the computer room in *zila panchayat* to be called *Soochana Kosh. Soochanalayas* have telephone line connectivity to begin with. The hardware is procured and given to the *gram panchayat* under agreement with the *zila panchat*. The *gram panchayat* in turn gives it for operation to the *Soochak* under agreement. The *gram panchayat* provides, readies and maintains the building where the *Soochanalaya* is housed. It also provides the telephone and electric connection as well as the furniture.

The person operating the *Soochanalaya* is a local matriculate operator and is called *Soochak. Soochak* is not an employee but an entrepreneur. *Soochak* only needs maintenance and numeric data entry skills. He needs very limited typing skills since most of the intranet software is menu-driven. He is similar to a subscriber trunk dialed booth operator. Three member panels were selected who received training at their own cost at the *zila panchat*. At the end of the training, the best trainees were selected as *Soochaks*.

at his own cost. Each *Soochak* is expected to earn a net income of at least Rs.30,000 per annum at conservative projections. The following information is available at the *Soochanalaya*:

- ***Commodity Prices*** – The variety-wise rates of 15 prominent cereal crops as well as the volumes of incoming agricultural produce are provided to the villagers from *Soochanalayas*. These rates are quoted for nearby Dahod as well as distant Mumbai and Delhi *mandis*. The previous two days' rates are also given. Horticulture crops like tomato, potato, peas, green chilies and guava are also produced in substantial quantity in the district. The rates of these commodities are provided in case of Ratlam, Indore, Chennai, Ahmedabad, Mumbai, Delhi and Hyderabad *mandis*. Charges for these price information are Rs.5.
- ***Copies of Land Records*** *(Khasra*, B1/*khatauni* and map) – Documents relating to farmer's land including map, *khasra* and B1 are given on the spot at a charge of Rs.15 per extract. All the banks in the district have agreed to accept extracts issued from *Soochanalayas* for the purposes of banking transactions. Farmers need these extracts every *kharif* and *rabi* season to obtain crop loans from banks for purchasing seeds and fertilizers.
- ***Online Registration of Applications*** – So far, the villagers had to go to the *tahsil* court to file applications for obtaining income/caste/domicile certificates or for getting demarcation done or for obtaining landholder's loan passbook (*rin pustika*). For this, they would again made repeated visits to the court to enquire about the progress of the application as well as to finally collect the prepared document. Now, through *Soochanalayas* they may send the application at a cost of only Rs.10 and thereafter, in a maximum period of 10 days, preferably less, an intimation of the readiness of the certificate would be sent back to them through *e*-mail at the concerned *Soochanalaya*. Thereafter, they may go to the concerned court to collect the certificate.
- ***Public Grievance Redressal*** – Wherever there is some problem in the delivery of services, the villagers travel at the cost of time, money and livelihood to block, *tahsil* or district headquarters without any certainty that they would even be able to meet the officer concerned. Now through the *Soochanalaya*, the villager may send his/her complaint with assurance of reply within a maximum period of seven days, preferably lesser, at a charge of Rs.10. The reply of the disposal of his complaint may be received back at the *Soochanalaya* through *e*-mail. Complaints include hand-pump disorder, teacher absence, mid-day meal, scholarship sanction/disbursement, poor seed/fertilizer, employee establishment (matters like leave or provident fund sanction) queries, etc.
- ***Hindi E-mail*** – The district and block levels may communicate through *e*-mail among themselves.
- ***Interactive Multimedia Training*** – Through computers, government functionaries may be trained interactively using multimedia techniques. Schoolchildren may be given interactive multimedia education of high quality.

Case Study 3. Warna Wired Village Project

Warna Nagar, a cluster of 70 villages in Maharashtra is an eye of the "Wired Villages" project. Warna Nagar cooperative society and its sub-societies include Warna Dairy Development Society, Warna Cooperative Bank, Warna Foods, Warna Women's Cooperative Society, etc. Sugarcane is major crop of this area and most of the sugar production of the two districts of Kolhapur and Sangli is processed at this Society. From each village 200-300 farmers are registered as society members. The "Wired Village" project initiated in 1998 has been jointly implemented by the Government of India through National Informatics Center (NIC), Government of Maharashtra and Warna Cooperative Society. The manpower and maintenance cost is borne by the Warna Cooperative Society itself. NIC, Pune was involved in setting-up the hardware and software and NIC, Delhi established connectivity of WAN links such as VSAT and dial-up connections. The software required for the system such as web page designing, database designing and client-based applications used by the farmers such as dairy, sugarcane information systems had been developed by the NIC, Pune.

Central Hub – The central hub, which is the main server station of "Wired Villages" is situated in Tahasaheb Kore Institute of Engineering Technology at Warna Nagar. This is equipped with servers based on Pentium II with 64 MB RAM, 4.1 GB hard disk and 32x CD-ROM drive. The 64 kbps band-width VSAT connection has been established as a gateway WAN link to NIC, Pune for connecting into their network and into global network. This enables the main computer center to download information from NIC, Pune or the global network for latest information. The router is used to establish a WAN link to remote computer booths from the main computer center. Presently the router supports 10 simultaneous connections, i.e., 10 users can access information at a time.

Computer Booths – The computer booths are serving as information centers for the farmers in their villages. The computer booths are provided with a Pentium II computer having 64 MB RAM, 2 GB hard disk, printer and an UPS (uninterrupted power supply) power backup system. a dial-up connectivity with a modem and telephone line has been used to connect the main computer center to retrieve the information, send the queries, grievances to the central server station. The speed of dial-up connection is around 19,200 BPS (bytews per second) to 28,000 BPS and average connectivity time is about 10 seconds. Telephone charge of around Rs.350 is paid by village level society. The computer booth is operated by the booth operator the main link between the farmers and information gateway center.

Information Needs – The information sought relates to crops cultivation practices, land development, pesticides, diseases control details, marketing details, bills payments positions of sugarcane and dairy, etc. Apart from information retrieval, there are two client-based applications, to serve the farmers needs. They are: (1) Dairy Information System; and (2) Sugarcane Information System.

- In *Dairy Information System*, the information on all the farmers, who are part of the dairy system, is maintained. Other details available to members of the dairy cooperatives include the quantity of milk supplied by each farmer, fat content, their billing information and credit details, etc. This information is maintained and updated at the central database on daily basis.

C In *Sugarcane Information System*, information on shareholders is maintained. About 200-350 shareholders are there in each village for sugarcane crop. This system maintains the details of the cultivation schedule; quantity harvested and supplied to the society, deductions effected by the society towards credits, net income due to the farmers is available with respect to each shareholder.

Every village is also linked with the Directorate of Marketing in Pune, which facilitates farmers in getting information on rates of vegetables, fruits and other crops.

Information Technology Center – Six Information Technology Centers have been established to give training to staff, students and farmers of the village. These centers also function as computer booths and are maintained by a booth operator. NIC, Pune has developed a Computer-based Question Bank, in the local language "*Marathi*" which will be used to test the computer knowledge awareness of the students of 5th-10th standard. These students are being trained to get acquainted with the computer systems. Testing will be in subjects covered in the school like mathematics, science, etc. and a certain percentage of marks will be awarded from this test to the final marks of the students. A batch consisting of five students will be examined for one hour. This center also serves as a computer booth. NIIT (National Institute of Information Technology) is engaged in helping create CDs on different topics which when available will be used at these centers for interactive coaching.

Case Study 4. Parry's Corners: *e*-Inclusion of Farming Community

EID Parry (a company of Murugappa Group in South India), in association with n-Logue Technologies, a rural communication technology diffusion firm set up under the aegis of Telecommunications and Computer Networks (TeNeT) team of IIT (Indian Institute of Technology), Madras, has connected 38 villages in Nellikuppam *taluka* of Cuddalore district of Tamil Nadu. The technology deployed is the corDECT Wireless Access Technology (which allows simultaneous flow of voice and data on a single line at a much cheaper rate).

The corDECT system was deployed with the Access Center at Nellikuppam, the town where the 150-year-old Parry Sugar Factory is located. Since then about 38 internet connections have been given in the villages surrounding the area. Out of this, 14 are kiosk run by franchisees, who are farmers from the respective villages. In the next few months, the facility will be extended to another 150-odd surrounding villages falling under the 25-km radius, which would benefit over 25,000 farmers in the region. The kiosks, as they are called, are not the ordinary internet surfing centers which city dwellers are used to. Most of the kiosks are set up at the residence of a farmer selected by the company on the basis of his credentials. Each kiosk has a corDECT wall set, a PC, printer, telephone, furniture and a power source with a back-up. The company at present is providing the facility free of cost, but plans to charge the farmers once the mission takes off.

Parry has developed an agri-portal www.indiaagriline.com that can be accessed by farmers through the kiosks. The content of the portal covers seven topics such as details about farm practices, farm business, farm advisory services, community details such as prices of different crops in nearby markets, weather reports, etc. The portal also offers

detail information about six crops including sugar, banana, cashew, tapioca and groundnut. Besides, the portal has personalized content like the details about payment by the sugar company to farmers, etc. and other generic local contents like finance schemes available with the local banks, high secondary examination results, etc. While farmers can access the generic information from any of the kiosks freely, they need to register with kiosk for accessing personal information.

The project in one stroke not only hooks the farmer to telephone network but also to the internet at a speed of 28/64 kbps. The facility is slowly changing the life of the farmers, who, instead of traveling to the company or other places to get their business done, now walks into the neighborhood kiosk and click the mouse to get the information. According to one farmer Arunachalam, who is a sugarcane grower and runs the village kiosk in Pagandai, "Farmers, though illiterate or semi-literate, now realize the potential of the technology. Slowly, it is trickling down and in the near future we can expect more people using the technology". Nearly 50 farmers from the surrounding area are visiting his kiosk at his house and making use of the technology he says.

Case Study 5. Information Technology at Farmers' Doorstep

National Institute of Agriculture Extension Management (MANAGE), an autonomous organization of the Ministry of Agriculture, Government of India, has undertaken a project on providing "Information Technology at the Farmers' Doorstep" in Rangareddy district of Andhra Pradesh. Computers were installed in 11 villages in the Rangareddy district in 2000. One system with one printer, a modem a 1 KVA UPS was provided to each village. The systems were placed in the premises of MACTCS (Mutually Aided Cooperative Thrift and Credit Societies). The connectivity at these 11 villages was set up at a total cost of Rs.1.1 million. In the Rangareddy district project, the 11 village information-kiosks cater to surrounding 25-30 villages, where these MACTCS have group members. These places are well connected with major roads, which are important from the point of the catching bus, etc. Thus the total reach of the Rangareddy district project is around 250-300 villages.

Village Information-Kiosks have telephone line connectivity to begin with. The hardware is procured and given to the women groups or farmers' groups under agreement with the president of the respective MACTCS. The MACTCS have an accountant (basically to maintain MACTCS finances), and a manager and 10-12 organizers who manage the village information-kiosks. Two of the MACTCS have constructed their own buildings and have provided adequate space for "computer room". They have also provided the telephone and electric connection as well as the furniture. These functionaries have been provided "Basic IT Training" by MANAGE IT facilitator at the village information-kiosks sites. MANAGE has provided the service of one IT facilitator at each of the 11 village information-kiosks for a period of six months to ensure proper training to all the farmers and farm families (the ladies, boys and girls), and also to assess

the information needs at the village level. The IT facilitators at these village information-kiosks have already trained over 20 persons at each site on "MS Office", internet and *e*-mail, browsing and search engines. At some of the villages the younger generation has already learned MS-FrontPage and other web-designing software tools. These high school level students have shown very keen interest in learning new technology. The language has not been found to be a barrier.

Service Provision – Most of the farmers in these villages are involved in vegetable cultivation and they supply their produce to the city market. Government of Andhra Pradesh has opened eight *Rythu Bazars* (farmers' market), where the farmers (or their family members) can bring their produce and sell the same to the consumers directly. MANAGE has arranged to host the *rythu bazar* prices on its web-site and all the farmers can have access these prices very early in the morning everyday. Moreover, the general market prices of agricultural produce, across the whole country are also accessible to these village information-kiosks, through agriwatch.com. Agriwatch.com has given free access to their web-site to these 11 villages (although the access to the pricing information on their web-site is otherwise priced).

The farmers also access the MANAGE web-site to learn about various training programs in and around Hyderabad. They access Rangareddydistrict.com to learn about the various development schemes of the district. The District Rural Development Agency has put up all its schemes and their operational guidelines on their web-site. These include various watershed programs, cooperatives, Department of Agriculture Schemes, youth programs, housing, programs for handicapped persons, programs for animal husbandry, programs for scheduled tribes and Nehru *Yuvak Kendras* (Nehru Youth Centers). Access to information puts pressure on State development officers to deliver results in time. Transparency has improved as a result of the IT. The rural community have become of their eligibility for housing loans, crop loans and other schemes and they are able to inform the concerned officers about their demands with full supporting documents, very much in time, due to information availability through the web-sites. The rural community is also using multimedia CD learning packages for making pickles, learning about maternity and child health, importance of child education, issues regarding child labor, nutritonal aspects and also expert systems on crops.

Empowerment of Rural Women – The knowledge and skill level of MACTCS directors has improved very significantly. MANAGE had utilized their enhanced skills on internet, at recently held Krishi Expo 2002 at Delhi during 27 February-5 March 2002. Two of the MACTCS members (one director and one president) were part of the MANAGE team and they made an excellent presentation to the Honorable Union Minister of State for Agriculture. They also made presentation during the seminar on "Information Technology in Agriculture and Rural Development" at New Delhi. It was well received and women members from far-off States of Uttar Pradesh and Bihar discussed with them, on the use of IT for rural areas and planned exposure visits to each others place.

Examples from Developing Countries

It initiatives in agriculture are taking shape in several developing countries. Many new initiatives seek to facilitate access by farmers to internet-based information networks, computer databases and multimedia tools:

1. ***Telephone Network in Rural Areas***

- In many developing countries women do much of the agricultural work. They may take crops to market or negotiate prices for their crops or livestock. In such cases, the benefits of telecommunications in getting information about prices and markets and in getting expert advice from extension agents should apply to women.
- In Bangladesh, Grameen Phone has established a rural mobile telephone network run by women who rent them out to other villagers to earn extra income for their families. Choosing women to manage these initiatives, aims to address the unequal power relations that exist between men and women in these communities, helps to erode the existing hierarchies, and promotes development goals that are based on more broad-based and bottom-up knowledge strategies.
- Rural telephone switches are being produced by and for India. In 1980, India had fewer than 2,500,000 telephones, almost all of them in a handful of urban centers. The country had only 12,000 public telephones for 700 million people, and 97 percent of India's 600,000 villages had no telephones at all. India was using its priceless foreign exchange to buy the West's abandoned technology and install obsolete equipment. The technological disparity was getting bigger, not smaller. By 1987, a three-year effort by many of India's young engineers had produced a series of telephone switches, manufactured in India to international standards, and adapted to village use. The 128-line rural exchange was housed in a metal container, cost about US$8,000, required no air conditioning, could be installed in a protected space in the village, and would switch phone calls more or less indefinitely in heat, dust, and monsoons.
- An organization of artisan fishermen on the pacific coast of southern Honduras has "learned to use video to document the destruction of their mangroves by politically powerful commercial farmers. One fisherman simply holds up a newspaper to establish the date while another records the company-owned bulldozers plowing under mangroves in the background. These snippets, the fisherman have learned, can be sent to friendly politicians in the Honduran Congress".

2. ***Satellite Imagery***

- In the Philippines, land resource maps were developed for the entire country, demonstrating that useful national land resource data could be completed in a short time at low cost. The project produced map coverage and national, regional, and provincial statistics within one year for about US$1.7 million. The study was jointly funded by the World Bank, the Swedish Agency for International Development, and the Philippine Department of Environment and National Resources.
- Using satellite data a comprehensive land resource database of the Arun River basin of Eastern Nepal was developed from existing maps and photos. Outputs included the first ever basin-wide mosaic of land usage and capability, maps of forest degradation hot spots, and sample land resource maps and data of improved quality. The database and simulation models revealed important observations that were helpful during project design and execution. Total cost was US$20,000, about 2 percent of the cost of the environmental assessment. Existing maps and photographic information were utilized beyond their initial intent, supplemented with field work where necessary. Existing data would have been difficult or impossible to use manually.

3. ***Web-sites and Internet Connectivity***

- The "Pakistan.com" web-site is dedicated to improve the knowledge access to Pakistani farmers. The attempt is to provide the extension services to the farmers at village level.

- Toolnet is a network for small-scale development projects that fosters exchange of information, experiences, expertise, and solutions to technical problems. It provides multifunctional electronic mail to link field workers, local organizations, technological institutions, international development organizations, and individuals to each other and to national and international networks. It is sponsored by TOOL, a non-profit organization in the Netherlands directed toward technology transfer to and among developing countries. Toolnet access points are operating or planned in about 25 countries worldwide.
- The IDRC Pan Asia Networking Program (www.panasia.org) aims to connect institutions such as universities and education and research centers in regional networks.
- A pilot project in the Philippines in *barangays* in Mindanao is bringing together internet access, computers and practical training resources in Multipurpose Community Telecenters (MCTs). The MCTs, a partnership between government, private sector, community and academic organizations, provide Philippine-related information on a wide range of subjects from health and education to rural enterprise development and agriculture.
- The Farmknow web-site established by the China Agricultural University has been established to allow farmers around Beijing to diagnose problems with their vegetable crop from a database of over 70 locally occurring agricultural diseases and 30 insect pests. Farming specialists are available to provide assistance and respond to *e*-mail questions.
- India emerges as one of the leading IT economies in the world – with especially rich activity ongoing in hi-tech hubs like Bangalore, Chennai and Hyderabad – there are few problems finding highly talented programmers to create web-based extension sites. Publicly and privately created agricultural portals in India are quite similar in scope and services to those in the United States, and have proliferated in the past year. These include Khetibaadi, India Agronet, Kisan, Krishiworld, Krishi Udyog, and AgriWatch. The Agricultural Gateway to India (AGI) is a public portal which provides a broad selection of resources including multilingual audio descriptions of rice varieties.

4. ***Community Information Center***

- Community information center provides diverse access to internet, information services in response to community needs: public telephone and fax; government service directories; regional employment listings; agricultural prices from brokers in several cities; posting crop and pest observations for the agricultural extension agent; electronic mail for distance education radio courses; and self-paced training. The center is supported by user fees and subscriptions, provider charges for some postings, sectoral support for educational and agricultural activities, and vouchers from other sources exchanged by users for services. In the Philippines, a government Information Sharing Technology Network is planned to link government offices down to the community level and to collect public opinion and economic planning data.

5. ***Capacity Building Networks***

- Science networks are supplanting journals. A daily wire service is operational for preprints and live reports by researchers in more than 10 disciplines in agriculture and life sciences. About 20,000 *e*-mails flow daily to more than 60 countries with abstracts of new preprints and research reports. Thousands of full papers are downloaded daily. IT has completely changed how people in the field exchange information.

- Digitization of libraries is putting valuable information literally at the finger tips of internet users.
- New demands for education and training must be met. Demand for specialized informatics professionals, computer literacy throughout the workforce, and lifelong training are challenges for most countries in the face of rapidly changing technology and shifts in job mixes. Meeting the demand will require the efforts of universities, private companies, training institutions, computer societies, and accreditation councils.

CONCLUSION

1. ***Enabling Environment for IT***

There is need to create an information-friendly environment, characterized by telecommunications reform and information policies; laws protecting investment, open and well-regulated information and communication markets; education policies that favor a skilled labor force; and effective regulatory and standard-setting institutions. Such an environment supports availability, diversity, and low cost of information services and products. Clearly, the task of creating such environment falls to not one but all of the partners for development.

2. ***Creating Suitable Infrastructure***

For any IT program to succeed requires basic infrastructural requirements and systems development (telephones, electricity, telecoms service providers), together with availability and responsiveness of technical support and expertise.

3. ***Development of Software and Information Content***

To be useful to the end users there is need to develop information content and format appropriate to the context of users. Also to develop capacity of managers/operators of information services to identify and supply the information needs of users and human capacity (literacy, numeracy) of beneficiaries to make use of information.

4. ***Making IT Sustainable***

While a limited number of pilot programs can demonstrate the usefulness of the IT, in the long run the IT will spread in the rural areas if it can lead to income generation, cost recovery, ability to pay, participatory market demand assessments to identify optimal location of information services. There is need for exploring options for and promoting new partnerships between government agricultural information services and the private sector which can benefit poor farmers.

5. ***Building Capacities***

A massive capacity-building program for information managers at various levels needs to be designed which is flexible and responsive to the local context in which information is used and generated. There is need for provision of training packages and information management resources as well promotion of local capacity in information collection, storage and dissemination including using innovative formats for the target audience based on the local cultural context. Developing appropriate training materials for field level, national and regional organizations is also required.

6. ***Linking "Old with New"***

There is need for developing new mechanisms to link ITs with traditional face-to-face communication; building on existing systems to develop more decentralized information management and exchange. Developing new ways of building on existing agricultural information systems rather then building new ones. Promoting the integration of internet, IT

and traditional information systems within the new pluralistic approaches to agricultural extension.

7. ***Learning from Success Stories***

Developing models for realistic approaches to IT that can be used more widely according to the scale of the infrastructure and resources available. Providing a forum for discussing and evaluating international experiences that contribute to lesson-learning and constitute best-practices.

The IT revolution is sweeping the world. Technological capacity to transfer information and communicate across large distances has increased rapidly in recent years. In the developing countries the urban areas are increasingly harnessing IT to improve their quality of life. But this information must be made available to the rural areas as well if the benefits of IT are to empower the rural communities to improve their livelihoods, rather than perpetuate existing social, economic and political disparities between the 'information haves and have nots'.

REFERENCES

Bhaskar, G. and K. Venkateshwar Rao, 1999. *Case Study on Warna Wired Villages*, MANAGE, Hyderabad.

Carney, Diana, 1998. *Changing Public and Private Roles in Agriculture Service Provision*, Overseas Development Institute, London, U.K.

Crowder, Van L. and J. Anderson, 1998. *Integrating Agricultural Research, Education and Extension in Developing Countries*, Research, Extension and Training Division, FAO, Rome.

Engel, P., 1990. "The Impact of Improved Institutional Coordination on Agricultural Performance: The Case of the Nariño Highlands in Colombia", Linkages Discussion Paper No. 4, The Hague: International Service for National Agricultural Research (ISNAR), Sage Publications, CA.

FAO/CP Investment Centre, 1997. *National Agriculture Technology Project*, India and FAO, Rome.

Francis, C. A., *et al*., 1995. "Designing an Integrated Cropping Systems Research Program: Central Agricultural Research Institute (CARI), Liberia", *Journal of Sustainable Agriculture*, Vol. 5 (3).

Kaimowitz, D., *et al*., 1990. "A Conceptual Framework for Studying the Links Between Agricultural Research and Technology Transfer in Developing Countries", in D. Kaimowitz (ed.) *Making the Link: Agricultural Research and Technology Transfer in Developing Countries*, Westview Press, Boulder.

Mashelkar, R. A., 1999. "Economics of Knowledge", 16th Deshmukh Memorial Lecture, India International Centre, New Delhi, India.

Merrill-Sands, D. and D. Kaimowitz, 1989. "The Technology Triangle – Linking Farmers, Technology Transfer Agents and Agricultural Researchers", The Hague: ISNAR.

Ortiz, R., 1990. "A Joint Venture in Technology Transfer to Increase Adoption Rates", in W. F. Whyte (ed.) *Participatory Action Research*.

Roling, N., 1990. "The Agricultural Research – Technology Transfer Interface: A Knowledge Systems Perspective", *Making the Link – Agricultural Research and Technology Transfer in Developing Countries*.

Schmitz, J. G., 2001. "Agricultural Information Systems", P. Bhatnagar (ed.) *Proceedings of the India Soy Forum*, SOPA, Indore.

----------, 2001. "Digital Libraries and Web-based Training", in B. Khan (ed.), *Web-based Training*, Educational Technology Publications, NJ.

Schmitz, J. and C. Hewes, 1996. "Agriculture on the Web: Future of the Cyberfarm", Proceedings of Information Agriculture 1996, Potash and Phosphate Institute, Atlanta, GA.

Sharma, Rita, 1997. "Agricultural Reforms: View from the Field", *The Economic Times*, New Delhi, India, March 1997.

----------, 1999. "Privatization of Agro Extension Services", *The Economic Times*, New Delhi, India, January 1999.

----------, 1999. "Agriculture Research and Extension Interface – Indian Experience", *Agricultural Research and Extension Interface in Asia*, proceedings of the study meeting organized by National Productivity Council and Asian Productivity Organization, held in New Delhi, India, 16-21 December 1997, APO, Tokyo.

Sharma V. P. and Lakshmi Murthy, 1999. "Case Study on Info Village Project", M. S. Swaminathan Research Foundation, Chennai, MANAGE, Hyderabad, India.

Sharma, V. P., 2002. Personal correspondence, MANAGE, Hyderabad, India.

Sivakumar, S., 2000. "Soya Chaupal: An Integrated Concept as a Model Solution", *Oils and Fats Today*, SAARC.

Van den Berg, Margreet H., 1999. "The Agricultural Knowledge Infrastructure: Public or Private?", an exploratory study in collaboration with the Extension, Education and Communication Service, Research Extension and Training Division, FAO, Rome.

World Bank, 2001. *Agriculture Extension Investments: Future Options for Rural Development*, Agriculture and Rural Development Department, World Bank, Washington, D.C.

1. BANGLADESH

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INTRODUCTION

Bangladesh is a low-lying country with a total area of 56,977 miles^2 or 147,570 km^2. It stretches latitudinally between 20º34' and 26º38' north and longitudinally between 88º01' and 92º41' east. It is largely surrounded by Indian territory except for a small strip in the southeast which lies adjacent to Myanmar. Bay of Bengal lies on the south. Most of the country's area is relatively flat lying in the deltaic plain of the Ganges-Brahmaputra-Meghna river system. The only significant uplands are in the northeast and southeast of the country with average elevation of 224 m and 610 m, respectively. The country is covered with a network of rivers and canals forming a maze of interconnecting channels.

Bangladesh has a tropical monsoon climate marked by sweltering temperatures and high humidity. The country has primarily four seasons; the winter (Dec.-Feb.), summer (Mar.-May), monsoon (June-Sept.) and autumn (Oct.-Nov.) During summer and monsoon tropical cyclones, storms and tidal bores are not uncommon.

The population of Bangladesh is about 125 million. Majority of the population are Muslim. Hindus, Buddhists and Christians make up 13 percent of the entire population. Over 98 percent of the people speak Bengali, English however, is widely used.

The lowest administrative unit is the union run by an elected union council. Each union comprises about 20,000 inhabitants and about 8-10 unions cluster into an *Upazila*. Government services are concentrated at the *Upazila* level. There are about 460 *Upazilas* in Bangladesh. Several *Upazilas* form a district. The total number of districts stands at 64. The entire country is broadly divided into six administrative divisions, namely, Dhaka, Chittagong, Khulna, Rajshahi, Barisal and Sylhet.

Bangladesh has an agrarian economy. Agriculture accounts for nearly 20 percent of the GDP (base year 1995/96) and provides employment to about 64 percent of the workforce. Jute and rice are the main cash crops. Other crops are tea, sugarcane, oilseeds, fruits, vegetables, spices, wheat, potatoes, tobacco and cotton. The major industry in Bangladesh is jute processing followed by cotton, steel, garments and pharmaceutical.

As an emerging nation, Bangladesh places special priority on economic and social development. Development efforts center on poverty reduction and food security. In order to accelerate the development process the government has recently decentralized the administration and has undertaken major development programs. A large number of NGOs are also involved in development activities to benefit the rural poor.

RECENT DEVELOPMENTS IN AGRICULTURAL RESEARCH

Agriculture is the mainstay of the Bangladesh economy. Rural agriculture communities dominate the economy not only because they produce 96 percent of the total food (Figure 1) but also because agriculture is the largest employer (Figure 2).

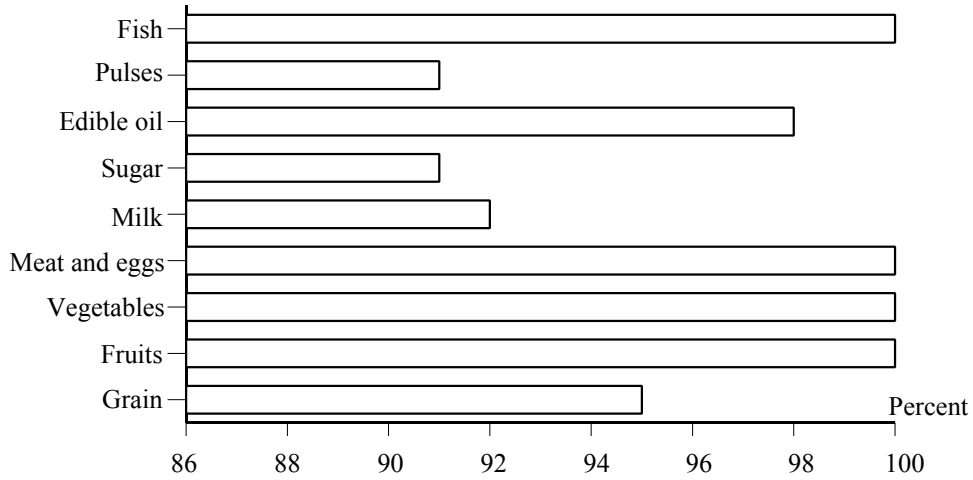


Figure 1. Percentage of Consumption Originating from National Production in Nine Food Categories

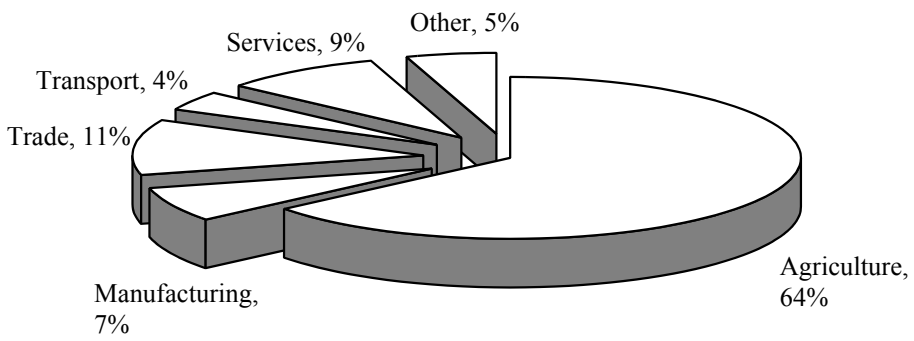


Figure 2. Sector Employment Distribution

Since 1974 the absolute number of persons in the agriculture sector, both male and female have increased by 70 percent even though the percentage declined to 64 percent, currently. Moreover, agriculture is by far the largest employer of women. In 1995-96, 79 percent of the total number of employed women were 15 years or older worked in the sector. In addition to persons employed directly in agriculture, significant numbers work in industries dependent on agriculture. The sector is also the largest user of land and water (Figure 3).

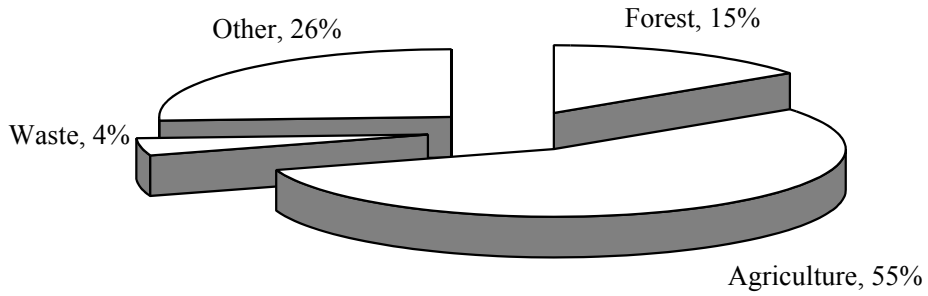


Figure 3. Current Land Use Distribution

To satisfy the growing demand for cereals, production must increase by 21 percent between 2002 and 2010. The rate of growth in other sub-sectors must be even higher to meet an increasing demand generated by both population and income growth.

Rice dominates agricultural land-use in most seasons, since 1983 the agricultural land base declined by almost 1 million ha. It is essential, therefore, that the research system continues to develop technologies which increase productivity from each hectare sown to rice and other indispensable crops. To increase the production of all crops from an agricultural land base that is shrinking, average crop yield, as well as cropping intensity must increase. Moreover, land devoted to cereal production must be freed to diversify into production of pulses, oilseeds and other cash crops.

THE BANGLADESH NATIONAL AGRICULTURAL RESEARCH SYSTEM

The Bangladesh National Agricultural Research System (NARS) is composed of Bangladesh Agricultural Research Council (BARC) and the 10 Agricultural Research Institutes (ARIs). NARS is obligated to serve society at large as well as the producers and processors within the agriculture sector. The organizations under NARS and their obligations are shown in Annex-I.

ORGANIZATION AND MANAGEMENT OF RESEARCH

The Bangladesh NARS was strengthened by promulgation of the Act of Bangladesh Agricultural Research Council (BARC) 1996 and subsequent amendments of the Acts of ARIs. The Council Act provides the foundation of the governance of NARS and guidance for unified NARS Human Resources Development. The Executive Council and Governing Body regularly provide guidance and strategic instruction for improvement of research management and research programs of the NARS institutes. This has reduced duplication of the intra- and inter-institute research.

The governing body of the Council reviews the research plan and progress and provides strategic guidelines to the Management Board of the institutes for further improvement of the research program and management. ARI management board can now take timely decisions that facilitate research agenda implementation. Significant progress has already been achieved in transforming the research institutes into more participatory and efficient organizations. But much more must be accomplished. All institutes must adopt and practice modern methods of research management as well as modern methods of research.

The present system of leadership selection, scientists advancement, research programming and monitoring and financing will have to be increased in the future for increasing the overall effectiveness and efficiency of the research organizations.

THE CURRENT STATUS OF AGRICULTURAL EXTENSION IN BANGLADESH

As elsewhere, agricultural extension in Bangladesh is facing at least two challenges:

Information and organization in the agriculture sector must assume greater importance. People involved in agriculture need improved skills, information, and ideas in order to develop agriculture that will meet complex demand patterns, reduce poverty, and preserve or enhance ecological resources. Extension has an important role to play.

Extension funding and delivery face difficulties that go with the definition and concept of extension, e.g., size of the task; large numbers of potential clients; problems establishing the cause and effect necessary to obtain political and financial support – to prove that extension inputs leads directly (and solely) to production gains; liability for other public service activities beyond agricultural knowledge and information transfer; budget sustainability; and interaction with knowledge generation. A number of efforts to define or characterize extension have been undertaken over the years. The current view is that it is to see extension as both a system and the set of functions performed by that system.

The set of functions includes: transferring technology in many directions and by multiple methods for sustainable agricultural production and marketing; transferring management to mobilize and organize farming, rural groups, and communities; and transferring capacity to educate, build human resources, and enhance local capacity, e.g., in integrated pest management, market information, farm management, and in negotiating financial, input, and market services.

The agricultural extension system in Bangladesh includes all public and private institutions that transfer, mobilize and educate rural people as distinct from a service or single institution that traditionally provided advice only.

HISTORICAL CONTEXT

The 1960s was the era of interpersonal communication and community development, and also the beginning of the Green Revolution. The technology transfer orientation of extension was strong. From the mid-1970s, public sector extension again limited advice to technical agricultural matters, mainly major annual food crops, and the multipurpose agents began to be replaced by systems that focused more closely on extension and its management.

The main features of the 1970s included integrated rural development approaches, and the rise of the training and visit (T&V) extension system. The 'diffusion' model of extension gave way to the 'get the technology right' model, where farm-level constraints explained non-adoption of technology, with a prescription to remove the constraints through an integrated package of services.

The 1980s brought an increasing emphasis on participatory approaches. Concerns about increasing the productivity of women and preserving ecosystems were also added. The 1990s became the era of alternatives, where new approaches were being piloted. The era of alternatives, or more diverse agricultural extension service delivery arrangements (GO, NGO,

private sector) arrived and the concepts of partnerships, contracting-out extension services were placed on the agenda.

Extension coverage (the ratio of extension personnel to farmer population) by public extension services in developing countries varies from 1:1,800 to 1:3,000. Developed countries of Europe, North America, and Asia have ratios averaging about 1:400. In Bangladesh, the Block Supervisor (a grassroots extension worker operating within crops agriculture) was charged with working with 1,200-1,500 farm families in his or her block (area).

CURRENT STATUS OF AGRICULTURAL EXTENSION – WHAT HAS BEEN THE RESPONSE IN BANGLADESH

The National Agricultural Extension Policy (NAEP, 1996) was a logical response to the need to develop revised extension approaches that recognize the changing environment and challenges facing agricultural extension. As mentioned earlier, the situation in Bangladesh is part of a worldwide process where revised, alternative or new approaches are being piloted. The NAEP is concerned with the agricultural extension system.

The implementation strategy for the NAEP was clear in terms of the implementation plan and the Department of Agricultural Extension (DAE) under the Ministry of Agriculture strategic plan was their response to the NAEP and the associated implementation strategy.

In the historical context of Bangladesh agricultural extension, the NAEP incorporated new thinking that emerged during the implementation of the GOB (Government of Bangladesh)/WB/Department for Integrated Development (DFID) Agricultural Support Service Project (ASSP). This was particularly in terms of the change from a T&V-based system to a Revised Extension Approach (REA). The fundamental differences between the two approaches are shown in Table 1.

The implementation strategy required that an institutional framework be put in place. This was to be largely achieved by the establishment of a committee structure (Annex 2), increased awareness raising and the use of media. The DAE was adopting a move towards placing the needs of farmers at the center of the agenda. By the mid-1990s, Farmer Information Need Assessments (FINA) were envisaged as the starting point of the REA. It was expected that each Extension Service Provider (ESP) within the agricultural extension system in Bangladesh would develop their own strategic response. To this extent, the NAEP was not meant to be a blueprint for all ESPs – each ESP would develop their own strategy in response to the principles of the NAEP. The NAEP was envisaged as a policy framework that emphasized a more sector-wide approach to agriculture. Agriculture, as used in the NAEP, refers to farming in its broader sense covering crops, fisheries, livestock and other forms of the biological husbandry, taking place in the context of farmsteads/rural households in Bangladesh.

There are many strengths in the NAEP and piloting activities have been undertaken. The NAEP and the REA of DAE have emphasized the need for linkages between government agricultural research, agricultural extension, NGOs and farmer communities. The objective is for an extension system that responds to the identified needs of rural farming communities and promotes partnership between extension service providers and the research system.

Table 1. T&V System and Revised Extension Approach

T&V System	REA in Bangladesh
Assumes linear communication process – from research via extension to farmers	Communication starts with farmer needs assessment and technical response developed in response to identified needs (multiple communications)
Top-down	Bottom-up
Favored general technical prescriptions with little scope for adaptation	Promotes decentralized, localized technology adaptation and extension planning
Narrow range of extension methods	Favors a wide range of extension methods depending on technology and target group including mass and folk media
Based around core individual contact farmers	Favors group approach for maximum coverage and facilitates partnerships with other organizations (GO/NGO/private)
Contact farmers tended to be biased towards larger male farmers who were regarded as model farmers	Extension services targeted to all categories of farmers, including small, marginal, landless and female
Expensive and unsustainable as relied on the supply of inputs to contact farmers	Less reliant on input supply as encompasses low cost extension methods
Uniform scheduling of seasonal extension process – limited flexibility and scope for partnership	Local planning allows for flexibility and partnerships where appropriate
Contact farmers often failed to disseminate messages as they were not selected by the community	Farmer-led approaches will be based on local community decisions
Appropriate for simple generic technologies that are widely applicable	Appropriate in the context of complex technology requiring local adaptation, and integrated advice that incorporates livelihood concerns and environmental est practice

The provision of improved extension services for rural households across sectoral boundaries is a principle of the NAEP and reflects the livelihood needs of those households. Given the history and compartmentalization of extension in Bangladesh (with separate Ministries for Fisheries and Livestock, Forests and Environment and the Ministry of Agriculture being concerned with crops only), there remains a problem of cross-sectoral collaboration in extension service delivery that the NAEP was established to overcome. The challenge of implementation is less at the micro level where greater cooperation is evident.

INTEGRATION OF AGRICULTURAL RESEARCH AND EXTENSION

In the Bangladesh context, direct integration of agricultural research and extension may not be possible, because the organizations have historically developed separate identities.

However, linkages between the organizations may be strengthened. Attempts at developing stronger linkages have been continuing since 1974. The National Agricultural Technical Coordination Committee (NATCC) at national level and the Agricultural Technical Committee (ATC) at regional level have been playing a vital role for this purpose.

AGRICULTURAL RESEARCH AND EXTENSION LINKAGES

The linkages between the NAEP and the NARS is shown as Annex-II. There are specific research – DAE extension linkages committees. Annual workshops are held at Bangladesh Agricultural Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI). There are formal DAE-NGO Liaison Committees. In addition, linkages are maintained with the universities.

AGRICULTURAL TECHNICAL COMMITTEES

ATCs were constituted by Ministry of Agriculture order of 6 February 1996. These bodies are intended to provide a linkage between crop research stations in 18 "regions" of the country and the relevant DAE districts in those "regions" for ensuring technical review of the DAE seasonal district crop extension plans.

The original membership of the ATC included DAE's regional and district managers, DAE's subject-matter specialists, representatives of other departmental extension services and scientists from the NARS stations in the regions. There was a need to establish a regional forum for coordination of all extension partners under NAEP. In order to achieve this, the former crop related technical review functions of the ATC were extended to cover other agricultural extension disciplines. The extended ATC is able to act as the regional (or divisional) coordinating committee for the NAEP. If necessary the ATC can have a number of technical sub-committees (e.g., crops, livestock, fisheries, forestry) to review the technical content of proposed extension programs of DAE and other GO or NGO extension service providers. Membership of ATC comprises all relevant GO (ESPs, research organizations, etc.), NGOs and farmer representatives. The membership of individual discipline – specialized sub-committees (if thought necessary) could be selected according to the specialist disciplines concerned. The main ATC committee: (i) acts as a regional forum on technical research and extension matters for the national NAEP coordinating committee (Extension Policy Implementation Coordination Committee [EPICC]); and (ii) acts as the regional mechanism for coordinating agricultural research programs for the National Agricultural Technical Coordinating Committee (NATCC).

NATIONAL AGRICULTURAL TECHNICAL COORDINATION COMMITTEE

The NATCC established in September 1984 has been replaced by a new body in 1997 of the same name, but with revised composition and terms of reference. The objective of the new NATCC was to establish strong and effective coordination between the agricultural research and agricultural extension organizations. Membership of the NATCC has now been broadened to include all agricultural research institutes under the NARS.

CONCLUSION

Integration of agricultural research and extension is essential for enhancing the growth rate of the agriculture sector, but the method of integration may vary from country to country. In Bangladesh, an attempt may be made by making prevision for the entry level officers of DAE and other extension service providers to work in a research station for a certain period on deputation. The entry-level officer may be given some responsibility for research work in their place of posting under the supervision of the research station.

REFERENCES

Bangladesh Agricultural Research Council, 2000. *Bangladesh NARS – 2020: A Vision for Agricultural Research*, Dhaka.

Ministry of Agriculture, 1996. *New Agricultural Extension Policy (NAEP)*, Government of Bangladesh.

----------, 1997. *A Strategy for Implementation of the New Agricultural Extension Policy*, Government of Bangladesh.

----------, 1999. *Agricultural Extension Manual*, Department of Agricultural Extension, Dhaka.

Annex-I

The Bangladesh National Agricultural Research System

Bangladesh Agricultural Research Council
Establish national research priorities; coordinate research and foster inter-institute collaboration; monitor and review the research program of each institute; assist institutes to strengthen research capacities; establish system-wide operational policies and standard management procedures; assure that each institute is optimally governed.

Bangladesh Agricultural Research Institute
Conduct research to ensure increased and stable production of cereals (excluding rice), oilseeds, pulses, fruits, vegetables, tubers, spices, palms, and nuts through scientific management of land, water, fertilizers, pests and diseases; develop varieties of crops with resistances to biotic and abiotic stresses; improve farming systems to optimize production; develop tools and machinery to improve labor productivity; train research and extension officers in improved crop production technologies; publish newsletters, bulletins, and journals; test packages of new technologies on farms.

Bangladesh Rice Research Institute
Conduct research on all aspects of rice in order to develop modern varieties of rice with high-yield potential for different ecosystems, develop component technologies for improving productivity of rice-based cropping systems, and transfer rice production technologies through training, workshops, seminar, and publication.

Bangladesh Institute of Nuclear Agriculture
Adapt advanced research techniques for the development of a stable and productive agriculture by evolving new crop varieties, technologies to improve management of crops, land and water, as well crop quality, and practices to control disease and insect pests.

Soil Resources Development Institute
Provide soil management advisory services to farmers; assess potentials of land resources through soil survey; assist government and other agencies with planning for agriculture, afforestation, soil conservation, land reclamation, settlements, irrigation, drainage, and

Bangladesh Jute Research Institute
Conduct agricultural and technological research on jute and allied fibers.
Agricultural Research: Develop short duration high-yielding varieties of both white and *tossa* jute; white jute varieties with improved fibers; short duration varieties of kenaf and *mesta*; agronomic and crop protection technologies to shift major cultivation from white to *tossa* jute; socio-economic analyses of jute production, prices and markets.
Technological Research: Identify fiber properties that are essential to produce quality products from new jute varieties; develop processes and equipment for manufacturing new jute products and for improving the quality of conventional jute products; provide technical services to manufacturers with emphasis on establishing new jute industries.

Bangladesh Sugarcane Research Institute
Develop high-yielding, high sugar content cane varieties with low fiber content which are disease- and insect pest-resistant for refined sugar and '*gur*' production; develop early, medium and late maturing varieties to accommodate intensive cropping sequences of major agro-ecological zones; develop improved cultural practices including intercropping and relay cropping patterns; develop varieties and practices to exploit the potential of minor sugar crops.

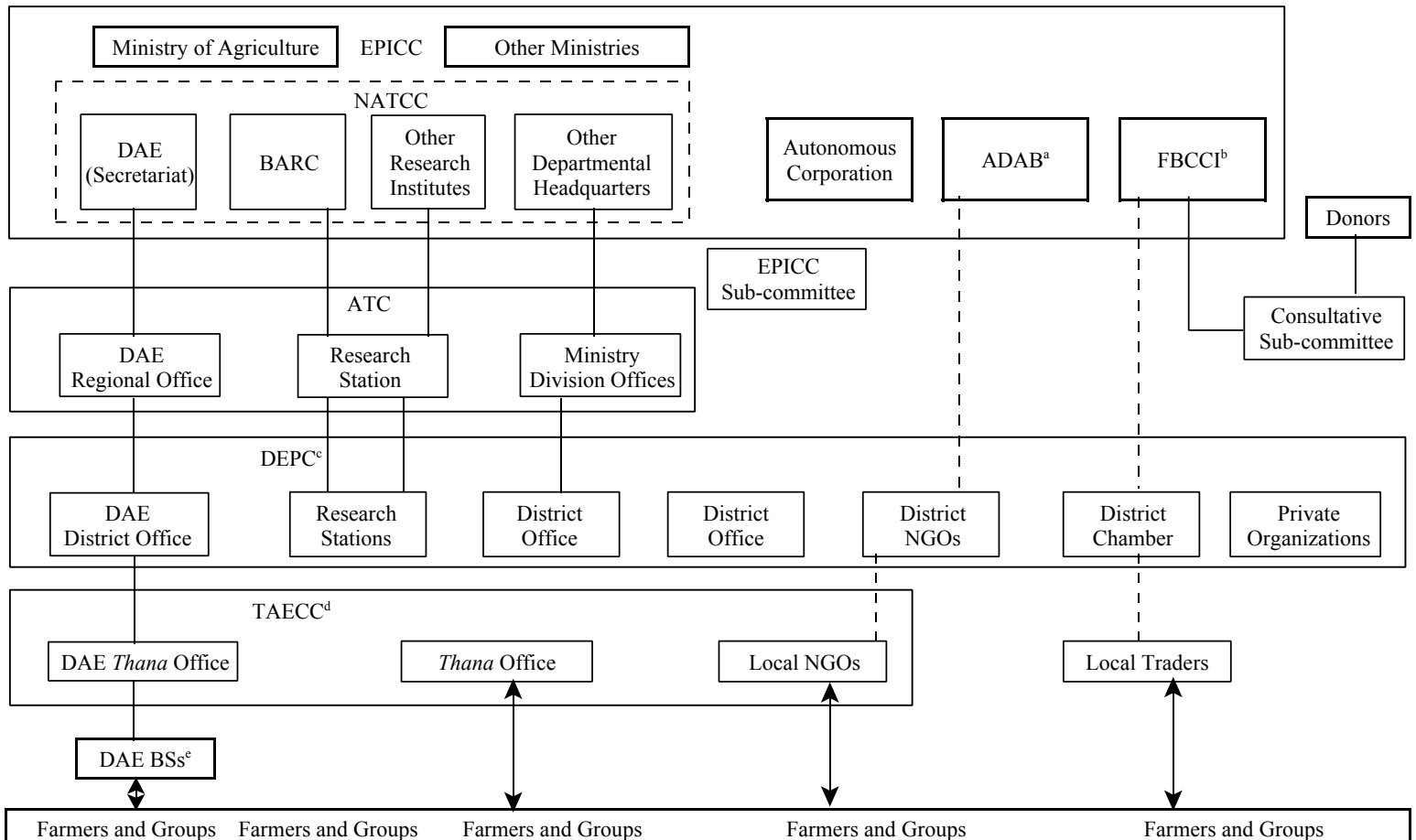
Bangladesh Tea Research Institute
Increase yields and profits by developing improved production technologies and high-yielding, high quality tea clones.

Bangladesh Livestock Research Institute
Conduct research to: (a) solve problems that constrain the growth and development of

flood protection by providing basic soil data, and information and technical support. **Bangladesh Fisheries Research Institute** Conduct and coordinate research on freshwater and pond fisheries, brackish water fisheries, and marine fisheries; and assist with development of efficient and economic but sustainable methods for fish production, management, processing and marketing.	livestock production at the farm level; and (b) improve the livestock component of farming system. **Bangladesh Forest Research Institute** Develop management practices to increase productivity of national forests and village groves and to convert wastelands and marginal lands to forestry and agro-forestry uses, develop technologies for rational utilization of forest products; generate technologies to conserve or restore environment balances through increased stocking densities of both rural and urban forests; transfer technology through extension services and other agencies to end-users.

Annex-II

Structure of NAEP Coordination Committee



Notes: [a] Association of Development Agencies Bangladesh (umbrella body for NGOs); [b] Federation of Bangladesh Chambers of Commerce and Industry; [c] District Extension Planning Committee; [d] *Thana* Agricultural Extension Coordination Committee; and [e] Block Supervisors of DAE who work at field level.

2. REPUBLIC OF CHINA

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INTRODUCTION

Taiwan is a subtropical island with an area of nearly 36,000 km^2 (13,900 $mile^2$). Of the entire island, only one-fourth of the land is arable. From the natural endowment point of view, Taiwan is not an ideal place for agriculture development. However, in order to ensure the food security for the people on this island and to provide the foundation for the nation industrialization, agriculture had played a very important role in the economic development of Taiwan at the early stage. The sizeable foreign exchange earned from agricultural export at that early stage laid a solid foundation for Taiwan to develop from an agriculture-based economy into an industrialized one. Although the share of agriculture in the nation's GDP fell from 28.54 percent in 1960 to 2.06 percent in 2000, the agriculture sector continues to be the most important basic industry considering its multifunctional role in providing food security, social stability, rural development and environmental conservation.

Advancement in science and technology is the driving force for national development and social progress. The 21stcentury is an era of knowledge-based economy, in which the key to profit is the know-how that can add value to a product. Same rationale can be applied to agricultural production. With small-scale farms and limited natural resources, the agricultural development in Taiwan can only depend on science and technology. Agriculture is an applied science and research generates new and improved technologies and better farming practices for increasing the efficiency of production. Under the strong support of the National Science Council (NSC), Council of Agriculture(COA) and other agriculture-related institutions and agencies, the research and development of agricultural technologies has been greatly supported and advanced. Through the application of advanced technologies the agriculture sector was transformed from a traditional industry into a knowledge-based industry.

However, before research results and technologies can be applied to actual production, they need to be effectively transferred to farmers through the channels of agricultural extension. An effective extension can link research results and farmer's needs appropriately and farmers can adopt the new technology for increasing their production efficiency. Hence, the integration of agricultural research and extension plays an important role in knowledge-based agricultural development. In Taiwan, the agricultural extension system of pubic sector has been well established. Farmers can get the required information and technology easily and quickly. However, the coordination and integration among various extension agencies needs to be improved. In addition, the knowledge flow of newly developed technologies

from researchers to extension personnel and then to farmers must be improved. There are several key factors for a successful integration of agricultural research and extension: the organization of a research and extension system; quality of researchers, extension workers, and farmers; communication channels among researchers, extension personnel and farmers; and budget allocation for research and extension. In this paper, the current status of agricultural research and extension in Taiwan, and the issues and measures for the integration of research and extension in the country will be discussed.

AGRICULTURAL RESEARCH IN TAIWAN

Key Areas of Agricultural Research

The key areas of agricultural research in Taiwan are first identified by the COA and then reviewed by the NSC. The key areas of research include:

- *Biotechnology*: Transgenic plants, animals and fish, animal disease vaccines and diagnostic kits;
- *Agronomy and Horticulture*: Crop physiology, production technology, and hereditary breeding, post-harvest handling;
- *Agricultural Machinery and Engineering*: Agricultural hydrology, ecological hydraulics, and agricultural automation;
- *Plant Protection*: Entomology, plant pathology and agricultural chemicals;
- *Soils and Fertilizers*: Soil survey, soil fertility, environmental protection and microbial fertilizers;
- *Forestry*: Water and soil conservation, ecology and wildlife conservation and forest management;
- *Fisheries Science*: Physiology, aquaculture, and fish pathology;
- *Animal Husbandry and Veterinary Medicine*: Animal husbandry science and veterinarian medicine;
- *Food Science*: Foodstuff chemistry, foodstuff microbiology, and nutrition; and
- *Long-term Ecological Research*: Material and energy balance and changes, and plant interrelationships.

Agricultural Research Institutions

The research institutions established in Taiwan cover various fields of agricultural science. They include public research institutions, agriculture-related departments of universities and colleges, and private and non-profit research institutions. Some of the research institutes have been founded more than 100 years ago. Besides, some institutions are established in different areas where the natural environments are significantly different.

A total of 22 institutions including the Institutes of Zoology and Botany of Academia Sinica, COA-affiliated research institutes and stations, and public enterprise-owned institutes are the main research organizations at the central government level (Table 1). In addition, seven agricultural research-related institutions are operated by the non-profit organizations while 12 departments of universities or colleges are involved in agricultural research. However, the precise number of departments of universities and colleges engaged in agricultural research is easy to obtain because the research boundary between other sciences and agriculture is not so clear-cut.

Table 1. The Number of Agricultural Research Institutions in Taiwan

	Type	No. of Research Institution
Office of the President:	Academia Sinica	2
Central Government		
Executive Yuan:	COA	16
	Ministry of Economic Affairs	2
	Ministry of Finance	2
	Ministry of Education	12
Private/non-profit		7
Total		41

The agricultural research institutions are listed as follows:

1. ***Central Government Institutions***
   (1) Institute of Botany, Academia Sinica, Office of the President
   (2) Institute of Zoology, Academia Sinica, Office of the President
   (3) Taiwan Agricultural Research Institute, COA
   (4) Taiwan Forestry Research Institute, COA
   (5) Taiwan Fishery Research Institute, COA
   (6) Taiwan Livestock Research Institute, COA
   (7) Taiwan Animal Health Research Institute, COA
   (8) Taiwan Agricultural Chemicals and Toxic Substances Research Institute, COA
   (9) Taiwan Endemic Species Research Institute, COA
   (10) Taoyuan District Agricultural Improvement Station, COA
   (11) Miaoli District Agricultural Improvement Station, COA
   (12) Taichung District Agricultural Improvement Station, COA
   (13) Tainan District Agricultural Improvement Station, COA
   (14) Kaohsiung District Agricultural Improvement Station, COA
   (15) Taitung District Agricultural Improvement Station, COA
   (16) Hualien District Agricultural Improvement Station, COA
   (17) Taiwan Tea Experiment Station, COA
   (18) Taiwan Seed and Seedling Improvement and Propagation Station, COA
   (19) Taiwan Wine Research Institute, Taiwan Tobacco and Wine Monopoly Bureau, Ministry of Finance
   (20) Taiwan Tobacco Research Institute, Taiwan Tobacco and Wine Monopoly Bureau, Ministry of Finance
   (21) Taiwan Sugar Research Institute, Taiwan Sugar Company, Ministry of Economic Affairs
   (22) Taiwan Pig Research Institute, Taiwan Sugar Company, Ministry of Economic Affairs
2. ***Non-profit Institutions***
   (1) The Asian Vegetable Research and Development Center
   (2) Taiwan Banana Research Institute
   (3) Food Industry Research and Development Institute
   (4) Agricultural Engineering Research Center
   (5) China Grain Products Research and Development Institute

(6) Development Center for Biotechnology
(7) Fishing Boat and Marine Engineering Research Center

3. ***Universities and Colleges***
(1) College of Agriculture, National Taiwan University
(2) College of Science, National Taiwan University
(3) College of Agriculture, National Chunghsing University
(4) College of Science, National Chunghsing University
(5) National Taiwan Ocean University
(6) College of Marine Science, National Sun Yat-sen University
(7) National Pingtung University of Science and Technology
(8) College of Agriculture, Tunghai University
(9) College of Biology, Chinese Culture University
(10) College of Agriculture, National Chiayi University
(11) National Ilan Polytechnic Institute of Agriculture and Engineering
(12) National Kaohsiung Institute of Marine Technology

Research System

Research institutions listed above conduct research independently. Coordination and integration in agricultural research is important in the situation of limited resources. However, the agricultural research conducted by universities and/or colleges is not well coordinated and integrated. Overlapping and duplication of research topics conducted by universities and colleges, even those COA-owned institutions, is not uncommon. In order to avoid duplication and to resolve the problems more efficiently, team research needs to be promoted, especially team research among different institutions by scientists with same disciplines. Also, long-term studies of agricultural science and technology are needed for the sustainability of agricultural development. It is observed that the coordination and integration in research is better among COA-owned institutes and stations. The research projects in these institutes are mission-oriented with a problem-solving approach and are implemented under the guidance of the COA.

Through a common understanding, the basic agricultural research is mainly handled by the Academic Sinica. The universities and colleges conduct more basic than applied research for teaching and training purposes. Public enterprises and private research institutes are engaged in specialized or specifically designated research work. Most applied research and some basic research is carried out mainly by the COA-owned research institutes (Table 2). The district agricultural improvement stations (DAISs) mainly conduct local technology development and practical research. Beside the research and experimental loads, the DAIS has to provide the agricultural extension services to farmers with the assistance of local farmers' associations. Research for seeds and seedlings of crops and special crops such as tea, sugarcane, tobacco, and banana are conducted by specialized stations or institutes. However, some degree of overlapping in the research among different institutions is unavoidable due to competition for research funds and the interests and specialization of researchers.

Under the guidance of the COA in considering the needs of farmers, the research topics for various research institutes have been extensively reviewed and evaluated. After being approved by extensive evaluation and review, the budget for research is allocated. Same procedure for evaluation and review is applied to the applicants from universities and colleges, and other research agencies on a competitive basis.

Table 2. The System and Coordination of Agricultural Research in Taiwan

Level of Research	Implementation Agency	Performance Agency
Theory and basic	National Science Council	Academic Sinica, universities
Applied	COA	Research institute, universities
Experimental development	COA	Research institute, stations
	Ministry of Economic Affairs	Research institute
	Ministry of Finance	Research institute
	Non-profit agency	Research institute

For effective coordination and integration among research institutions under various Ministries, the COA is proposing to form the National Research Academy of Agricultural Science. Through this mechanism, cooperation among agricultural research institutions will be enhanced. The overlapping in agricultural research projects can be reduced and coordination and integration can be improved among agricultural research institutes.

Research Resource

A total of NT$294,474 million has been spent on scientific research and technology development in Taiwan from 1996 to 2000 (Table 3). Of which, the COA spent NT$9,281 million for agricultural research in the past five years. In 2000, a total of NT$2,449 million have been utilized by the COA for research purpose.

Table 3. The Budget Used in Agricultural Research

(Unit: NT$ million)

Year	PDAF[a]	COA	Total of Agriculture[b]	Total of Nation
1996	4,800	1,720	6,520 (14.03)	46,477
1997	2,502	1,619	4,121 (9.04)	45,607
1998	2,637	1,668	4,305 (8.07)	53,337
1999		1,825	1,825 (3.07)	59,736
2000		2,449	2,449 (2.74)	89,317
Total	9,939	9,281	19,220	294,474

Notes: [a] PDAF = Provincial Department of Agriculture and Forestry; and [b] figures in parentheses are percentage of total of nation.

It is clear that the total research fund for the nation has increased from NT$46,477 million in 1996 to above NT$89 billion in 2000. However, the proportion of funds used by COA for agricultural research has declined dramatically from 14.03 percent in 1996 to 2.74 percent in 2000. It appears that the government does not lay adequate emphasis on agricultural research. Facing the strong competition of world trade, more funds need to be put into agricultural research in order to boost the competitiveness of the agriculture sector through the development of new and improved agricultural technology. In the long run, enough budget should be allocated for the continuous development of agriculture.

The NSC is proposing to change the government-owned research institutions including the agricultural research institutes into juridical organizations. The NSC considers that the government should not pay for research budget totally and each research institute should raise

partial funds for their own research by selling the know-how or technology to the farmers or users. However, this proposal does not seem suitable for agricultural research institutions because the poor farmers may not have the money to buy know-how, new technology, and new varieties from research institutions.

Research Personnel

The human resources for research are the key for technology development. According to the survey conducted by NSC, a total of 6,780 manpower-time had been input into agricultural research by the COA in 2000 (Table 4).

Table 4. The Manpower Input in Agricultural Research

Year	PDAF	COA	Total of Agriculture	Total of Nation
1996	1,547	2,186	3,733 (11.86)	31,473
1997	1,608	2,125	3,733 (11.64)	32,068
1998	1,655	2,035	3,690 (8.34)	44,227
1999		2,110	2,110 (5.00)	42,216
2000		6,780	6,780 (8.69)	78,002
Total	4,810	15,236	20,046	227,986

Note: Figures in parentheses are percentage of total of nation.

As mentioned above, the scientists at the agricultural research institutes and improvement stations of the COA serve as the main manpower for new technology development. A total of 1,340 scientists work on the research related to crop, seed and seedling propagation, forestry, fishery, livestock, animal health, agricultural chemicals and toxic substances, and endemic species at 16 institutes or stations (Table 5). The ranking of researchers at the agricultural research institutions is classified into four levels, i.e., Senior Researcher, Associate Researcher, Assistant Researcher and Assistant. It is equivalent to the ranking of Professor, Associate Professor, Instructor, and Teaching Assistant in the universities or colleges.

The quality of agricultural researchers is very high in Taiwan. Most of the researchers under the COA have Doctorate, Masters or Bachelor degrees in their respective fields. For example, there are five Doctors and 11 Masters among 39 researchers in Taitung DAIS, the smallest station in Taiwan. These high quality research persons play an important role in the advancement of agricultural technology. Continuous input of young and highly qualified researchers is required for the sustained development of agriculture. Providing young scientists with channels for continuous study on advanced sciences is needed to increase the research efficiency and to keep the research alive.

The salary for researchers and the award system for agricultural research need to be raised and improved for encouraging scientists to devote themselves to research. Low payment cannot attract high quality scientists to stay at research institutes. And the loss of high quality researchers will be harmful for the development of agriculture.

Table 5. The Manpower for Agricultural Research under COA

Institute or Station	Senior Researcher	Association Researcher	Assistant Researcher	Assistant	Total
Taiwan Agricultural Research Institute	28	39	65	81	213
Taiwan Forestry Research Institute	22	26	48	49	145
Taiwan Fishery Research Institute	22	28	36	41	127
Taiwan Livestock Research Institute	22	48	50	53	173
Taiwan Animal Health Research Institute	9	8	17	16	50
Taiwan Agricultural Chemical and Toxic Substance Research Institute	10	14	29	19	72
Taiwan Endemic Species Research Institute	8	14	27	20	69
Taiwan Tea Experiment Station	7	11	23	16	57
Taiwan Seed and Seeding Improvement and Propagation Station	7	12	23	15	57
Taoyuan DAIS	8	13	26	19	66
Miaoli DAIS	5	8	17	11	41
Taichung DAIS	7	13	26	18	64
Tainan DAIS	8	14	28	21	71
Kaohsiung DAIS	6	11	21	15	53
Hualien DAIS	5	9	17	12	43
Taitung DAIS	5	8	15	11	39
Total	179	276	468	417	1,340

AGRICULTURAL EXTENSION IN TAIWAN

The agricultural extension and education work in Taiwan originated from the Joint Commission on Rural Reconstruction Committee – the predecessor of the COA. The purpose of agricultural extension work is to advance farmers technical know-how, raise the efficiency of farming operations, improve the lives of rural families and develop rural society. In 1952, the Committee started the rural and school 4-H clubs, initiating the cultivation and guidance of rural youth. In 1954, the adult farmers' extension and education program was initiated. In 1956, home economics extension and education program was started for rural females. Later, in 1975, fishery extension and education was implemented, and in 1984, the 4-H clubs and home economics extension and education work were successively initiated in fishery villages. The implementation of each of these programs was entrusted to all levels of farmers' organizations and fishermen's organizations. All the research institutes and improvement stations of the COA provided the technical assistance to these programs.

Starting from 1981, the COA has provided financial support annually for public agricultural universities and colleges to setup the Agricultural Extension Committee and hire agricultural extension professors who also serve as research scientists at the DAISs. Furthermore, in 1987 such funding was expanded to include public marine schools. In 1989, the agricultural extension and home economics services have been extended to the mountainous areas to help the aboriginal people to improve their farming skills and living environment.

Agricultural Extension System

In Taiwan, there is no specialized institution solely for agricultural extension. The highest administrative agency responsible for agricultural extension service is the Council of Agriculture. The relationship among the administrative, executing, and assistant agencies is illustrated in Figure 1. Under the instruction of the COA, the DAIS work together with extension professors of universities to guide and help the county and township farmers' associations in executing their extension services. The COA can also entrust the agriculture bureau of county government to help the county farmers' association providing extension services to the farmers. Under the supervision of the county government, the township government may also guide the township farmers' association to perform extension activities. Frequently, the DAIS may also guide the township farmers' association to perform the extension work such as training and education, and technological demonstration.

Farmers' and/or fishermen's associations play an important role in agricultural extension. Currently, there are 304 farmers' associations and 40 fishermen's associations in Taiwan. The range of executing agencies for agricultural extension are the provincial, county, and township farmers' associations. However, there is no subordination relationship between the provincial, county, and township farmers' associations. Sixty percent of the total profits earned by the banking unit of the township farmers' association are used as funds for extension purposes. Also, due to direct interface with farmers, the township farmers' association is the basic executing agency in this extension system. The agricultural technology, home economics, and 4-H instructors are the key persons in the extension section of the township farmers' association. Most of the agricultural policies, measures and practices of new cultivating technologies are extended from the township farmers' association to the farmers. The township farmers' association also provides the extension service to the aboriginal farmers in their service area.

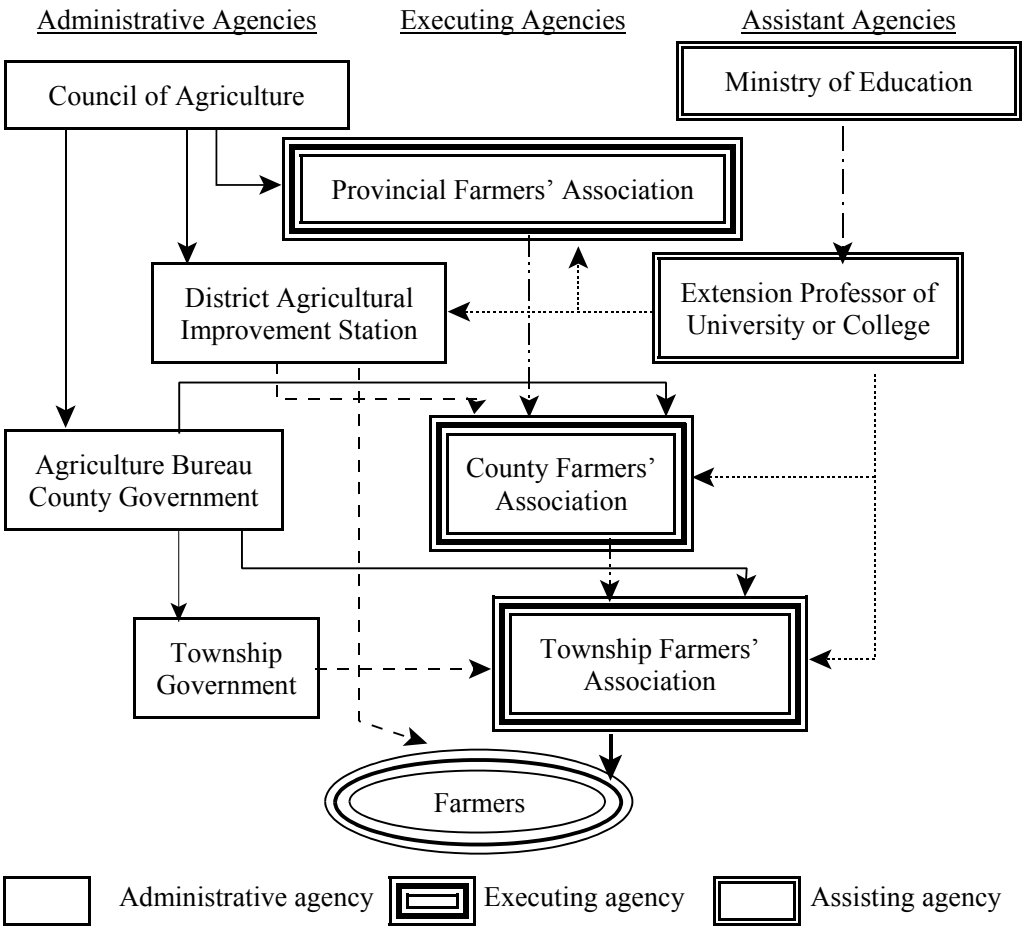

Figure 1. The Agricultural Extension System in Taiwan

Similar pattern also applies to the fishermen's association for providing the extension services to the fishermen. Other agriculture-related research institutions may also provide some extension service, primarily the technological demonstrations, to the farmers under the assistance from township farmers' association.

Coordination and Improvement of Agricultural Extension

As shown in Figure 1, the COA can only entrust the county government to perform the extension activity for farmers. The DAIS with the help of the agricultural extension professors can only guide or assist the county and township farmers' associations in performing the assigned extension services indirectly. A1so, the DAIS can only serve as the coordinator in agricultural extension between the farmers' associations and the county government. If the coordination among these agencies is not effective the extension service will not achieve its objective of reaching the farmers.

The efficiency of transferring newly developed technology from research institutions to the farmers will be reduced if the extension system is not well coordinated. For solving

the coordination and integration problem among agencies in agriculture extension, the COA is proposing the Act of Agricultural Extension. The proposed law will cover the formal relationship among agencies in handling the extension service and the functions and quality of extension workers. The extension service to the farmers will be greatly improved after the passing of this law by the Congress. The Agricultural Extension Center of DAIS will serve as the coordination and integration center in agricultural extension in the region. In this case, the farmers will be benefitted more from the extension service.

Currently, the number of extension workers is not adequate. A survey conducted in 1997 showed that a total of 2,318 persons are involved in agricultural extension (Table 6). Most extension workers are with the farmers' associations. Lesser numbers of extension personnel are in fishermen's associations. Government's extension workers are only 7.2 percent of total. The workload of each extension worker in extension service is very high. In order to provide farmers with better extension service, increasing the number of extension personnel both in the public and private sectors is urgently needed.

Table 6. The Number of Agricultural Extension Personnel in 1997

Level	Government	Farmers' Association	Fishermen's Association	Total
Central	168			168
Provincial/city		89	7	96
County/city	91	137		228
Township/district		1,692	134	1,826
Total	259	1,918	141	2,318

The quality of extension workers in their communication skills and specially of knowledge needs to be improved. Providing extension workers with advanced on-the-job training and study opportunity is necessary for improving their ability of serving farmers. Moreover, government budgets used for agricultural extension need to be increased. If possible, the government must allocate enough budget for covering the expenses used by the farmers' associations.

INTEGRATION OF AGRICULTURAL RESEARCH AND EXTENSION

The development of improved or new technology for increasing production efficiency is the mandate of agricultural research institutions. Government has established various kinds of agricultural research institutes to cover different fields of agriculture. The research results developed need to be transferred effectively to farmers if the technology adoption is to be successful. Hence, extension plays an important role in the effectiveness of the information dissemination and new technology transfer process. However, there is no special independent agency established responsible for agricultural extension even under the COA. The research institutes under the COA usually publish their new findings for the public and do not directly extend their research results to the farmers. As a result, the adoption of research findings and innovation by farmers is limited and, therefore, the importance of coordination and integration between research and extension.

The district agricultural improvement station of the COA is the only research institute mandated with both the functions of applied research and extension. The operation of the integration and coordination of research and extension is very effective in these institutions. The new technology and invention can be easily extended to farmers. The farmers can get assistance and information from DAIS, easily. Farmers always consider the researchers and extension workers of the station, as their friends. The DAIS in Taiwan provides a good example of successful integration of research and extension.

Integration of Research and Extension in DAIS – An Example

There are seven DAISs including Taoyuan, Miaoli, Taichung, Tainan, Kaohsiung, Hualien, and Taitung in Taiwan. The service area varies among different DAIS. Each DAIS consists of two Divisions, namely the Crop Improvement (CID) and Crop Environment (CED), and one Agricultural Extension Center (AEC). As an example, the organization of Taitung DAIS is used to show the general organization of a DAIS (Figure 2).

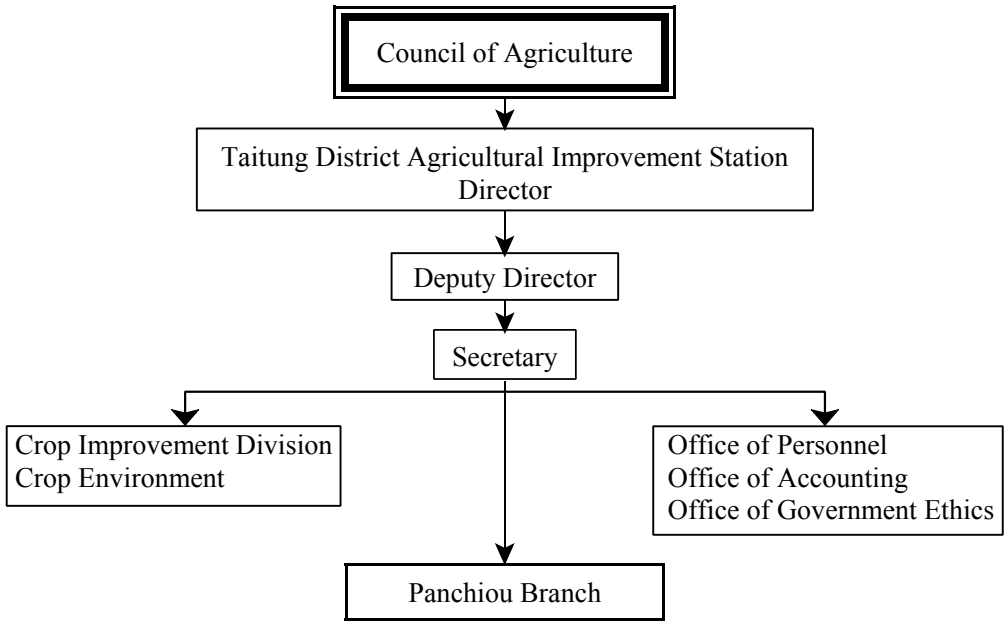

Figure 2. The Organizational Chart of Taitung DAIS

The major functions of DAIS are to conduct experiments on the improvement of crop variety and cultural practices, to study methods for maintaining soil productivity and fertility, plant protection, and to develop the agricultural machinery. The research findings and improved technologies are then extended to farmers jointly by researchers and extension staff of the station. The station also provides services of soil and plant sample analysis, nutritional diagnosis, crop pest and disease diagnosis to the farmers free of charge.

The extension workers at the AEC of the station also handle the training and education in crop production, rural community improvement, and natural environment conservation for farmers and home economic service to rural women. Several kinds of training courses including crop production, plant protection and management, food processing, computer

operation, marketing, and home economics are provided to the rural youth, farmers, aborigines, and rural house women. Providing guidance and assistance to the Agricultural Production and Marketing Team (APMT) is one of the main tasks of the AEC.

In addition to the staff at the AEC, all staff in the technical division also serve as extension workers. Demonstrations on new crop varieties, improved cultural practices, plant protection methods, farming machinery are carried out through the field-day activities, and new technologies of production and marketing are usually disseminated by the scientists from the technical divisions. Under this system, the integration and coordination of research and extension is very effective. Researchers in the technical divisions can observe the production and marketing problems during the field-days and farmers' visits and can then initiate proposals for research. Farmers receive on-time problem-solving service during the visits of researchers or extension workers from the station.

The DAIS also provides information to farmers through the publication of newsletters, magazines, videotapes, video compact discs. Telephone hot lines and the automatic answering system are also provided for farmers to use in case of needs. Recently, most of the DAISs have established their own web-site. Farmers can easily get latest information through the internet.

It has been recognized that the DAIS does a very good job not only in developing new varieties and technologies, but also in effective extension of research results and findings. Also, through the efforts of the staff members in coordination and integration, an effective relationship and friendship among the DAIS, local governments and farmers' and fishermen's associations are firmly cemented. In this way, farmers can receive higher benefits from the extension system. The smooth operation of the integration of agricultural research and extension through the DAISs in Taiwan has proven to be effective in transferring new research results from research institutes to farmers.

CONCLUSIONS

Agricultural research and extension are two important factors in the enhancement of agriculture production efficiency in Taiwan. New and/or improved varieties, technologies, and advanced farming practices generated from research are instrumental in increasing the yield and income of farmers, especially of the small farmers. In Taiwan, the COA-owned institutions and stations carry out most of the agricultural research. In today's knowledge-based economy, agricultural research of Taiwan should be further strengthened by allocating more research funds and encouraging high quality scientists for research activities. For increasing research efficiency and preventing waste of research funds, integration and coordination among research institutions must be improved in Taiwan. However, for the long run, the National Academy of Agricultural Science has been proposed for continuous development of agriculture in Taiwan.

Extension plays an important role in the effective transferring of the research results from scientists to farmers. Good extension workers can ensure that newly developed technologies are adopted by the farmers. In Taiwan, the number of extension workers in the public sector is relatively low. Most extension workers are working in the farmers' and fishermen's associations. However, the extension work in the farmers' association and fishermen's association is only for elementary information dissemination rather than for the transferring of new or improved technology. Agricultural research institutes usually do not conduct extension activity directly for farmers. Although there is no specialized public

agency for agricultural extension services, the DAIS of the COA carries out the major technical extension work and services. The DAIS in Taiwan plays two important roles of research and extension. Almost all the scientists at the station serve as extension workers to extend their research results and know-how to the farmers mainly in a face-to-face manner. Coordination and integration among extension agencies need to be improved and the quality for extension personnel needs to be enhanced.

The integration of agricultural research and extension is not an easy task. The integration and coordination of agricultural research and extension work is effective at the DAISS. The function of the dais in Taiwan may serve as a model for the integration of agricultural research and extension. Farmers as well as farmers' association are benefitted by the extension services from the station. For further improvement of agricultural extension, the law of Agricultural Extension Act will be sent to the Congress for approval.

Today's agriculture not only concerns the production of farm products, but also concerns the construction of rural community and the conservation of natural environment. Every phase of modern agriculture needs the input of science and technology. Also, the farmers need to get more information and know-how than ever before. Agricultural research and extension will become more important in the future. Therefore, the more the integration between agricultural research and extension, the more it will contribute to the development of modern agriculture.

REFERENCES

Asian Productivity Organization, 1999. *Agricultural Research and Extension Interface in Asia*, report of the APO study meeting held in New Delhi, India, 16-21 December 1997, Tokyo.

Chinese Agricultural Extension Association, 2000. *Agricultural Extension Anthology*, Vol. 45, Taipei.

Council of Agriculture, 1996. *A Report on Agricultural Research in the Republic of China on Taiwan*, Taipei.

----------, 2001. *Agricultural Statistics Yearbook 1999*, Taipei.

National Science Council, 2001. *The Yearbook of Science and Technology of the Republic of China*, Taipei.

3. FIJI

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INTRODUCTION

Recent Developments in Agricultural Research in Fiji

The Ministry of Agriculture, Sugar and Land Resettlement (MASLR) in Fiji is responsible for the provision of services to farmers. The current policy of the government has been outlined in the policy paper *Opportunities for Growth* (Government of Fiji [GOF], 1993) and the *Fiji Agriculture Sector Review* (1996). The main thrusts of these policies were:

- refocus away from self-sufficiency and import substitution towards export-led growth;
- deregulation of the rice, dairy and poultry industries, and reducing tariffs and subsidies to focus on improving efficiency of local producers;
- fresh fruits and vegetables for exports as replacements against falling sugar prices and quality;
- further expansion of exports of traditional root crops such as taro, kava, ginger and duruka (*Sacahharum edule*); and
- supply of off-season crops to the Northern Hemisphere region.

MASLR is currently developing a new Corporate Plan for the short, medium, and long term. The mission statement currently in place is:

> "MASLR is committed to ensuring that the economic development of the primary sector is consistent with the principles of ecologically sustainable development, through an acceptable resource tenureship and conservation framework that foster collaborative and innovative approaches to needs and opportunities, with the aim to optimize sectoral growth, guarantee food security and improve the standard of living of all the people of Fiji."

The Ministry aims to facilitate agricultural production for selected crops and livestock commodities though infrastructure development in smart partnership with the private sector. The main objectives are:

- to provide regulatory oversight to orderly development
- promote private sector growth
- promote long term sustainable practices.

The main policies of the Ministry are:

- to increase sugar production through expansion to new land and intensification of existing sugarcane land
- refocus away from import substitution towards export-led growth
- deregulation of the rice, beef and poultry industries, reduction of tariffs
- refocus away from production orientation towards financial performance
- promote diversification
- consolidate and intensify production with emphasis on quality assurance
- provide support services such as research, extension, marketing, planning, regulatory and infrastructure development
- promote private sector investment
- privatize selected operations
- preserve and conserve land assets.

Research Division's Mission and Objectives

The Research Division is committed to the provision of high quality and relevant applied agricultural research and support services and the dissemination of research findings. In line with this mission statement the main objectives of the Research Division are:

- develop elite lines of germ plasm
- conserve existing genetic resources
- develop package of cultural practices
- pest and disease management and quarantine pathways
- natural resource management
- provide quality and timely policy advice
- maintain an efficient research institutional capacity.

It is essential that the Research Division maintain a pool of qualified scientists in the appropriate disciplines with adequate physical and financial resources to effectively implement research programs. It is therefore of paramount importance that:

- research staff are released for advanced and specialized training
- provide funds for staff to attend research conferences to maintain professional and institutional linkages
- maintain a critical mass of researchers to allow for staff turnovers
- maintain an adequate library and information capacity
- develop research facilities to optimize staff productivity.

Previous Institutional Analyses

1. ***1982 International Service for National Agriculture Research (ISNAR) Review***

ISNAR conducted a review of the Research Division in collaboration with the MASLR team. The review reported that:

- the research planning process needed wider consultations with all the relevant stakeholders

- C medium- and long-term plans should be developed to include review of human, physical and financial requirements
- C transfer of regulatory and non-research functions
- C additional travel, operational and maintenance funds should be made available
- C research and extension linkages with other stakeholders including farmers should be strengthened
- C research publications must target a wider audience
- C structural changes are necessary to integrate crops, livestock, land use, and economists.

2. ***1985 ISNAR/MASLR Research Review***

This review largely reiterated the recommendations of the *1982 Review Report*. The major thrust was to conduct quality research and to continue with the research programs already in place.

3. ***1991 ISNAR Review***

ISNAR again reviewed the 1982 and 1985 Research Plan. There was very little attempt made to implement the recommendations. The current research program is similar to the 1985 Plan in terms of scope and the commodities being investigated, however, the recommended plan has been given very little attention.

Current Research Division Structure

The Research Division is a component of the Services Department of the MASLR and is responsible, through the Director (Research), to government through the Permanent Secretary and the Deputy Permanent Secretary (Figure 1). Within the Research Division, an administrative and four major technical mainstreams have been established (Figure 2), and these are largely: Agronomy; Horticulture; Plant Protection; and Fiji Agricultural Chemistry Laboratory (FACL).

The activities of these mainstreams are carried out at the research stations located in strategic areas around Fiji. The Administrative Unit is responsible for assisting the Director (Research) administering the Research Division activities in the following areas of operations:

- C Preparing budgets, annual work programs, research Corporate Plans and reports
- C Linkage with the Permanent Secretary through the Director (Administration and Finance) for allocation of research funds
- C Administering farm management operations in all the research stations
- C Providing library and information services to the research staff
- C Administering externally funded research programs.

1. ***Agronomy***

The Agronomy Section is responsible for coordinating and conducting field cropping research activities, monitoring and reporting. The main activities involved are:

- C introduction, evaluation, conservation and utilization of genetic material
- C development of package of cultural practices
- C development of prototype machines and tools of farm mechanization
- C developing and maintaining of pool of foundation seed stock
- C dissemination of information
- C crop improvement
- C enhancing knowledge of research and extension personnel
- C fertilizer management.

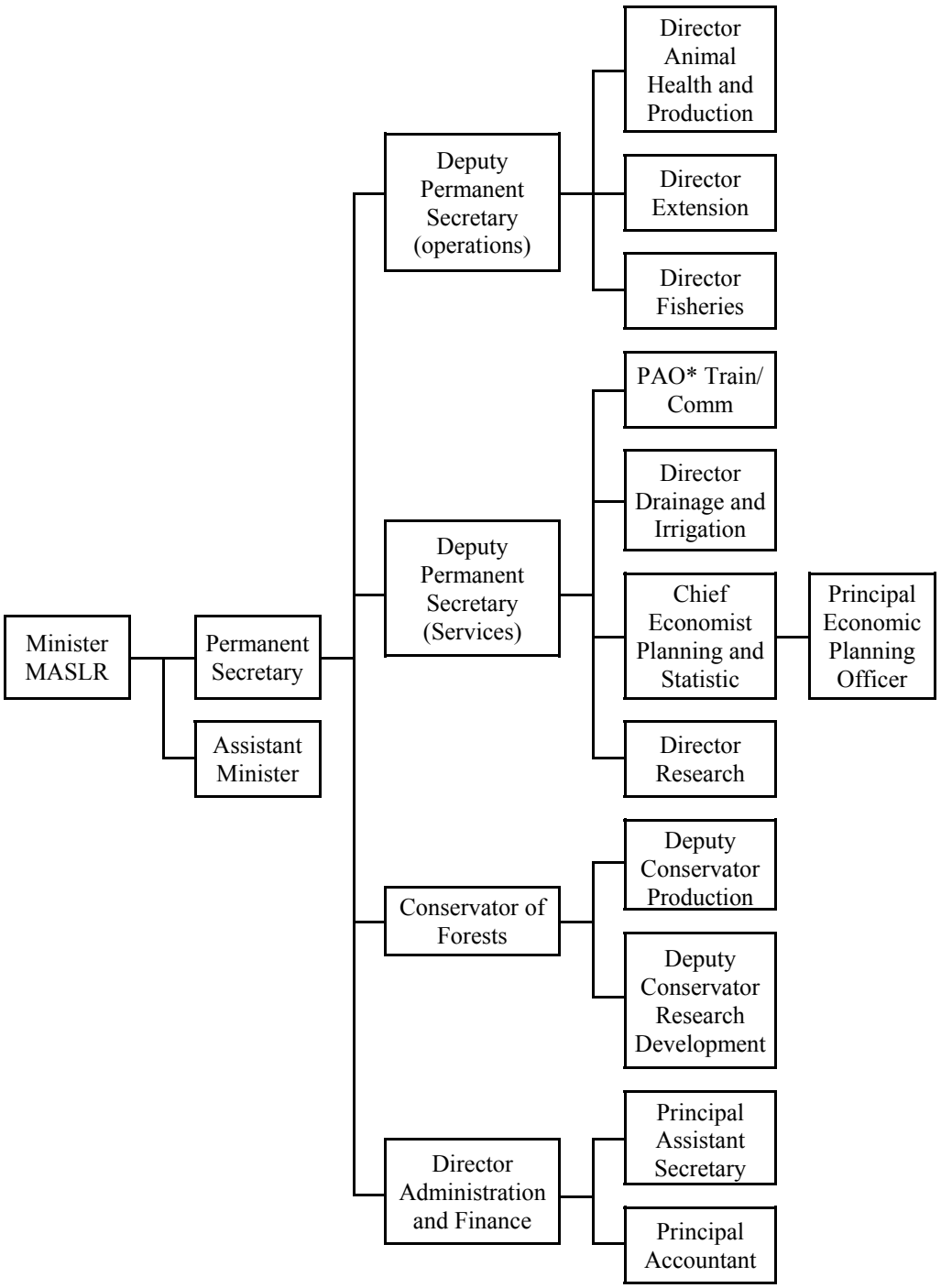

Figure 1. The MASLR Organization Chart to Level of Head of Division

Note: * PAO = Principal Agricultural Officer.

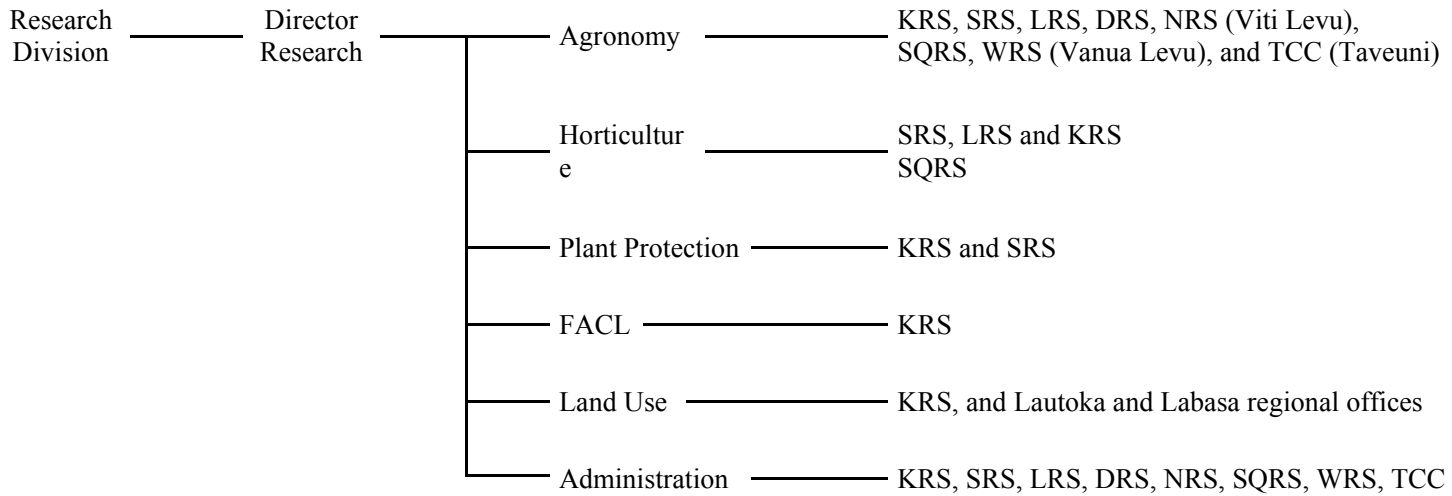

Figure 2. Research Division Activity Area and Location Organization Diagram

Notes: KRS = Koronivia Research Station; SRS = Sigatoka Research Station; LRS = Legalega Research Station; DRS = Dobuilevu Research Station; NRS = Naduruloulou Research Station; SQRS = Seaqaqa Research Station; WRS = Wainigata Research Station; and TCC = Taveuni Coconut Centre.

These activities are carried out in the research stations. Some of the current projects include:

- pre- and post-harvest handling processes
- seedbed management
- genotype x environment trials
- fertilizer trials
- cropping/farming systems
- on-farm trials for adoption of technologies
- reporting and publications.

2. ***Horticulture***

The Horticulture Section coordinates and conducts horticultural activities, monitoring and reporting. The main activities focus on tropical fruits, vegetables, pulses and cereal crops and are very similar to the Agronomy Section's mode of research operations.

3. ***Plant Protection***

The Plant Protection Section is mainly involved with services activities aiming at protecting all crops to minimize damages and losses due to insects pests and diseases, monitoring and reporting on progress of research activities. These activities mainly involve:

- identification of pests
- mitigate to manage the control levels
- developing and evaluate control methods
- developing quarantine control pathways
- controlling herbicide/pesticide usage through registration of chemicals.

4. ***FACL***

FACL is a service unit of the Research Division and it is also the government's analytical center for chemical, plant, feeds, forensic, water, and food value-adding. The main activities are:

- collection of samples
- linkages with other government agencies
- chemical and physical analysis operations
- monitoring and reporting
- Food Technology Value Adding Research
- government witness to court cases in providing forensic analytical data.

Research Stations

There are eight research stations administered by the Research Division and they are located in strategic areas around Fiji. These stations are:

- Koronivia Research Station (KRS) (Research Headquarters);
- Naduruloulou Research Station (NRS);
- Sigatoka Research Station (SRS);
- Legalega Research Station (LRS);
- Dobuilevu Research Station (DRS);
- Seaqaqa Research Station (SQRS);
- Wainigata Research Station (WRS); and
- Taveuni Coconut Centre TCC).

Finance and Budgeting

There are recurrent (operational) and capital funds budgeted and allocated. The annual approved provision is around F$3-4 million. There are additional provisions allocated from external donor agencies for regional research programs and these are around F$0.5-1 million. The breakdown is as follows:

Policy and administration:	18 percent
Capital crops research:	82 percent
Aid-in-kind in addition to the capital projects	22 percent

Staffing

Research staff distribution is as follows:

- Eighteen established administrative positions
- Ninety-eight established researchers
- A total of 116 research staff and 154 permanent unestablished staff.

CURRENT SITUATION OF AGRICULTURAL EXTENSION IN FIJI

The Extension Division is responsible for crop extension and livestock extension is the responsibility of the Animal Health and Production Division of the MASLR. Their main objectives are to provide extension services for enhancing the quality of living standards through increasing agricultural production. Extension activities mainly involve:

- transferring innovative and appropriate technology to improve farmers' performance and productivity
- assisting agro-based industry development for exports
- provision of advisory services
- training of farmers on commercial farming management
- facilitating increase in agricultural production for exports
- agricultural census
- community development in agriculture
- provision of timely and quality policy advice.

Organizational Performance

The Extension Division management is very much centralized at the MASLR Headquarters. The Director (Extension) is the administrative head of the division and is responsible to the Permanent Secretary and the Deputy Secretary (Operations) for the overall management of the resources and extension programs in Fiji. There are six Principal Agricultural Officers (PAOs) who are responsible to the Director (Extension) for the implementation of extension programs. There are four major geographical divisions which are managed by four respective PAOs of whom two are based at headquarters for projects and administration, respectively. Each geographical division is further divided into districts and localities. The district is managed by a Senior Agricultural Officer (SAO) and a locality is managed by a technical officer with few technical assistants depending on the size of the district and farming population (Figure 3).

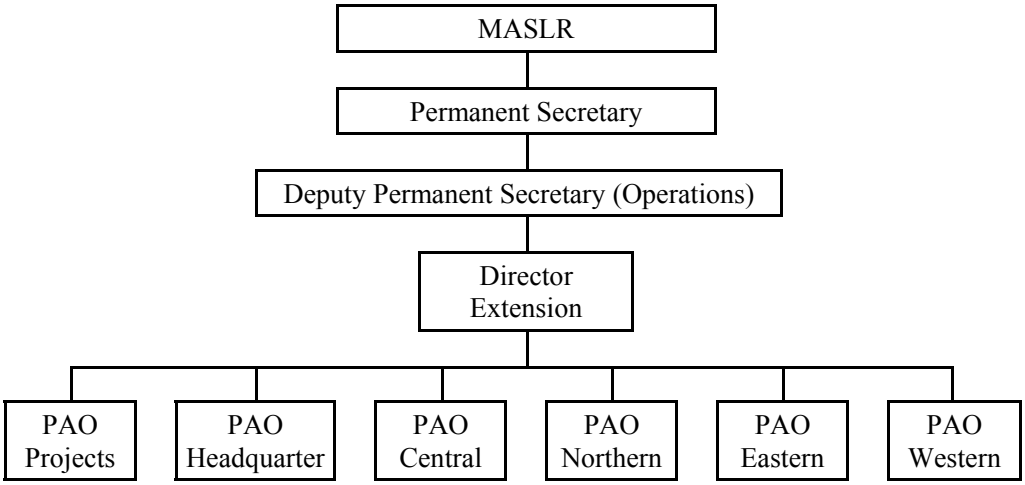

Figure 3. Extension Division Organization Structure

The Administration Section is responsible for:

- preparation of corporate plans, annual work program, budget, work plans and reports
- linkage with the Permanent Secretary through the Director (Administration and Finance)
- provision of farm management and project proposals
- linkage with research and other stakeholders including the private sector.

The four main geographical divisions are: Central; Northern; Western; and Eastern. Each of these divisions is headed by the PAO who is responsible for:

- providing appropriate extension services
- implementation of extension programs
- facilitating crop production
- developing linkages with stakeholders
- reporting and evaluation
- conducting agricultural census work
- organizing community development in agriculture.

Challenges and Improvements

Key roles for extension officers have been identified as:

- assisting industry-directed extension services
- technology transfer and particularly the promotion of profitable sustainable and organic production practices;
- supporting bilateral quarantine agreements (BQA)
- focus on assisting exporters, producers and processors
- provision of subject matter specialists to support agro-based industries
- Refocus away from general extension towards on-farm demonstrations.

Enhancing the standard of living of the agricultural community depends largely on:

- the adoption of sustainable agricultural production methods
- field enforcement and certification to be established
- training of agriculturalists at the Fiji College of Agriculture
- enhancing quality and consistency of production.

LINKAGES BETWEEN AGRICULTURAL RESEARCH AND EXTENSION

The main strategies for increasing agricultural production to meet the challenges of food security, domestic and international markets are:

- enhancing quality and consistency of supply – support agro-based industries with improved extension efforts, enforce legislation to improve quality standards, support BQAs
- safeguarding and commercially exploiting Fiji's quarantine services – strengthening MASLR Quarantine Authority, increased surveillance to prevent smuggling of plant and animal materials
- ensuring environmental sustainability
- improving export market access – air and sea services
- encouraging commercialization of the subsistence sector
- corporatization of the Research Division to improve services on development of technologies
- Rationalizing and refocusing of extension towards specialized programs
- review and improve agricultural lending services – Fiji Development Bank
- promoting farming as a business.

In private sector development the MASLR has four essential core functions:

- Information generation and dissemination, monitoring and policy advice;
- Creating an environment for private sector development;
- Ensuring sustainable agricultural production; and
- Facilitating the development and transfer of innovative and appropriate technology.

REVITALIZED AGRICULTURE SECTOR – 2002

The MASLR is currently reviewing its management structure with its new corporate plan for the short, medium and long term.

Vision

A revitalized agriculture sector to meet the challenges of national food security and requirements of domestic and international markets.

Mission

To excel in the provision of customer-driven services in order to maximize the sustained development of the agriculture sector.

Key Result Areas

- Provision of quality and timely policy advice
- Enhancing quality of life through increased agricultural production and value-added services
- Accelerating the use of appropriate and innovative technology
- Ensuring sustainable land utilization and management practices
- Strengthening and provision of sound corporate management structures and systems
- Maintaining an effective, dynamic and customer-focused organization
- Ensuring strict compliance with quality standards agreed to under international agreements and statutory regulations.

Key Objectives

- ***To decentralize*** – To facilitate 'prompt decision-making process' on service delivery. As a 'customer focused' organization it is considered essential that decisions must be made nearest to where the services are delivered. The responsibility for managing agricultural service delivery will be delegated to the various strategic functional units identified.
- ***To separate*** – The operational management of agricultural service delivery from the strategic functions and management.
- ***To Refocus*** – The MASLR Headquarters on strategic management, policy development and planning, human resources development and better management of executive support services.
- ***Key Strategies*** – Adoption of corporate planning framework, formulation of strategic plan 2003-05, and 2003 Corporate Plan.
- ***Restructure of the MASLR*** – Realignment of posts and budgetary allocations, establishment of the proposed management system and structures, position descriptions, integrated approach of central agencies, people focused and empowered through capacity building and upgradation of skill in alignment with Public Sector Reform (New Management Structure).

REFERENCES

Asian Development Bank, 1998. *Management Strategy for Agriculture Growth*, Asian Development Bank Report 1998 for Ministry of Agriculture, Fisheries and Forests.

Fiji Agriculture Sector Review, 1996.

ISNAR, 1985. *Agricultural Research Plan, Fiji*, ISNAR Report (ISNAR R 21).

Ministry of Agriculture, Fisheries and Forests. *Crop Extension Business Plan 2000*.

Ministry of Agriculture, Fisheries and Forests and ALTA, 1995. *Structures and Procedures of the Research Division Report*, USAID.

----------. *Strategic Plan 2001-03*.

4. INDIA

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INTRODUCTION

Poverty, ignorance and lack of initiative were the legacies from the past. After independence, India found herself faced with many vital problems of economic and social reconstruction. Purchase of food grains from abroad were straining the resources of the country. A series of unprecedented natural calamities aggravated the situation further. It was natural that the country had to give serious thought to building of food self-sufficiency.

Agriculture has been the anchor for achieving socio-economic growth. Impact of modern agricultural technology has been remarkable. The Green Revolution is one of the success stories that ushered in an era of food self-sufficiency and rural prosperity. Presently, agriculture accounts for about one-third of the annual GDP and two-thirds of the national employment. The total food grain production has increased from 51 million mt in 1950-51 to nearly 209 million mt in 2000-01. The strong agricultural research and extension base coupled with the hard work of farmers and appropriate policy support have helped this achievement despite increasing population growth. In fact, the rate of agricultural growth has outstripped the rate of growth of population.

Globalization and the WTO agreement have now made the situation highly volatile, competitive and knowledge-based. While food security still remains a matter of concern, the present scenario has resulted in new priorities and calls for a meaningful integration of research extension programs.

AGRICULTURAL CHALLENGES

The challenges of optimum socio-economic growth are many and varied. These have acquired a new dimension in the context of the current development scenario. The important agricultural challenges are:

- agricultural sustainability in the green revolution area
- harnessing production potential of rainfed area
- judicious use of land and water resources
- management of common property resources
- development of human resources
- emphasis on diversification
- emphasis on post-harvest technology

- strengthening supply and marketing systems
- investment in infrastructure development
- strengthening linkages within the system
- developing information network.

AGRICULTURAL DEVELOPMENT PROCESS

The Ministry of Agriculture, Government of India, through its Department of Agricultural Research and Education (DARE) and Department of Agriculture and Cooperation (DAC) coordinates the agricultural development work. The DARE looks after agricultural research and education, where as DAC looks after extension through its well-established network from national to grassroots level. The agricultural development process involves three major systems viz.: (i) research system; (ii) linking (extension) system; and (iii) client (farmers) system (Figure 1). The research system consists of Indian Council of Agricultural Research (ICAR) institutes, State Agricultural Universities (SAUs) and other organizations, which create new knowledge and technology. The linking (extension) system consists of change agents, extension personnel belonging to government and non-government agencies and others who act as linkages between the research and client systems and facilitate the transfer of agricultural technology. The client (farmers) system consists of intermediary, i.e., input manufacturers, bankers, suppliers and ultimate users (farmers) of the technology. The desired development can take place only if these three systems participate, interact and collaborate with each other. New knowledge and skills, cost-sharing and functional complementarities resulting from integration of research and extension make it easier to carry out on-farm research, field demonstrations, education and training sessions, outreach extension programs and other activities.

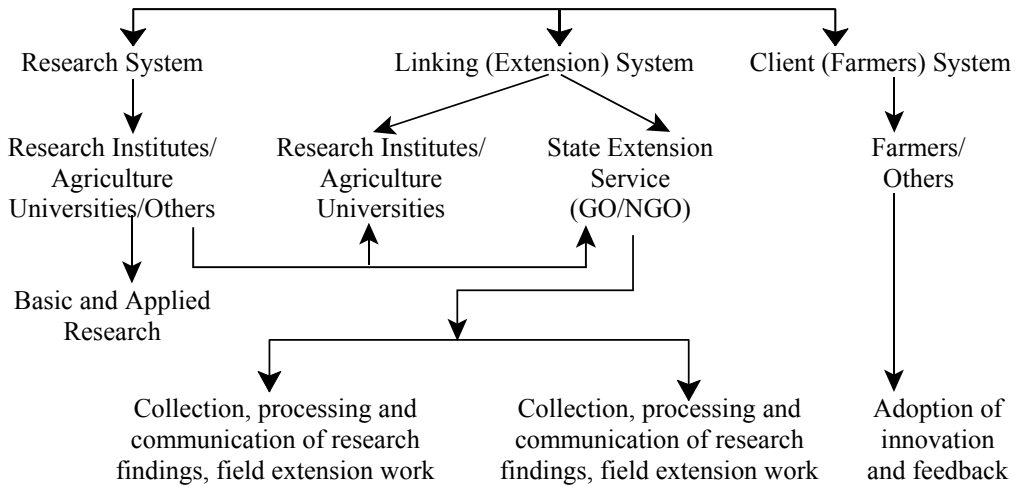

Figure 1. Agricultural Development Process

STATUS OF AGRICULTURAL RESEARCH

India's agricultural research system is one of the largest systems in the world. The National Agricultural Research System (NARS), which is at the forefront to guide

technological breakthroughs in agriculture, was strengthened with the establishment of the ICAR in 1929. The SAUs, which came into being as autonomous institutions during 1960s, also became a part of NARS. The NARS led by the ICAR has four national level institutions (deemed to be university), 45 ICAR institutes, 30 national research centers, four Bureaus, 10 project directorates, 84 All India Coordinated Research Projects and 16 other projects/ programs in the public sector. Apart from this, there are 31 SAUs and one Central Agricultural University. This NARS system not only generates technologies and develops human resources, but is also involved in technology assessment, refinement and dissemination.

The ICAR functions through a national grid of cooperative research in which role of the central institutes (ICAR) and SAUs is well established as equal partners. The ICAR is directly involved in fundamental and applied research through its various institutes and national research centers covering areas which stretch beyond state or regional interests. The SAUs as well as public, quasi-public and private institutions address problems relating to the states, regions or specific locations. The research system is based upon integration of research, education and extension. Its extension role is to upgrade professional skill of extension personnel and farmers and to collect, synthesize and communicate the research results of extension value to the state extension agencies and farmers.

The coordinated research projects have been designed on a production-oriented and problem-solving basis and interdisciplinary approach involving scientists from SAUs and ICAR institutes. From 1997, the agricultural research and extension programs have been reorganized under the National Agricultural Technology Project (NATP), which aims at making organizational reforms in the research system, develop production-oriented research and innovative transfer of technology.

Research Achievement

Since independence, a number of technologies have been developed in different areas. The significant achievement are as under:

1. ***Crop Science***

- About 2,300 improved crop varieties/hybrids have been developed making the India self-sufficient in many important crops/commodities.
- Field crop production has increased many fold, e.g., wheat (10-times), sugarcane (six times), maize (five times) and rice, cotton and oilseeds (four times). The productivity has increased fourfold in wheat, about 2.5 fold in rice, maize, cotton, rapeseed and mustard.
- Establishment of a national gene bank with capacity for storing more than one million accessions.
- First country in the world to develop hybrids in cotton, grain pearl millet, castor, pigeon pea and safflower and second in rice and sorghum.

2. ***Horticulture***

- Largest producer of fresh fruits and vegetables in the world and the largest exporter of spices and cashew.
- About 460 High-yielding Varieties (HYVs) and hybrids of horticultural crops developed.
- Average productivity of vegetable crops increased by about three times.

- Release of HYVs and improved propagation technologies in cashew helped in increasing production and productivity.

3. ***Animal Science***

- "White Revolution" placed India as the leading producer of milk in the world with a production of 68.8 mt during 1996-97.
- High-yielding crossbreed strains, e.g., Karan Swiss, Karan fries and frieswal with first lactation yield of more than 3000 liters developed.
- Three new high-producing strains of sheep, e.g., 'Avikalin', 'Avivastra' and 'Bharat Merino' evolved.
- Developed highly dependable and efficacious vaccines against livestock and poultry diseases, e.g., foot-and-mouth disease, rinderpest, ranikhet, etc.

4. ***Natural Resource Management***

- Soil resource maps of 12 States and two Union Territories released.
- Technologies developed for sustaining rainfed farming systems for different watershed areas.
- Silvi-pastoral systems for arid and semi-arid regions developed.
- Technologies for amelioration of salt affected and problem soils developed.

5. ***Agricultural Engineering***

- Several manual animal/tractor-operated equipments and machinery designed, developed and commercialized for land preparation such as multipurpose tool frame, Central Research Institute for Dryland Agriculture (CRIDA) plough and disc harrow-cum-puddler, etc.
- Post-harvest management of farm produce equipment such as grain cleaners, solar cop driers and processors, etc. developed and commercialized.
- Under energy management in agriculture, designed and developed improved yokes and harnesses for draught animals resulting in reduction of drudgery of animals, required draught power and increase in output capacity.
- Under Lac technology, processes developed for recovery of Lac dye, insulating varnish, etc.
- Greenhouse technology for low volume high-value crops has been developed and commercialized for higher productivity and availability of quality products in off-season.

6. ***Fisheries***

- 'Blue revolution' for higher income and export in marine fish. Production has gone up nearly six times.
- Modern processing techniques such as freezing, value addition and formulation led to major jump in marine products exports.
- Improved variety of Rohu seed – CIFA (Central Institute of Freshwater Aquaculture) 1R-1 christened as '*Jayant*' having better growth rate released to fish farmers.
- A mini fish gene bank established.
- Pearl culture technology has been developed.

Future Research Thrust

The ICAR has completed the perspective 2020 plan for all of its institutions. As a bottom-up approach, the Council has also prepared ICAR Vision 2020 for harnessing science to achieve food and nutrition security. It proposes to address the issues of biodiversity, natural resource management, farming system approach, rainfed agriculture, post-harvest

management, farm mechanization, gender issues, information networking and effective partnership with other public and private institutions.

NARS needs to be reformed and reoriented according to a strategic research plan supported by public investment. The policy support to create an enabling environment is essential. It should stress on land reforms, input-output pricing, investments in irrigation, infrastructure, insurance, legislation for biodiversity, geographic appellation, varietal protection and farmers' rights. Economic liberalization provides new opportunities for export-led growth in agriculture through achieving and exploiting export competitiveness. For increasing research efficiency, the public and private sectors are required to come together to articulate research needs and design a strategy to address them together. A demand-driven research agenda on the principle of comparative advantage is needed to improve overall research efficiency and research output.

Agricultural research centers on integrated use of natural resources such as soil, water, climate and biological diversity. A paradigm shift from commodity centered to an ecologically, economically and socially sustainable farming systems centered approach to agricultural research is essential as is the organization of education, extension and skill empowerment on the basis of farming systems intensification, diversification and value addition. Considering the present developments and opportunities, the critical areas for research interventions are:

1. improving availability of seed/planting material of high yielding varieties;
2. developing and promoting use of hybrids, especially for rainfed ecologies;
3. expanding areas under different crops and commodities through diversification;
4. improving productivity of crops, existing plantations and livestock;
5. developing technologies and infrastructure for post-harvest management, marketing and agribusiness;
6. mechanizing small farms and developing strategies for exploiting their potentials through group farming and self-help groups;
7. transferring technology through assessment and refinement continuously; and
8. enhancing export potential in selected areas where India has comparative advantages.

STATUS OF AGRICULTURAL EXTENSION

The agricultural scenario indicates that there are three distinct types of agricultural production systems: commercial, Green Revolution and Complex, Diverse and Risk-prone (CDR) agriculture. The commercial and Green Revolution production systems are capitalized family farms/plantations with high use of purchased inputs, relatively uniform environmental conditions and production suitability with moderate risk, whereas CDR production system is mostly practiced in rainfed agriculture by small and poor households with low purchased inputs and high risk of production suitability.

Agricultural extension is a State subject and State agriculture department looks after the extension works. In addition, there are extension functionaries working under other State development departments, NGOs and private organizations to supplement the work of extension system. There are about 103 million farm families spread over 127 agro-climatic zones of the country with a variety of crop and animal production systems. The ultimate purpose of extension system is to provide useful and timely technological information to the farmers and feedback the field problems to the research system. There is an alarming

knowledge-practice gap in agriculture. The reasons for low adoption of technologies are: (a) poor linkages among research, extension and client systems; (b) lack of economically viable, operationally feasible and socially compatible technologies; (c) poor technological knowledge of farmers and extension personnel; (d) lack of quality seeds and timely supplies inputs; and (e) poor infrastructure and marketing facilities.

The farmers particularly differ on their socio-psychological, economic and communicational characteristics and behavior which should be taken into account, while planning and implementing agricultural programs.

Many efforts have been made to shorten the process of technology generation and its adoption by the research and extension systems. The efforts made after independence are briefly described under the following broad approaches:

Efforts by National Extension Service System

1. ***Community Development Approach***

A comprehensive program for agriculture and rural development, called Community Development Program was launched on 2 October 1952. It was a broad-based program covering all aspects of village life including agriculture, health, education, rural industries, transport and communications and social welfare of women and children. The program being multidisciplinary in nature had little impact on agricultural development, but had considerable progress on overall upliftment of standard of living. Along with the pressure of food scarcity and growing population, greater attention had to be given to increasing food grains production and thus, the approach was diverted towards intensive agricultural development.

2. ***Area Approach***

Intensive Agricultural District Programme (IADP) was launched in 1960-61 to demonstrate the potentialities of higher food production through a package of practices in areas which specially endowed with assured water supply, infrastructural facilities, good soil etc. Since the program led to a significant increase in crop yields, the government expanded to more districts through a program called Intensive Agricultural Area Programme (1964-65). This program emphasized intensive agricultural development of the area as a whole. These programs paved the way for launching the High-Yielding Varieties Programme (1966-67). The main ingredients of the new technology were the use of HYV seeds, irrigation, appropriate doses of chemical fertilizers, pesticides, improved implements, credit etc. The program helped in agricultural production by vertical yield improvement and was identified as the best strategy for realizing the optimum genetic potentiality of new seeds. However, since this program bypassed areas, which were not endowed with assured irrigation on adequate rainfall, the Drought Prone Area Programme (DPAP) was launched during the Fourth Five-Year Plan period with a thrust to optimize utilization of land, water, livestock and human resources. Desert Development Programme (DDP) was also introduced in 1977-78 with the emphasis on checking desertification in hot and cold arid deserts. The schemes of afforestation, water harvesting and animal husbandry were also implemented. The Command Area Development (CAD) Scheme was launched during the Fifth Plan period with the main objective of development of the command areas of irrigation projects. The area approach laid to increase in agricultural production, but favored the 'haves' and increased the gap between the 'haves and have nots'. This called for focus on economic development programs with social justice.

3. ***Target Group Approach***

Under this approach, Small Farmers Development Agency (SFDA) and Marginal Farmers and Landless Laborers Agency (MFAL) (1971) were launched besides Tribal Development Programme. Under these programs, the target groups were helped to adopt improved agricultural technology and diversify their farm economy through animal husbandry, dairying, poultry, horticulture. These programs are now part of the Integrated Rural Development Programme (IRDP). The problem of employment was also becoming very serious, therefore, employment schemes especially in the rural programs were formulated.

4. ***Employment Approach***

In order to combat employment problem, Crash Scheme for Rural Employment was launched in 1971. It was to provide employment to about 1,000 persons in every district during the working period of 10 months in a year. Pilot Intensive Rural Employment Project (1972-73) was expected to provide information on the basis of which rural works program could be integrated with other development programs. This helped in formulating the Food for Work Programme (1977-78) which aimed at creating some additional employment in the rural areas on projects designed to create work of durable utility to the rural population. From October 1980, this program was restructured as the National Rural Employment Programme (NREP) with the objective to generate gainful employment for the unemployed and the under-employed persons in the rural area,s to create productive community assets for direct and continuing benefits to the poverty groups and bring about a general improvement in the overall quality of life in the rural areas. Rural Landless Employment Guarantee Programme (RLEGP) guaranteed employment for at least one member of every landless household up to 100 days in a year in such a way that durable assets are created for strengthening rural infrastructure for the speedy development of the rural economy. The two above programs NREP and RLEGP have been merged with Jawahar Rozgar Yojana (JRY), JRY has been restructured in 1999 and has been renamed as Jawahar Gram Samridhi Yojana (JGSY) for creating infrastructure including durable assets for sustained employment of rural poor, besides generating 50-100 days of work for at least one member each of the poor rural families. A distinguishing feature of the scheme is that the central assistance will be given directly to its district rural development agencies and *Zila Parishad*.

5. ***Integrated Development Approach***

The performance of the most rural development programs was not up to the expectation, so IRDP was formulated to cover the whole country with the objective to assist families below the poverty line in the rural areas by taking up self-employment ventures in a variety of activities like agriculture, horticulture, sericulture and animal husbandry in the primary sector and service and business activities in the tertiary sector. IRDP's emphasis is on the family. At least 30 percent of the beneficiaries are women. Under IRDP, a scheme for rural youth – Training of Rural Youth for Self-employment (TRYSEM) was started in 1979 with main objective to equip rural youth (18-38 years) with necessary skills and technology and enable them to take up vocations of self-employment. It helped the development of agricultural workers, landless laborers and rural artisans. Here, the priority was given to youth from schedule castes and tribes and to women. Another scheme exclusively for women under IRDP was Development of Women and Children in Rural Areas (DWCRA). The main objective of the program was to improve the lot of rural women through the creation of income-generating activities in the district. The program envisages formation of groups of 10-15 rural women each for carrying on income-generating activities.

Each group is sanctioned a revolving fund of Rs.25,000. These programs (IRDP, TRYSEM, DWCRA and Million Wells Scheme) have been restructured into a single program called Swarnajayanti Gram Swarozgar Yojana (SGSY) as a holistic program of micro-enterprises covering all aspects of self-employment which include organizing rural poor into self-help groups in April, 1999.

6. ***Single Line Approach***

The Training and Visit (T&V) system was launched in 1974 for effective transfer of available agricultural technology. The project basically involved reorganization of the already existing community development approach of extension by developing professionalism in the extension service. The striking change the T&V system has brought is the shift from multipurpose extension to agricultural knowledge system. The system has developed strong linkages between scientists and extension and farmers. The features of the system are professionalism, single-line command, concentration of effort, time-bound work, field and farmer orientation, regular and continuous training and linkages with research.

7. ***Participatory Approach***

This approach aims at creating congenial environment for developing local capability of the community so as to promote continued adoption of improved agricultural practices. This is achieved by mobilizing internal and external resources through community action on watershed area basis. The main focus is to undertake need-based demand-driven programs for sustainability in terms of agricultural production, inculcate the spirit of sharing benefits from community enterprises and develop common property resources, infrastructure and rural institutions for sustained development in an integrated manner. The local people are involved at every stage of the project, and the monitoring and evaluation of their action by people give rise to accountability and learning experience for defining better remedial measures. National Watershed Development Programme for Rainfed Areas, Waste Land Development Programme, etc. are running under this approach.

Under the innovative approach to sustain the capabilities of technology generation and dissemination and to respond to the current and emerging needs in agriculture, the NATP was launched. The extension approach under NATP has adopted integrated bottom-up planning approach by establishing Agricultural Technology Management Agency (ATMA) in selected districts on pilot basis. It is an innovative approach with new institutional arrangements for technology dissemination having 'farmer first', 'farmer centric' and 'farmer empowerment' focus. It is a shift from Transfer of Technology (TOT) to extension process approach. The ATMA is to coordinate the research, training and extension activities of GOs, NGOs and others in the district in partnership mode.

Extension Efforts by Research System

The ICAR extension system aims at demonstrating the latest technological advances by the scientists to the actual users, training extension functionaries and serving as a feedback mechanism for the research system. The major programs included National Demonstration (1964-65), Operational Research Project (1974), Lab to Land Programme (1979) and Krishi Vigyan Kendra (KVK) (1974). During 1992, all these four programs were integrated under the KVK project. With this merger, the KVK has a wider role and its mandates are to undertake training for farmers, farm women, rural youth and others on agricultural matters including special skill-based training for entrepreneurship development, conduct on-farm research for technology refinement and front-line demonstrations to demonstrate production potentialities of latest agricultural technologies to the farmers and extension workers and

provide advisory services to farming and others on agricultural matter. The plan is to establish one KVK in each district. At present, the Council has established more than 300 KVKs, which are run by ICAR institutes, SAUs and NGOs.

In 1995-96, "Institute Village Linkage Programme" (IVLP) was introduced for technological interventions with emphasis on stability and sustainability along with productivity in different production systems. The program intends to establish closer linkages between research and extension in the assessment, refinement and TOT.

The changing economic scenario has made the world a global village and created new opportunities and priorities in agriculture. A highly professional and market-driven integrated approach is required to be able to compete globally. The emerging priorities in extension are:

1. technological options and development in agricultural production
2. location-specific and need-based extension, participatory extension for technology development and dissemination
3. linkages and coordination among development departments and organizations
4. use of new communication channels and media support
5. human resources development including gender empowerment and entrepreneurship development
6. cost-sharing of extension services and privatization of extension
7. policy changes for building effective extension strategy.

INTEGRATION OF RESEARCH AND EXTENSION

Agriculture and rural development programs in India have done a commendable service especially in terms of food production, income and employment generation and reduction of poverty. Still miles have to be covered for sustainable agricultural and rural development. The current development scenario are changes in the rural institutions; globalization and liberalization; revolution in information technology and electronic media; growing importance of NGOs in agriculture; role of private agencies; women concerned development paradigm; diversification and value addition; management-based development, etc.

The challenges now facing Indian agriculture are more daunting in both research as well as extension systems. The systems are not adequately geared up to meet the future requirements. With the old approaches still to make way for new ones, symptoms of complacency and loss of definite directions are becoming apparent. The following areas require due attention to efficiently manage the situations:

- Control, accountability and sustainability in agriculture
- Developing a comprehensive National Agricultural Policy
- Addressing the educational and technological needs of target groups
- Farm women and need of women extensionists
- Improving communication support in extension services
- Strengthening extension management and strategy building.

Agriculture and rural development is a holistic concept encompassing both natural and human resources development in an integrated manner. The integration enunciates that all things are connected and their interaction in nature is complex. Stimulus to one creates response not only in that, but also in the system as a whole and therefore, agricultural

development is not a matter in isolation. The web of interdependent factors involved is not political, social and institutional; rather it is an integration of knowledge, information and resources between research and its partners. The institutional factors involve those performing the basic duties of education and developing new technologies and the duties of actually transferring the technology to the ultimate beneficiaries. The former is the indirect role and the latter is the direct role. Unfortunately, those who are directly involved in this crucial development work have not been able to deliver the goods to the desired extent due to one or other reasons. This indicates that nothing can be achieved by such isolation. A strong linkage has to be developed to make these two direct and indirect agencies work in close liaison for the benefit of the farmers at all levels and through them finally the whole community.

Existing Integration

Every country, which has modernized its agriculture and achieved higher agricultural production, has done so basically through the introduction and integration of science and technology into its farming system. India is one of the most successful examples of changing traditional agriculture to a modern one through development of new agricultural technology for different agro-ecological situations and farming systems, transferring and integrating the same to farmers' field and sustenance of technology by providing needed input, credit and infrastructure facilities. It has tried to create innovative research and extension systems and established effective linkage between them and farmers. The integration among different partners is, by and large, indirect and without understanding to one another (Figure 2). As a result, desired results are not forthcoming. T he studies indicate that farmers in favorable and risk-free situations accept most of the recommended technologies, whereas there is little uptake of technologies in the unfavorable farming situations. The integration of research with its client is mostly indirect.

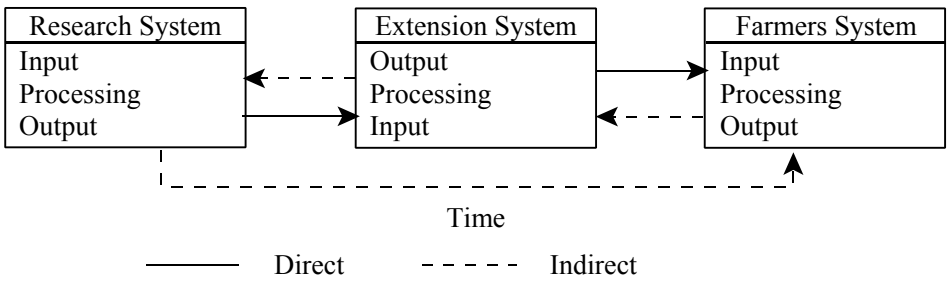

Figure 2. Integration in Technology Transfer System

The present integration among different systems is week. This needs to be adequately strengthened. Largely, it is one-way. The integration of research with its client is mostly indirect. The present situation depicts that the farmers can no more work in isolation, they need purposeful interaction and interdependence. The effective and frequent communication within the three systems is necessary. The farmers need to play a definite role even at the technology generation stage and there has to be closer linkages between research and extension in technology development and transfer.

The T&V system of extension service in 17 States and National Agricultural Extension Project (NAEP-I, II & III) and National Agricultural Research Project (NARP) have come to a close. The experiences gained and the infrastructure developed under these projects need to be appropriately utilized. The T&V system was able to transfer relevant research findings. It made extension activities more specific to facilitate interaction with research, established formal links between research and extension through subject-matter specialists and shaped efficiency of formal links by professional values. However, it had adverse effect in terms of bias in favor of advantaged resource-rich farmers. The system was weak in responding to the need of resource-poor farmers. It was not broad-based and followed a top-down approach. Many farmers did no derive benefits as they needed a detailed understanding of technical requirements rather than what was offered by general prescription of the system. Farmers often wanted credit and inputs more than the advice offered by the system. The evidence on the extent to which the system had promoted adoption is limited and mixed. The behavioral dimensions were not given adequate attention and the role of organization was overemphasized.

The present complexities in developing effective integration between research and extension are:

- increasing number of institutions, i.e., GOs, NGOs, private agencies and cooperatives with increasing number of mechanisms needed to coordinate their activities
- wider range of clients, commodities and environments
- diverse nature of agriculture requiring multifaceted interventions
- top-down planning
- lack of effective linkages in low potential, heterogeneous agro-ecological areas
- increase in number the resource-poor and low potential farm holdings.

Today, besides the network of official extension, a large number of autonomous and private organizations and individuals are involved in promotion and communication of agricultural and other technologies of rural change. What is needed at the moment is coordinated and integrated approach in this task. The studies suggest for having a separate and specific extension strategy for different areas and villages and categories of rural people, which are at different stage of development. Such integration must ensure that the research tackles farmers' priority needs and problems, farmers and TOP keep up with research development, research results are applied to solving farmers' problems, the technologies are adopted with local agro-ecological and socio-economic conditions, farmers have access to the information inputs and services required to support a technology, successful technologies are promoted and distributed widely to farmers and researchers can capitalize on users knowledge and obtain feedback on the relevance and performance of technology. This requires both functional and institutional integration of research and extension, which means research and extension be viewed as an integrated agricultural knowledge and technology system, particularly at district and below. For the functional integration, the important functions to be ensured are information input feedback by extension, joint testing of technology or adaptive research on local conditions and needs, transformation of research results, meaningful communication of research results, motivation and training on required skills and provision of adequate service support. Integration is likely to be effective if both research and extension should share a common overarching goal and sense of mission, feel that they depend on each other and work as partners not as competitors. This needs a

complete departure from top-down to bottom-up and from TOT to extension education based on demand-driven and market-driven information. The studies suggest having a separate and specific extension strategy for different areas and villages and categories of rural people, which are at different stage of development. The major problems of inadequate integration are:

1. structural and organizational problems
2. motivational/incentive problems
3. resources problems
4. communication problems.

Based on the lessons drawn from different extension and developmental efforts, the attempt is being made for long-term agricultural research and extension integration strategy through NATP – the latest project with the assistance of World Bank. In view of the highly productive and sophisticated nature of agricultural technology and changing global scenario, the emphasis is laid on integrated technology management with a view to address key constraints in technology dissemination, introduction of new institutional modes in operating technology dissemination, operationalizing them on pilot basis in 28 districts of seven selected States (four districts in each) and improving relevance of these processes to the changing agricultural scenario and needs of the farmers. This has been organized in the concept of ATMA at the district level. The organizational mechanism to run this project is:

At National level	– Project Management Committee
	– Project Management Unit
	– Technology Dissemination Management Committee
	– Technology Dissemination Unit
	– National Institute of Agricultural Extension Management (MANAGE) institute
At State level	– Inter Departmental Working Group
	– State Nodal Officer
	– State Agricultural Management and Extension Training Institute (seven SAMETIs)
At District level and below	– ATMA Governing Board
	– ATMA Management Committee (AMC)
	– Farmer information and advisory centers at block level
	* Block Technology Team (BTT)
	* Farmer Advisory Committee (FAC)
	– Farmers Interest Groups (FIGs)

The concept is based on bottom-up planning procedure in partnership mode involving all stakeholders and operating through groups. The strategies and actions are based on problems identified through intensive participatory rural appraisals (PRA) and on Strategic Research and Extension Plan (SREP) basis. In fact, it is the SREP-driven research strategies and operated by pooling and sharing of resources. There is intensive use of information technology and media back-up. There are adequate backward and forward linkages. All the research, training, development and extension activities run by public, private and other organizations in the district are integrated under ATMA. The program focuses on

participatory extension management by organizing demonstrations/trainings and exposure visits for new technologies with due attention on income and employment generating activities including entrepreneurship development. Emerging experiences are group approach which is gaining ground, involvement of farmers in planning and implementation and emergence of marketing strategy at micro level and focus on post-harvest, processing and value addition. Still the program has to go a long way. Its effectiveness will largely depend upon the commitment of stakeholders involved.

The appropriate blends of technology, services and public policies, are essential to accelerate agricultural progress. The most important areas requiring meaningful integration of research and extension are:

1. promotion of agribusiness through establishment of agribusiness/Agriclinic centers
2. strengthening extension system through establishment of a national research center for agricultural extension
3. use of distance education in dissemination of farm technologies
4. promotion of computer-aided extension.

REFERENCES

Paroda, R. S., 2000. "Farm Research Policy Support Essential", *Survey of Indian Agriculture*, pp. 17-24, The Hindu Publication.

Robbins, S. P., 1997. *Essentials of Organizational Behaviour*, San Diego State University, Practice-Hall of India Pvt. Limited, New Delhi.

Velayudham, T. K., 1994. *Challenges Facing Agriculture and Rural Development*, Oxford & IBM Publishing Co. Pvt. Ltd., New Delhi.

Venkataramani, G., 2000. "Overview-Scaling New Heights", *Survey of Indian Agriculture*, pp. 5-7, The Hindu Publication.

5. INDONESIA

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INDONESIA

Indonesia comprising more than 30,000 islands is located in South East Asia. The population of the country was around 200 million in 2000 and the growth rate of the population is about 2 percent per annum. The availability of food and its distribution are still an important national issue. For example, rice is grown mainly in Java and Bali (49.6 percent) followed by Sumatera (22.4 percent), Sulawesi (9.8 percent), Kalimantan (5.3 percent) and Nusa Tenggara (3.3 percent). In fact, rice production has decreased over time due to reduction of planting area in Java (Ministry of Agriculture, 1998). Sometimes rice is imported when the national production is not enough due to bad season. An alternative staple food such as sorghum is now being developed (Sumarno and Zuraida, 2000). Sumatera leads in the production of estate crops such as rubber, oil palm and coffee, while Java is ahead in the production of tobacco, sugarcane and tea. Both food crops and estate crops are very important from the Indonesian economic point of view.

In the present paper, current status of agricultural research and extension, their linkage with each other and some selective research in agricultural commodities, i.e., rice, sorghum and oil palm are reported and discussed briefly.

RECENT DEVELOPMENT IN AGRICULTURE RESEARCH

Agricultural Research Center

Research and development in agriculture are conducted by four departments, i.e., Ministry of Agriculture, Ministry of Research and Technology, Ministry of Education, and Ministry of Maritime and Fishery. The Ministry of Agriculture has seven research centers i.e., (Ministry of Agriculture, 1998):

1. Research Center for Social and Economic Agriculture.
2. Research Center for Soil and Agro-climate.
3. Center for Research and Development of Food Crops.
4. Center for Research and Development of Industrial Crops.

5. Center for Research and Development of Horticulture.
6. Center for Research and Development of Animal Husbandry.
7. Institute for Agricultural Equipment and Machine.

The Ministry of Research and Technology has three institutes which are strongly related to agricultural activities, i.e., (Badan Tenaga Nuklir Nasional, 2000):

1. LIPI (Indonesian Institute of Science)
2. BATAN
3. BPPT (Agency for Assesement and Application of Technology).

The Ministry of Education has more than 20 universities, having faculty of agriculture and related subjects. Some universities are:

1. Indonesian University, Jakarta
2. Bogor Institute of Agriculture, Bogor
3. Bandung Technology Institute, Bandung
4. Padjajaran University, Bandung
5. Gadjah Mada University, Yogyakarta
6. Dipanegoro University, Semarang
7. Samratulangi University, Manado
8. Brawidjaya University, Malang
9. Airlangga University, Surabaya
10. Udayana University, Bali
11. Sriwijaya University, Palembang
12. Bengkulu University, Bengkulu
13. Lampung University, Banda Lampung
14. Riau University, Riau Pakan Baru
15. Andalas University, Padang
16. Sumatera Utara University, Sumatera Utara
17. Syah Kuala University, Nagro Aceh Darussalam
18. Jambi University, Jambi
19. Hasanuddin University, Makasar
20. Mataram University, Mataram NTB
21. Palangkaraya University, Kalimantan.

The Ministry of Maritime and Fishery has one research center, namely, Center for Research and Development of Fisheries.

The universities are usually conducting basic research, whereas the research centers under the Ministry of Agriculture and others are carrying out applied research. Sometimes both types of research are simultaneously carried out by the research centers.

National Research Priorities

The Indonesian Government through the Ministry of Research and Technology proposes to revitalize research and development in agriculture by means of a new policy called National Research Priorities in Agriculture. The priorities are as follows (Ministry of Research and Technology, 2002):

1. Research program in the production system of commodities – This is to develop high quality of plant varieties, conserve soil base and reduce the use of pesticides while insulating agriculture against the vagaries of nature.
2. Research program in agricultural equipment and machinery – It is necessary to have appropriate design production technique for agricultural equipment and machinery.
3. Research program in post-harvest technology – The post-harvest technology has become very important to avoid damage of food during storage and handling.
4. Research program in agribusiness management and marketing – According to the experience, it is difficult to enhance the profitability of the farmer as long as the management and marketing system is not established.

CURRENT SITUATION OF AGRICULTURAL EXTENSION

Agricultural extension is carried out by the Ministry of Agriculture. The Ministry has several organizations in the province called "*DINAS PERTANIAN*". Personnel engaged in extension work are well trained by Training Division of the Ministry of Agriculture. However, agricultural extension was not effective due to weak linkages between the agricultural program and the real situation in the field. There is no harmonization between production and marketing.

To overcome the lack of information in technology development, some research institutes, particularly BATAN, LIPI and BPPT launched a special program of technology dissemination called "IPTEKDA (Technology for Rural Development)". As a result of this program, new technology, i.e., varieties of rice, feed supplement for fattening and reproduction of cow or sheep, effective fertilizer use, etc. have been introduced directly to the farmer. In this case, joint operations for agricultural extension have been established between the research institute, local university and local government (Proyek Pemberdayaan dan Pemasyarakatan, 1999).

At least 16 local governments have been involved in the joint program, i.e., NTB, East Java, Yogyakarta, North Sulawesi, South Sulawesi, Bengkulu, Wonosobo, Jepara, Blora, West Kalimantan, Bali, Central Java, North Sumatera, Garut, South Kalimantan and NTT.

In addition some NGOs are also participating. For example, ITAPEE, Environmental Awareness Society (EAS), Yayasan Pertanian Lamping (YPL), PESANTREN, etc. (Departemen Peranian, 2000).

LINKAGES BETWEEN AGRICULTURAL RESEARCH AND EXTENSION

The linkages between agricultural research and extension are very important. Direct participation of research institutes, universities and NGOs in the extension program led by the Ministry of Agriculture seem to be significantly better. The lack of budget and poor mechanism for agricultural marketing makes extension in effective. Many constraints need to overcome particularly in the improving the agricultural marketing systems.

Some systematic programs, through which research results could be disseminated efficiently are needed. Dissemination can be through publications, regular seminars, workshops trainings for farmers and extension staff, establishment of financial assistance schemes, involvement of all research institutes, universities and NGO's in agricultural exhibitions (Ikeda, 2000).

It is expected, therefore, that the future agricultural performance should have (Ministry of Research and Technology, 2002):

1. close linkages to the agribusiness system.
2. priority in the utilization of technology for process efficiency and agricultural productivity.
3. emphasis on development of agriculture based on the market demand.
4. thrust on creation of professionalism in agricultural management.
5. ability to explore new and more appropriate technologies which are location-specific less dependent on nature and environmentally friendly.
6. build and strengthen the agricultural system management by mutual benefit of joint venture system.

Normally, agricultural extension was usually undertaken by the organization under the Ministry of Agriculture at the province level, the organization is called "DINAS PERTANIAN". Recently, however, extension activities was also undertaken by different research institutes in the Ministry of Research and Technology under their program, IPTEKDA (Proyek Pemberdayaan dan Pemasyarakatan, 1999).

The linkages between agriculture research and extension seem to be improving as a result of the participation of some research institutes in the extension program. In fact, the research institutes establish a trilateral cooperation with the local university and local government. In addition, some NGOs such as ITAPEE, PESANTREN and the environmental group have induced linkages between researchers and users.

In order to support future agricultural performance in Indonesia, some effort should be made, i.e.,:

1. Conduct research and development activities which are useful to and needed by the farming community.
2. Improve linkages between researchers and the extension personnel.
3. Accelerate technology transfer to the end-users.

CONCLUSION

Agricultural research is carried out by different research and development centers and universities. BATAN has made a significant contribution to provide some new varieties of rice and other food crops through radiation-induced mutation techniques.

Agricultural extension is usually undertaken by the organization under the Ministry of Agriculture, particularly at this province called "DINAS PERTANIAN". However, recently, the activities are also conducted directly by research institutes such as BATAN, LIPI and BPPT which are under the Ministry of Research and Technology.

Linkages between research and extension appear to be improved as a result of trilateral cooperation between research institutes, universities and local government. In addition, the role of NGOs such as ITAPEE has become very important in forging the linkages.

REFERENCES

Anonymous, 1998. "Laporan Tahunan Pusat Penelitian Kelapa Sawit, 1997", p. 11-57, Medan.

Anonymous, 1998. *Innovation of Agriculture Technology*, Book 1, Agency for Agriculture Research and Technology, Ministry of Agriculture, Jakarta, 1998.

Anonymous, 2000. "Laporan Kegiatan BATAN 2000", Badan Tenaga Nuklir Nasional, p. 12-13, Badan Tenaga Nuklir Nasional, Jakarta.

Anonymous, 2002. "Panduan Penyusunan Proposal RUT X", Bidang Pertanian, Ministry of Research and Technology.

Departemen Peranian, 2000. "Rencana Strategis dan Program Kerja Peningkatan Ketahanan Pangan 2000-04", Badan Urusan Kebutuhan Pangan, Jakarta, July 2000.

Human S., T. Nakanishi and M. T. Razzak, 2001. "Mutation Breeding of Sorghum in Indonesia", *Radioisotope Journal* 50 (5): 17-23 (2001).

Human, Soeranto, Tamako Nakanishi, and Mirzan T. Razzak, 2001. "Variable Improvement in Sorghum for Supporting Development of Sustainable Agriculture through Mutation Technique", presented at Seminar on JSPS Core University Program in applied biomass, 28 December 2001, Bogor.

Ikeda, Hidetaka, 2000. "How to Promote the Regional Cooperation in Asia under the New Framework", proceedings of Seminar on Methodology for Plant Mutation Breeding: Screening for Quality for Regional Nuclear Cooperation in Asia, p. 1-20, 24-28 January 2000, Jakarta.

IPTEKDA, 1999. "Laporan Kemajuan Pelakasanaan Program IPTEKDA BATAN", Agustus-Oktober 1999, Proyek Pemberdayaan dan Pemasyarakatan IPTEKDA, 1999/2000, BATAN, Jakarta.

Oil Palm Research Institute, 1997. "Pusat Penelitian Kepala Sawit, Indonesian, Medan.

Subandi, Maksum Dahlan dan Amsir Rifai, 1998. "Hasil dan strategi penelitian jagung, sorghum dan terigu dalam pencapaian dan pelestarian swasembada pangan", pp. 347-362, Indonesia Teknologi Pertanian, Buku 1, Balai Penelitian dan Pengembangan Pertanian, Jakarta.

Sumarno and Nani Zuraida, 2000. "Plant Breeding Strategy for Better Quality of Food Crops", Proceedings of Seminar on Methodology for Plant Mutation Breeding: Screening for Quality 2000, p. 21-36, held in Jakarta, 24-28, January 2000.

6. ISLAMIC REPUBLIC OF IRAN

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INTRODUCTION

Islamic Republic of Iran has a total land area of 1,648,195 km^2 out of which 1.4 million ha are arable and used for annual crops. In the year 2000, the total population of the country was estimated at about 65 million, with an annual growth rate of over 1.5 percent, and 41 percent of population living in the rural areas. Of the total labor force of 13.9 million, 26.6 percent (3.7 million) are engaged or employed in the field of agriculture (Tables 1-3). The contribution of agriculture to the total GNP of Iran was 26.9 percent (Taeb and Keshavarz, 1999).

Table 1. Social and Economic Development in Islamic Republic of Iran (Selective Indicators)

Indicator		1973	1993	1996
Population (million)		33.5	59.6	60.06
Percent of total:	Urban	45	57	61
	Rural	55	43	39
Annual growth rate		3.2	2.1	1.5
Below 15 years of age (percent)		45.5	53	39.5
GNP per capita (Rl. 000, in current price)		-	229	370
Women's employment		13	19	25
Adult literacy (percent of total)		39	55	70

Table 2. Population Density Over Time

Year	Population (million)	Cultivated Area (000 ha)	Relative Density*	Urban Ratio (percent)
1976	33.7	1,247	20.4	47
1986	49.4	1,273	30.0	54.3
1991	55.8	1,369	33.9	57.7
1994	60.0	1,395	36.4	

Note: * Based on total area of country (1,648,000 km^2).

[*] Ms. Minoo Aghajani was not a participant in the seminar but co-authored the paper.

Table 3. Employment Status in Various Sectors, 2000

Sector	Number (million)	Percent
Agriculture	3.9	26.18
Industry	4.7	31.54
Services	6.3	42.28
Total	14.9	100.00

It is therefore obvious that agriculture plays a pivotal role not only in the provision of employment opportunities for a major section of the society but also makes a significant contribution to the national income. The average annual per capita income of urban and rural areas in 1991 was Rl.2.84 million and Rl.1.56 million, respectively, indicating a significant disparity in income distribution. (Tables 4-5).

Table 4. Area Under Cultivation: Basic Agricultural Commodities

(Unit: 000 ha)

Commodity	1982	1992	2000	Increase (1982-2000) (percent)
Wheat	5,940	6,781	5,101	-14.1
Barley	2,163	1,757	1,194	-44.8
Rice	442	563	534	20.8
Pulses	431	946	1,015	135.5
Potatoes	116	150	168	44.8
Onions	44	40	43	-2.3
Sugar beets	134	204	162	20.9
Sugarcane	28	26	255	810.7
Oilseeds	90	227	208	131.1

Table 5. Food Production Trend in 20 Years, 1984-2000

(Unit: 000 mt)

Commodity	1974	1984	1994	2000	Annual Growth (1984-2000)
Wheat	2,884	6,206	10,869	8,087	1.8
Barley	724	2,293	3,045	1,686	-1.6
Rice	826	1,484	2,259	1,971	2.0
Pulses	186	304	627	561	5.2
Potatoes	355	1,784	3,185	3,658	6.5
Onions	496	843	1,112	1,343	3.7
Sugar beets	3,749	3,392	5,295	4,332	1.7
Sugarcane	1,097	1,857	1,857	2,367	1.7
Oilseeds	71	118	288	246	6.7

The major agricultural crops in Iran are wheat, barley, rice, cotton, food legumes, sugar beet, potato, vegetables and forages. Among the industrial and cash crops/plants, cotton,

sugar beet, tobacco and pistachio are the most prominent. However, wheat (5.1 million ha) and barley (1.2 million ha) occupy approximately 60 percent of the total annually cropped area. The predominant farming system is cereal-livestock-pastoralism. Most of the major arable area is devoted to cultivation of wheat and rice, the self-sufficiency level of which is 85 percent and 82.4 percent, respectively.

The other major commodities are livestock and fisheries. Despite the fact that the total land area of Iran is very large, only 10 percent of it is arable and put under annual crops. However, there are huge areas categorized as pastures, rangelands and forests. Therefore, livestock husbandry is among the most important components of farming and farm income.

The small ruminants (sheep and goat) form the biggest component (79.6 million heads) followed by cattle/buffaloes (7.0 million and 0.47 million), asses (1.9 million), horses, mules, and camels (0.255, 0.133, and 0.140), respectively (FAO, 1994). Iran is also blessed with a long coast both in the north (Caspian Sea) and south (Persian Gulf). Therefore, fisheries and marine life play very important role in the economy of the country. According to the statistics released in 1996, total output of fish, shrimps, etc. amounted to 525,000 mt. The total agricultural exports during 1994 amounted to US$985 million. The total share of agriculture in the GNP was equivalent to 27.1 percent.

Iran is rich in natural and agricultural resources. To meet the ever-increasing demand for food and agricultural products, it was necessary to systematically develop a functional and efficient agricultural research and production infrastructure with the aim of generating appropriate production technology and subsequently disseminating it to the farming community. Existence of vast agricultural areas and highly diverse agro-climatic conditions provide a golden opportunity for producing a range of agricultural commodities. To attain sustainable agricultural production while conserving the resource base, the Government of Iran draws a plan to establish an agricultural education and research system for the country.

First activities in the field of agricultural research and education in Iran started at the advent of the 19th century. Since then it has undergone changes in the direction of improving the efficiency and effectiveness of the activities and generating appropriate technology for better qualitative as well as quantitative production of agricultural commodities. Over a period of time very elaborate and extensive agricultural research, development and education system encompassing three Ministries of Agriculture, Jihad-e-Sazandegi and Higher Education has been established in the country supported by a very strong national commitment. The structural functioning and responsibilities of each Ministry are briefly described below:

Ministry of Agriculture

Activities for improvement of agricultural research in this Ministry are conducted through the Agricultural Research, Education and Extension Organization (AREEO). The establishment of agricultural research institutes in Iran, dates back to more than 80 years. At that time, the research institutes were generally independent and some of them had their own branches in different provinces. In 1975 the Agricultural and Natural Resources Research Organization (ANRRO) was established as a central entity assigned to formulate policies, make decisions on research priorities and coordinate the activities of the existing research institutes. This organization has played a crucial role in drawing up agricultural programs, which is evidenced by the pronounced increase in the production of field and horticultural crops (Table 6). The organization during the years of its existence used to be headed by the Deputy Minister of Agriculture in research and education. Alongside this, a central

agricultural research council was created as the highest coordinating and decision-making body. This council used to be chaired by the Deputy Minister and its other members included Director Generals of all the research institutes and two senior scientists.

Table 6. Farm Yield in 16 years (1984-2000)

Commodity	1974	1984	1994	2000	Average Increase 1984-2000 (percent)
Wheat:					
Irrigated	1,145	1,735	3,050	3,475	4.4
Rainfed	247	639	856	2,227	8.1
Barley	518	1,060	1,733	2,282	4.9
Rice	2,340	3,357	4,010	5,910	3.6
Pulses	388	705	660	1,000	2.2
Potatoes	5,461	15,379	21,301	21,874	2.2
Onions	38,154	19,159	27,753	31,538	3.2
Sugar beets	23,579	25,400	25,970	26,621	0.3
Sugarcane	121,889	75,928	71,006	92,696	1.25
Oilseeds	671	1,311	1,269	1,311	0

In the meantime to coordinate the activities of different branches of the research institutes, an agricultural research center was established in every province. Such centers were assigned to implement integrated and multidisciplinary research, to develop specific technologies and to cater to the needs of each eco-region. They were authorized to make decisions on research at the local level and could give preliminary approval to research projects referred to them. In 1990, research institutes relating to the range, forest and animal sciences were separated from the Ministry of Agriculture and subsequently transferred to the Ministry of Jihad-e-Sazandegi. Meanwhile the three Organizations, i.e., Agricultural Research, Agricultural Education and Agricultural Extension Organizations were merged leading to the formation of AREEO.

Ministry of Jihad-e-Sazandegi

Immediately following the victory of the Islamic Revolution in 1978, a chain of revolutionary establishments, including the organization of Jihad-e-Sazandegi, was founded. The main objective of creating this organization was to provide preliminary assistance for farmers and the rural community across the country and to rehabilitate and develop the rural areas. Jihad used to be available whenever and wherever it was needed. Within less than a decade with the help of Jihad-e-Sazandegi, more than 95 percent of the villages were provided with electricity and clear drinking water. Millions of kilometers of rural roads were also constructed and peasants were provided with valuable services. Unfortunately, the word "Jihad" has been among the most misunderstood words in history. "Jihad" is an Arabic word from the root of "Jahd". The exact translation of Jahd in English would be "effort" and in Arabic literature "Jihad" means "relentless effort" or unusual levels of effort. After Islam, the term "Jihad" has gained some spiritual and religious weight. Therefore, contrary to what is predominantly used in the western media, "Jihad" does not mean "Holy War"! Holy War; in its true meaning, may be considered as only one of the examples of Jihad. In fact any

effort that is exerted for the sake of God (which in no way could be different from the good will for people) can be considered as Jihad. This could explain the principle behind choosing the term Jihad-e-Sazandegi for this revolutionary organization; meaning "effort with good and spiritual intention for reconstruction".

The success and popularity of this organization, mainly attributed and correlated to the revolution and its spiritual leader late Ayatollah Ruhullah Khomeini, encouraged the government to upgrade the position of this revolutionary body to the level of a Ministry (Ministry of Jihad-e-Sazandegi) in the year 1990. Hence, before the year 2000, there were two Ministries involved in agriculture in Iran: Ministry of Agriculture that was mainly involved in agronomy, horticulture and related research, education and extension and the Ministry of Jihad-e-Sazandegi that was in-charge of animal husbandry, fishery and natural resource management.

All research and education activities under the Ministry of Jihad-e-Sazandegi used to be coordinated by the Deputy Minister for Research and Education. Following research institutes and centers were functioning under the supervision of the above-mentioned Deputy Minister.

- Fisheries Research Institute;
- Rural Research Institute;
- Soil Conservation and Watershed Research Institute;
- Jihad Engineering Research Institute; and
- Thirty Provincial Research Centers.

In 1990, following the separation of the responsibilities of the two Ministries, three following research institutes were also transferred from ANRRO to the Ministry of Jihad-e-Sazandegi:

- Range and Forest Research Institute;
- Animal Husbandry Research Institute; and
- Razi Serum and Vaccine Research and Production Institute.

In 2000, due to problems caused by the separation of the two Ministries of Agriculture and Jihad-e-Sazandegi, it was decided to re-merge the two Ministries into an integrated Ministry of "Jihad-e-Agriculture" or Agricultural Jihad. As a consequence of this integration, all research and training institutes and activities under the Ministry of Jihad-e-Sazandegi were integrated with and merged in AREEO.

Main Responsibilities of AREEO

At present, AREEO, comprising of 22 national research institutes, 60 research centers, 300 research stations, 40 training centers, two agricultural colleges and 35 extension offices in the provinces is known as the largest, oldest and most competent research organization in the country. The main responsibility of AREEO is to provide research, education and extension services for the agricultural community of the country. The following are some of the main tasks undertaken by AREEO:

- To draw up an overall agricultural research, education and extension policy for the country.

- To lay out agricultural research programs of mutual concern with international and local research institutes.
- To draw up programs interrelating researchers and scientists in different fields of agriculture, in and out of the country.
- To plan necessary programs to provide research manpower from local and foreign sources.
- To evaluate development programs of different research institutes.

AREEO Research Institutes and Affiliated Centers

1. Seed and Plant Improvement Research Institute (SPII)
2. Soil and Water Research Institute (SWRI)
3. Plant Pests and Diseases Research Institute (PPDRI)
4. Sugar Beet Seed Institute (SBSI)
5. Agricultural Engineering Research Institute (AERI)
6. Fisheries Research Institute
7. Rural Research Institute
8. Soil Conservation and Watershed Research Institute (SCWRI);
9. Jihad Engineering Research Institute
10. Agricultural Biotechnology Research Institute of Iran (ABRII)
11. Cotton Research Institute
12. Drylands Agricultural Research Institute (DARI)
13. Rice Research Institute of Iran (RRII)
14. Pistachio Research Institute (PRI)
15. Iran Citrus Research Institute (ICRI)
16. Agricultural Economics Research Bureau
17. Date Palm Research Institute
18. National Salinity Research Center (NSRC)
19. Iranian Agricultural Engineering Research Institute (IAERI)
20. Range and Forest Research Institute (RFRI)
21. Animal Husbandry Research Institute (AHRI)
22. Razi Serum and Vaccine Research and Production Institute (RAZI).

In addition to the aforementioned institutes, there are 60 provincial research centers and 300 research stations under AREEO. These centers and stations receive technical backstopping from the above-mentioned institutes. AREEO supports the institutes financially and conducts periodical evaluation of the institutes activities. Priority setting and budget allocation is another responsibility of AREEO. Institutes are also involved in the following activities:

1. Preparation of annual program reports
2. Priority setting
3. Transfer of research funding to the target people/entities
4. Conducting training courses and workshops at both national and international levels
5. Providing facilities for conduct of graduate thesis and post doctoral research
6. Providing logistical support and improvement of physical facilities of experimental stations and laboratories
7. Conducting national, regional and international seminars/conferences

8. Production of hybrid and elite seeds and disease free planting material
9. Production of animal and human vaccine and serum
10. Other research related activities.

Funding Agricultural Research in Iran

Considerable investments in human and financial resources are required to build capacity for agricultural research and application. Developing countries rely mainly on public funds for their research. Moreover, percent of GDP devoted to science and technology in each country could be used as a measure for the availability of funds for research. This value is more than 2 percent in the case of developed countries (up to 4 percent in some industrialized countries) compared to less than 1 percent in most of the developing countries (reaching to as low as 0.1 percent). In Iran percent of GDP devoted for science and technology is less than 0.5. On the other hand, most of investments in the developed countries are made by the private sector, whereas in developing countries due to the lack of sufficient protection, the private sector's investment is little or negligible. Agricultural research in Iran is mainly funded by and conducted in th public sector. Minor research activities are currently being conducted in the private sector. Two major public sectors involved in agricultural research are the universities under the Ministry of Science, Research and Technology (SRT), and the National Agricultural Research Institutes (NARIs) under the Ministry of Agricultural Jihad.

The Role of Universities

The first college of agriculture in Iran was established about 80 years ago. Presently 15 universities in Iran offer courses in different fields of agriculture and natural resources. These universities are mainly involved in education and only about 10 percent of their activities are devoted to research. Agricultural research in the universities is mainly conducted by graduate students as part of their requirement for university degrees. The faculty members and professors are also carrying out very limited and scattered research. The attention to increase the research activities in the universities has recently been intensified and the annual budget for research in universities is significantly and consistently increased. Results of research from universities have been published in national/international scientific journals with very limited impact on the development of agriculture in Iran. For example, there has been essentially no variety released from the universities during the history of university activities in Iran. All the varieties released were the result of research conducted by NARIs under the Ministry of Agriculture.

Private Sector

Investment and activities of private sector in agricultural research and development in Iran started about two decades ago. The number of private companies in this field has been increasing during the last few years. Examples are presented as following:

Rana Agro-Industry Corp. is one the pioneering private companies in this field, which was established in 1992. In a joint venture with a British company, Rana produces tissue culture derived date palm and banana plantlets with an expansion program for large-scale production of other fruit trees and ornamental plants. There are several other companies that are currently producing good quality research equipment, supply and chemicals used in molecular biology laboratories. CinaGene is the leading company in Iran producing and offering restriction enzymes and other enzymes used in molecular biology, PCR (polymerase

chain reaction) kits, DNA (deoxyribonucleic acid) markers, plasmids and many other research items. Considering the lengthy and bureaucratic procedure of placing orders for these items from abroad and taking into account the cost and shipment of such commodities, the Company has been welcomed by Iranian research institutes and universities. Paya Pajhouh Company and many others are manufacturing electrophoresis sets and other basic laboratory equipment.

Evolution of Agricultural Extension in Iran: Current State, Reforms and Changes

There was no integrated organization as "Agricultural Extension" before the foundation of the Ministry of Agriculture in 1941. After the establishment of this Ministry, the staff of the Provincial Agricultural Headquarters handled the affairs relating to rural awareness. By the end of the World War II, the prevailing circumstances drew the attention of most countries, and Iran in particular, to the agricultural extension activities. In line with such perception, the Agricultural Extension Department was founded in 1948 as an affiliate department to the Ministry of Agriculture. In 1953, the integrated institution of agricultural extension was formed within the framework of an independent instructional organization under the auspices of the Ministry of Agriculture.

As a whole, the Agricultural Extension Department spent the first decade of its activities merely on educational matters and made some achievements in this field. From 1962 onward, employing extension instructors for executive affairs and deviation from educational matters became popular by the appointment of extension officers to the implementation of the so-called Land Reforms Program. In 1973, the implementation of projects to increase agricultural production was entrusted to the Agricultural Extension Department. The main activities of the extension staff would, in practice, be exclusively limited to the areas such as provision of loans and credit, preparation and arrangement of works, handling and distribution of seeds.

As the time lapsed, the attention of the state authorities gradually changed from educating and training farmers and conducting extension projects towards early outcome administrative affairs with seemingly high output figures.

The most significant changes and evolutions which happened in the extension sector during the last two decades could be listed as follows:

- The agricultural extension was defined institutionally within the framework of a headquarter with its own organizational authority. The general strategy of the extension headquarters was based upon subjective professional areas and, at the same time, public agricultural extension to address the common rural people.
- The projects to increase production of agricultural commodities were separated again from the extension activities and entrusted to the Seed Production and Provision Company.

Following the objective of developing meaningful relation between research and extension (both in quality and quantity), the Agricultural Extension Organization was merged with the Agricultural Research and Education Organization in 1993 and the newly formed establishment was named Agricultural Research, Education and Extension Organization. As one of the AREEO Deputies, the Extension Department consisted of four offices:

1. Office of Study and Survey of Extension Methods;
2. Office of Program Production and Technical Publications;

3. Office of Coordinating Extension Affairs and Transferring Findings; and
4. Office of Extension of Rural Women's Activities.

At the provincial levels, prior to the establishment of AREEO, the extension body used to act within the framework of the Extension Department, under the supervision of Director Generals of the Agricultural Headquarters of each province. At that time, the Department was financed out of the national credits and the fund was allocated through the Headquarter.

Upon the establishment of AREEO, the Provincial Agricultural Headquarters were promoted into Provincial Agricultural Organizations. Also within those Organizations, AREEO Deputy Offices was established. Accordingly, the Extension and Education Departments were combined at the provincial level, and education and extension management became the responsibility of the provincial AREEO Deputies. The credits required by the extension sub-sectors were then transformed from national to provincial.

The state of the AREEO Extension Deputy Department during its eight-year period of performance since 1993 can be classified, according to its functional pivots of actions, as follows:

1. Functioning on the basis of public extension addressing various target groups (rural women, rural youth, assistant workers, etc.);
2. Inclination towards extension in the form of projects aimed at strengthening the credits; and
3. Inclination towards technical/professional extension and transfer of findings.

However, under the Ministry of Jihad-e-Sazandegi, the extension activities were not combined and integrated with research and education. In fact, such activities were carried out under the supervision of the Deputy Minister for Extension and Peoples' Participation. After the merging of the two Ministries, and in the phase of re-organization and Top Chart preparation (which is currently underway), extension has become a matter of dispute. In this regard two different opinions have been put forward: one is suggesting the complete integration of extension in AREEO, and another is backing the complete separation of extension from research and education.

Problems Affecting Agricultural Extension

One of the major problems affecting agricultural extension in Iran is the ambiguity in its position. Obviously, extension would stand in a much stronger position when it is integrated or combined with research and both are covered under the same umbrella. Researchers are much better paid compared to the extension officers. Moreover, when research and extension are separated from each other, establishing coordination between them becomes more complicated. Existence of overlapping among activities of offices under the Deputy Ministers for Agronomy and Horticulture is another major problem which is cased by the fact that a wide range of activities in this deputy are of extension nature. Such activities include application and implementation of supporting policies for promotion of a certain cropping system or technology. Appointment of extension personnel to executive projects or administrative positions at headquarters levels is another problem. Serious budget shortages and, in particular, lack of funds for hiring sufficient extension personnel and minimal access to transportation facilities are also notable. The aforementioned problems result in:

1. exhausting the extension manpower;
2. degradation of technical knowledge among the extension staff, as they were assigned to non-technical affairs;
3. lack of a specified limit for extension activities;
4. lack of distinction of duties at service centers;
5. lack of clarity in the relationship and linkages between extension sector and the other units;
6. the inter-mix of extension operational areas with those of other executive sectors which subsequently resulted in emergence of parallel activities on the one hand, and the performance of separate sector activities with different objective-making on the other have caused the major, macro-strategies and policy-makings in the field of agricultural extension to become ambiguous and greatly influenced by the individuals' personal favors and attitudes; and
7. lack of balanced investment in training and equipping manpower, which in turn has produced a large gap between the extension manpower and those of other departments, especially the Research Department.

The Link between Research and Extension

Despite the importance of both research and extension, neither of them can be independently effective. Without the support of research, extension will lose its scientific value and may even gradually diverge from its primary direction. Also, being deprived of the assistance of extension, research will become blind with respect to the real problems of the agriculture sector and would be forced to rely on reports or thesis scattered in libraries or research centers. Our experience indicates that the presence of separate research and extension organizations/authorities would bear no fruit particularly in terms of coordinating the two. Taking this into account and in order to establish a strong relation between the two organizations, the legal draft of establishment of AREEO was ratified by the Islamic Parliament in 1993. The mechanisms that have been adopted in order to achieve an increasing cooperation between research and extension, have been based on designing and implementing programs which could prove useful in paving the way for joint collaboration of researchers and extension functionaries. The following are among such mechanisms:

1. joint research-extension projects;
2. comparative "on-farm" projects;
3. participation of extension personnel in research activities;
4. devotion of 20 percent of researcher's time for extension activities;
5. appreciation of the transfer of research findings through holding festivals such as the Day of Farms or the Week of Research Findings Transfer, etc.; and
6. revising the evaluation criteria for researchers and extension functionaries.

Although in recent years these mechanisms have been implemented to strengthen the collaboration between the two sectors, but due to the aforementioned problems the desired level of success has not yet been achieved.

SELECTED REFERENCES

Central Bank of the Islamic Republic of Iran, 1996. *Summary of Economical Changes in the Country*.

FAO, 1994. *FAO Production Yearbook, 1993*, Food and Agriculture Organization of the United Nations, Rome, Italy.

----------, 1997. "The State of Food and Agriculture", country time series, FAOSTAT, Rome, Italy.

Iran Statistical Year Book 2000.

Management and Planning Organization, Statistical Center of Iran.

Ministry of Agriculture, 1997. *Agricultural Statistics 1995-96*, Government of Islamic Republic of Iran, Tehran.

----------, 2001. *Agricultural Statistics 1999-2000*.

Mohsenin, M., *et al*., 1997. *The Availability and Employment of Agricultural Graduates in Iran*, AREEO, Tehran, Iran.

Mozafarzade, F., 1998. "A Glance at Iran's Research Planning", *Rhyaft*, 18:64-68.

Taeb, M. and A. Keshavarz, 1999. "Country Status Report: Iran", National Agricultural Research Systems in the Asia-Pacific Region – A Perspective, Asia-Pacific Association of Agricultural Research Institutions, FAO Regional Office for Asia and the Pacific, Bangkok.

NSC, 1996. *Bulletin of the Commission on Agriculture National Research Council*, No.5.

7. JAPAN

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INTRODUCTION

In Japan, located in the Asian monsoon zone, rice crop is cultivated nationwide as a key cropping system suitable for the hot and rainy summer season. Mountainous areas account for 61 percent of the total national land and there is only limited flat land available in Japan. Consequently, competition exists in land use. Under these circumstances, the ratio of farmland is about 14 percent of the total national land, and the cultivated land under management per farm household is very small, about 1.6 ha.

To support the large population with limited farmland, technological improvement is crucial for sustainable development. Research and extension have played a major role in the improvement of Japanese agriculture.

AGRICULTURAL RESEARCH IN JAPAN

Organization

Agricultural research needs to be promoted consistently from basic research to applied or advanced research. It needs to be implemented under the condition that researchers of various academic fields, including both natural and social science, cooperate with each other. Under this basic concept, various types of organizations promote research activities.

1. ***Private Sector***

Seed companies, agricultural machinery companies, agricultural cooperative associations and other agriculture-related private organizations have their own research centers. The main objective of the research activity in private sector is development of technologies immediately applicable to farmers. Private sector has the ability to assess the needs of their customers. The source of their research usually comes from the results of basic research implemented in public institutes.

2. ***Universities***

Universities have a role to carry out not only academic study but also strategic research activities that provide the seeds of new technological advancement. Application of research results to industry is also an important objective.

3. ***Prefectural Research Institutes***

Prefectural research institutes implement their research activities in close cooperation with extension organizations. The main purpose of research is technology development and refinement applicable for improvement of the rural economy and the regional agricultural industry.

4. ***National Institutes***

The Ministry of Agriculture, Forestry and Fisheries (MAFF) supervise national agricultural research institutes including agricultural independent administrative institutions (IAI) in Japan. Their research theme is usually basic, one that is time-consuming with low returns, but essential to farmers. In other words they conduct research on subjects unable to be taken up by private research institutes.

Recent Basic Policy of Agricultural Research

The conditions surrounding agriculture, forestry and fisheries and the food industry have changed significantly in line with the recent trend of internationalization of the Japanese economy, and diversification and sophistication of the consumers' needs. Also technical achievements have played an important role in the improvement of productivity, the increase of added value, and so on. Furthermore, remarkable progress has been made recently in advanced fields of science and technology including biotechnology. It is anticipated that the new technology will pave the way for the development of agriculture.

In this regard, Agriculture, Forestry and Fisheries Research Council of Japan published "*Basic Targets for Researches and Development on Agriculture, Forestry and Fisheries*" in November 1999. This plan focuses on two major fields of research: technologies to support farming operations such as the improvement of productivity and management structure, and technologies to bring about innovative agricultural techniques such as genomic sequencing and environmental research. Under these major fields, the plan indicates the direction in which research should be undertaken by public and private institutes for the next ten years.

1. ***Technologies to Support Farming Operations***
   i. Improvement of productivity and management structure of the farming economy
   ii. Supply of safe, quality and variety food and stable development of the food industry
   iii. Improvement of multi-functionality of agriculture and rural area promotion
   iv. Development of agriculture through optimum use of regional characteristics and resources
   v. Contribution to world food problem and environmental issues
   vi. Research on agricultural politics for the future development of agriculture.
2. ***Technologies to Bring About Innovative Agricultural Techniques Such As Genomic Sequencing and Environmental Research***
   i. Promotion and acceleration of life-science research for innovative productivity improvement and future development to a new science field
   ii. Promotion and acceleration of ecological and environmental research for improvement of material recycling function of agriculture.

Reorganization of National Agricultural Research Institutes Into "Independent Administrative Institutions"

National agricultural research institutes in Japan have worked as technology development centers since early 20th century. In April 2001, Japanese Government reorganized them into "Independent Administrative Institutions" (IAI).

IAI is a newly created public corporation established under the concept of separation of policy planning and implementation, which was shown by the Administrative Reforms Committee of the Japanese Government. Not only national agricultural research institutes affiliated with MAFF but also national research institutes affiliated with other Ministries, investigation centers such as National Pesticide Investigation Station and education organizations such as National Farmers' Academy are reorganized into IAI.

The characteristics of IAI are defined in the General Law of Independent Administrative Institutions enacted in July 1999. IAI is an independent organization separated from the national government. Government decides the objectives that should be achieved by each IAI within five years through their activities. IAI makes mid-term plans to achieve mid-term objectives. Mid-term plans are to be approved by the government. IAIs carry out their activity according to the mid-term plans. The government bears the cost of the activity nearly 100 percent. President of an IAI can decide internal organization, number of staff members, their recruitment and salary. The external evaluation committee that is organized by the national government evaluates the efficiency and effectiveness of IAI activity.

Management, organization, treatment of employees is completely different between the IAIs and the former national research institutes. IAIs are expected to overcome rigidity, bureaucratic red-tape and inefficiency that are thought to be characteristic of governmental organizations. Considering the situation of agriculture in Japan, 29 national agricultural research institutes have been reorganized into eight IAIs and one national institute (Figure 1).

AGRICULTURAL EXTENSION IN JAPAN

Present Activities of Agricultural Extension

Agricultural development largely relies on the advancement of technology. Especially in Japan, where land is limited, technological advancement of farmers is the key factor in increasing productivity and improving competitiveness in the global market.

In some rural areas, workforce for agriculture has been decreasing and the proportion of elderly people has been increasing rapidly. This causes serious problems in the rural society. Under such conditions, not only the improvement of productivity but also effective utilization of traditional rural crops and improvement of the rural environment is necessary for the creation of a more vital rural area and agriculture. Technological advancement is also indispensable for such effort.

There is some limitation in the ability of individual farmers to assess new technologies by themselves and adopt them to improve their farm management and rural economy. Therefore it is necessary that extension organizations refine and recompose the technologies developed by the public research institutes into a form acceptable to farmers. Appropriate technology transfer according to the requirement of farmers is important.

Agricultural extension in Japan has been implemented under the "Agricultural Improvement Promotion Law" since 1948. Its basic role is to link researchers and farmers. It has been emphasisd by government as one of the basic policies like research and administration.

The characteristic of agricultural extension in Japan is as follows.

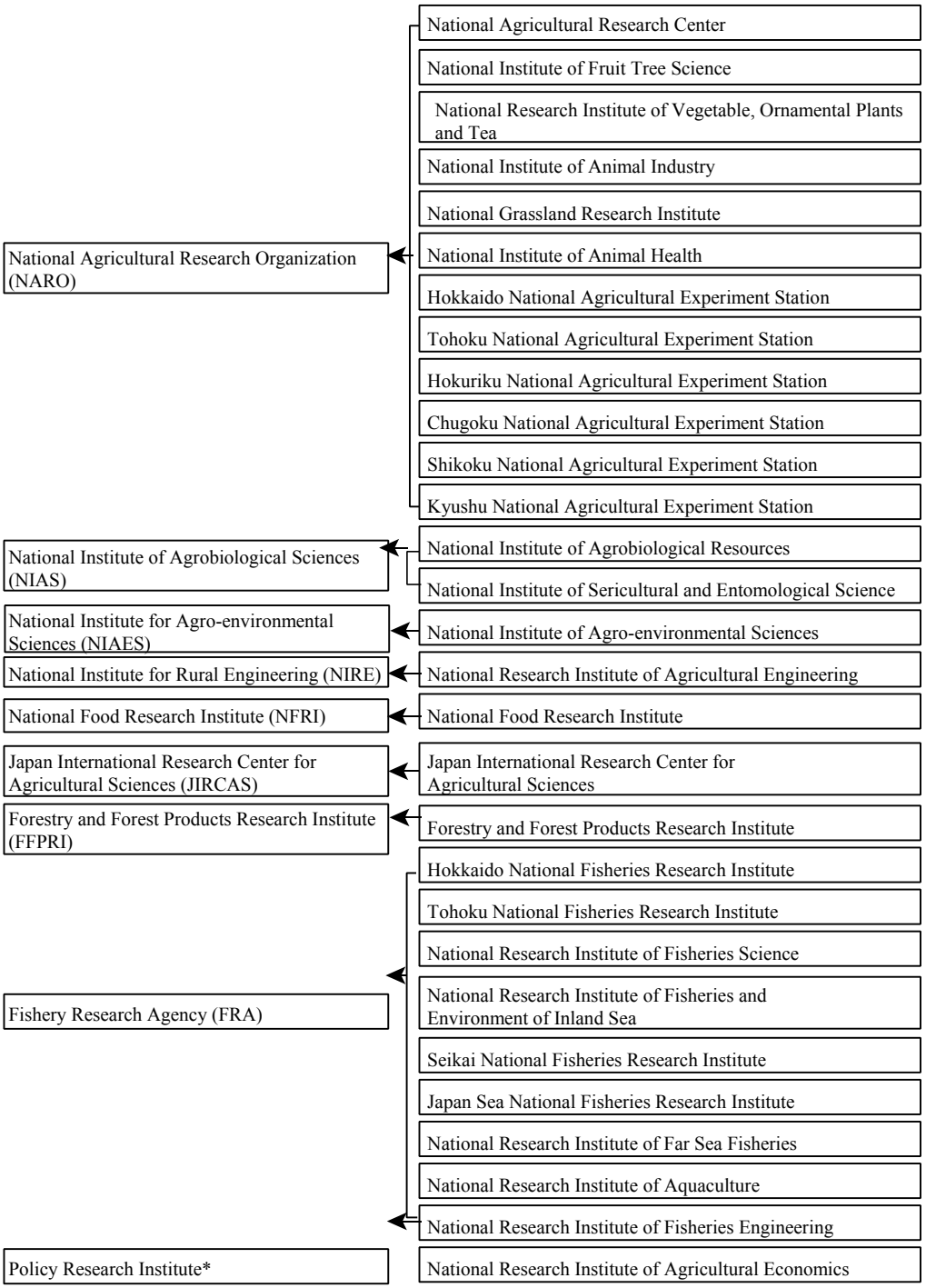

Figure 1. Reorganization of National Agricultural Research Institutes into IAI

Note: * National research institute, not IAI.

1. ***Cooperative Activity Between National and Local Governments***

Agricultural Improvement Promotion Law defines agricultural extension as cooperative activity between national and prefectural (local) governments. The major theme of national agricultural policy is maintaining food security, preservation of land and environment, etc. The prefectural agricultural policy stressed the promotion of regional agricultural production and development of rural economy, etc. The law asks national and prefectural government to implement agricultural extension under the coordination of both policies. Therefore agricultural extension in Japan is called "cooperative agricultural extension service" in the law. According to this basic concept, agricultural extension is implemented under the scheme as in Figure 2.

Basic plan: National government makes the "National Basic Plan for Agricultural Extension". While preparing the plan the national government should take into account the opinion of prefectural governments. After the development of the "National Basic Plan", each prefectural government makes "Prefectural Basic Plans for Agricultural Extension" under consultation with the national government.

Regional agricultural extension centers and agricultural extension workers with license: Prefectural governments have established 466 regional agricultural extension centers. In these centers, 9,358 extension workers with special qualification work directly with farmers for technology transfer. Six hundred and thirty-four (634) subject-matter specialists work in prefectural research institutes and the administrative divisions of prefectural governments. Subject-matter specialists supervise extension workers, undertake investigations about the specific theme concerning extension activities and coordinate between researchers and administrators.

Education and training to young farmers in farmers' academy: One national and 41 prefectural farmers' academies are established to provide young farmers agricultural education and training.

Grant to prefectural governments: National government provides grant to prefectural governments for their agricultural extension activities (¥27,745 million in FY2002).

2. ***Intermediation Between Researchers and Farmers***

According to the requirement of farmers and the rural community, extension centers request research institutes to develop new technologies. On the other hand, extension centers receive new technologies from the research institutes, improve them by on-farm trials and then transfer them to farmers.

Training for extension staff is conducted in the research institutes to build capacities of the extension systems in transferring advanced and varied technologies. Overseas training is also carried out. Information network is established among extension centers, research institutes and administration divisions.

3. ***Extension Activities Focusing on Individual Farmers***

Agricultural development is believed to rely primarily on the ability and motivation of each farmer. Therefore, the main target of agricultural extension in Japan is each "individual farmer". Extension workers usually stay in rural area, advise farmers directly and transfer technologies and knowledge to farmers themselves. Basic purpose of extension activities is to encourage farmers who have the ability to solve the problems in their farm management by themselves. From this point of view, on-farm training is thought to be essential in extension activities.

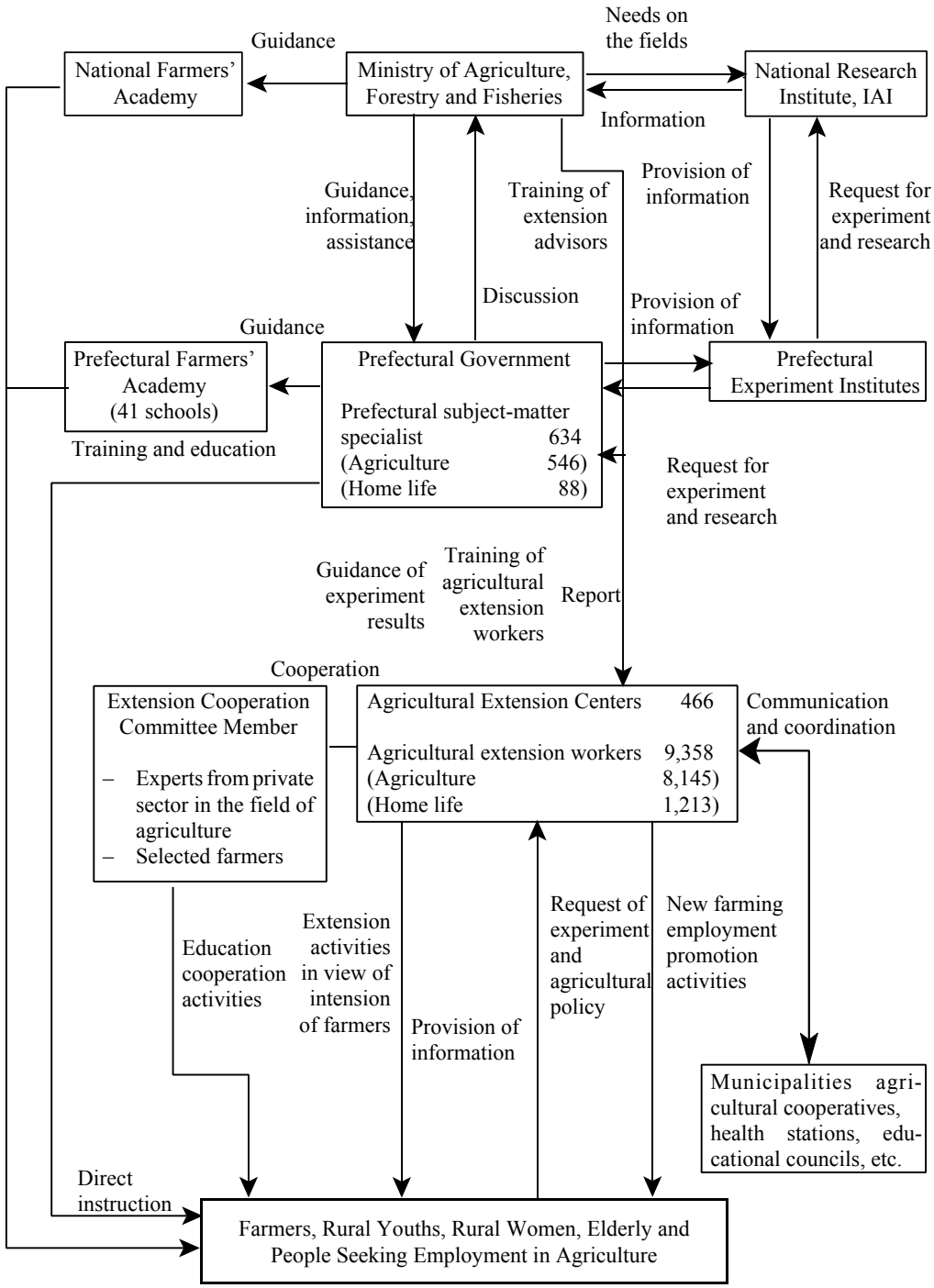

Figure 2. Agricultural Extension system in Japan

Note: Figures are as of 1 April 2001.

For youth contemplating working in agriculture, extension centers provide them information about employment in agriculture, short-term training courses and other activities to encourage them. After they begin working in agriculture, various training courses are prepared according to their development stages.

4. ***Integrated Extension Activity for Agriculture and Home Life***

Agricultural production and home life has a close linkage. To make agriculture a more interesting profession, home life as well as agricultural production needs to be improved simultaneously.

In Japan, most of the farms are managed by only family members and this tends to burden the members. To solve these problems, home life improvement is necessary. Life hour management (to distinguish between working hour and private time) is very important. Agricultural extension in Japan promotes production and home life improvement holistically.

Recent Change of Agricultural Extension and Its Impact

It has been more than 50 years since modern agricultural extension began in Japan. Extension organization and its major theme have been changing according to the circumstances around agriculture and rural society.

From late 1940s to early 1960s, agricultural extension placed emphasis on increase of major crop production and introduction of new crops like vegetable and animal production. The unit of extension activity was comparatively small (village basis) and there were totally 1,632 extension centers (in 1955).

From mid 1960s to early 1980s, the average age of farmers increased and the total number of farm households decreased. Agricultural production of major crops resulted in surplus. Production adjustment of rice was started and free trade of agricultural production proceeded. Main theme for agricultural extension in this period was reconstruction of regional agriculture, raising core farmers and lowering production costs. The unit of extension activity became larger (province basis) and the total number of extension centers decreased to about 600.

From mid-1980s, the problem of agriculture and rural areas became more complex. The international competitiveness of agricultural production became the most important issue. Aging of core farmers increased and farmlands were increasingly abandoned. Moreover, devastation of hilly and mountainous areas and promotion of sustainable agriculture became the new theme of Japanese agricultural policy. Extension workers were challenged to solve these problems. On the other hand, administration reform and decentralization of power caused decrease in the number of extension centers and extension workers and absorption of extension centers in other administration organization.

Recent problems affecting agricultural extension are as below:

1. ***Extension Organization***

Administration reform forces changes in the extension organization. In more than half of all prefectures, extension centers were merged with other administrative organizations and the total number of extension centers and extension workers are decreasing year by year. This organization reform is expected to have a good effect on strengthening the linkages between extension organization and other related administrative divisions. On the other hand, it weakens the originality of extension activity like technology transfer.

2. ***Improvement of Extension Workers' Ability and Concentration of Resources***

These days, change of rural economy and agriculture is important. The numbers of extension issues that cannot be solved merely by the application of simple technology are increasing. On the other hand, extension workers are expected to solve the various administrative problems other than technology transfer. The area of extension activity is becoming broader. Concentration of human resources and budget for important extension issues and improvement of extension worker's ability through special training are necessary.

3. ***Budget Assistance from the National Government***

Budget assistance for extension activity from national government is decreasing. When modern agricultural extension activity started in 1948, two-thirds of the total budget of the extension activity was subsidized by the national government to prefectural governments. But the ratio of subsidy has decreased to about one-third of total budget.

LINKAGE BETWEEN AGRICULTURAL RESEARCH AND EXTENSION IN JAPAN

Present Condition of Linkage

The "*Basic Targets for Research and Development on Agriculture, Forestry and Fisheries*" refers to the linkage between research and extension as follows:

- To strengthen their linkage, research institutes and extension organizations should share a common objective.
- Researchers should be encouraged to join in the technology transfers from research institutes to farming operators.
- Comprehensive research projects and technology transfers under the collaboration among public research institutes, extension organizations and private sectors should be promoted.
- Technologies developed in the national research institutes should be easily applicable to farmers.

On the other hand, the Agricultural Improvement Promotion Law, which is the basic law for agricultural extension activity in Japan, the Extension Basic Plan, which shows the basic direction of extension activity, and other administrative notifications, describe the linkage between research and extension as follows:

- Prefectural governments should take necessary measures to develop close linkages between the investigations by subject-matter specialists and the research related to extension activity, conducted by researchers of prefectural research institutes (Promotion Law).
- To facilitate technology generation and dissemination that meet the needs of farmers, prefectural governments should promote close cooperation among extension organizations, research institutes and agricultural universities (Basic Plan).
- Subject-matter specialists should collect information about the research subject, and the research result and should transfer this information to the extension workers. They should also participate in the discussion of selecting the research subject as representatives of the extension staff ("*Extension Activity Guideline*" published by Director General, Agricultural Production Bureau, MAFF, March 2000).

For strengthening linkages between research and extension, research institutes and extension organizations carry out various activities.

1. ***Training of Extension Staff in Research Institutes***

To strengthen professional ability, national and prefectural research institutes provide training programs for subject-matter specialists and extension workers.

2. ***Transfer of Research Results to Extension Organizations***

National government provides subsidy to prefectural governments to promote collection of research results, construction of database and extension activities using the database.

3. ***Participation of Extension Staff in Research Activities***

National government provides subsidy for prefectural governments to promote research activities undertaken by subject-matter specialists under the cooperation of the research institutes. The subject of research should be of immediate relevance to the problems of regional agriculture. Research results are presented at a seminar and disseminated to a wider audience.

4. ***Report of the Research Results to Extension Organizations***

National agricultural research institutes and IAI hold "Research Promotion Meetings" every year end. The purpose of the meeting is to review, evaluate and debate about the research results and prepare the plan for the next year. In this meeting, research institutes select the best technologies. The selected technologies are reported to extension organizations as booklets or on the web page and transferred to farmers by extension workers.

Problems and Countermeasures

Linkage between agricultural research and extension has been an important issue since modern extension activity started on 1948. As the technological ability of farmers is rising, they tend to require more advanced and complex technologies. To match their requests, researchers should develop more advanced but farm-oriented technologies and extension staff should transfer the developed technologies more rapidly and effectively to farmers.

Researchers and extension staff try to strengthen their linkage through various activities mentioned earlier. But previous investigation has shown that many extension workers think they do not achieve successful linkage with researchers and the developed technologies are not effectively transferred to farmers.

The following two items are identified as constraints in the effective linkage between research and extension:

- Technology development generally has a long gestation period. There is, therefore, a time lag between demand for new technologies by extension organizations and the development of such technologies by research institutes.
- Research institutes and extension organizations tend to carry out their duties independently of each other, as their missions become more complex and the target areas become wider. Researchers concentrate their effort on writing a thesis rather than conducting farmer-oriented technological development.

To strengthen the linkages between research and extension, both organizations should share the objective of their research/extension activities. Prefectural governments should

make prefectural extension basic plans in line with the national extension basic plan. Prefectural governments constitute drafting committees for preparation of the basic plan but only 20 percent of all prefectures have representatives of research institutes as committee members. Remaining 80 percent prefectures choose their committee members only from persons related to extension organizations.

On the research side, prefectural governments usually prepare prefectural research basic plans that show the basic concept of the research activity in the prefectures. Seventy percent of all prefectures allow subject-matter specialists to participate in the process of drafting the research basic plans. But some prefectures prepare the basic plan only through researchers, excluding extension staff.

Research/extension basic plan should be made both by researchers and the extension staff. It provides them a good opportunity to promote the linkage between research and extension.

Construction of research activity database helps extension staff and farmers to look for appropriate methods to solve the technological problems on farm. Such a database is also useful for extension organizations in the screening process of technological requests from farmers to research institutes.

Feedback of extension results to research institutes is also important. It provides useful suggestions to the researchers and, therefore, help in improvement of the technology.

Some Prefectures Began Remarkable Trials for Integration

In Hokkaido and Akita prefectures, a new organization named "Technology Extension Division" was established in prefectural research institutes. The project team is organized in the division, consisting of researchers and extension staff, to solve the technological problems in the region.

In Fukushima prefecture, research database was constructed, by which every extension worker and farmer can search the research results of prefectural research institutes.

In Hokkaido prefecture, subject-matter specialists summarize the research results and make manuals that are easy to use by extension workers in their activities.

CONCLUSION

Integration of research and extension play an important role in appropriate technological development and transfer. It is necessary to facilitate cooperation between research institutes and extension organizations in order to make them more responsive to sophisticated technological and management needs of the farming community.

REFERENCES

Agriculture, Forestry and Fisheries Research Council of Japan, 1999. *Basic Targets for Research and Development on Agriculture, Forestry and Fisheries*.

Ministry of Agriculture, Forestry and Fisheries, 2000. *Annual Report on Food, Agriculture and Rural Areas in Japan FY1999*, Government of Japan.

----------, 2001. "Reference Book for Cooperative Agricultural Extension Activity", Government of Japan.

Miwa, E., 2002. "Research Organizations of Agriculture, Forestry and Fisheries in Japan: Reform in 2001", *Farming Japan* 36-1, 5-7.

Miyashita, K., 2001. "Toward the Reorganization into Independent Administrative Institutions", *Research Journal*, 1,7-10.

Shindo, K., 2001. "Agricultural Research for Farmers and Effective Extension Method", *Agriculture and Extension* 9, 46-49.

Sugimoto, T., 2001. "History of Agricultural Extension and Its Mission Today", *Agriculture and Economy* 14, 5-12.

----------, 2001. *Agricultural Extension, on Its Turning Point*, Agricultural Extension Association, Tokyo.

8. REPUBLIC OF KOREA

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INTRODUCTION

Agriculture in Korea has progressed in line with the development of the national economy in the 20th century. Although the role of agriculture in economic development has declined considerably over the last few decades, the agriculture sector plays a key role in the Korean economy.

Small farms characterize Korean agriculture. About 60 percent of farm households have less than 1 ha of farmland. Rice is the dominant crop, accounting for about 78 percent of the total farm households; 55 percent of the total area cultivated; and 31 percent of the value of total agricultural production in 1998. Korean agriculture employs about 2.3 million people – 11.8 percent of the total working force – and produces ₩20 trillion, which was 4.4 percent of the GDP in 1998. Agricultural output has increased greatly as a result of productivity gains, derived mainly from high-yielding variety seeds and increased investment in the agriculture sector. Agriculture has become very intensive with respect to its use of inputs such as chemical fertilizers, pesticides and machinery.

Faced with the difficulties of adjusting to the opening of markets, a rapid decrease and aging of the agricultural labor force, frequent natural disasters and price fluctuations, the Korean government is giving a new direction to its agricultural policy. A series of agricultural policy reforms are aimed at preparing the sector to compete effectively in world markets and to further modernize it. This, and other changes, mean that the Korean agriculture sector is in transition and is becoming more market-oriented, although the pace is gradual.

Since its inception in 1962, Rural Development Administration (RDA) has focused its efforts on the development and dissemination of technologies to produce adequate amount of major staple, and horticultural crops. Self-sufficiency of rice has been achieved from the mid-1970s through the Green Revolution. The ever-increasing demand for horticultural crops could have been met smoothly from the 1980s through the White Revolution. These achievements were made possible through the intensified efforts in research, extension, coupled with a sound policy for promoting agricultural production. In the 1990s, as a result of the Uruguay Round agreement and the subsequent establishment of the World Trade Organization (WTO), a new global trade order emerged. In short, the markets are to be opened globally. With this background, RDA has to revise its strategy with respect to the development of technologies: it has to shift its goal from "producing more" to "producing competitively".

The extension system is a national network that links research, know-how and technology to the needs of rural people where they live and work. The purpose of this paper

is to describe the current status and directions of Korean agricultural research and extension. This paper is prepared from the Annual Report of the RDA (RDA, 2000) and the other available literature concerning agricultural research and extension.

DIRECTIONS OF THE AGRICULTURAL RESEARCH AND EXTENSION

Overall Directions

In 2000, RDA focused its efforts in generating and upgrading the agricultural technologies suitable to Korean conditions. For Korean agriculture to perform well in the new circumstances, agricultural research should focus on competitiveness of agricultural production, and due attention needs to be given to the conservation of environment.

The competitiveness is to be pursued in two ways: 1) reduction of labor input by upgrading the farm mechanization for field crops and adoption of automated system control in the greenhouses for horticultural crops; and 2) promotion of superior quality agricultural produce to better meet the consumers' demand.

The conservation of environment is to be pursued by adopting the measures to optimize the externality of agriculture and to maintain the health of agricultural environment by optimizing the use of agricultural inputs.

To accelerate development and extension of useful technologies, it is important to have unified efforts in research and extension across various levels. At the central level the basic research programs like the management of genetic resources, monitoring of the quality of soil, identification of pests, breeding of major crops, development of environment-friendly farming technologies, maintenance of animal resources, and development and utilization of biotechnologies should be carried out. At the regional and local levels the research programs should involve validation trials and on-site demonstration of the technologies developed. The universities, on the other hand, should engage in fundamental and basic research. Accordingly, RDA should be responsible for coordination of national agricultural research.

Major Area

Identified research areas with corresponding extension programs are focused on food security, environmental health, safety and quality of agricultural produce, advanced biotechnologies, adoption of high-end sciences in agricultural technologies and research on agriculture in North Korea.

1. ***Development and Dissemination of Technologies for the Attainment of Food Securities***

Efforts have been continued for the development of rice varieties with high-yielding potentials, adequate level of resistance to biotic and abiotic stresses and good palatable quality, suitable for direct seeding and full mechanization. Cultivation technologies to minimize labor and material inputs are being developed to strengthen competitiveness of products, development of technologies to minimize post-harvest losses in quantity and quality of rice remain important objectives of research.

2. ***Technologies for Conservation of Environment***

In Korea, it is aimed that by the year 2005, the uses of chemical fertilizer and synthesized agricultural chemicals would be reduced by 30 percent. Integrated Nutrient Management (INM) and the Integrated Pest Management (IPM) are the tools being adopted to achieve this goal. Studies on climatic change and the research to minimize the occurrence of greenhouse gases like methane and nitrous oxide (N_2O) from various agricultural systems are also being carried out.

3. ***Improvement of Safety and Quality of Agricultural Produce***

Efforts have been made to improve the techniques for supply of high quality vegetables, fruits and mushrooms, year round. Efforts are being made to strengthen the safety standard in the use of various agricultural chemicals like pesticides and food and feed additives. In this context, the adoption of alternative means to reduce the occurrence of pests is being sought extensively.

RDA has reviewed the international competitiveness of major agricultural products and identified a total of 13 commodities with a competitive edge. To assist farmers in producing those commodities for export, special teams consisting of researchers and extension specialists were tapped for operation.

4. ***Application of Genetic Engineering***

For more than 10 years now, RDA had invested considerable resources in building up its research capability in genetic engineering. As a result, it was recently possible to conduct some basic and applied research covering cell culture, genetic transformation, isolation of useful genes, generation of pest-resistant transgenic plants, development of useful microbes and transgenic animals. At the same time, RDA has been actively involved in the International Rice Genome-Sequencing Project (IRGSP) in cooperation with the U.S.A. and Japan.

As the consumers' concern on safety of genetically modified organisms (GMO) has increased, RDA has been working on this issue rigorously in cooperation with the relevant organizations home and abroad. Recently RDA has obtained eight GMOs including a rice plant resistant to some herbicides. These are being closely tested for usefulness and safety to both humans and environment.

5. ***Adoption of High-end Agricultural Technologies***

Application of high-end science has been identified as one of the most significant strategies in achieving breakthrough for the advancement of agricultural technology. In this context, RDA is currently working on the following areas: upgradation of farm machinery for automation; automation of environment control in the greenhouses and warehouses; use of robots for farm work; computerized monitoring of biotic and abiotic stresses of crops; and non-destructive assay of the quality of agricultural products.

6. ***Research on Agriculture in North Korea***

North Korea has been suffering from severe shortage of food in the recent years, due mainly to inadequate agricultural infrastructure and limited availability of agricultural inputs. Sharing a similar natural set-up in agriculture, the two Koreas would have much to share in agricultural technologies. Short- and long-term strategies should be formulated to properly address the issues on agriculture in North Korea. For short-term strategy, RDA has been conducting relevant research, studying the crop varieties and the cultural practices adopted in North Korea. As long-term goals envision unification of the two Koreas, there is a need to update the information on the natural resources and constraints to agriculture in North Korea, and draw a long-term plan for agricultural development for the unified country.

THE AGRICULTURAL EXTENSION SYSTEM AND SERVICE

Mission and Goal of Agricultural Extension

1. ***Mission***

The "Rural Development Law" describes objective of the organizations as development of farmers' welfare through conducting agricultural experiment and research,

transfer of scientific techniques and knowledge about agriculture and rural life, and training of rural leaders and farmers.

The followings are specific missions of the RDA:

a) Conducting experiments and research for developing agricultural technology concerning food crops, livestock, veterinary medicine, horticulture, sericulture and farm machinery, etc., and for developing farm management.
b) Transferring scientific technique and knowledge for improvement of agriculture and rural life, especially through informal education and demonstration of the effect of scientific knowledge and technology on agriculture and rural life, and through fostering rural people's organizations.
c) Training farmers, local leaders, rural youths, students and teachers in agricultural high schools as part of cooperative education, as well as research and extension officials in agricultural technology organizations.

2. ***Goal***

The efficiency of farm management to meet the demands of competitive agriculture and substantial increase in farmers' income are the key concerns of the Korean agricultural extension services. Extension activities for agro-technology transfer in Korea are based on the following objectives:

a) To attain a stable and labor-efficient production of major grain crops.
b) To improve the quality and cost-efficient production of cash crops and livestock.
c) To maintain safe and pollution-free crop production and adequate pest management.
d) To create extra revenues by exploiting high-tech agriculture.
e) To provide technical support on production for special local or export markets.
f) To develop sustainable agriculture.

To accomplish the above goals and objectives, the area-specific model projects for higher income and new technologies are implemented at the national as well as regional level.

Agricultural Extension System

1. ***Organizational Set-up***

RDA is the central government organization for agricultural research and extension services. It was first established in 1906 as the Agricultural Demonstration Station, and subsequently renamed as the Agricultural Experiment Station in 1929, the Institute of Agricultural Improvement in 1947 and the Institute of Agriculture in 1957. It was reorganized as the Office of Rural Development (ORD) in 1962, and it was reconstituted in 1994 as the present form of RDA by incorporating four national offices from the Ministry of Agriculture and Forestry (MAF). The organizational structure of RDA is presented in Figure 1.

RDA, an outside arm of extension and research of the MAF is the national level headquarters for rural development planning and implementation in Korea. Headed by an administrator, the RDA maintains various extension programs through one bureau and two offices: the Extension Service Bureau, the Farm Management Office and the Public and Technical Information Office. There are four divisions under the Extension Service Bureau.

In the Extension Service Bureau, the Extension Planning Division is responsible for budgeting, personnel management and the support of facilities and equipment for national extension activities as well as integrated community-based rural development, while Home Economics Division is responsible for matters related to rural welfare. Other divisions,

which are staffed with production-oriented specialists are Food Crops Division, Horticulture and Livestock Division.

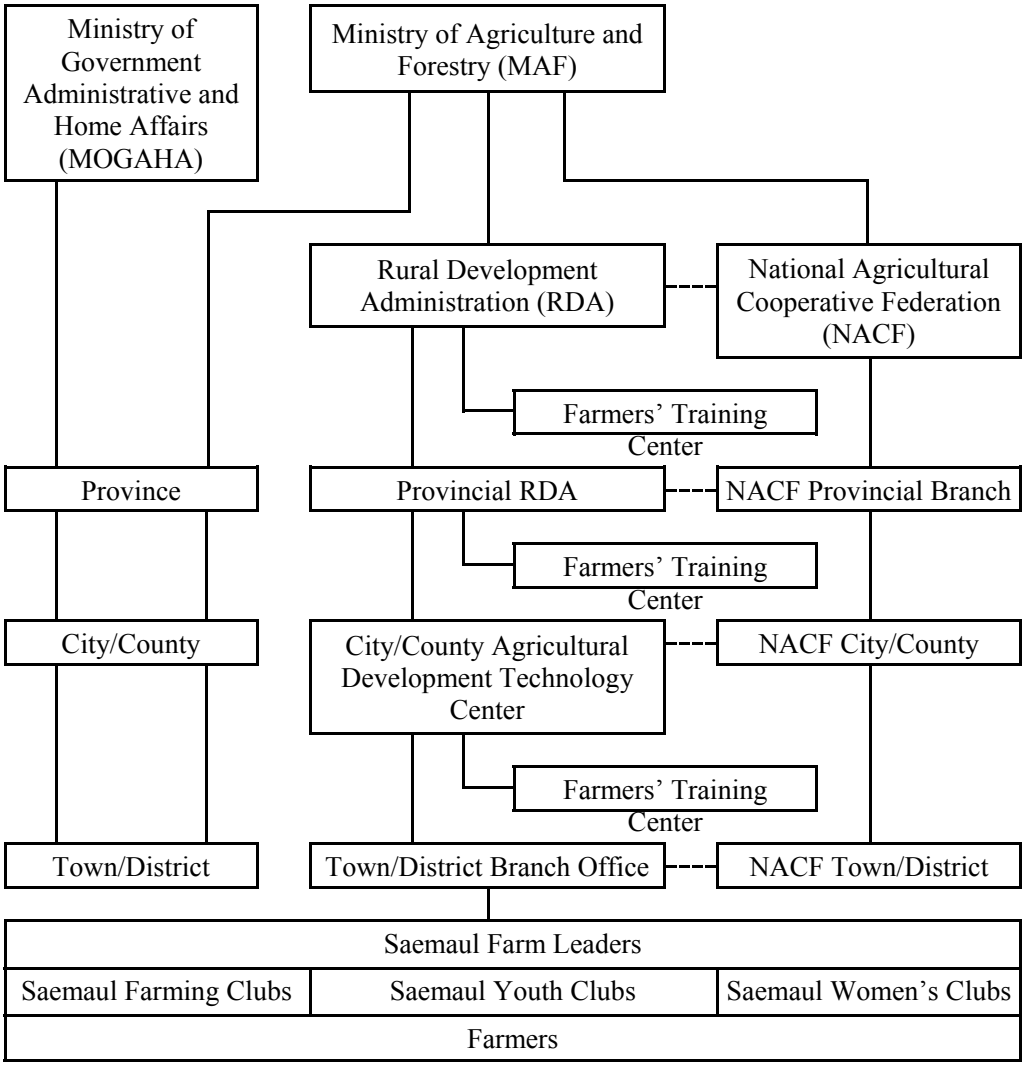

Figure 1. Organization for Agricultural Extension in Korea

Source: RDA.

The Farm Management Office is to support both parts of research and extension on farm management and computing services with its two divisions. The Public and Technical Information Office, popularly known as "Agricultural Information Center", is responsible for all the information services of RDA, particularly the preparation, production, distribution and utilization of extension teaching materials. Technical Training Division, which was removed to the National Agricultural College of the RDA in 1999, is responsible for farmers' training and extension workers throughout the country.

The Provincial Rural Development Administrations (PRDA), numbering nine in all, represent the provincial organization of the RDA, and PRDAs are outside arms of the provincial government and consequently controlled administratively by the governors.

The 157 city/county rural extension offices are administratively and technically under the hierarchical control of PRDA. But at the same time, each extension office forms an outside arm of the respective city/county government. The County Extension Office, however, is considerably dependent on the county government in many ways, including financing, which is probably the most important aspect of agricultural extension work.

There are real grassroots extension organizations under the jurisdiction of the county extension offices named "Farmers Counseling Office" totaling 527 across the country at the town/district level. Each office is geographically responsible for extension programs. These local extension offices make plans and carry out localized programs, and at the same time execute national extension programs financed by the national government.

The number of extension agencies reached 181 at city/county level and 1,464 at town/district level in 1987. However, the numbers of extension offices decreased to 157 and 534 respectably in 1998, a year after implementation of localization as shown in Table 1.

Table 1. Number of Extension Agencies by Selected Year in Korea

Year	Central	Provincial Level	City/County Level			Town/District Level (Total No. of City/County Offices)	
			City	County	Total		
1987[a]	1	9	42	139	181	1,464	(22)
1994[b]	1	9	46	136	182	1,302	(28)
1997[c]	1	9	69	93	162	1,415	(9)
1998	1	9	67	90	157	534	(18)
1999	1	9	67	90	157	527	(9)
2000	1	9	67	90	157	527	(9)
2001	1	9	69	88	157	456	(9)

Source: RDA.

Remarks: [a] A year before 1988 Seoul Olympic; [b] preparation for localization; and [c] implemented localization.

2. ***Agricultural Extension Personnel***

The number of extension educators has steadily increased to reach a total of 7,979 at the end of 1990. After localization of the extension service in 1994, administration authority was transmitted from central to local government. Again in 1997, government decided to change the nomination right of field extension personnel from the central to local government. And now, we have 5,032 extension officials throughout the country, as shown in Table 2.

Extension educators at the national level or RDA are a total of 71, mostly senior subject-matter specialists in 2000. There are a total of 235 extension personnel at the nine PRDAs, and a total of 4,726 extension educators are stationed at the 157 county extension offices.

Percentage-wise, approximately 6 percent of the total number of extension personnel is stationed both at the national-level (RDA) and at the provincial-level agencies. The remaining 94 percent of the total extension personnel are working directly with rural people,

stationed at the local level of either county extension offices or their branch offices. An extension educator covers eight villages of the lowest administrative unit with 292 farm households and 402 ha of farmland on the average.

Table 2. Changes in Number of Agricultural Extension Educators by Selected Year in Korea

Year	Central	Province	City/County	Total	Remarks
1962	75	180	2,918	3,173	Enact Rural Development Law
1970	73	236	6,051	6,360	Rice and Barley Guidance
1981	105	226	7,648	7,979	Farm Income Guidance
1997	91	289	6,459	6,839	Implemented Localization
1998	85	241	5,219	5,545	1st Restructuring
1999	71	235	4,726	5,032	2nd Restructuring

Source: RDA.

Linking System Between Research and Extension

The organization and operation of Korean agricultural research and extension are more or less independent from the general scientific community because of the exclusive nature of RDA's functions. With institutional arrangement, a systemic participation of extension specialists to research works and *vice versa* is maintained, which has the advantages in fast dissemination of research results and in practical problem-oriented research. Research sector provides technological information and frequent training to extension workers to maximize efficiency of the knowledge transfer. Two different regular courses are offered to extension personnel: one-week basic and professional training and five-month special intensive course for newly employed workers. The local extension workers also directly carry out limited research activities such as regional adaptability tests for new cultivars, germ plasm collection, and operation of the forecasting fields for plant insects and diseases.

On the other hand, RDA has also established close ties with agricultural colleges/ universities particularly for agricultural education. All formal schools including institutions for higher education in agriculture are under the jurisdiction of Ministry of Education (MOE). The Rural Developmental Law has enforced institutional linkage between rural development and education since 1971. Under the law, the Institutional Cooperation Committees of national and provincial level were embodied and have functioned for the control of cooperative matters which include: a) selection of cooperative projects on research and extension; b) joint appointment of research and extension personnel with academic staff of universities; c) decision on research fund awards for universities and colleges; and d) enhancement of mutual use of research facilities between RDA, Provincial Agricultural Research and Extension Stations (PARESs), universities and colleges.

The National Committee is the main body governing the cooperation between agricultural research, extension and education. This is specifically chaired by the RDA administrator, and the dean of the Agriculture and Life Sciences College of Seoul National University as the vice-chairman. It has 20 members comprising the research and extension personnel, professors, and administration staff from MAF, MOST (Ministry of Science and Technology), MOE, and the Forest Development Administration. At the provincial committees' level, these are headed by the dean of agricultural college of the national university located in their provinces, and the directors of the PARESs as vice-chairmen.

Each of them has 12-17 members composed of research and extension staff and the agricultural personnel from the local government.

Both national and provincial level have 21 and 10 special committees, respectively, which assist the Institutional Cooperation Committee for specific purposes. Professors chair the special committee with five personnel from research and extension. The committee selects and evaluates the research and extension projects and discusses the detailed project planning and evaluation. Through this institutional process, 200-300 projects were funded by RDA annually before 1996. The joint utilization of research facilities between RDA and the agricultural colleges has resulted in increased research efficacy and budget savings. RDA experimental fields are often used for research and practical training of the students.

Korea has also developed institutional cooperation between county level extension offices and agricultural high schools. The Councils for the Establishment of Pilot Agricultural High School have been organized at the central and provincial level since 1972. They are under the dual jurisdiction of MOE and MAF. The chairman of the Provincial Board of Education is the Chair of the Council, and the Director General of PARES is the vice chairman. The Council consists of eight members including extension staff and agriculture- and education-related administration personnel. The Council discusses cooperative activities such as designation of cooperative agencies, joint appointment, and mutual use of facilities. Agricultural high school teachers participate in workshop activities of the county extension offices.

RDA has a joint appointment system with agricultural universities. This system expands manpower in both parties and has an advantage of systematic transmission of scientific and technological information. There are 148 professors concurrently appointed as staff in research and extension institutions under RDA, and 195 research and extension personnel are appointed as faculty members in the universities. The universities offer both graduate and undergraduate studies to the research and extension staff. During the last five years, 94 research and extension personnel obtained Ph.D. degree and 332 master degrees. RDA staff also provides lectures in various agricultural universities.

The new technology for on-farm level is disseminated to farmers by the Technology Dissemination Bureau of RDA or PARESs through the national extension service channels. The Research Management Bureau of RDA assesses the research results obtained annually to identify their usefulness as extension material before transferring them to the Technology Dissemination Bureau. The result adopted for dissemination is published as guide material for extension workers.

Institutionalized meetings secure systematic participation of extension specialists in research. RDA holds monthly staff meetings for directors of all bureaus (including research and extension), and heads of research institutions and PARESs. It has meetings of bureau directors at RDA headquarters twice a week, chaired by the Administrator or Deputy-Administrator. Every meeting discusses both research and extension activities. The result of the meetings is officially directed to the related institutes or personnel. Meetings between research and extension workers at all ranks are held as well in constituent institutions whenever needed.

Special researchers, professors in universities or colleges, extension workers, and administration personnel also systematically participate in research planning and evaluation. They are regularly invited to the research planning and evaluation conferences hosted by research institutions. During these conferences the validity of research objectives, approach methodologies, scientific values and economic feasibilities are all evaluated. These meetings

are organized by respective research institutions according to specialty of the topic and are normally held in late January for summer crops, sericulture and livestock, and in mid-August for winter crops. The procedure and results of research are evaluated at least twice a year. Interim evaluation is made mid-year to identify mid-term difficulties.

Strength and Weakness of the Extension System and Service

1. ***Strength***

The strengths of Korean agricultural extension system can be summarized as follows:

a) Since both functions of research and extension are integrated under the same administrator of RDA, the results of agricultural research and experiment and newly developed technology could be more effectively, efficiently and timely disseminated to the farmers though the nationwide extension channels and networks. Problems, which emerge in the course of extension activities, can be easily adopted as research projects.

b) Results of research are thoroughly examined, screened, and subjected to economic analysis by the research and extension joint evaluation committees. These results are reflected in agricultural policies and extension services. Related extension specialists are always aware of research programs going on and actively participate in research planning and evaluation activities.

c) Participation of researchers in extension programs is not only helpful for technical dissemination but also provides very useful information for improving agricultural research programs. Researchers have opportunities to review the applicability of their research findings on the farm field through their involvement in extension activities such as field observation trip, training farmers, evaluation meeting, etc.

d) The institutional cooperative relationship of the extension service system with provincial and local governments, known as general administrative agencies is another characteristic. With this relationship, the extension program is not only easily integrated into comprehensive rural development policies, but also supported by the administrative agencies.

e) Besides this close cooperative relationship between the extension program and administrative policies at all levels, the budget for agricultural extension services comes from central, provincial and city/county governments in collaboration with one another.

f) Figure 2 shows the linkage of research and extension for agricultural technology transfer in Korea. There was need to revitalize the agricultural extension system since there was considerable change in communication mechanics between RDA and forefront extension centers, following the recent devolution of extension services to local governments. Among other things, more effective means for the delivery of information are available to all concerned, planners at the RDA, front-line extension officers at the front-line centers and the farmers. For this education and training are to be strengthened at all levels, particularly for rural youth.

2. ***Weakness***

a) The agricultural extension system has weaknesses such as the authoritarian or top-down method of extension presently used, difficulties in coordination of development efforts between disciplines working on different dimensions of the same problem, and continuing problem of communication between the researcher, extension agent, and farmer.

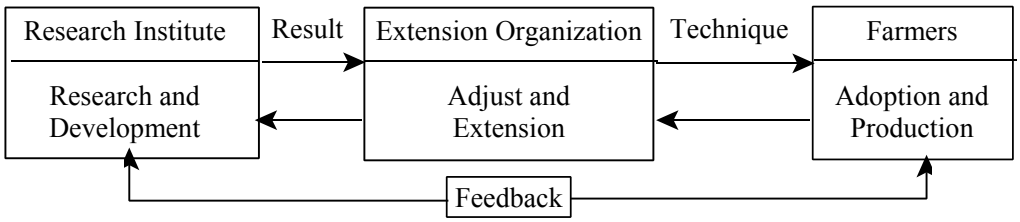

Figure 2. The Linkage of Research and Extension in Korea

b) There is a lack of extension programs in community development and interdisciplinary programs. There are usually five areas of extension programs: agriculture, home economics, youth program, community development, and interdisciplinary programs. Agriculture programs should address both environmental concerns and profitability. Audiences should include both producers and those who provide input, services, and education for producers.

c) Extension programs have failed due to ignorance or lack of appreciation for local socio-economic conditions, lack of farm markets, lack of staff motivation and supervision, inability of extension personnel to motivate local people, and farmer reticence in regard to innovations. In fact, the simple existence of a new technology is not enough.

d) There is a lack of program specialists and program assistants among Korean extension personnel. Extension personnel can most generally be classified into one of five staffing roles: administration, program specialists, country agents, paraprofessionals or program assistants, and support or clerical (Seevers, *et al*., 1997). Program planning is critical to the success of extension programs. Program specialists should be experts in a particular subject who are trained to translate and disseminate researcher-based material.

e) There is not enough to provide staff development programs and opportunities. Most of the generalist extension agents have great difficulty keeping abreast of technological developments on all fronts. Therefore, without frequent updates and training, extension workers can become outdated and unable to provide the recommendations for current practices. Local extension staff serves as linkages to transfer technology from the researcher to the local level. Therefore, providing information, instruction, advice, stimulation, and encouragement to farmers is also part of the extension agent's duties.

f) Today, the problems faced by the society are becoming so specialized and complex that extension is sometimes criticized for insufficient impact, ineffectiveness, inefficiency, and, sometimes, for not pursuing programs that foster equity. A need exists for more specialization and a higher-level subject-matter competency within extension. Extension should operate more on a regional basis. There is need for more involvement in research by extension personnel. Extension staff should be trained both in terms of information transfer and use of new computer hardware and software. A need exists for more interdisciplinary work.

g) There is lacking of in-service extension training of female staff in management skills and agents in technical and information-transfer skills. It also lacks in extension services forming linkages with rural women's groups for collaborative agricultural development efforts. Therefore, these actions require at a minimum that extension:

(1) develop client profiles of women farmers as target groups; (2) determine and consider the levels of participation for women farmers in extension programming; (3) calculate the production/yield risk factors of women farmers; and (4) ensure appropriate technology and practices to serve women farmers. Most of all, imagination is needed to overcome the socio-economic, political, and cultural barriers that operate against women being integrated into mainstream societies (Rivera and Corning, 1990).

FUTURE DIRECTIONS FOR AGRICULTURAL EXTENSION

The mission of extension is to enable people to improve their lives and their communities (Seevers, *et al*., 1997). To improve the effectiveness of extension, it should be based on classical management principles: (1) extension agents should carry out extension functions exclusively; (2) extension should be closely linked with research; (3) training should be regular and continuous; (4) work should be time-bound; and (5) a field and farmer orientation should be maintained (Rivera, 1990). It is important to know the extension system's strengths and weaknesses. It also needs to know more about other extension systems and their strengths and weaknesses. Based on the current status of agricultural extension, some recommendations are made as follows:

1. Keeping an organization as large and complex as the Korean agricultural extension system operating smoothly requires effective and efficient management. The structure of a typical extension organization contributes significantly to the need for effective management.
2. Extension is flexible, but procedures are needed to ensure that its organization evolves along with changes in its target audiences and technologies.
3. Extension workers are often asked "to do more with fewer resources", "work smarter", or "restructure" as they make decisions about programs. The costs and financing of public extension are paramount concerns. Therefore, future extension will focus on issues and initiatives for which specific funding in grants and contracts is allocated. The governmental role will be reduced to a minimum.
4. Extension has a history of helping rural people use scientific, research-based information to solve practical problems and use available resources. However, the complexity of economic, social, and environmental issues that extension must now address, is no longer limited within the bounds of the rural county. As a consequence extension services should examine the efficient and effective use of extension resources in metropolitan counties.
5. In the past, extension has focused its efforts on educating rural people primarily on agricultural topics. Now extension will no longer be able to afford to be all things to all people. It will be increasingly important to establish a target market approach for developing and delivering educational programs to increasingly diverse clientele groups.
6. Traditional extension programs have been well suited to moderate-sized farms, specifically, those operated by individuals having a less-than-technical education. In the future, extension will be challenged to serve not only the small and moderate-sized farmers who constitute the majority of farm numbers, but also the increasing number of commercial farmers.

7. It will become increasingly necessary for extension to establish linkages beyond its traditional agricultural clientele base. Extension will be required to explore new opportunities and clientele linkages.
8. Historically, extension has focused on information transfer to its clientele groups. In the 1990s, the emphasis will be shifted to discovery learning/problem-solving/ thinking/application skills.
9. Staffing extension to meet the needs of the rural clientele is a challenging task. Future extension staffing patterns should reflect the difference between clients' needs for information versus education, and provide for a staff with skills, facilities, and strategies to meet those needs effectively.
10. Extension typically tries to be responsive to local needs, but few people recognize a need for international education. Extension should have a unique role to play in helping traditional rural and agricultural clientele to recognize the need for education on international issues.

CONCLUSION

Korea has experienced and attained agricultural development through effective research and technology transfer, for example, the "Green Revolution" and the "White Revolution" have enabled self-sufficiency of rice and year-round production of fresh vegetables. The extensive use of modern farming techniques, particularly highly productive and superior quality cultivars, better water management, intensive use of chemicals and advanced cropping methods, made possible a steady increase in productivity. Growth in agricultural output has been increasingly based on development of scientific and technical capacity to invent and diffuse new mechanical, chemical, and biological technologies.

Rural extension offices cover all rural areas to guide farmers into new technologies. There are thus few gaps in farming techniques among the classes of the sizes of landholdings. Almost all of the increases of agricultural production in Korea occurred as a result of new mechanical, chemical, biological technologies, and on their dissemination to farmers, since these innovations are not land augmenting and technologically scale-neural as well. Mechanical innovations also had a dramatic effect on the volume of output per worker and on land cultivation intensity.

For future progress, adjustments in agricultural research, extension and education have to be immediately given attention to adapt with the changes in demand, institutions, physical conditions, and emerging technologies. With this adjustment, current coordination efforts should be maintained among institutions related to agricultural development. These institutions must function well and should be closely linked together for farmers' rapid adjustment to socio-economic and technological changes.

Patent applications or arrangements for commercialization of agricultural technologies usually depend upon researchers. The absence of a coordinating body for commercialization of agricultural technologies within the agriculture sector should be addressed. It may be desirable for the extension services to take part in the commercialization process, while RDA's Research Management Bureau may work as the coordinating body for agro-technology commercialization.

Finally, further enhancement of partnerships among research, extension and education institutions matched with an effective management system will surely result in a complementation of resources and expertise in moving towards more productive and sustainable agricultural development.

REFERENCES

Ahn, J. G., 2001. "Agricultural Extension Services in Korea", *Training on Rice Technology Delivery System*, International Training Program, KOICA and RDA.

Cheong, J. W., 2000. *Saemaul-Undong: A Nationwide Community Development Campaign in South Korea, 1970-2000 in Agricultural Policy Development*, International Technical Cooperation Center, Rural Development Administration.

Cheong, J. W. and S. S. Kim, 2000. *Program Development for Supporting U-turn Farmers in Rural Settlement*, Ministry of Agriculture and Forestry.

Jones, S. R., 1986. "The Evolution of Agricultural Extension in Developing Countries", paper presented at the Second Annual Meeting of the Association of International Agricultural Education on 10 April 1986, the Chevy Chase, Maryland.

Kim, J. G., 2000. *Agricultural Extension Organization and Programs*, International Technical Cooperation Center, Rural Development Administration.

Kim, S. S., 1997. "A Study on the University Agricultural Extension Education in Korea", *Korean Journal of Agricultural Extension*, 4(1).

----------, 1999. "A Systems Approach to the Linkages among Agricultural Research, Extension and Farmers in Korea", *Korean Journal of Agricultural Education*, 31(2), 61-84.

----------, 2000. *Education and Leadership Development for the New Village Movement in Korea*, International Technical Cooperation Center, Rural Development Administration.

----------, 2001. *Localization of Extension Educators in Korea*.

Lee, S. H., 2001. "Agricultural Research and Extension Linkage in Korea", *Training on Rice Technology Delivery System*, International Training Program 2001, KOICA and RDA.

Rivera, W. M., 1990. "Future of Extension Worldwide", *Journal of Extension*, 28(3), http://www.joe.org/joe/1990fall/fut1.html.

Rivera, W. M. and S. L. Corning, 1990. "Empowering Women Through Agricultural Extension: A Global Perspective", *Journal of Extension*, 28(4), http://www.joe.org/joe/1990winter/a9.html.

Rural Development Administration, 2000. *Annual Report 2000*.

Seevers, B., D. Graham, J. Gamon, and N. Conklin, 1997. *Education Through Cooperative Extension*, Delmar Publishers, Washington.

9. MALAYSIA

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INTRODUCTION

Agricultural research in Malaysia is being carried out mainly by the Malaysian Agricultural Research and Development Institute (MARDI). This institution was established in 1969 as a result of an effort to separate the research and extension function of the Department of Agriculture (DOA), Malaysia under an Act of Parliament. The Act empowers MARDI with flexible administration, having few bureaucratic restrictions, thus allowing for a more congenial environment for productive research. Thus, the primary objective of MARDI is developing and promoting new and improved technologies in agriculture. These technologies will serve to increase productivity and efficiency, hence modernizing the agriculture sector as well as maximizing farm income.

As the result of the above institutional changes, DOA reorganized itself to fully focus its role as a lead agency in agricultural development, providing extension services especially to farmers and smallholders. The main thrust was to develop self-reliant farmers involved in commercialized agriculture so as to increase productivity and income as well as to uplift their standard of living and quality of life.

As the result of the separation of research from extension considerable concern had been expressed for the need for integration. Bilateral cooperation MARDI-DOA Committee was then formed formally. In 1976 this committee then underwent some structural changes and operated at two levels, i.e. federal level as well as State level with the launching of the Extension Liaison Unit under the World Bank Project. In 1985 the cooperation was once again upgraded and the organizational structure changed to operate at three levels, namely, (a) Main Committee MARDI-DOA at headquarters level; (b) Technical Committee MARDI-DOA at federal level; and (c) Bilateral Cooperation Committee at State level. The role of the Main Committee was for decision-making at the policy level related to research-extension linkages, and to monitor the progress of the Technical Committee at the federal level. The Technical Committees provided a forum for discussion to determine new technologies, methods of technology transfer, current problems encountered in the implementation and acceptance of new technology by the clientele groups as well as to coordinate the activities in transferring technology from MARDI to DOA. There were seven Technical Committees formed and they were:

i. Technical Committee on Rice
ii. Technical Committee on Cocoa/Coconut
iii. Technical Committee on Fruits

iv. Technical Committee on Miscellaneous Crops
v. Technical Committee on Soil Science
vi. Technical Committee on Agricultural Engineering
vii. Technical Committee on Extension, Training and Information Management.

Bilateral Cooperation Committee at the State level was called State Agricultural Research and Development Committee (SARDEC) focusing on the implementation of joint projects. It also provided a forum for continuous flow of feedback from area levels regarding implementation problems and response of the clientele groups with respect to new technologies that were being introduced via the bilateral mechanism.

RECENT DEVELOPMENTS IN AGRICULTURAL RESEARCH

The most recent development is to transform MARDI into a corporatized research and development (R&D) center which leads technological innovations in the food and agricultural industry. However it still maintains its main functions:

- to conduct scientific, technical, economic and sociological research, with respect to the production, utilization and processing of all crops (except rubber and oil palm) and livestock;
- to serve as a center for the collection and dissemination of information and advise on scientific, technical and economic matters concerning the agricultural industry, including the publication of reports, periodicals and relevant professional journals and papers;
- to serve as a center for specialist extension service in the agricultural industry;
- to advise on the training of workers for scientific and technical research and extension;
- to provide grants-in-aid for the purpose of pure and applied scientific, technical and economic research concerning the agricultural industry;
- to maintain liaison with other organizations both public and private, indigenous and foreign; and
- to conduct commercial research and production for effective promotion and utilization of its research findings.

The research activities of MARDI are divided into six sections; namely, Horticultural Crop Research; Food and Industrial Crop Research; Food Technology Research; Livestock Research; Strategic, Environment and Natural Resource Research; and Economic and Technology Management Research.

With the corporatization of MARDI there was a need to review the existing mechanism for cooperation between MARDI and DOA. This was to make sure that the effectiveness of the linkages could be improved as policy, strategies, management system and other factors changed. This became necessary because MARDI as a corporate body needs to generate its own income from its core activities and other resources belonging to it. Also to be self-sufficient, cost of operation has to be reduced significantly. Presently, the main sources of income are from contract research, technical services (hard and soft services), sale of products, land development and investment in MARDITECH Corp. (private company formed under MARDI). Triggered from the above development there was an attempt to introduce

a new form of cooperation between DOA-MARDI in 1996 to replace the existing system, as in Figure 1.

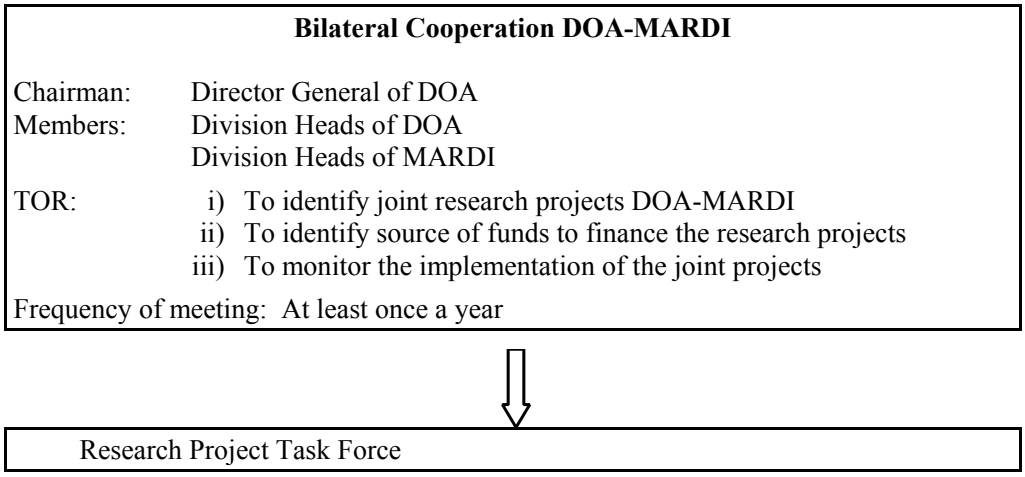

Figure I. Bilateral Cooperation DOA-MARDI

Thus, there was a new item added to the terms of reference, i.e. to identify sources of funds to finance the research projects. However this committee did not materialize in its fullest form. Most of the effort of MARDI is being occupied by activities to earn income and to cut costs as much as possible. So bilateral cooperation activities between DOA-MARDI which do not generate income for MARDI are becoming progressively less important.

CURRENT SITUATION OF AGRICULTURAL EXTENSION

DOA is the main agency involved in agricultural extension. Its main mission is to provide quality and efficient services to farmers, entrepreneurs and the private sector on crop technologies, agro-based industries and regulatory services related to increase national agricultural productivity. The most current role played by DOA is to expedite the transformation of traditional agriculture sector to modern, dynamic and commercialized sector. Thus the new features of the agriculture sector are:

- large-scale production and mechanization – with the formation of industrial agro-technology parks
- private sector participation
- technology and knowledge intensive, information communication technology
- horizontal and vertical diversification – product-based approach
- enhancing support services (R&D, marketing and financing)
- human resource development (farmers, workers, service providers)
- development of agro-tourism
- technology power house – role of plantation houses.

In order to expedite the transformation, DOA provides professional and quality extension services in a wide range of agricultural fields in an effort to promote the utilization of modern and efficient technologies. The various fields include the development and management of crops and agricultural commodities, crop protection, soil management and agricultural engineering. These services are provided to other government agencies, private companies and institutions, farmers' cooperatives, entrepreneurs, farmers and individuals who are interested in agriculture; be it on commercial or on a small scale.

Advisors and consultancy services in the form of agriculture project feasibility studies related to agriculture covering aspects such as soil survey and crop suitability (matching of soils, climate and crops), engineering requirements, crop husbandry and economic and financial components are made available to agricultural entrepreneurs, other government agencies, statutory bodies and private agencies (individual and organizations). Product of the feasibility study reports contain cash flows, farm budgets, soils maps, topography, land use and crop suitability, and charts of recommended farm activities.

Crop Technology Packages is another form of advisory and consultancy services provided on request to other government agencies, private organizations and individuals. Services also include agronomic and management aspects, and post-harvest technologies.

Agro-based industry development services are available on request to other government agencies, private organizations and individuals. Scope of services include product development for food and handicrafts, training, technical support and advisory services for entrepreneurs; provision of processing facilities, development of databases on entrepreneurs and raw material producers; quality control and product standardization, assistance to entrepreneurs in securing credit, strengthening marketing network and encouraging development of agro-tourism.

Other forms of advisory and consultancy services provided by DOA are seed production technology, landscaping and area beautification, agro-tourism, farm irrigation system development, pest and disease control, soil management, analytical and geographic information services.

The traditional form of extension service to farmers in the rural area with the purpose of winning, farmers confidence and to persuade and convince them to adopt new and improved farm technologies, has become obsolete. Even the Training and Visit (T&V) system introduced under the World Bank Loan is no longer in operation. However the T&V system was later modified into project-impact approach on the basis of group farming. Since then, the group farming approach has remained as the dominant method of extension of the DOA.

As present the relevance of knowledge as base for extension services is becoming more prominent as Malaysia strives to change from a production economy to a market-economy. With the current emphasis on transforming the agriculture sector into a modern, commercial and efficient sector, one can expect that the target groups will also change from smallholder dominance to entrepreneurs who will be active information seekers, rather than a relatively passive information receivers. The role of the extension agents will therefore be more of knowledge workers who would give advisory and consultancy services to the target groups.

Given the current focus to commercialize the farm projects, the DOA has determined that all projects must start with project feasibility studies and a 'Business Plan'. Essentially, the plan will identify the combination of enterprises that will guarantee a sizable income

(income of RM3,000.00 per month per farmer). In-built is also the schedule of activities based on the Crop Technology Packages developed by DOA.

LINKAGES BETWEEN AGRICULTURAL RESEARCH AND EXTENSION

Ministry of Agriculture (MOA) as the main organization overseeing both the DOA and MARDI is responsible to take the lead in ensuring that research and extension are working together when any agricultural program is being planned and implemented. Under the Third National Agricultural Policy (1998-2010) MOA has highlighted agricultural transformation as a new vision of the agriculture sector, this new vision is:

- for the next 10 years focus is on "Modernization of Agriculture Food Sector"
- agriculture is going to be the 3rd engine of growth (apart from manufacturing and services)
- vision towards making Malaysia as a prominent World Food Producer
- work towards dramatic income improvement for the agriculture community.

In order to achieve the vision above, the agriculture sector of Malaysia needs to be very competitive. For the strategic plan for competitiveness, following factors are being considered:

- Types of producers
- Source of products, price, quality
- Delivery and distribution
- Promotion (international, regional, domestic)
- Law and regulations
- Quality system (GAP [Good Agricultural Practices], SPS [sanitary and phyto-sanitary], GMP [Good Manufacturing Practices], HACCP [Hazard Analysis and Critical Control Point], SQF [Safety Quality Food] 2000)
- Accreditation system
- Auditing system.

MOA has identified the efforts needed to be competitive, such as:

- efficient management
- modern technology
  - – use of high-yielding quality seeds
  - – effective fertilization
  - – effective pest and disease control
  - – efficient and sustainable use of resources
  - – mechanization and automation to overcome labor shortage

So much so, private companies have the financial resources to use modern technologies, and have the management expertise. Thus an effective approach to transformation is through participation by private companies in large-scale commercial production. Private companies participation in future is likely to increase from 30 percent, at present to 70 percent in future. The smallholders 70 percent, now with average farm size less than 2 ha will be reduced to 30 percent in future. The approach for large-scale commercial production has also been laid down as follows:

- Establishment of Permanent Food Production Parks
- Formation of Group Farming Projects
  - Nucleus orchards
  - Vegetable commercial projects
  - Paddy group farms or mini estates
  - Coconut group farms
- Floriculture Agro-Technology Parks.

The focus of extension efforts presently and in future are more advisory and consultative in nature as well as in providing technical support services to entrepreneurs and private companies and to some extent to farmers' groups who participate in group or mini estate farming. The mechanism adopted by MOA to make sure MARDI and DOA as well as other related agencies under the MOA are integrated, is MOA Incorporated (MOA Inc.)

Under MOA Inc. a task force consisting of appropriate persons from all relevant agencies under the MOA is formed on request at the district level to carry out project feasibility study and if viable to make a comprehensive project proposal. The role of the MARDI representative is to make sure that the latest technology is being included and the DOA representative is to see that the mechanism of transfer of the technology is being carried out effectively.

There are altogether 13 departments and agencies under the MOA. They are:

i. Department of Agriculture (DOA)
ii. Department of Fisheries (DOF)
iii. Department of Veterinary Services (DOV)
iv. Department of Irrigation (DDI)
v. Malaysian Agricultural Research and Development Institute (MARDI)
vi. Malaysian Fisheries Development Board (MFDB)
vii. Federal Agricultural Marketing Authority (FAMA)
viii. Farmers' Organization Authority (FOA)
ix. Agriculture Bank of Malaysia (ABM)
x. Muda Agricultural Development Authority (MADA)
xi. Kemubu Agricultural Development Authority (KADA)
xii. Pepper Marketing Board (PMB)
xiii. National Hydraulic Research Institute of Malaysia (NAHRIM).

CONCLUSION

Research-extension integration provided by MOA Inc. is considered the most appropriate under the Malaysian conditions. This is so because it incorporates other important services, such as marketing by FAMA, financing (loan) by ABM and irrigation by DOI. To utilize the new technology they may need more capital to purchase appropriate material, equipments and machinery. With ABM present in the task force, initial steps towards application for bank loan to finance the project can be initiated. Similarly, with the presence of FAMA in the task force, proper planning for systematic marketing of produce can be undertaken in order to obtain a high price. Thus the extra cost incurred in utilizing the new technology is giving a positive return to the farmers. This will determine the spread of the technology transfer and its sustainability.

REFERENCES

Department of Agriculture, 1993. "Technology Transfer MARDI-DOA – An Evaluation", Annual Meeting of Directors 1992, 9-12 January 1993, Kuala Terengganu, Malaysia.

----------, 1996. "Proposal for Mechanism of Cooperative Relationship DOA-MARDI", Bilateral Cooperation MARDI-DOA Main Committee, 15 November 1996, Malaysia.

----------, 1996. "Proposal for Restructuring of Cooperaion Structure MARDI-DOA", Bilateral Cooperation MARDI-DOA Main Committee, November 1996, Malaysia.

----------, 1996. "Bilateral Cooperation DOA-MARDI", November 1996, Malaysia.

----------, 1997. "Strategic Planning Department of Agriculture in Seventh Malaysia Plan (1996-2000)".

Malaysian Agricultural Research and Development Institute (MARDI). Corporate Strategic Planning MARDI (1996-2000).

MARDI Net.

Ministry of Agriculture, 2000. "Briefing to National Economic Action Council", 4 April 2000, Malaysia.

----------, Agrolink Web Site, 12 April and 11 December 2001.

----------. "Overview of Agriculture Sector in Malaysia", Briefing Notes of Minister of Agriculture.

Sofian Mohd. Salleh, Dato', 2001. "Model and Method of Agricultural Extension and Technology Transfer – The Malaysian Experience", paper presented at the APEC-ATCEG Seminar on Agricultural Technology Transfer and Training, 21-22 February 2001, Yogyakarta, Indonesia.

10. NEPAL

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INTRODUCTION

Nepal is a landlocked agricultural country with a land area of 147181 km^2. It is characterized by steep slopes and elevation varying from 60 m to 8,484 m above sea level. The country has five distinct physiographic regions with different climatic conditions. They differ in type of topography, climate productivity, fauna and flora. High Himalayan region in the northern border has an altitude above 4,000 m and contains 23 percent of the country's landmass with less than 0.3 percent cultivable land area. It has alpine and tundra type of climate. The altitude of the High Mountain ranges from 2,200 m to less than 4,000 m have 19 percent of land area and 8 percent of the cultivable land. This region has cold temperate and alpine climate. Middle Mountain has an altitude ranging from 800 m to less than 220 m and contains 29 percent of the land area and 41 percent of the total cultivable land. It has warm temperate to cold temperate type of climate. Siwalik region has about 15 percent land area and 9 percent cultivable area with subtropical and warm temperate type of climate. The southern flat land known as Terai, covers about 14 percent of land area and 42 percent of cultivated land.

More than 70 percent of the landholdings are less than 0.5 ha of farmland and average holding size in Hills is even less than 0.18 ha. Irrigation facility is available only in 30 percent of total cultivated agricultural land. Traditionally rice, maize, wheat, millet, barley and potato account for nearly 84 percent of cropped area. Other important agricultural crops include oilseeds, pulses and sugarcane. Climate, altitude, rainfall, ethno-social behavior and availability of inputs primarily decide cropping systems. The total share of agriculture in farm family income is more than 70 percent.

The agriculture sector's contribution to the national economy is around 40 percent of the GDP, and accounts for about 80 percent of total labor force. Agriculture remains the most important economic activity and its sustainable growth is a prerequisite for economic development and poverty reduction in Nepal and so His Majesty's Government of Nepal (HMG/N) has prioritized this sector for accelerating its growth.

AGRICULTURAL RESEARCH AND EXTENSION SYSTEM IN NEPAL

Increase in agricultural production and productivity is the function of various components of the agricultural development system. The effectiveness of any one component is dependent on the degree of effectiveness of another component function. Each component

of the system has a number of roles to perform. Agricultural extension is one component that educates farmer and agricultural research is another component, which generates knowledge. Similarly, other components have also their respective roles that contribute in agricultural production. However, the farmer is the final decision-maker and success or failure of any agricultural development depends on acceptance or refusal of farmers.

AGRICULTURAL RESEARCH SYSTEM

In 1966 for the first time in the history of agricultural development a separate institution was established for research activities. But again in 1972 it was merged with other departments in one unified Department of Agriculture (DoA) to bridge the interdepartmental coordination problem. Despite all these efforts agricultural research, in general, has not been able to make progress as per the technological demand of farmers. So, need for a separate research institution as well as system was felt necessary in order to make adequate and appropriate technology readily available for the farmers.

Thus, in the process of reassessing, Nepal Agricultural Research Council (NARC) was established in 1991. It is an autonomous apex body at the national level to undertake agricultural research activities for increasing agricultural productivity and production by generating appropriate agro-technologies suitable to various agro-ecological zones. NARC, in agricultural research, deals with the field problems of farmers by generating needed improved technologies based on on-station, on-farm, participatory, collaborative and contract research with complete package of practices for various agricultural and horticultural crops, livestock and fishery. And at the same time, it verifies on station research outcomes in farmer's field through its outreach research system by involving their active participation and delivers successful technologies to farmers through extension agencies. NARC Act 1991 states that the mission of NARC is to conduct high level studies and research on problems of the agriculture sector and to find out solutions for solving the problems and thereby uplift the quality of life of the Nepalese people. To achieve the above mission, NARC has the following three major objectives:

1. to conduct and/or assign quality studies and research related to agriculture;
2. to find ways and means to resolve problems in the agriculture sector; and
3. to provide necessary assistance to HMG/N in formulating national agricultural policy.

To pursue these objectives, NARC has the following mandates:

1. to conduct and/or assign agricultural research;
2. to determine priorities in studies and research related to agriculture;
3. to provide consultant services and research support services to agricultural research;
4. to coordinate, supervise, monitor, review and evaluate research activities related to agriculture in the country;
5. to maintain/document up-to-date records of agricultural research; and
6. to conduct and/or assign other necessary activities related to agricultural research.

In order to conduct the total agricultural research projects and activities, NARC has established two institutions and separate wings of four Regional Agricultural Research

Directorates (RARD), 14 National Commodity Research Programs (NCRP), 18 Disciplinary Divisions (DD) and 18 Agricultural Research Stations (ARS).

The two institutions are National Agricultural Research Institute (NARI) and National Animal Science Research Institute (NASRI).

NARI deals mainly with the agricultural and horticultural crop research and related activities. It includes seven related disciplinary divisions, e.g., Agronomy, Agriculture Botany, Soil Science, Plant Pathology, Entomology, Agricultural Engineering and Horticulture Research. The Director for crops and horticulture presently administers NARI's overall activities. Eleven national crops-related programs like rice, maize, wheat, grain legumes, oilseeds, hill crops, sugarcane, tobacco, potato, ginger and jute are also technically handled by the Directorate of crops and horticulture.

NASRI deals mainly with the livestock and fishery research activities in the country. It includes five related disciplinary divisions such as Animal Breeding, Animal Nutrition, Animal Health Research, Pasture and Fodder Research and Fishery Research. The Director for livestock and fishery administers its overall activities. The Directorate of livestock and fishery also administers three livestock and fishery programs such as National Bovine Research, National Swine and Avian Research and National Sheep and Goat Research.

Organizational Structure of NARC

1. **Nepal Agricultural Research Council**

This is the apex body of the organization, which makes the final decision for technical, administrative and financial matter. Minister of Agriculture and Cooperatives (MoAC) is the chairman and Executive Director of the NARC is the member secretary of the Council.

2. ***Executive Board***

Executive Board of NARC is the chairperson whereas Director of crops and horticulture is the member secretary of the Board. Other members are Director General (DG) of DoA and DG of Department of Livestock Services (DoLS), Joint Secretary/Ministry of Finance (MoF), Joint Secretary/MoAC, Joint Secretary (agriculture sector)/National Planning Commission and representative from Regional Directors (RD) of NARC.

3. ***NARC Management***

Executive Director is the head of the organization supported by two technical directors (Director of crops and horticulture and Director of livestock and fishery), one director for planning and coordination, one director for financial management and one director for personal administration.

4. ***Disciplinary Divisions***

There are 21 divisions working technically under respective directors. The DDs conduct basic research and technically support commodity programs (CP), Regional Agricultural Research Station (RARS) and ARS.

5. ***Commodity Programs***

There are altogether 15 CPs running under respective directors. They have national mandates and conduct collaborative research with ARS, other CPs and DDs. They provide research material as well as technical assistance to RARS, ARS, NGO and private sector.

6. ***Regional Agricultural Research Stations***

There are altogether four RARSs located in the Terai belt of the country. They conduct research on regional problems and also on research projects proposed by CPs, DDs and ARS.

7. ***Agriculture Research Stations***

There are 15 ARSs in different parts of the country under four RARSs. Each ARS has its own command area or district. It conducts research on related command districts problems as well as research projects proposed by DD, CP and ARS.

Planning Process

The overall research planning process of NARC is based on regular interaction meeting of researchers with end-user clients. On-farm or outreach research program provides an important forum for such interaction where an interface between extensionist and researcher also exits. NARC research strategy has placed on-farm research in the forefront involving both farmers and extension staff. NARC conducts Rapid Rural Appraisal and Participatory Rural Appraisal (RRA/PRA) within the command districts of various research stations to identify problem and solutions. At present NARC starts its program planning from grassroots level with scrutiny at various upward levels. So, the research programs have a demand-driven rather than top-down approach.

Planning process has the following steps:

1. ***Village Level Planning and Review Workshop (VLPRW)***

This type of workshop was started in the outreach sites of various stations in mid-1990. In this workshop location-specific problems and production potentials are put forward by the farmers for discussion. Scientist and extension workers respond to the farmers' problems and queries on verified or proven technology. New research problems and opportunities are identified and prioritized for project formulation.

2. ***Planning and Coordination Meeting (PCM)***

Proposed programs drawn from the VLPRW are scrutinized at the PCM in ARS where extension workers of the command districts and selected farmers from outreach research sites participate in the discussion. The discussion mainly concentrates on:

(a) results of the outreach activities presented by OR coordinator.
(b) Subject-Matter Specialist (SMS) presentation of farmer's reactions on technology dissemination of the command district/area.
(c) ongoing activities and the past achievements by NGOs involved in agricultural research and development in the command area.
(d) policy guidelines by NARC headquarter representative.

Then after thorough discussion common research problems are prioritized.

3. ***Regional Technical Working Group (RTWG) Meeting***

NARC headquarter personnel, scientists from commodity programs as well as ARS of the regional command districts, extensionists from agriculture/livestock from the command districts and representatives from Regional Directorates of Agriculture (RDA) participate in the meeting. Discussions are mainly on:

(a) existing farmers field problems.
(b) status of newly generated technologies and suggestions for new research problems.
(c) delineated research programs in PCM are put forth and scrutinized based on national priority.

4. ***Project Formulation and Preliminary Review of the Project Proposals***

Once the problems are identified and prioritized for research, RARS/ARS scientists prepare project proposals. During preparation of project proposals NARC guidelines are followed. Once the project proposals are prepared, multidisciplinary team composed of

senior scientists review at the regional level for further improvements or they may reject. If approved, the project leader makes necessary corrections and forwards it to the planning division of NARC to be reviewed by Subject Matter Technical Panel (TP).

5. ***Review of the Project Proposed by Technical Panel***

Once the project proposals are received by the Planning Division of NARC they are grouped according to their respective technical panels. TPs are composed of senior scientists from NARC, experts from DoA, DoLS, and Institute of Agriculture and Animal Science (IAAS) and from various organizations and institutions. TPs review project proposals according to the TOR. They are fully authorized to amend, merge or even reject. Coordinators of TPs present their findings in the plenary session. Once the project proposal is approved then it is sent to the sectoral panel to review at sectoral level.

6. ***Sectoral Panel***

Once the project proposals are evaluated by TP, sectoral panel has little to do with project proposal evaluation process. But, the panel looks after:

(a) whether the proposed program is in line with the sectoral problems.
(b) whether the budget is appropriately allocated at the sectoral level.
(c) percentage of the resource allocation is proportionate compared to previous years.

Sectoral panel is composed of 3-4 senior scientists. Its coordinators submit program budget with their comments to NARC Planning Division for further process.

7. ***NARC Executive Board***

Submitted proposals are reviewed by NARC management who make necessary amendments before presenting it to the NARC Executive Board. Executive Board reviews:

(a) resource allocations for regional level, sectoral level and agro-ecological zone basis.
(b) compliance with five-year plan and Agricultural Perspective Plan (APP).

8. ***NARC Council***

Executive Board presents the proposed program/budget to NARC Council for final approval. The Council also looks after whether the proposed program/budget is in line with the five-year plan and APP and whether it complies with the resource allocations for research.

Future Strategy (as stated in Vision-2020, September 2001)

1. ***Promotion of Science and Technology System***

NARC will play a lead role in promoting agricultural, natural resources science and technology systems as well as a scientific culture both within and among its collaborators and partner institutions.

2. ***Donor Support and Collaborative Projects***

NARC will promote collaborative and donor-supported technology generation projects by providing better access to funds and more effective implementation procedures by research institutions.

3. ***Research Priority Setting as Basis for Research Programming***

NARC will set research priorities and organize research and technical programs so as to have the maximum positive impact in the shortest possible time on the agriculture sector, particularly with regard to commercializing agricultural enterprises and directly assisting small farmers and entrepreneurs.

4. ***Use of Indigenous Knowledge and Locally Available Resources***

NARC will ensure that indigenous knowledge, traditional practices and locally available resources are dully considered and tested in research programs and technology development.

5. ***Management and Development of Genetic Resources***

NARC will give due consideration to the preservation, management and development of plant and animal genetic resources as basic research assets and as part of the national heritage.

6. ***Processing and Value Addition***

NARC will promote commercialization in the agricultural and natural resources (ANR) sector by facilitating research which will result in value addition through development of downstream processing opportunities and post-harvest technologies related to cereal, cash, vegetable and fruit crops, livestock and fisheries.

7. ***Information and Publication***

NARC will ensure that all research findings, new technologies and relevant information are made available to the concerned stakeholders through an effective system of information gathering and dissemination.

AGRICULTURAL EXTENSION SYSTEM

Institutionalized agricultural extension services in Nepal began with Indian Aid and American support. Initially extension services were designed following the Block Development Approach of India under the newly established Tribhuvan Village Development Department in the year 1952-53. Later under the US Point Four Program, additional support came for agricultural extension and research activities. Agricultural development in Nepal, since then, has gone through significant structural transformation. Establishment of Agriculture Extension Section in 1959, creation of a Department of Agriculture Extension along with four departments in 1966, unification of departments into a single Department of Agriculture in 1972, separation of a Department of Livestock Development and Animal Health in 1979 followed by the creation of Department of Horticulture in 1990 with independent extension activities are some landmarks of agricultural extension in Nepal. Reorganization of the departments within the Ministry took place in 1992 with the formation of a unified Department of Agriculture Development which split again into two departments: the Department of Agriculture with extension responsibility for cereal, horticulture and industrial crops and fishery and Department of Livestock Services for livestock extension and animal health.

Despite more than several decades of planned development and receiving highest priority, the performance of the agriculture sector has not been encouraging. In order to break the ice, several agricultural development approaches and extension systems suggested by donors including Training and Visit System, Integrated Rural Development Approach, Tuki System, Block Production Program, Cropping System, Farming Systems Research and Extension Systems Approach, etc. have been tried in the past. These approaches have not become the driving force needed to mobilize the vast majority of the small and resource-poor farmers of the country. The various approaches being implemented are found to be more inclined towards the individual approach. These approaches were discontinued due to either shift in policy or withdrawal of donor support. Most of the systems implemented were supply-driven viewing farmers as recipients of new information. Because of this

inconsistency and lack of continuity in program implementation, the then Ministry of Agriculture formulated National Agricultural Extension Strategy in 1994 to ensure sustainability of the program.

Organizational Structure of Department of Agriculture

1. ***Department of Agriculture***

DoA is the government institution mandated for extension of technology to serve the farmers and the farming community. To do its work smoothly and serve the farming community, from center to grassroots level, it has a network of nine technical directorates, one Central Agricultural Training Center, 13 sections, five RDAs, 16 regional labs (seed, soil and plant protection), seven Plant Quarantine Checkposts, 25 farms and stations, one Aquaculture Training Center, seven Sericulture Offices, 75 District Agriculture Development Offices (DADOs) and 932 Agricultural Service Centers (ASC).

2. ***Director General***

DG is the head of the department assisted by two Deputy Director Generals (DDG). One for planning and manpower development and the other for management, monitoring and evaluation who also looks after general administration and financial administration. Institutionally, DG is fully responsible for program planning, budgeting, implementation, monitoring and evaluation of the agricultural development program.

3. ***Directorates***

There are nine technical directorates in DoA, e.g., Horticulture Development, Vegetable Development, Market Development, Fishery Development, Economic Analysis and Statistics, Plant Protection, Crop Development, Industrial Insect Development and Agriculture Extension and Training. These directorates are technical divisions of the respective fields. They assist DoA in technical aspects and technically backup the DADO as well as sectoral sections, labs, checkposts, farms and stations.

4. ***Training Centers***

There are three categories of training centers under DOA, e.g., one Central Agricultural Training Center (CATC), five Regional Agricultural Training Centers (RATC), and one Fishery Training Center (FTC). CATC is located in the premises of DoA, five RATCs and one FTC are located in the Terai belt of the country. These training centers impart training to officers, mid-level extension workers as well as farmers on technology, extension skill and sociological aspects. Curriculum development and training are conducted jointly by research scientists, extensionists and trainers.

5. ***Projects***

Besides directorates and training centers there are some donor-assisted project such as World Bank-funded Agricultural Research and Extension Project (AREP), Asian Development Bank-funded Crop Diversification Project (CDP), Department for International Development (DFID)-funded Seed Sector Support Project (SSSP), Swiss Development Cooperation (SDC)-funded Sustainable Soil Management Project (SSMP) working in various districts for agricultural development. These projects are guided by the national need to fulfill the national development goal.

6. ***Sections***

There are altogether 13 sections under respective directorates which assist the directorates in core technical matters and conduct extension work through DADO and 932 ASCs established all over the country. For the dissemination of the technology these sections

as well as directorates of respective areas prepare extension material with the help of Agriculture Information and Communications Center (MoAC) and disseminate the research output/technologies/package of practices to the farmers and extension workers.

7. ***Regional Directorate of Agriculture***

To collaborate, coordinate, monitor and supervise different agriculture-related institutions and programs there are five RDAs in the country. They provide guidelines with set norms, monitor and supervise the DADO and its program. For the regional agricultural development program RDAs are responsible and they report to the DoA. RDAs also maintain linkages with RARS and coordinate the programs, which are conducted collaboratively by research and extension.

8. ***District Agriculture Development Office***

There are 75 DADOs in the country which are supported, monitored and supervised by RDA and technically by sectoral directorates and sections. The district offices are fully responsible for preparation of district program/budget, planning and implementation and reporting to RDA and DoA and for coordination among various related institutions involved in agricultural development. They have to maintain active linkages with RARS and ARS as well as with other stakeholders like NGO, private sectors and District Development Committees (DDC) who approve the district programs/budgets for further process.

9. ***Agriculture Service Center***

The DADO operates through a network of some 932 ASCs. ASCs are intended to be the focal point for providing agricultural services and assisting farmers group to obtain inputs for farmers. Field level extension workers are based and operate from there. The ASCs also function as training centers for farmers and a meeting point between researchers, extensions and farmers.

Extension Policies and Strategies

Agricultural Extension System though started in 1952/53 as an integral part of the village development program has no long-term policies and strategies. There have been frequent changes in programs and implementation procedures as there is change in organization and its leadership. During early 1950s the policy was to increase production by use of modern means and tools of production. In 1975, by Royal Directives, broad outline of the Agricultural Developments Policy was formulated. The policy envisages pasture and livestock development programs to be implemented on priority basis in the mountain region, horticultural development in Mid Hills and cereals/cash crop in Terai. APP recognizes the need for different strategies for the Terai, Hills and Mountains. The Terai strategy is technology-driven. Policy reforms are directed to accelerate the use of fertilizer, to harness the potential of groundwater and to enhance the productivity of few selected commodities (cereals, off-season vegetables, etc.) In Hills the strategy taken is demand-driven. Raising income primarily from cultivation of off-season vegetables and from exports of high value commodities is the main strategy as Hills and Mountains have regional and seasonal advantage over Terai.

The Terai strategy mainly focuses on production of food crops while the Hill/Mountain strategy focuses on high value commodities such as citrus, apple, silk, honey, off-season vegetable and vegetable seeds and livestock.

APP concentrates on a limited number of priorities on the basis of comparative advantage. APP priority inputs are fertilizer, irrigation, rural roads, and electricity. APP priority outputs are livestock, high value crops, agribusiness, and agro-forestry. It also

emphasizes on maintenance of natural resources, integration of crop-livestock-forestry, soil fertility and pest management, promotion and conservation of biodiversity, improvement of land and water management, increase productivity, and land and water management. For all segments of society the extension policies and strategies are uniform. The gender issues have been well taken into consideration in all these approaches. All these policies and strategies fall broadly under the following guidelines:

- Disseminate technology by various means of extension teaching methods and supply of limited inputs.
- Facilitate the farmers in organizing themselves into groups for the disbursement of credit and production inputs.
- Stratification of farming community into various target groups.
- Encourage participation of women farmers into mainstream of agricultural development.
- Identification of agriculture pockets based on the potential of different commodities.
- Modernization of agricultural extension by adopting bottom-up planning, projectization, decentralization and partnership.

Planning Process in Agricultural Extension

1. ***Agricultural Service Center/Sub-Centers***

First of all bottom up planning starts at ASC level by following Problem Census Problem Solving (PC/PS) procedure. Once the problems are identified, they are prioritized followed by standard economic procedures and also considering the national goals. After prioritization they are presented in a projectized form to the regional directorate along with necessary required budget.

2. ***District Level***

After the DADO gets the programs from all the ASCs it compiles, reviews and takes care that the programs are in accordance with the national priority (envisaged in APP and Five-Year Plan) as well as conforming to farming community needs. While forming budgets for the district budget, ceiling provided to the district by MoAC is also to be considered. District needs and priorities are also taken care. When the district office thinks the programs are appropriate, implementable and within the budget ceiling then they are sent to District Development Council after approval of Agricultural Development Committee.

3. ***District Development Council***

Each sectors annual program has to be approved by the District Development Council (local government). Once they get the program/budget of the districts from all the sectors it is discussed critically, reviewed and if any modifications are to be made they are authorized to do so. After it is approved by the District Development Council then it is presented to the Regional Directorate and discussed in the program/budget workshop.

4. ***Regional Directorate of Agriculture***

Regional level programs and budget workshop is held once a year. All the district offices under respective regions present their annual programs/budgets in the workshop. Researchers also participate in the workshop. At this level programs and budgets are discussed technically considering national priority and districts needs. After the program budgets get approved the regional level RDAs collect all the program budgets of their region and send them to the planning division of the DoA.

5. ***Department of Agriculture***

The Planning Division of the DoA compiles the planned programs of all the districts, scrutinizes them and submits them to the MoAC.

6. ***Ministry of Agriculture and Cooperatives***

MoAC compiles the programs along with the budgets of all the departments and scrutinizes them for approval by Planning Division.

7. ***National Planning Commission (NPC)***

Once approved by MoAC it is submitted to the NPC for final approval.

8. ***Ministry of Finance (MoF)***

Once approved by NPC it is sent to MoF for budgetary approval. Finally MoF sanctions the budget for the district programs through MoAC and DoA.

Future Extension Strategy

It has been decided to take future course of agriculture development programs in the following manner:

- Improvement in availability of inputs and service delivery mechanisms.
- Strengthening of existing groups and farmers to farmer's technology delivery system.
- Prioritization of farmers' needs by extension workers and farmers jointly.
- INGO/NGO/GO/CBOs (community-based organizations) active participation in technology dissemination.
- Current extension system has not been able to address all groups and ranks of people. Women, small and marginal farmers are to be addressed. In this context, in the coming days the present extension system must be reviewed in terms of improvement at the district level, infrastructure, monitoring and evaluation system.
- Developing national agricultural extension strategy based on bottom-up planning and projectization.
- Empowerment of women farmers and disadvantaged groups.
- Improvement in human resource management systems.
- Partnering with private and other related agencies in order to increase productivity.

RESEARCH AND EXTENSION LINKAGE

Research is the main source of information for extension. Thus, extension and research linkages need to be very intimate, efficient and effective. Research-extension linkage system in Nepal is affected whenever there has been change in organization and leadership. At the time when DoA was having dual responsibility of research and extension, there was minimum problem of linkage. But since the research organization got separated, gradually the problem of linkage also started increasing. Some of the mechanisms for coordination and linkages developed lately are as follows:

1. ***Scientific Seminar and Workshop***

Summer and winter workshops organized by commodity improvement programs invite RDs, DADO and other related line agencies to interact on developed technology, program for dissemination, monitoring and evaluation.

2. ***Program Monitoring***

Commodity improvement programs also monitor their various districts programs every year. Visiting group of scientists meet farmers and extension agents and interact with them in the field and receive their consent on ongoing activities. Based on that, research programs are developed for future, which are related with farm and farming community's problems.

3. ***Regional Seminar and Review Meetings***

RDA organizes program/budget seminars and review workshops where researchers, NGOs and private sector also take part in the discussion. Research and extension personnel in the presence of central planning people prepare technically feasible, cost-effective and problem-oriented programs and budgets of the districts for the coming year.

4. ***Curriculum Development and Training***

CATC/RATCs impart various types of training to officers, mid-level workers as well as to the farmers. Curriculum is developed after discussion among extension, research personnel and trainers. During training research scientist communicate research findings to the trainees.

5. ***Outreach Research***

On farm research sites are selected jointly by farm/station researchers and district level extension staff based on jointly carried out diagnostic surveys. Each farm/station has a small nucleus of on-farm research staff who conduct research involving district SMS on the sites.

6. ***National Workshop/Seminar***

Occasionally a national seminar on agriculture is organized where policy-makers, planners, researchers, extension personnel and other related line agencies take part. In this seminar extension and research policy and future strategy are discussed and it works as a guideline for regional and district research and extension programs.

7. ***Extension Activities***

DADO carry out many extension activities like field days, demonstrations, farmers' fair, field trials and other various activities where researcher and farmers are also invited to participate. They discuss issues related to developed technology, its appropriateness, problems and constraints encountered during implementation and in finding out solutions to combat these problems.

8. ***Technical Working Groups***

Central and Regional working groups meeting are held every four months where researchers and extension agents interact on farmers' problem and receive message regarding any newly developed technologies and also to develop projects to find out the appropriate solutions.

Weaknesses and Strengths of Agricultural Development

1. ***Weaknesses***

(1) Inadequate rural roads.
(2) Very little rural electrification.
(3) Waiver of subsidy for shallow tube-wells.
(4) Unavailability of required budget.
(5) Frequent changes in leadership.
(6) Existence of rampant poverty.
(7) Fragmented land holdings.
(8) Mountainous terrain.
(9) Unavailability of transport facilities and required infrastructure.

2. ***Strengths***

(1) Existence of different agro-climatic conditions within a short distance.
(2) Availability of vast water resources.
(3) Availability of genetic variability.
(4) Availability of well-trained agricultural manpower.

CONCLUSION

Agricultural extension and research are mutually dependent. Extension requires the findings of research to inform the farmers, as well as support of research in solving farmers' problems. Without research involvement, it is unlikely that extension will be able to serve the farmers through dissemination of improved practices that lead to increase in productivity required for rapid and sustained agricultural growth. Similarly, researchers require extension's guidance on problems that farmers face on new issues that become apparent from field exposure and on which research attention should be focused.

REFERENCES

Ganesh, K. C. (Chief Industrial Entomologist). "Agricultural Research and Extension System in Nepal", Department of Agriculture, Lalitpur, Nepal.

Gautam, J. C. and P. B. Singh, 1998. "Policy Consideration in Addressing Equity Through Research and Extension in the Context of Agricultural Development in Nepal", paper presented for the Seminar on Equity Considerations in Agricultural Services in Nepal, 22-23 July 1998, Dhulikhel, Kabhre, Nepal.

Maharjan, B. B. and H. K. Shrestha, 2000. "Research Planning and Projectization Process of Nepal Agricultural Research Council", paper presented in the Consultative Workshop on Bottom-up Planning and Projectization held at Horticulture Development Project organized by DoA/AREP, 17 October 2000, Kirtipur, Kathmandu, Nepal.

NARC, 2001. *VISION-2020, Agricultural Research for Sustainable Livelihood Improvement*, September 2001.

Thapa, Tek B. (Regional Director, Central Development Region/DoA, Nepal), 1988. "Equity Considerations in the Formal Sector Agricultural Extension Services", paper presented at the National Workshop on Equity Considerations in Agricultural Extension Services in Nepal, 22-23 July 1988, Dhulikhe.

World Bank, 1997. "Project Appraisal Document Nepal Agricultural Research and Extension Project", *Document of the World Bank, Report No. 16658-NEP*, South Asia Region, Rural Sector Development Unit, 25 July 1997.

11. PHILIPPINES (1)

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INTRODUCTION

Global competitiveness remains as the biggest challenge for Philippine agriculture today. Despite the advancement in science and technology and the investments made in research and development (R&D), these have not significantly impacted on resource-marginal farmers' household productivity and rural incomes. Current literature is replete with observations indicating that the age-old problem of weak linkages between research and extension (R&E) continues to beset the flow of information, knowledge, and resources among actors in R&E's technology-delivery-utilization system. As a result, farmers have limited options in making decisions on technologies appropriate to their specific farming needs and those within their local social, cultural, economic and political environment.

Strengthening research-extension linkages (REL) has actually been an ongoing concern of agricultural research over the years. In fact, the causes of weak linkages in this area had been well studied and analyzed; recommendations had likewise been forwarded in several forums organized in the past. But today we find ourselves still struggling to overcome the same issues and problems we thought we had already addressed more than a decade ago (PCARRD Workshop Proceedings, 1995). This makes us wonder if we have at all attained a good understanding of the problem which we have long wanted to resolve.

This paper builds on the premise that there have been some fundamental precepts in REL that we have failed to adequately discuss in the past efforts at providing solutions to REL issues. Weaknesses in the linkage are traced to this missing task. We shall then point out the characteristics of such weaknesses, outline their specific causes, and forward them as our collective thoughts for discussion and consideration.

CURRENT STATUS OF AGRICULTURAL RESEARCH

As early as 1972, agricultural research in the Philippines has been undertaken by three major groups: the Department of Agriculture (DA) research stations and/or agencies, agricultural state colleges and universities (SCUs), and the Department of Science and Technology (DOST) research institutes. Collectively, they comprise the bulk of the so-called

National Agriculture and Resources Research and Development Network or NARRDN, a loose aggrupation of some 132 government research agencies working on agriculture and natural resources R&D. As a NARRDN member, each agency/research station is assigned a specific role (either as a national/regional R&D center or as a cooperating station) and commodity assignment. Hence, each of the 22 commodity groupings has its own set of a national research center, several regional centers, and sub-network of cooperating stations. A research agency may thus be designated to play multiple roles, i.e., as a national center for one or more commodities while simultaneously serving as a regional center/cooperating station for other commodities depending on its existing R&D capability, available facilities, and commodity interest.

To date, there are 14 regional consortia organized by PCARRD to manage and coordinate the various activities of the NARRDN member agencies. Together, the member agencies undertake joint program planning, coordinate research programs, reviews and project evaluation/monitoring, share resources, pursue shared goals through R&D integration and complementation of efforts, exchange research information and discuss issues of common concern. Budgetary financial support provided by PCARRD to these consortia is of the order of PhP (Philippine peso) 31.29 million annually.

However, with the passage of RA 8435 better known as the Agriculture and Fisheries Modernization Act (AFMA) in December 1997, leadership in agricultural R&D is currently being shared by DOST-PCARRD and DA-BAR (Bureau of Agricultural Research). To some extent, such a move created more confusion and dissipation of efforts among the members of the NARRDN. This is so since the two agencies have their own set of priorities and they control a substantial portion of the public investments in agricultural R&D. In addition, there are a number of limitations to the conduct of research in this country. Some of these concerns are:

1. ***Incentives and Disincentives for Researchers***

The relatively low number of research output per involved expert (less than one research output per capita a year) in the regional research centers may be reflective of conditions which put severe disincentives to undertaking research. The main human resource pool in the regional centers consists essentially of the faculty members of the regional SCUs. National consultations with the Network members revealed that faculty work conditions (full teaching load of 18 units, and not a few times carrying teaching overload) add to the problem. And as faculty members obtain their Ph.D. degrees, they are assigned full administrative functions. As yet, there are no institutional standards by which engagement in research are credited into faculty loads. The same remains for administrative and extension activities.

2. ***Low Funding Levels of Research Projects***

Compared to the average funding levels for research projects in the national centers, research expenditures are relatively low in the regional centers (about PhP370,000 per project) and are quite discouraging in the cooperating stations (about PhP130,000 per project). Thus, if a research project has an average of a one-year duration, that would be about PhP30,000 worth of expenditures per month in the regional centers, and about PhP11,000 per month in the cooperating stations. One can just ask what can be done with such levels of funding to expect a research output that will have a high productivity in terms of applications at the local or regional level.

3. ***Quality of Research Output***

While there is a significant number of researches undertaken by the entire Network over the period of 1990-2001, and while one can identify in which fields of specialization these studies fall, there is not much information available on the quality of the research outputs as measured by these criteria: (i) relevance to either local, regional or national concerns; (ii) robustness of research results; and (iii) extent of technology/info utilization.

4. ***Disjointness of Research Output***

While the research output of the various members of the Network could be classified under particular headings signifying areas of specialization, there is insufficient evidence that the various researches were consciously guided by a common theme or direction. A broad examination of the work and financial plans and projects completed at a number of SCUs shows that except for a few major commodities, research projects are highly fragmented and are on a short-term basis. There is little effort for disseminating research findings and outputs nor of linking these to the extension system for the benefit of the clientele. It is also obvious that the profile of research projects does not reflect a sense of problem-orientation (David, *et al*., 1998).

5. ***Misallocation of Budgetary Resources***

The inefficiency of public sector funding has been significantly lowered by the misallocation of the limited budgetary resources and by institutional weaknesses of the agricultural research system. Allocation of research expenditures across commodities and regions have been highly incongruent as to their relative economic importance as measured by the gross value-added contribution of the commodity to the economy. Relatively greater research budgets are provided to minor commodities such as cotton, silk or carabao, and too little to major ones like corn, coconut, fisheries and others. The allocation of budgetary resources by type of expenditures also affects the productivity of research. As often complained about, meager resources are available to perform research activities and to properly maintain physical facilities, after the salaries of research personnel have been paid. The average share of personal services to direct budgetary outlays is close to 60 percent and can be as high as 70-80 percent in many cases. In situations like this, the research manpower is underutilized or the research agenda is driven by donor's priorities (David, *et al*., 1998).

CURRENT SITUATION OF AGRICULTURAL EXTENSION

The present agricultural extension system in the Philippines is a result of the evolution of approaches brought about by experimentation in methodology with external funding agencies, policy reforms resulting from periodic changes in leadership in the DA, and the enactment and implementation of two important legislations that affected R&E in the past three decades. It is a product of a shift towards a community-based participatory approach from a top-down extension delivery system. The **community-based approach** is centered on participatory development. It was spurred by the increasing trend towards **decentralization** of extension systems which most Southeast Asian countries have adopted as they sought development policies that are customized to local conditions and needs. To decentralize is to build local administrative capability in delivering services especially to the poor and remote areas. It adheres to the principles of local self-reliance, participation and accountability.

Nonetheless, decentralization has also been questioned on the way it functions and the way benefits are distributed. The functional problems generally include quality of

governance particularly in areas of low literacy level, problems of coordination among stakeholders, and problems of reallocation of resources from the relatively wealthier areas to poorer ones. Distribution of benefits among stakeholders had been perceived to lead to dominance of elite groups in decision-making.

In the Philippines, the AFMA and the Local Government Code of 1991 are two policy instruments that have significantly affected governance in agricultural extension.

AFMA emphasizes the role of the private sector by encouraging the participation of farmers and fisherfolk cooperatives and associations, as well as other private groups, in certain extension services like community organizing, skills training in agribusiness and management, popularization of training materials, promotion of regenerative agricultural technologies, and the use of participatory approaches. Government agencies such as the DA and the SCUs are mandated to assist in the local government unit (LGU)'s extension system by improving its effectiveness and efficiency through capability-building and complementary extension activities in the forms of technical assistance, training of LGU extension personnel, improvement of physical facilities, extension cum research, and information support services. Under Rule 921, the extension functions of the DA have to be delegated to the regional field units (RFUs) and the Agricultural Training Institute (ATI) training centers, in collaboration with LGUs and SCUs, under the overall national coordination of the Office of the Undersecretary of Research Development and Extension (RDE). The training centers are tasked to design and implement agricultural training programs that are consistent and functionally integrated with the regional agriculture and fisheries development strategy and program as led by the Office of the DA Regional Director.

On the other hand, the Local Government Code of 1991 decentralized the management of extension programs in the country, which effected the devolution of agricultural extension function to the LGUs. It provided for the devolution of power to administer extension services and to access resources from the central agencies to the provincial, municipal, and *barangay* (village) authorities. Assessments of the performance of the devolved extension system in specific cases revealed the system's shortcomings. In a study in the Calabarzon area, Tiwari (1994), Bergonia (1998), and Cabanilla (1995) bared that changes in the organizational structure resulted in problems of linkage between extension and research, in drafting of clear-cut objectives and mission of LGUs, in accessing financial and communication support, to name a few. The limited number of extension workers especially in less endowed municipalities created heavier workloads. Vargas and Acoba confirmed in 1997 that after devolution, budgetary appropriations for extension became inadequate, lesser technical assistance was made available to farmers, farm visits became occasional, mobility to the rural areas became sluggish, and financial support grew unstable. Problems encountered in the Code's implementation are also beset by the LGUs' seeming incapacity to envision priority concerns. However, in an ongoing study commissioned by the Philippine Institute for Development Studies (PIDS), it was shown that the trend has been changing, owing to the growing awareness and participation of younger and more enlightened local chief executives.

After the devolution, two modes of extension management emerged (Appendix A). Model 1 characterizes local extension management of LGU-supported/initiated programs. Model 2 characterizes the implementation of production programs initiated by other extension providers such as the DA, SCUs, NGOs and others (Cardenas, Hondrade, Alcober and Medrano, 2002).

Under the devolved extension system (Model 1), all extension providers must now link and collaborate with LGUs before any program at the LGU level is implemented. When the extension function was devolved to the LGUs, the latter maintained autonomy and independence in differentiating their extension programs from each other (provincial, municipal and *barangay*). Another feature of the devolution was the emphasis given to the NGO, highlighting its role in policy-making: an NGO representative was provided a seat in the local/municipal legislative bodies. At these levels, the LGUs plan their own extension programs that are appropriate to the needs of their constituents.

The performance outcome of this mode is highly dependent on the existence of local resources – both financial and manpower – that largely come from the local government development fund. But the 20-percent development fund set aside from the Internal Revenue Allotment as share in the local development fund is not sufficient to meet the needs of poor LGUs, which most often must use the fund to meet the cost of devolved functions including health, social services and agriculture of which extension is just a part. Cardenas (1996) noted that 5th and 6th class municipalities comprising 81 percent of the total municipalities of the country had only about PhP9,000 per annum for maintenance and operation expenses (MOE), which covered the cost of undertaking service functions. Figures collected by the PIDS, for example, showed that in 1998, the allocation for agriculture constituted only 3.7 percent for all LGUs budget. Agriculture got a much lower share compared to infrastructure (15 percent), health (13 percent), and education (8.6 percent). This has led to limited activities and insufficient if not total absence of a concrete program on extension and to the inability of extensionists to attend enrichment-training programs.

Model 2 is practiced when institutions outside the LGU initiate an extension program. This includes the DA national food security programs, and extension programs of SCUs, NGOs, private organizations and other government agencies. As a protocol, no extension program is implemented unless this is cleared and properly linked/ coordinated with the local government officials (Cruz, 1996; and Tiwari, 1994) for approval of the head of the LGU. A memorandum of agreement/understanding normally formalizes this arrangement.

The DA which could customarily undertake in the pre-devolution era extension service particularly in training and production functions (which it would assign to the ATI and the DA-RFUs) can no longer link directly with farmers, as Model 2 would reveal that it must first consult and formalize arrangement with the LGUs. This transition of powers and functions has significantly affected the sustainability of RELs (Cardenas, Hondrade, Alcober, and Medrano, 2002). Only a few cases of linkages with LGUs are successful. This has to do with the nature of the linkage (*ad hoc*): it is not possible to gain substantial knowledge and experience on a given innovation in a limited term (utmost five years) and work on its institutionalization successfully.

Results from the study by Cardenas (2000) revealed that RELs under Model 2 can be strengthened by the following: information-gathering on local farming systems and transforming it to research problems; production of technology packages incorporating farmers' indigenous knowledge; and performance-evaluation of technologies under farmers' conditions. These have to be undertaken with the participation of major actors or stakeholders in rural extension. The procedures of linking research systems and extension services could also be managed by the strengthening of institutions, institutional reorganization, and adoption of policy changes – requirements that are expected to enhance agricultural RELs.

Because of the reorganization of the Philippine agriculture and fishery sectors, and the devolution of extension functions, the relationship between R&E suffered some setbacks. Experience, observations, as well as related literature, reveal the following problems:

1. ***The Absence of A Unified Framework***

Multiplicity of extension providers (government agencies, NGOs, private sector, people's organizations) guided by multiple concepts of extension that operate on rather loose organizational arrangements could be attributed to the absence of a unified framework for extension arrived at by consensus. This type of framework must recognize the five major factors/resources affecting extension: a) technical, which includes facility (machinery), skills, and knowledge; b) social, which refers to the organization and relationships of people and institutions (stakeholders) involved in extension; c) economic, which pertains to capital and other resources needed to effectively implement extension programs; d) political, which refers to the leadership and decision-making structure of the community where extension program is implemented; and e) environment, which refers to the natural resource base and its sustainable management for production purposes. At this juncture, the participation of macro planning units such as the NEDA (National Economic Development Authority), DA, DENR (Department of Environment and Natural Resources), DAR (Department of Agrarian Reform), DOST, and DTI (Department of Trade and Industry) is imperative.

2. ***Inadequate Support Services***

Support services are not quite organized to properly respond to users/industry needs, again due to the lack of organized and systematic frequent dialogues. Manpower training must be strengthened by enhancing knowledge and skills of project implementors and beneficiaries at all levels of governance. Training programs have to be piloted prior to their massive implementation. A regular training monitoring and evaluation must be put in place to ensure that talents developed are properly utilized.

3. ***Ad Hoc Institutional Linkages and Missing Tasks***

On institutional linkages, which is inevitable under the devolved extension function, many field workers decry the existence of memoranda of agreements to be plain "lip service". It is necessary therefore for institutions to collaborate and share a common perspective and objective, target groups, and activities to serve as the foundation for instituting a complementation strategy, instead of leaving them out to *ad hoc* arrangements. This strategy of institutionalizing linkages among concerned collaborators must be considered at the very start of planning and not at the phase-out stage of development projects. This requires allocation of additional resources such as manpower, financial, and facilities. Monitoring and evaluation is crucial, and the indicators for assessment must be arrived at by consensus by all stakeholders.

4. ***Encouraging People's Participation***

In promoting participatory extension, technology users must underscore the importance of the philosophy, "to see is to believe". There is a need to stress information education campaigns and availability of support extension materials, the use of appropriate extension techniques that fit learning levels and styles of potential beneficiaries, and institutional mechanisms such as organizing people into cooperatives (but which must be considered very carefully, as past experiences have shown that cooperatives organized among marginal-resource farmers had been unsustainable due to their inability to meet the demand of membership and participation).

Analysis of the REL Issue

Eponou, in 1996, emphasized the vital role of linkage policy in the extension system. He defined linkage policies as the stated commitment of the key institutions and/or actors of the agricultural system to link with each other in order to achieve the necessary level of synergy and to exchange the necessary information, knowledge and resources. The key elements of a linkage policy are explicit commitment to link with others, clear linkage strategies, and allocation of resources to sustain linkages.

Recent attempts to address the REL issue can be drawn back from five past activities: the DA Policy Conference in Extension in April 1988 in Davao City and the 4th BAR Conference in Tacloban City, July 1988 (Bonifacio, 1994); the Philippine Agricultural Extension Study (1990); the Seminar Workshop on Strengthening Research-Extension Linkage in June 1995 (PCARRD, 1996); and the Regional Expert Consultation on Strengthening Agricultural Extension Systems for Sustainable Agriculture and Rural Development in Bangkok, Thailand (1996). Appendix B presents an annotation of what the five activities came up with as explanations to the weak REL.

Analysis of the REL issue can be divided under two historic periods: the pre-devolution and post-devolution stages. Before the devolution of extension functions to the local governments, the dominantly understood causes of the weak linkages, according to Dar and Cardenas in 1997, were structural fragmentation of R&E institutions; unresponsiveness in research by the academe regarding extension needs; lack of communication among researchers, extension workers and farmers particularly in program planning; top-down/linear communication flow; separate definitions of policy objectives; slow (and even missing) process of transferring research results; inadequate funds, manpower and incentives; and the absence of a participatory system for doing R&E.

In the post-devolution era, explanations for the weak REL were the meager support of extension by local executives; lack of local government officials' technical know-how and skills in monitoring and evaluating extension activities; political interventions; disproportionate allocation of resources across activities where extension gets lower priority; absence of a systematic database; immature technologies and the slow translation of research results into popular language; lack of understanding of the technology transfer context among researchers, extension workers, and policy-makers; inadequacy of professional training of extension practitioners; slow process of certification of technology; lack of farmer-centered approaches; discrimination in status between researchers and extension workers; and inadequate funding for R&E.

So if we know the causes of the weak REL, why has there been no improvement in the delivery of basic services? The following are perspectives which, from the point of view of the research system, are relevant in strengthening RELs:

1. ***REL Is Both Concept and Practice***

Concerned institutions seem not to have a common understanding of the meaning, structure and function of linkages. To level off the concept of linkage vis-à-vis its practice has not been seen as an important issue in past discussions. Exception was the paper of Brown and Librero (1996) which defined linkage as referring to the "means by which an institution bridge interactions with other agencies or organizations to ensure complementation of functions, better communication and efficiency of operation" whether formally or informally, top-down or supply-driven, temporal or permanent, long term or short term. In another paper, Cardenas (1993) defined the term in the context of a researcher-farmer linkage

as a patterned relationship that exists among researchers, farmers and extension workers; it includes activities as the exchange of goods and services and support from all individuals and entities involved in a process called technology management. Linkages serve to gain support, overcome resistance, encourage resource sharing, structure the environment of concerned actors to facilitate the transfer of norms and values.

Thus, the linkage function enhances the operationalization of the technology transfer system (Cardenas, 1993), particularly in agenda formulation and priority setting. It incorporates the capabilities of both researchers, extensionists and farmers in addressing needs; mobilization and effective utilization of resources; development and maintenance of a critical mass of researchers, change agents and farmers, working collaboratively; assurance of information flow between researcher, extension worker, farmers, policymakers and the public; and monitoring and evaluation of extension-research program.

2. ***REL Is Both A Management Issue and A Technology Issue***

The REL does not only involve transfer of technology but it also entails collection, processing, and utilization of knowledge and information. Extension managers must possess a deep understanding of the program's objectives, requirements, methods, and benefits. They must possess the skills in managing and sustaining the linkages over time. Linkages serve as devices for managing the interdependence of the institutions in agricultural knowledge and information system as well as in the environment. They require financial, human and physical resources that have to be planned and budgeted by all parties involved. Linkages as social processes warrant that extension managers, farmers, extension workers and other actors must have a clear idea of the distribution of gains and costs to be expected which could further guide strategy building. Transparency, confidence and consensus are therefore necessary for a sound linkage.

3. ***REL? Why Not Research-Farmer Linkage?***

Discussions focused on RELs relegate farmer-related issues to a corner. Focus on the REL further reinforces the top-down/linear/one-way relationship between the researcher and the extensionists (Appendix C). This could limit the discourse involving the exchanges that are possible between the two. By a researcher-farmer linkage, on the other hand, the farmer is situated at the center and linkages are defined according to social interactions that the farmer initiates. This implies a redefinition of the role of extension not only as a conduit for knowledge transfer but as a facilitator to increase farmers' access to available resources, institutional and otherwise (Ramirez, Cardenas, and Ranaweera, 1995).

CONCLUSION

The sustainability of any linkage mechanism is judged in the context of how well the mechanism contributes to a synergetic, and effective working relationship between research and extension institutions over the longest time possible. Problems in agricultural RELs are connected to issues that embrace conceptual, political, economic, social, and managerial paradigms.

Having these as parameters then, we could now reflect on whether the devolution of extension function as a structural reform strategy was indeed the best alternative to strengthen the research-extension system and whether it was able to bring in more innovative changes in agriculture at all level of management and development. As we have eventually found out that there have been issues we have not seen before and there have also been issues that *we have seen but have not done much to address*, may we be more determined to confront such

issues so we can successfully achieve a functional REL in each of our country's agriculture and fishery sectors.

REFERENCES

Bergonia, Celsa B., 1998. "Municipal Extension Performance Across Income-class Differentiation in Laguna", unpublished M.S. thesis, University of the Philippines Los Baños (UPLB).

Bonifacio, Manuel F., 1994. "Images of Agriculture: Problems, Issues and Trends in Technology Transfer", Department of Sociology, UP Diliman, PCARRD, Los Baños, Laguna.

----------, 1995. "Technology Extension Services", *Achieving International Competitiveness Through Technology Development and Transfer Assessment Reports*, DOST-UNDP Project.

Brown, Ernesto O. and Aida R. Librero, 1996. "The NARRDN-LGU Linkage: PCARRD Experiences in and Extension", *Strengthening Research and Extension Linkage*, PCARRD Book Series No. 157/1996.

Cabanilla, Liborio S., 1995. "Devolution of Agricultural Extension to LGUs: A Socio-Economic Analysis", paper presented to the Local Government Academy.

Cardenas, Virginia R., 1993. "Random Notes: Researcher-Farmer Linkage", training handout, Department of Agricultural Education and Rural Studies, UPLB.

----------, 1998. "Elements of the Extension Delivery System", *Extension and Communication*, learning modules published by the UP Open University, Los Baños, Laguna.

----------, 1998. "The Historical Background of Extension", *Extension and Communication*, learning modules published by the UP Open University, Los Baños, Laguna.

----------, 2000. "Extension Delivery Systems in Practice: A Review and Analysis", Philippine Institute for Development Studies and Bureau of Agricultural Extension, terminal report.

Cardenas, Virginia R., *et al*., 1996. "Socio-economic Resource Appraisal of Lake Taal", FSP/UPLBFI, terminal report, May-September 1995.

----------, 2001. Consultant's Report, ILRI-IFAD TAG 443, terminal report.

Cardenas, Virginia R., Rosa Fe Hondrade, Dolores Alcober and Editha Medrano, 2002. "Strengthening Research-Extension Linkage: Institutional Analysis of Selected Cases", presented before the Technical Advisory Committee of PCARRD, 2 August 2002.

Costales, Achilles C., *et al*., 2002. "Agriculture and Resource Economics Research and Development: Status and Directions", PCARRD, February 2002.

Cruz, Federico A., 1996. "Trends, Issues and Concerns in Devolution: The Case of Laguna Province", professorial chair lecture, DAERS, UPLB.

Dar, William D. and Danilo C. Cardenas, 1997. "Strengthening the Research-Farmer Linkage: The Research System Perspective", paper presented during the DA-PCARRD-UPLB Workshop on Strengthening Research Extension Linkages for the Gintong Ani Program, ATI-NTC, UPLB, College, Los Baños, Laguna.

David, Cristina C., *et al*., 1998. *Philippine National Agricultural and Natural Resources Research System: Resource Allocation Issues and Directions for Reforms*, Philippine Institute for Development Studies and the Department of Budget and Management, December 1998.

Department of Agriculture, 1991. *Philippine Agricultural Extension Study Team Report*, Diliman, Quezon City, Philippines.

Eponou, Thomas, 1996. *Linkages Between Research and Technology Users in Africa: The Situation and How to Improve It*, ISNAR Briefing Paper 31, the Hague, the Netherlands.

FAO, 1994. "Participatory Rapid Appraisal of Farmers Agricultural Knowledge and Communication Systems (Mamala Report)", PHI/92/TO1 Technical Support Services Project.

----------, 1996. *Proceedings of the Regional Expert Consultation on Strengthening Agricultural Extension Systems for Sustainable Agriculture and Rural Development*, 17-20 September 1996, FAO-RAPA, Bangkok, Thailand.

Havelock, Ronald G., 1986. "Linkage; Key to Understanding the Knowledge System", in George M. Beal, Wimal Dissanayake, and Sumiya Konoshima (eds.), *Knowledge Generation, Exchange and Utilization*, Westview Press, Inc.

Legaspi, Perla, E., 1999. "The Role of LGUs in the Management of Fisheries/Aquatic Resources: Some Policy Issues and Proposal", *Philippine Journal of Public Administration*, Vol. XLI, January-October 1999.

Philippine Council for Agriculture and Natural Resource and Development (PCARRD), 196. *Strengthening Research and Extension Linkage*, PCARRD Book Series No. 157/1996.

Ramirez, Ricardo, Virginia R. Cardenas, and Nimal Ranaweera, 1995. "Participatory Rapid Appraisal of Farmers Agricultural Knowledge and Communications Systems", *Journal of the Asian Farming Systems Association*, Vol. 3, No. 2.

Rondinelli, Dennis A., 1987. "Administrative Decentralization of Agricultural and Rural Development Program in Asia", in William M. Rivera and Susan G.Schram (eds.)

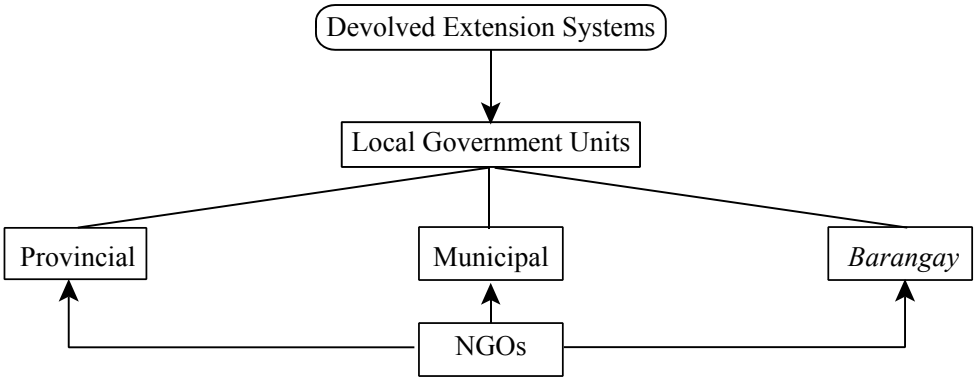
Agricultural Extension Worldwide: Issues Practices and Emerging Priorities, Croom Helm Ltd.

Tiwari, S. B., 1994. "Agricultural Extension Under the Local Government Units Within the Calabarzon Area, Philippines", unpublished thesis. UPLB.

Appendix A

Model 1

LGU-initiated Extension Program

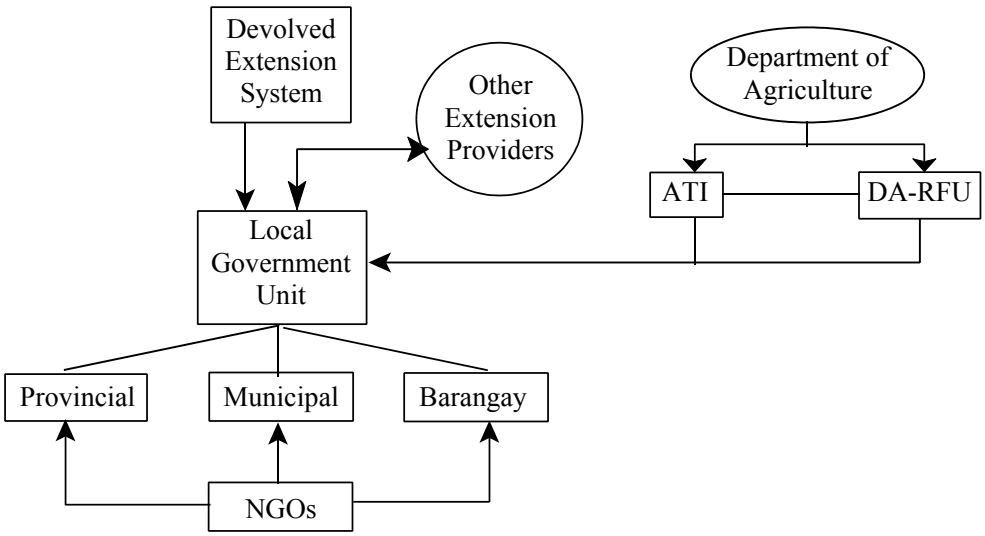


Model 1: Local Government-initiated Agricultural Extension Management in the Philippines Under the Devolved Extension System

Source: Cardenas, 2000.

Model 2

Externally Initiated (e.g., DA National Programs)



Model 2: Externally-initiated Agricultural Extension Management in the Philippines Under the Devolved Extension System

Source: Cardenas, 2000.

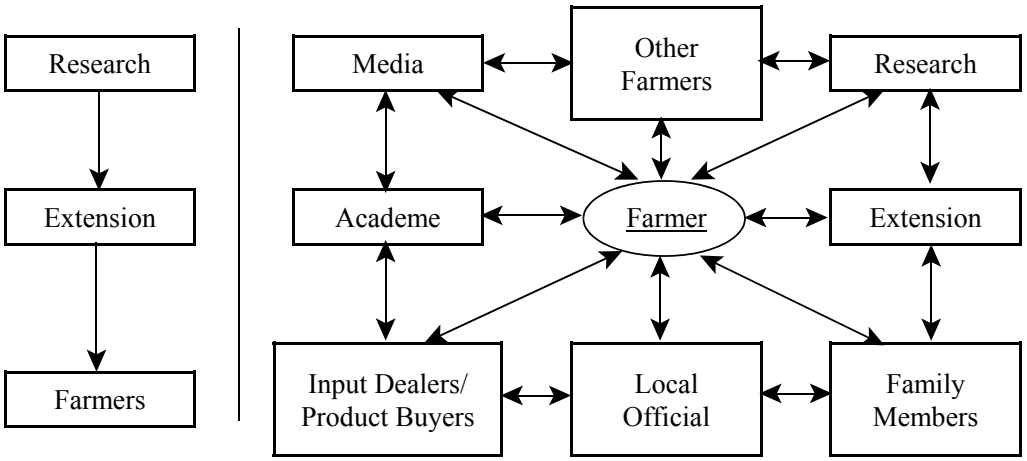
Appendix B

Some Explanations for the Weak Research-Extension Linkage

DA Policy Conference in Extension, April 1988, Davao City (Bonifacio, 1994)	4th BAR Conference, July 1988, Tacloban City (Bonifacio, 1994)	Philippine Agricultural Extension Study Team (PAEST), 1990	Seminar-Workshop on Strengthening Research-Extension Linkage, June 1991	Regional Expert Consultation on Strengthening Agricultural Extension Systems for SARD*, FAO, September 1996
C Slow processing of research results and the unresponsiveness of the academic outputs to the practical needs of extension workers C Fragmentation and duplication of research C The lack of communication between researchers and extension workers C The mutual exclusion of researchers and extension workers in the process of setting objectives, priorities, and activities C Lack of interest on each other's area of work C One-way flow of communication from researcher to extension worker and then to farmer	C Lack of involvement of farmers in research and extension C The separate definition of policy objectives by researchers, extension workers, and farmers (REF) C Lack of dialogue among REF to iron out kinks in work relationships C Lack of demonstration or information centers for farmers C Inadequate mechanisms for technology transfer C Lack of sufficient funds for on-farm trials C Insufficient database C Delayed transfer of technology to farmers C Inadequately trained manpower to carry on research and extension activities C Inadequate incentive systems for the conduct of research and extension activities C Unclear role of extension in on-farm research (OFR)	C No mechanism exists, whereby research results generated outside the DA are systematically transformed into extension messages for dissemination to rural families C Research-extension activities within DA across its units/agencies are fragmented C Lack of feedback mechanism between research and extension with the phase-out of BAEx (Bureau of Agricultural Extension) and the transformation of technical bureaus to staff bureaus which de-emphasized their research functions C Absence of participatory system in doing research and extension	C Weak support from local executives due to vested interests and other priorities C Program development hampered due to the lack of technical know-how, monitoring and evaluation skills of local government officials C Tendency for linkage to be politicized C Tendency for unequal sharing of efforts and resources C Information too technical and unavailable C No systematic database C Immature technologies C Non-translation of needed information into local dialects C Outdated information	C Institutional structure; a separate research and extension C Lack of understanding of the technology transfer context among researchers, extension workers and policy-makers C Technology transfer context is not part of the training curriculum of degree programs that prepare researchers and extension workers C Long process of technology development and certification by appropriate authorities C Lack of farmer-centered approaches and existing mismatch between what is required and being done C Discrimination in status between researchers and extension workers C Inadequate funding mechanism for extension activities

Note: * Sustainable Development of Agriculture and Rural Development.

Appendix C



Research-Extension Linkage vs. Research-Farmer Linkage

12. PHILIPPINES (2)

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INTRODUCTION

The Philippines can count itself as one of the most blessed countries of the world, with rich agriculture, fishery and marine resources, and a highly educated large population. Yet, it has to face the challenges, threats and opportunities posed by a changing global and local agricultural scenario.

The local agriculture scenario shows that in 1999, while world food production exhibited modest growth, Philippine agriculture showed exuberant performance at 3.4 percent growth rate. Vigorous growth was evident in most sectors, especially cereals where *palay* (paddy) and corn posted production increases of 55 percent and 29 percent, respectively. However, this was not sustained and by the year 2000, a slowing down in performance was observed in both crops and livestock production.

Significant challenges face Philippine agriculture today. It must address the issues of dwindling agricultural resources, notably water and land, a relatively fast growing population and rural poverty. Presently, there are about 79 million Filipinos and the population is growing at the rate of 2.3 percent annually. About half of the people live in the rural areas and are dependent on agriculture and agriculture-related industries for their livelihood. More than 50 percent of rural families are living on incomes below the poverty threshold. Moreover, an average Filipino spends 80 percent of his income on food. Lastly, Philippine agriculture has to face the challenges, threats and opportunities of a liberalized trading regime as a result of its membership in the World Trade Organization (WTO).

Research, development and extension (RDE) are critical factors in enhancing agricultural productivity. Research and development (R&D) generates new or improved technologies and better farming practices that are instrumental in increasing the productivity and incomes of small farmers and fisherfolk. Since R&D results need to be effectively transferred to end-users – extension plays an important role in the technology transfer process.

As mandated by law, the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA) coordinates agricultural R&D, while the Agricultural Training Institute (ATI) coordinates agricultural extension activities. Likewise, it is the responsibility of the Local Government Units (LGUs) to facilitate extension services at the municipal and farm level. In the same manner, some government agencies, State Universities and Colleges (SUCs) and the private sector also conduct their own research and extension work. Thus, coordination of various research and extension programs between and among concerned agencies continues to be an enormous challenge. The integration of research and extension activities is, therefore, important to ensure that R&D remains relevant to the needs of the clientele and effective in terms of its impact on their livelihood.

CHALLENGES OF THE AGRICULTURE AND FISHERIES RDE SYSTEM

Developments in agriculture such as genetic engineering of crops have not brought about significant changes in Philippine agricultural practices. Agriculture remains labor-intensive. Small-scale farmers lack capital inputs such as sophisticated farm equipment, thus, they still perform farm chores manually or with the aid of draft animals.

The weak social infrastructure in the rural areas also contribute to the slow modernization of the sector. Small farmers and fisherfolk lack proper education, necessary skills and assets to modernize their farming techniques and practices. Furthermore, there is no unified/integrated agriculture and fisheries RDE system to support capacity building and strengthening of rural institutions. Low investment in RDE, distortions in the prioritization and allocation of resources, weak research-extension linkage and lack of accountability and integration of the R&D system, also referred to as a problem of governance, are the basic problems in the agriculture RDE system.

Under-funded Agriculture and Fisheries RDE System

The above scenario is caused by the weak agriculture and fisheries RDE system of the country. Less than 40 percent of the budgetary appropriations for the agriculture, fisheries, agrarian reform and natural resources sector has been allocated for productivity-enhancing expenditures such as irrigation, RDE, and other support services. On the other hand, almost 20 percent was spent for price stabilization, and production support such as seed and planting materials, post-harvest facilities, farm equipment, credit subsidies, etc. Since most of these are private and not public goods and services, their purpose is more redistributive in nature, rather than growth-enhancing.

RDE is clearly underfunded. Public expenditures should increase two- or three-fold to be comparable with the RDE intensity ratios in other countries. Increasing budgetary allocation, however, should go hand-in-hand with correcting the misallocation of RDE expenditures across commodities or programs, across types of expenditures, and between program and project type of funding.

Despite policy initiatives promoting decentralization and devolution, central level offices of national government departments continue to control budgetary resources (about 80 percent). Thus, the ability of the LGUs and regional offices to influence the strategic directions and programs designed and developed by the central offices have been extremely limited. Studies show that the Internal Revenue Allotment (IRA) transfers have been much less than commensurate to the responsibilities devolved to the LGUs. Moreover, poorer regions which have greater proportion of population in agriculture also have lower budgetary resources and fewer devolved personnel.

Uncoordinated Agriculture and Fisheries RDE System

In the area of R&D, duplication of functions also exists. While the Agriculture and Fisheries Modernization Act (AFMA) has already established the organization that would be responsible for integrating R&D, this remains inactive. The BAR of the DA, the Ecosystems Research Development Bureau (ERDB) of the Department of Environment and Natural Resources (DENR), and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), the Philippine Council for Aquatic and Marine Research and Development (PCAMRD) of the Department of Science and Technology (DOST) and the Commission on Higher Education (CHED) of the Department

of Education, Culture and Sports (DECS) continue to undertake R&D activities following different priorities. Moreover, neither the DOST, DA, DECS nor DENR is able to monitor and control R&D funds for agriculture, fisheries, and environment and natural resources that are spread across SUCs. In addition, the product of SUCs' R&D are not properly harnessed and, thus, underutilized.

Unresponsive Agriculture and Fisheries RDE Beneficiaries

There appears to be low adoption of new technologies among most farmers, fisherfolk and intended users. This is due to unawareness of farmers of the technology, inappropriateness of the technology and sometimes due to high costs of production inputs. Low yields and productivity as well as declining international competitiveness of the sector are the clear outcomes of this behavior.

There are many interrelated reasons which may explain the general unresponsiveness of the RDE beneficiaries. For instance, the setting of the research agenda may not be adequately demand-driven resulting in a disparity between research priorities and actual needs of both farmers and the private sector. As previously mentioned, the current R&D system is fragmented due to duplication of functions by various research institutions. Each R&D institution has its own research agenda. It is normally driven by fund availability or the ability of the researcher to generate funds, rather than by the actual needs of farmers, fisherfolk and other clientele. For these reasons, R&D expenditures have generally not been in accordance with the relative economics of farm commodities and activities.

Weak Agriculture and Fisheries Research-Extension Linkage

The link between R&D and extension further weakened when agricultural extension personnel were devolved to LGUs. As most LGUs do not have an agriculture and fisheries agenda and they do not know how to utilize their DA personnel – technology adoption consequently suffered.

The current modalities and methodologies used for technology transfer should likewise be re-evaluated. The production-related decisions of farmers and fisherfolk are not only dependent on the availability of information but also on managing risks and sufficient access to needed inputs. Thus, private sector participation in RDE and other possibly effective alternate modes of technology-generation, transfer and promotion should be designed and tested.

NEW MODALITIES IN THE AGRICULTURE AND FISHERIES R&D SYSTEM

The Bureau of Agricultural Research

BAR was created in 1987 through Executive Order 116 to ensure that all agricultural research is coordinated and undertaken for maximum utility to agriculture. It is mandated to tap farmers, farmers' organizations and research institutions, especially the SUCs, in the conduct of research for the use of DA and its clientele particularly the farmers and fisherfolk.

In 1997, BAR's role in agricultural R&D management was strengthened through AFMA (Republic Act 8435). The Law tasked BAR to orchestrate the National Research and Development System in Agriculture and Fisheries (NaRDSAF) and to develop new modalities in R&D.

National Research and Development System in Agriculture and Fisheries

The NaRDSAF is aimed at a system that is strengthened through an organized partnership and collaboration among government agencies, SUCs, the private sector and industry. The objective is to help bring about an optimized R&D system, manned by adequate and trained scientists that will enable the agriculture and fisheries sectors to compete in the global market.

NaRDSAF is composed of two subsystems; the agriculture research subsystem and the fisheries research subsystem. The agriculture research subsystem includes the R&D institutions that are: members of the National Agriculture and Resources Research and Development Network organized by the DOST-PCARRD, agricultural R&D agencies of the Department of Agriculture Research and Development System (DARDS), private agriculture R&D organizations and specialized agencies, Bureau of Agrarian Reform Beneficiaries Development (BARDB) and the Policy Studies and Research Services (PSRS) of the Department of Agrarian Reform (DAR), and existing and potential centers of excellence (SUCs) in agriculture identified and accredited by the Commission on Higher Education (CHED). The fisheries research subsystem, on the other hand, is composed of R&D institutions that are: members of the National Aquatic Resources Research and Development System (NAARDS), fisheries R&D units of the DARDS, private fisheries R&D organizations and specialized agencies, and existing and potential national centers of excellence (SUCs) in fisheries identified and accredited by CHED.

The RDE Networks

To make the principle of "one system, one program" operational under NaRDSAF, BAR organized the national RDE networks. Organized thru a Memorandum of Agreement (MOA), these networks improve the quality of R&D governance by creating synergy among various R&D institutions and guided by a common agenda and program. These networks embody the functional integration of institutions and experts who are capable of planning, implementing, coordinating, monitoring and evaluating (M&E) RDE programs for high-impact commodities as well as discipline-based projects. A national lead institution is designated in each network. The various networks draft programs based on the RDE agenda.

The National RDE Agenda and Programs

In support of the RDE thrusts and themes, the national RDE agenda and programs are formulated for sectoral/commodity concerns in accordance with the needs of the industry as well as the small farmers and fisherfolk. Each national RDE network covers a major program area and performs upstream and basic research for technology generation. Each program area corresponds to a national RDE network identified as commodity- or discipline-based. The lead agency spearheads the networking activities and implementation. The national network is composed of national research institutions, SUCs, DA staff bureaus and attached agencies. It provides the overall research direction and guidance at the national, regional and provincial levels of implementation. Through the networks, an effective complementation of functions among various types of R&D institutions in the country is achieved.

The lead agency conducts technical review of the program prior to its submission to the Farmers/Fisherfolk Industry Advisory Committee (FIAC) composed of farmers/fisherfolk and industry players, for review and confirmation. The program is then endorsed to the Senior Scientists Advisory Committee (SSAC) for further review and endorsement. It is finally forwarded to the governing body of NaRDSAF, the Council for Extension, Research and Development in Agriculture and Fisheries (CERDAF) for approval.

The regional RDE network is composed of the Regional Integrated Agricultural Research Centers (RIARCs), Regional Fisheries Research and Development Centers (RFRDCs), training and extension centers, regional SUCs, private R&D institutions, DA regional bureaus-attached agencies, provincial institutes in agriculture and fisheries, industry sector, LGUs and NGOs. Just like the national RDE networks, the same process of project implementation is followed. Programs on the regional level focus on priority commodities addressing midstream research type of projects. Those at the provincial level focus on the needs identified at the municipalities and are called as downstream research, mostly on-farm research and community-based participatory action research.

Human Resources Development Program for RDE

BAR created a scholarship and non-degree assistance program to develop a cadre of highly competent researchers and research technical staff equipped with a sound background in agriculture, fisheries, and other related fields relevant to the attainment of a more efficient and effective R&D system.

The scholarship program specifically aims to develop the skills and knowledge of scientists, researchers, technical, and support staff of the DA or any agency under the NaRDSAF. It awards financial support to deserving R&D employees who wish to pursue a graduate degree and avail of the thesis/dissertation assistance program. The non-degree assistance program on the other hand, provides funding support for institutional capability building and provides incentives for scientists in attendance or participation in agriculture- and fisheries-related R&D short-term trainings, conferences, symposia and seminars.

International R&D trainings are also supported under the non-degree assistance program. Such trainings may also serve as a mechanism for transfer of technology among countries. The DA scientists and technical staff are also encouraged to apply for scholarships abroad under the scientists exchange program based on a bilateral country agreement.

The Agriculture and Fisheries R&D Information System

As provided for by AFMA, BAR shall coordinate the establishment and maintenance of a strong and responsive R&D information system for agriculture and fisheries. This R&D information system is linked to the National Information Network (NIN). The creation of the Agriculture and Fisheries Research and Development Information System (AFRDIS) is aimed to strengthen knowledge management in agriculture and fisheries R&D through information technology. It is also aimed to promote efficient and effective inter-institutional collaboration through coordinated planning and execution, information flow among stakeholders, and end-user involvement by facilitating access to information and knowledge.

In 2001, the BAR has established a cluster of Information Technology (IT) networks at four zones of the country (Northern Luzon, Central Luzon, Visayas and Mindanao). These IT networks are based in national SUCs and are considered as the lead in the zone. This year, 2002, other cluster regions in the country will be established.

THE AGRICULTURE AND FISHERIES EXTENSION SYSTEM

Reorganization of the National Extension System

The Philippine extension service has been in existence since the Spanish Colonial period, but was organized into a national system only in 1952. Since then, it has undergone several reorganizations. The Bureau of Agricultural Extension (BAEx) was changed to

Agricultural Extension Commission, and the title of "agricultural extension workers" was changed to "farm management technicians". BAEx, which was created by legislation, was subsequently restored until another proclamation abolished it and created in its place the national ATI. The agricultural extension function of the DA was then decentralized to the regions and provinces and put under the control of LGUs. The decentralization aspect of the proclamation was later superseded by an enactment in 1991 known as the Local Government Code. Currently, the Philippine extension system under AFMA, consists of three subsystems; the national government subsystem, the local government subsystems and the private sector subsystem. The organization of the current extension system is shown in Figure 1.

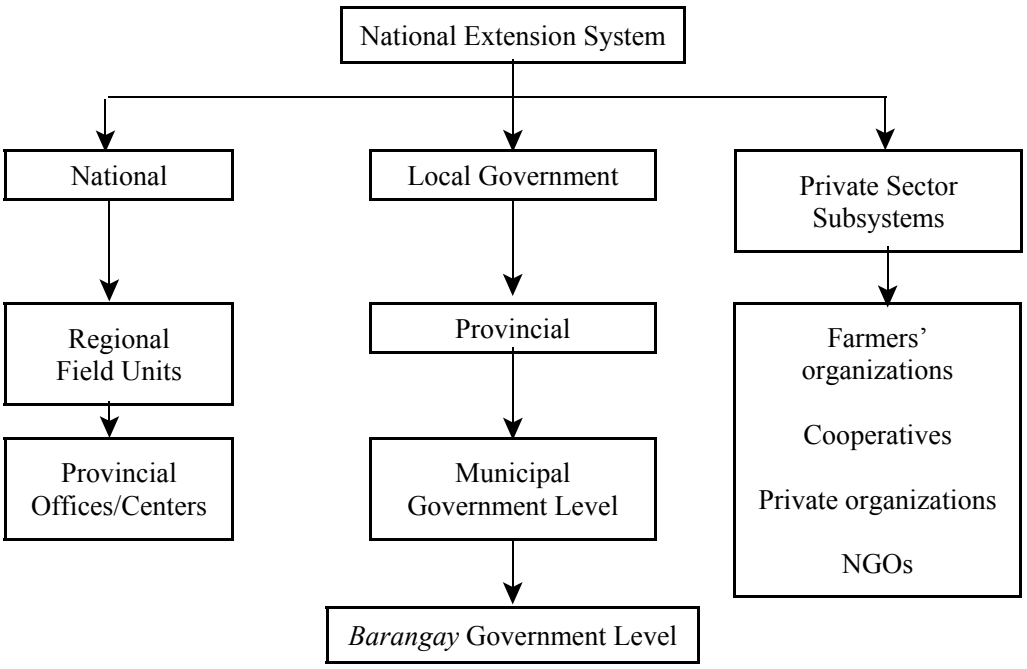

Figure 1. Graphic Representation of the National Extension System for Agriculture and Fisheries

The National Extension System for Agriculture and Fisheries (NESAF)

The three extension subsystems cited earlier compose the National Extension System for Agriculture and Fisheries (NESAF). The NESAF was created under AFMA to complement NaRDSAF and to coordinate the planning, implementation, M&E of the national extension program. The extension services of NESAF include: training, farm or business advisory, technology demonstration, and information and communication support. The delivery of agriculture and fisheries extension services is multidisciplinary involving the farmers, fisherfolk and their organizations, and those engaged in food and non-food production and processing including the private and public sectors.

The LGUs (municipal level) are responsible for delivering direct agriculture and fisheries extension services. The provincial governments integrate the operations for the agricultural extension services and undertake the annual evaluation of all municipal extension

programs. On the other hand, the extension programs of SUCs primarily focus on the improvement of the capability of the LGUs' extension services by providing degree and non-degree training programs, technical assistance, extension cum research activities, M&E of LGU extension projects and information support services through tri-media and electronics.

Private extension services include agribusiness firms and NGOs. They provide information related to their products or services. They also provide extension services as part of their special projects, trainings and other complementary services, especially in community organizing, use of participatory approaches, popularization of training materials, regenerative agricultural technologies, agribusiness and management skills.

Government agencies, especially the ATI and in cooperation with SUCs, assist the LGUs extension system by improving their effectiveness and efficiency through capability building and complementary extension activities such as technical assistance, training of LGU extension personnel, improvement of physical facilities, extension cum research and information support services. One specific scenario for these is that the ATI organizes training programs for a limited number of extension staff from different provinces or regions. The trained regional extension staff in turn train municipal extension staff who finally pass the information on to the farmers.

Supplementary Extension Services

Among the problems in the extension system is the inadequacy of the training courses. The extension staff feel that their training courses are not long enough to provide an in-depth treatment of the topics. This, in turn, affect farmers since the courses miss out a number of details which might have been very useful to them. In an effort to supplement the information transmitted in training courses, the DA sponsors regular national television programs. Regional and provincial offices also produce information campaigns for local farmers. In most regions, extension staff and farmers receive regular agricultural news service from local radio stations. These programs are the preferred sources of agricultural information among farmers because according to them, the information is received regularly. Moreover, most farmers own or have access to a radio, radio sets are convenient and portable and radio programs are aired in local dialects. Thus, it makes information easy for farmers to understand.

Group methods are also used for extension, such as seminars and training programs. Extension staff often hold training courses, seminars, and classes for local farmers. They also have one-on-one consultations with farmers, and conduct farm visits to help the farmers assess their problems. Indigenous methods of transferring technical information are also employed like ballads about agricultural technology.

Sometimes, newly developed technology is extended in a special program in selected cluster farms. For example, the Philippine Rice Research Institute (PhilRice) establishes technology demonstration plots on farms to test the suitability of certain rice varieties in a given area, and find the level of susceptibility of these varieties to local pests and diseases. This enables the Institute to give location-specific recommendations to farmers within the community. Another example is the expansion of the *Makamasa* production program to *Ginintuang Masaganang Ani* (GMA), and on-farm research is upgraded to community-based participatory action research. These approaches further strengthened the extension program by coupling it with production and research activities.

Challenges in the National Extension System

The DA also distributes booklets and leaflets to extension staff and farmers. Although these publications are provided free of charge, the number of copies is often not enough to meet the demand. In some cases, printed materials are in English, which only few small farmers are able to understand.

The other main constraint is financial. Budget limitations play a significant role in the transfer of technology and technical information. Farmers are not the only ones affected by this problem. Extension staff often complain that the training programs they conduct for farmers are cut to a limited number of days, and cover only basic information. Even the printed material given to extension staff and farmers is sometimes inadequate. Although the quality is good, the number of topics covered, and the number of copies printed, are often insufficient to meet farmers' needs. The limited funds affect the area of coverage of an information campaign, and the number of farmers that it can reach. Thus under the AFMA, the budget for agriculture and fisheries extension services is mandated to be at least 1 percent of the Gross Value Added (GVA) in agriculture. In the same manner, a national merit and promotion system governing all extension personnel, regardless of source of funding is instituted. This is to promote professionalism, excellence and productivity in the government extension services.

Although some technology transfer services are nationally funded, training programs and other extension activities initiated at the municipal level heavily depends on the budget allotted by the LGU. As a result, farmers belonging to LGUs that give priority to agricultural extension receive better services than farmers and fisherfolk in LGUs that give less priority to extension. Funding and the problems caused by decentralization are not the only concerns of the extension staff. Language is another constraint since the Philippines has more than 88 dialects. It has two official languages, English and Filipino, but many small-scale farmers are unable to understand either of them. Linguistic diversity forces extension staff to translate any text from English or Filipino into the local dialect before making it available to farmers.

The National Information System for Extension

To further strengthen the NESAF, the DA, in coordination with the public and private universities and colleges, developed an integrated multimedia support for national and LGU extension programs. Presently, the DA is assisting the LGUs in the computerization of communication support services to clients and linkages to the NIN.

THE AGRICULTURE AND FISHERIES RESEARCH-EXTENSION LINKAGE

The Council for Extension, Research and Development in Agriculture and Fisheries

To consolidate the R&D and extension systems for agriculture and fisheries, the Council for Extension, Research and Development in Agriculture and Fisheries was created under AFMA. The CERDAF carries out AFMA's mandate to enhance, support and consolidate the NaRDSAF, as well as to ensure the effective linkage with extension in the NESAF.

The objectives in the creation of CERDAF are: a) improve the responsiveness and usefulness of RDE to the livelihood concerns of agricultural and fisheries operators and entrepreneurs; b) provide increased and more definite budgetary support for agriculture and fisheries RDE, both at the national and local levels; and c) unify in strategy, approach and vision of the agriculture and fishery components of the ongoing National Research and

Extension Agenda (NAREA), as well as to unify the overall management of, and responsibility for the research and extension systems in agriculture and fisheries under the DA at the national level and under the LGUs at the local level.

The CERDAF is chaired by the DA Secretary. The chair draws resources from any component agencies and offices within the NaRDSAF and NESAF to accomplish its tasks. The BAR serves as the CERDAF secretariat for R&D, while the ATI serves as the secretariat for extension and training. The DA undersecretary for RDE is heading both CERDAF secretariats to ensure the effective consolidation of resources. The other members of CERDAF are the heads of DOST, DENR, DAR, National Economic Development Authority (NEDA), CHED, PCARRD, PCAMRD, representatives of national centers of excellence in agriculture and fisheries, SUCs, LGUs, people's organizations (POs) and NGOs in agriculture and fisheries RDE.

One of the functions of CERDAF is to promote the integration of RDE systems and enhance the participation of farmers, fisherfolk, the industry and the private sector in the development of the national RDE agenda. This is partly accomplished in 1999, wherein 14 commodity-based and nine discipline-based networks have completed their National Integrated Research Development and Extension Agenda and Programs (NIRDEAPs) and approved by CERDAF.

CERDAF oversees the implementation of the comprehensive programs of the RDE networks. This is to enhance, support, consolidate and make full use of the capabilities of the interlinked NaRDSAF and NESAF. It reviews and rationalizes the roles, functions and organization of the various agriculture and fisheries national RDE institutions, including the PCARRD and PCAMRD. It is also tasked to set policies in agriculture and fisheries national RDE in order to ensure sustainable food security, alleviate poverty, promote people empowerment, agricultural productivity and development, and promote internationally competitive agribusiness and fishery sectors.

The CERDAF is responsible in approving policies for the operationalization and continued strengthening of the institutional capacities, efficiency, effectiveness and integration of the national RDE system. This also includes the setting up of M&E system on the effectiveness and efficiency of its various components.

As a council, it creates committees, technical working groups and commodity teams to facilitate the accomplishment of its objectives. It sets policies on relations and exchange between Philippine and international institutions on agriculture and fisheries national RDE. Lastly, CERDAF approves the allocation of funds from national as well as foreign sources for national RDE programs.

The RDE Continuum

The RDE continuum illustrates the interdependence of research and extension. It shows that these functions belong to a continuum of scientific process that begins and ends with the interests and needs of the farming and fishing communities.

In response to the needs of various clients, the RDE continuum represents the type of activities and output generated at different levels of implementation.

The RDE Pyramid

At the apex are the national R&D institutions that are mandated to undertake upstream and strategic research and to provide overall national leadership in setting the national agenda and programs. Next in the hierarchy are the regional institutions that are tasked to undertake

midstream research followed by the Provincial Technological Institutes for Agriculture and Fishery (PTIA/Fs) and the provincial research staff whose tasks are to undertake downstream research in various agro-climatic conditions of the province. At the base of the pyramid are the LGUs, farmer organizations and NGOs that are involved in the transfer of technologies.

The RDE Convergence

The venue for the integration of the research, development and extension activities of DA and other private research entities in the region shall be the RIARCs. They serve as the seat of planning, orchestration of implementation and evaluation of the RDE program jointly undertaken and/or participated in by various stakeholders (farmers, entrepreneurs, consumers, extension workers and researchers). The state of agriculture modernity (issues and problems) jointly defined, recognized and identified by the stakeholders serve as the agenda for action in the formulation of the National Agriculture and Fisheries Research and Extension Agenda (NAFREA).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The current state of the agriculture and fisheries RDE system is still undoubtedly weak. Although the AFMA already devised ways to solve this gap, specific measures still need to be developed to address the uncoordinated RDE efforts of the government. Due to lack of control in agriculture and fisheries R&D, the problem of lack of funds tends to worsen. What is needed is not just the political will in strengthening the R&D system and extension and the linkage between the two, but the concerted and unified efforts of all stakeholders. In the same manner, the farmers and fisherfolk still need to mature in their views towards new technology. Until now they are still using traditional production methods, most likely because of the high cost and the complicated nature of the new production systems.

Recommendations

The weak agriculture and fisheries RDE linkage in the country is one of the greatest challenges in the modernization of Philippine agriculture. Thus, the following are recommended to strengthen R&D, extension and the linkage between the two:

- Encourage greater participation of the private sector, lowland and upland farmers, fisherfolk, indigenous peoples and their organizations in R&D activities including the commercialization and transfer of developed technologies.
- Set national RDE policies and targets in consultation with the private sector, civil society, and other stakeholders.
- Strengthen technology generation, promotion and commercialization programs, especially the linkage among the technology users, private sector, LGUs, SUCs and the DA, DENR and DOST.
- Enhance the role of LGUs, NGOs, POs in the RDE management process through people empowerment and capacity building strategies.
- Increase investments in R&D to boost basic and applied research and technology packaging and transfer activities for commodities of strategic importance to the country.

- Institutionalize the organizational structure for extension, research and development, both at the national and regional levels as well as in the LGUs especially in identifying the roles and functions of the implementors.
- Upgrade equipment and facilities of RDE institutions and strengthen the human resources development program to enhance the capacity to carry out high-impact and upstream research (e.g., biotechnology).
- Intensify RDE and adopt cost-effective and appropriate technologies (e.g., efficient irrigation and water management technologies).
- Promote joint government and private sector RDE activities.

REFERENCES

Asian Development Bank, 2001. *Basic Data on Developing Members*.

Bureau of Agricultural Research, 1999. *Annual Report*.

----------, 2000. *Information Bulletin* No. 1.

----------, 2000. *Annual Report*.

----------. NaRDSAF Medium-Term Development Plan 2000-2004.

----------. Strategic Plan for FY 2001-2005.

Contado, Tito E., 1999. *Formulating Extension Policy*, FAO Extension Policy.

Department of Agriculture, 1998. Administrative Order No. 6, "Implementing Rules and Regulations of the Agriculture and Fisheries Modernization Act" (RA 8435).

Encanto, Velma S., 2000. *The Flow of Information in the National Extension System and Current Information Needs*.

Medium Term Philippine Development Plan 2001-2004.

13. SRI LANKA

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INTRODUCTION

Sri Lanka is categorized as a low-income country by the World Bank, with a per capita income of US$814 in 2000 (or, on a 'Purchasing Power Parity' basis, of US$3,545). The country is divided into three agro-climatic zones on the basis of annual rainfall, the 'wet zone' (>254 cm/year), 'dry zone' (<191 cm/year), and the 'intermediate zone' (between 191 cm and 254 cm/year), and into three regions, based on altitude, namely: 'low country' (0-300 m); 'mid country' (300-1,000 m); and 'upcountry' (>1,000 m). The central hills are the source of the major river systems, which provide both irrigation water for downstream agricultural production, and generation of hydropower.

At the time of independence in 1948, the Sri Lankan economy was dominated by export-oriented commercial plantation crops (mainly tea, rubber and coconut), and spices (cinnamon, cloves, cardamom, nutmeg and mace) and paddy/rice and other field crops (other field crops (OFCs) – potatoes, onions, chilies, cowpea, green gram, soybeans, and black gram) farming for domestic consumption. The main plantation crops are long-lived perennials. Non-plantation crop agriculture dominated by paddy/rice, included vegetables, legumes, pulses, sugar and tobacco. This pattern changed little until the 1970s, though some limited industrial development took place, particularly after the adoption of import substitution industrialization (ISI) policies after 1956.

The achievement of sustainable and equitable economic development will be a major challenge for Sri Lanka for the next decade. The research and development (R&D) in the Sri Lankan agriculture has a pivotal role to play in achieving the development targets. The World Bank in its *Development Report* of 1991 identified four major strategies as market and people friendly approaches to development. These strategies include: investment in people and technology; integration into the higher and niche markets and global economy (i.e. globalization); improving the climate for agro-enterprises; and maintenance of macro-economic stability (World Bank, 1992). Although the desirability of development through a market-friendly approach is accepted in most developing countries, recent years have witnessed a growing concern about investment in technology through R&D in agricultural and industrial product sectors. Further, the R&D in product and market integration creates a new direction for development through various governmental and private sector research organizations by assisting improvements in productivity levels.

The major structural change in the economy in recent decades, has been a reduction in the share of agriculture and an expansion of the share of manufacturing and services

sectors (Somaratne and Ratnayake, 2002). However, agriculture, together with agro-processing activities and allied services, remains a major sector of the economy. From a dominant position at the time of Independence, the direct contribution of agriculture to GDP had fallen to 19.7 percent in 2000 (Central Bank of Sri Lanka, 2001). While the share of agriculture is now only about one-fifth of GDP, its contribution to employment is much larger, accounting for about 36.3 percent of total employment in 1999.[1]

Even though, since 1977, macro-economic indicators in the economy have shown a remarkable improvement within the liberalized economic policy framework, the growth of agriculture sector was depressed up to 1.8 percent in 2000. As identified by Somaratne and Ratnayake (2002), during the period from 1994 to 2000, factors affecting slow growth in agriculture were policy failures (i.e. lack of complementary agricultural policies implemented with a long-term vision), institutional failures (i.e. no clear-cut institution for attracting investment and new technological advancements), ineffective incentive policy packages for private sector investments, no mechanisms for playing a dynamic role of the state for market integration and vagaries of weather including the 'El niño' effects (Somaratne, 2002).

The aim of this paper is to review the recent developments in R&D in agriculture and current situation of agricultural extension system and explain the integration of agricultural research and extension in Sri Lanka.

This paper presents an overview of R&D system in the Sri Lankan agriculture, reviews the present agricultural extension system and its differences in mechanisms followed in integration of research and extension, and explains the investment in R&D and extension in the Sri Lankan agriculture. Conclusions and policy implications are included in the final section.

R&D SYSTEM IN THE SRI LANKAN AGRICULTURE

The primary objectives of development are economic growth, poverty alleviation and sustainable use of natural resources. The agricultural research system is central to translate these broad objectives into reality through improving productivity in agriculture. In turn, if the productivity in agriculture boosts from improved technology, which is widely taken up by all categories of farmer groups, the poverty reduction objective can also be fulfilled directly. The impacts of agricultural R&D are not confined to the rural communities. Urban consumers, who spend a larger proportion of their income on food, benefit directly from cheaper food or higher quality food. Investors in agro-based product sectors, who invest in agricultural raw material, gain from cheaper raw material. Increasing productivity levels of poor farmers through the impact of agricultural research may be a most cost-effective mechanism for poverty alleviation by bridging the income gaps. Agricultural R&D, which has generated remarkable increase in food production in the 20th century is important for ensuring food security for the country's population in the coming decades. During the last two decades in Sri Lanka, various agricultural research programs in plantation and non-plantation agriculture have been implemented as public goods by creating positive environment for enhancing levels of productivity in each crop sector. Even though, there was a mismatch in people's needs today and the technology generated to enhance the level of growth in the agriculture sectors, recent years have witnessed important changes in the

[1] Central Bank of Sri Lanka, *Economic and Social Statistics of Sri Lanka*, Colombo, 2000.

prioritization, financing, management, extension and organization of agricultural R&D in the country.

R&D System in the Non-plantation Agriculture Sectors

Sri Lanka has an age-old tradition of agricultural research. The early development of agricultural research was recorded in 1822 with the establishment of a Botanical Garden at Peradeniya by the British. This garden functioned as a center for plant introduction and testing of planting material for the British-owned plantations. In 1912, the Department of Agriculture (DOA) was established and a series of regional research centers were established under the supervision of DOA. Though the main research area was the plantation crops sector, research on improved rice varieties was also commenced in the 1920s. In the 1930s and the 1940s the main research on soil and water resources was undertaken. After independence in 1948, the focus of agricultural research was shifted from plantation crops to non-plantation crops (i.e. annual food crops) including rice. During this period 60 percent of rice requirement in the country was comprised of imported rice. The self-sufficiency in food was the major drive for investment in R&D in agriculture through DOA. As a result, during the1970s a network of regional research centers was established to undertake adaptive research considering the differences in agro-climatic zones in the country. During the 1990s, the agricultural research system consisted of a network of regional research centers specializing in research in the food crops sector including rice and a set of commodity-specific or resource-specific institutions. In 1993, the agricultural research system in Sri Lanka included 20 different institutes/centers under different Ministries, which are as follows:

1. ***Ministry of Agricultural Development and Research***:

Central Agricultural Research Institute	Plant Genetic Resource Centre
Angunakolapelessa Regional Research Centre	Maha Illuppallama Regional Research Centre
Aralaganwila Regional Research Centre	Makandura Regional Research Centre
Bandarawela Regional Research Centre	Farm Mechanization Research Centre
Bombuwela Regional Research Centre	Land and Water Use Research Centre
Central Rice Breeding Centre	Export Agricultural Crops Research Centre
Veterinary Research Institute	Agrarian Research and Training Institute

2. ***Ministry of Fisheries and Aquatic Resources***:

National Aquatic Research Institute

The functions of the DOA[2] were restructured in 1994, and three autonomous crop research institutes were designed namely:

- Rice Research and Development Institute;
- Horticultural Research and Development Institute; and
- Field Crop Research and Development Institute.

In addition, nine other supporting research centers such as: Plant Genetic Resources Centre; Socio-economic and Planning Centre; Natural Resources Management Centre; Farm Machinery Research Centre; Seed Development Centre; botanic gardens; Human Resources

[2] There are about 500 scientists who are employed at research institutes and centers together with another 4,500 technical and field staff in the DOA.

Development Centre; Seed Certification and Plant Protection Centre; and Extension and Communication Centre were also established to carry out research and extension functions in non-plantation agriculture. The whole objective of the restructuring process was to reform the traditional DOA into a dynamic, product-oriented organization with broad-based leadership having greater capability to meet the present day challenges (DOA, 1994). In 1998, the DOA[3] was restructured again introducing nine different institutions and centers amalgamating some centers to face the challenges in dynamic environments in the sector and the economy. The nine institutes and centers under the restructuring programs were established namely: Extension and Training; Seed Certification & Plant Protection; Field Crop Research & Development; Horticulture Research & Development; Rice Research & Development; and Socio-Economics and Planning. In addition, there are about 400 technically qualified agriculturists who are employed in the university faculties of agriculture including Post-Graduate Institute of Agriculture of Peradeniya University and veterinary medicine, and private sector companies in animal feed, seed production and marketing, and plantation management in Sri Lanka. However, their time allocation for research in agricultural development is about 10 percent (Tabor and Samaratunga, 1994). In 1987, the Sri Lanka Council for Agricultural Research Policy (CARP) was established to advise government on planning, prioritizing, coordination, financing and execution of agricultural research in the country.

After economic liberalization in 1977, forces in regionalization and globalization directly influenced the achievement of national targets in the Sri Lankan agriculture. With heavy government spending on the north-east war, the Sri Lankan Government had to reduce government spending on R&D in agriculture as well. This had an adverse effect on the process of generating new technologies for agriculture. In this context, the objectives of R&D such as price competitiveness of local agricultural products; product and market integration; productivity and quality improvement; export-oriented crop production; and lowering the cost of cultivation were not achieved (DOA, 2000). The DOA has established a government fund with Rs.100 million (US$1.1 million) to develop the seed industry, production of planting material of a range of annual crops, agricultural extension and productivity enhancement of rice, chilies and onion. In addition, special productivity enhancement drives – '*yaya demonstration programme*' was a success in enhancing productivity. It managed to increase rice productivity up to 5.28 mt/ha from an average yield of about 4 mt/ha. The mobile extension service of the DOA for testing soil nutrient levels of the individual farms was implemented to recommend the necessary fertilizer levels for each farm, which assisted in reduction cost in fertilizer application in agriculture. Further, the new technology of micro-irrigation – drip and sprinkler irrigation systems and greenhouse technology were introduced in agriculture (e.g. bell pepper, tomatoes, lettuce, cut flowers) attracting private sector investment with opportunities in market liberalization for targeted agricultural production for niche and export markets. The DOA has carried out various R&D programs with limited government funds and foreign funded projects through nine R&D institutes and centers including major pest- and disease-resistant annual crops, crop management practices, seed production technology, Integrated Pest Management (IPM) technology in vegetable cultivation, weed control, water management, micro-irrigation

[3] The mission of the DOA is to 'achieve excellence in agriculture for national property' (DOA, 2000).

systems, microorganism for soil improvement, plant protection, natural resource management, economics of micro-irrigation, and development of hybrid varieties of pole bean, '*elabatu*' capsicum, wiged bean, bitter gourd, sweet potato, and cucumber and fruit varieties – papaya, durian, rambutan. In addition, research on plant pathology – banana virus, and control of mites, pesticide residue analysis; food technology – post-harvest technology, use of ethral to induce ripening of mango, and product development – slimming tea and cookies, herbal wines, wine from cashew apple and other fruits, and banana-based value-added products was carried out recently. Further, the on-demand research projects were conducted with private sector companies for development of new agro-based products for MAS Foods (Pvt.) limited, Dambulla, Plenty Foods (Pvt.) Ltd. and Rain Hill (Pvt) Ltd. Conducting of joint research projects with private sector companies and DOA is a right step to encourage private sector for more demand-driven agricultural research projects (DOA, 2000).

In 1972, the Agrarian Research and Training Institute (ARTI) which is the premier socio-economic research institute in Sri Lanka was established in collaboration with FAO and UNDP. The main functions of the ARTI are to carry out research and conduct human resource development programs – training for agrarian development. In 1996, the name of ARTI was changed to Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI). During the last three decades (1972-2002), HARTI has conducted various socio-economic research studies in agrarian development, particularly the issues of land settlement and land markets; paddy/rice, OFCs and vegetable crop sectors; agro-based industries; irrigation/water management; rural development and rural institutions; agricultural marketing; regional planning and development; and other related agrarian issues, numbering about 520 research studies. In 2001, the HARTI[4] has restructured the existing divisional structure to meet new challenges and carry out research in dynamic socio-economic environment and agrarian development in line with globalization, regionalization and liberalization policy scenarios. The six research divisions of HARTI, such as Agricultural and Environmental Resource Management; Agricultural Policy and Project Evaluation; Marketing and Agri-Business; Irrigation, Water Management and Agrarian Relations; Statistics and Data Processing; Human Resources and Institutional Development; and Food Policy, Gender and Nutrition have been established to carry out socio-economic, agricultural policy analysis and agro-enviornmental research for agrarian development and improve human resources necessary for agrarian change and market integration (HARTI, 2002). The Post-harvest Technology Institute is another addition to the R&D system in agriculture in 1999, to undertake research on improvement of new technology to reduce post-harvest losses in agricultural crops and innovate new technologies for agro-based food products.

Research and Development in the Plantation Sector

The R&D system in the plantation agriculture sector in Sri Lanka is comprised of four main research institutes, namely: Tea Research Institute (TRI); Rubber Research Institute (RRI); Coconut Research Institute (CRI); and Sugar Research Institute (SRI), which are under the Ministry of Plantation Industries. The Forestry Research Department, which is under the Ministry of Natural Resources and Environment, has carried out research on development of forestry sector in the country.

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[4] The mission of HARTI is 'to become a center of excellence in socio-economic and policy analysis research in the South Asian region' (HARTI, 1999).

1. ***Tea Research Institute***

The TRI was established in 1993 to engage in, and to encourage foster and facilitate research in the planting and manufacturing of tea. The specific functions of the TRI are: (a) to conduct, assist and encourage scientific and technological research into and investigations of all problems and matters affecting the production and manufacture of tea, including the prevention and control of pests affecting tea, the prevention and control of diseases affecting tea and the improvement of the quality of tea, as well as the diversification of product manufactures from tea; (b) to disseminate and publish at its direction, results of such research; (c) to conduct, assist and encourage research into the economic viability of the tea industry in Sri Lanka, in line with future economic trends relevant to tea industry; (d) to establish and maintain relations with research institutions in Sri Lanka and abroad; and (e) to conduct and discharge its functions, joint study programs, seminars or symposia with foreign research institutions and research institutions in Sri Lanka.

The TRI has performed its R&D functions through the research divisions such as: Agronomy, Advisory and Extension Services; Agricultural Economics; Biochemistry; Entomology/Nematology; Plant Physiology; Plant Pathology; Plant Propagation and Breeding; Soils and Plant Nutrition; Technology; and other sub research stations (TRI, 1999). The TRI has undertaken various research studies on the development of the tea sector in Sri Lanka. The main themes considered and studies conducted recently were: development of inter cropping systems for tea; development of harvesting devices to overcome labor shortages, mechanical harvesting of tea; development of cost-effective control methods for integrated management of short hole borer (SHB) damage; studies on tea pruning – effectiveness, productivity, management of shade and fuel wood trees; water use in tea plantations; development of weed management strategies; development of chemical/ biochemical methods in the control of SHB; effect of aluminium content in carbonated tea; study on substances characteristics of green and black tea; study on new clones for their resistance and tolerance to the plant parasitic nematodes in each region; studies on biological control of major pests and diseases of tea; development and evaluation of clones for the up country; polyploid breeding; micro-propagation of tea; soil and fertilizer phosphorus studies; solar energy for tea drying; packing trials with paper sacks; development of sand separator; studies on economics of tea cultivation and tea sector studies; determination of optimum replacement of tea; and break-even analysis of tea cultivation. The government has given a prominent place for the tea sector in the R&D system, considering the tea sector as the highest net foreign exchange earner for the country.

2. ***Rubber Research Institute***

The RRI[5] was established in 1987 with the objectives: increasing productivity comparable to the international levels; optimal and sustainable utilization of land, labor and other resources; and maximization of domestic value addition to rubber (RRI, 1998). A conducive policy environment was adopted to achieve the above objectives by continuing the research and extension activities on all aspects of rubber cultivation and processing in a cost-effective manner and promoting rubber as an environmentally friendly and sustainable agricultural industry. The divisional structure of RRI includes: Genetics and Plant Breeding; Plant Science; Plant Pathology and Micro-Biology; Soils and Plant Nutrition; Biochemistry

[5] The mission of the RRI is to 'revitalize the rubber sector by developing economically viable and environmentally sustainable innovations' (RRI, 1998).

and Physiology; Agricultural Economics; Adaptive Research; Biometry; and Rubber Chemistry Departments including polymer chemistry, raw rubber and chemical analysis, rubber technology and development, raw rubber process development and chemical engineering. For the last five years (1996-2000), significant achievement was observed in R&D including research on rubber-based product development. Further, the achievements were reported in: soil fertility improvement and conservation; crop improvement; nutrient management; moisture stress minimization; integrated disease management; intercropping; harvesting – tapping system; processing and value addition; and economic studies (RRI, 2001).

3. ***Coconut Research Institute***

The CRI[6] was established with the objectives: developing appropriate crop production, protection and processing technologies for coconut through strategic, basic and applied research; acting as a national repository for the genetic resources of coconut and producing improved seed nuts; developing improved coconut-based farming systems by integrating intercropping and animal husbandry with a view to optimizing productivity and income from coconut lands; transferring technologies developed at the CRI to the extension staff of the Coconut Cultivation Board, coconut growers, plantation managers, students, and trainees by conducting training programs, field days, research – extension dialogues and field visits; and collect, collate and disseminate technical information on coconut and related activities. The CRI has identified priority research areas for development of coconut sector, which are as follows: genetics and plant breeding – high-yielding cultivars and varieties producing moderate yields under stress conditions and low input levels; conservation, evaluation and utilization of coconut germ plasm; breeding for alternative uses of coconut (e.g. fiber, sap, shell products, aqueous products); promotion of eco-bank concept to meet the annual demand of seed nuts; studies of the physiological and biochemical basis of drought tolerance; introduction of cost-effective moisture conservation practices; and coconut processing research and extension services. (CRI, 2001).

4. ***Sugarcane Research Institute***

The SRI has been established in 1981 to conduct research in respect of growth and cultivation of sugarcane and introduce new production technology for sugarcane-based products. The work plan has been prepared in line with changes in policy environment in the economy and future needs of the sugar industry. With the changes in policy environment, the goals and the research priorities of the SRI have been changed as follows: improvement of sugarcane varieties and crop husbandry practices; introduction of appropriate farm mechanization; improvement in cane handling and processing; efficient processing of by-products of sugarcane industry; stimulation of competition in sugarcane farming; and transferring new production and integration technologies. The priority area in research is to develop new technologies for smallholder and rainfed farming of sugarcane. In the traditional model, supply-driven technological development in sugarcane industry was observed as a top-down approach, without considering the need of grassroots level farmers' interests. However, today the focus has changed to develop appropriate technologies for the smallholding farming sector. The high price volatility of sugar has caused most farmers to give up sugarcane farming. The structure of R&D in SRI comprises of eight research

[6] The mission of the CRI is to 'provide a sound scientific basis for sustainable development of the coconut industry in Sri Lanka' (CRI, 2001).

divisions namely: Agronomy; Breeding; Chemistry; Economics, Extension and Training; Engineering; Microbiology and By-products; Pest Management; and Biometry and Data Processing. Each division has separate functions related to research in the sugarcane sector. Director works as the chief executive of the SRI. The SRI is governed by the Board of Governors for policy-making in terms of research, extension and administration.

5. ***Department of Export Agriculture***

The Department of Export Agriculture (DEA)[7] is empowered to provide certain functions and services including: improvement of production; productivity, quality and product diversity; organization and promotion of cultivation and processing; provision of inputs and services; conduct of agronomic, economic and market research; training of personnel involved in export agricultural crops (EACs) sector; and experimentation with new crops with export potential. The DEA is governed by the Director with the assistance of three Deputy Directors (Research, Development, and Administration). The Research Division of the DEA is operated under the direct supervision of the Deputy Director (Research). This division consists of three main units, namely: Commodity Research; Economic Research Unit; and Plant Protection Unit. Commodity research activities were carried out at the central research station in Matale and seven sub-stations in the wet zone. The DEA has its own research programs for carrying out commodity-specific research projects in the spice crop sectors (i.e. pepper, cinnamon, cloves, cardamom, nutmeg, citronella, betel, lemon grass, vanilla and areca nut) and beverages (coffee and cocoa) to develop new technologies through field and laboratory experiments to improve productivity levels and reduce cost of production. The DEA further analyzes the socio-economic issues relating to the export of agricultural crops through adaptive and socio-economic research projects. The DEA has finalized a research program for the next decade (2000-10) considering the future changes in the international (i.e. globalization and regionalization) and national policy environment. In this program, the new crops namely: garcinia, lemon grass and citronella were identified for future research. The main thrust areas for research were identified in the EAC sector such as: crop breeding; improved crop management; improved processing techniques; and basic R&D activities in the crops identified (DEA, 2001).

CURRENT SYSTEMS OF EXTENSION IN AGRICULTURE

The integration of research and extension is very vital for diffusing new technologies at farm level for improving productivity and encouraging product integration – value addition and post-harvest operations. Weak linkages between the research system and extension caused to reduce the expected output for investment in R&D. In the 1990s, extension system in agriculture was organized through 19 different commodity-specific services and many national and provincial government agencies, corporations and boards (Tabor and Samaratunga, 1994). The ratio of extension agents to farmers is approximately 1:400 although the distribution of extension services varies considerably by region and commodity (*ibid*). The budgetary constraints limit the mobility and quality of the extension programs in agriculture. Though, the extension system as a public good faced the inherited problems

[7] The DEA has been established in 1992. The mission of DEA is to 'develop export agricultural crop sector for enhanced earnings of foreign exchange while ensuring improvements to farmers' economy and safeguards to environment' (DEA, 2001).

of inefficiencies and malpractices, opening a new role for the private sector extension services in targeted crops and farming systems may be a paradigm shift in agricultural extension in Sri Lanka.

Extension Systems in Non-Plantation Agriculture

Within the non-plantation agriculture in Sri Lanka, various agencies involved in agricultural extension through operationalizing different strategies and approaches. Particularly the Extension and Training Division (ETD) of the DOA is directly responsible for synthesizing material into implementable packages and translating such knowledge into a language which can be easily transferred to the farmers and other target groups. The ETD through all units of DOA and the provincial system of agricultural extension coordinates the agricultural extension programs in non-plantation crop sectors. Further the ETD extends its functions for training of extension staff and agricultural entrepreneurs. The offering of a two-year Diploma in Agriculture for youth is an added responsibility of the ETD to train future extension staff for agricultural development. In the 1980s, an attempt was made to establish unified training and visit (T&V) system within the extension service to strengthen adaptive research and to improve extension-training capacity of the DOA. But the effectiveness of the T&V system was not achieved with the fragmentation of extension services.

In 1989, though the responsibility of agricultural extension in non-plantation agriculture was devolved to provincial councils, while the responsibility of extension training remained with the national government. The coordination on extension system and diffusion of technologies developed through R&D between national government and provincial council was another confusion and caused detrimental effects in national efforts of increasing growth in the agriculture sector. The need to strengthen the research and extension was highlighted with the review made by the Department of National Planning (1992). In 1993, the second agricultural extension project was initiated to upgrade training capacity of extension agents to improve the ability of using electronic media in the extension services and improve the standards of extension services. Traditionally, extension service of agriculture was involved in distribution of agro-inputs and the administration of farmer subsidy programs. As explained by Tabor and Samaratunga (1994), the highly fragmented, partially decentralized and underfinanced nature of the extension service has severely restricted the flow of results in agricultural R&D to the farming community. In 1995, People's Alliance Government attempted to rectify the mistake by appointing '*Samurdhi*' officers as Agricultural Development Assistants for extension functions in the non-plantation agriculture. Even today the dislocation of extension services caused severe problems in agricultural extension particularly among the subsistence paddy and OFC farming communities.

The policy liberalization encouraged private sector to invest in targeted greenhouse production of vegetables, fruits and cut flowers either for export markets or higher niche markets. The greenhouse-based production requires new technologies of micro-irrigation 'sprinkler and drip' systems, hybrid seed, nets and other structures for greenhouses. This would be a new shift from traditional extension to modern extension with commercial agriculture, which is mainly provided by private sector extension companies. In this context, government should also intervene with new extension systems by competing with private sector to intervene and gain the opportunities with liberalization to tap the potential in agriculture. The existing extension programs in non-plantation agriculture are based on DOA's programs and mechanisms. The agricultural enterprise development program was conducted to provide technical assistance and guidance to all levels of agricultural product-

based entrepreneurs. The farm women agricultural extension unit carried out extension programs for women on: promotion of food preservation and utilization of modern technologies; and promotion of improvements in family food systems. The research findings and new knowledge on modern technology – greenhouses, farming practices, new processing and packing systems are disseminated through various modes of electronic media namely television and farm broadcasting services and audio visual programs such as: technical books and leaflets; posters for exhibitions; posters for research papers; motivational posters; banners; silk screen prints; name boards/bulletin boards; and invitation cards. In addition a mobile extension and information service unit was established to make quick responses for farmers on their current extension needs. In future, the focus of state extension should be changed from supply-driven to demand-driven farmer-oriented extension programs to maximize resource use and minimize the risk in investment of agricultural extension. Research findings of the HARTI are disseminated through research reports, books, magazines, study circle seminars, proceedings of workshops and electronic and print media such as the radio and the newspapers. HARTI's involvement in various national level forums and committees for policy-making is also a clear mode for dissemination of knowledge generated through research.

Extension System in Plantation Agriculture

In the plantation sector, various crop-specific research institutions are involved in dissemination of research findings to policy-makers, producers, and processors. In the tea sector, the extension function is performed mainly by the Advisory and Extension Division of TRI at Talawakele and other regional centers. Research findings on tea are disseminated through formal meetings of TRI scientists and extensionists with end-users and officials of the Tea Small Holdings Development Authority (TSHDA) and published reports and papers at regular intervals. TRI uses various other modes for dissemination of research findings namely: training programs and lectures, seminars, field days, demonstrations and group discussions; regional programs involving regional scientific committees, regional planters associations and TSHDA groupings; regular field visits to estates and smallholders; on-demand visits to address specific problems on matters such as land selection, pest and disease outbreaks; advise through correspondence; laboratory analysis of soil, plant and other specimens; provision of resource personnel to plantation companies, TSHDA and other groups for training programs; holding exhibitions, workshops, and seminars at national and regional levels; and provision of publications and resource materials. Further, there are other means to disseminate research findings of TRI: specialized training for estate superintendents; making regular pre-planned advisory and extension visits; forward extension programs on adaptive demonstration trials (on fertilizer use, pruning, plucking, and nursery practices); information desks using information technology (i.e. TRI website, *e*-mail and Internet); upgrading extension centers with a 'Tea Museum' and 'AV Saloons' for accessing AV (audio-visual) publications; monitoring of the agriculture performance of tea plantations and smallholdings; production of extension materials – video programs; slides, photo collections; leaflets, booklets, and news letters; and TRI end-user meetings (TRI, 2000).

The dissemination of research findings at RRI is accomplished through various modes such as research reports, books, magazines, seminars, conferences, proceedings of workshops, refereed journal articles, and electronic and print media such as the radio and the newspapers. Though, there is no specific unit for extension, each research division performs the task of extension through above modes of dissemination. Particularly, training programs

for managers, factory officers and field officers, on-demand advisory visits, sample testing, educational video films based on research findings are the methods used to transfer new technologies and disseminate research findings to the target (RRI, 2001).

The CRI has its own extension division to transfer new technologies to end-users, plantation managers, and students. In addition, CRI disseminates new research findings through the extension staff of the Coconut Cultivation Board, by conducting training programs on various aspects of: coconut cultivation; processing and production of coconut-based products; field days; research-extension dialogues; and field visits. Further, the research reports, books, magazines, seminars, conferences, proceedings of workshops, refereed journal articles, and electronic and print media such as the radio and the newspapers are main sources of transferring new technologies and dissemination of other research findings relevant to the coconut sector. The SRI has a separate division for extension services. Once the technology is developed the Extension Division: makes arrangements to improve and update the farmers' knowledge; and disseminate research findings to end-users – farmers, policy-makers, industrialists, etc. Further, the information feedback mechanism is there to get the research problems and farmers' responses on new technologies from the grassroots level. Training on new technologies for extension personnel of the industry are also arranged through the Extension Division. The DEA has its own extension network to transfer new technologies through regional offices in major spice growing districts. Particularly, transferring of new technologies on various aspects of crop management – agronomy, soil conservation, shade management, pruning, and plant protection and post-harvest technologies are carried out. In addition, field demonstrations, in-service training programs, print media – technical bulletins, color folders, color posters, EAC distribution map, news paper articles, and electronic media – radio and television programs on various aspects of technology transfer, farmer clinic, radio drama, TV news and market information, and national exhibitions are conducted to disseminate new technology and knowledge to the end-users. The initiatives have been taken to develop spice-based products and organic spice products for integration of higher niche markets.

INVESTMENT IN AGRICULTURAL RESEARCH AND EXTENSION

Considering the public goods nature of R&D in agriculture, state intervention is necessary through facilitating investment to achieve national goals in the economy. Sri Lankan Government has been investing in R&D in agriculture since independence, under the various R&D programs in the state R&D institutions. The investment included expenditure on capital, recurrent and human resource development necessary for agricultural and agrarian research in the country. Depending on the macro-economic policy environment in the country, it is necessary to formulate complementary R&D policies for the development of each agricultural crop sector, considering the priorities and the long-term vision in each crop sector. The financing of R&D is based on government treasury allocations and outside grants from donors and loans from international financial institutions. As shown in Table 1, the financing of R&D in agriculture in Sri Lanka was gradually reduced over the years. At the same time, the indicators of R&D expenditure as a share of agricultural GDP (i.e. agricultural research intensity ratio) and as a proportion of total government expenditures have shown a declining trend over the years. Further the sector-wise analysis of R&D investment in agriculture has shown a clear bias in favor of the plantation sector (Table 2). However, the ratio is still high on basic research rather than applied research in most sectors. The time has

come to change the traditional supply-driven R&D to demand-driven R&D on tradables to gain advantages through trade. The supply-driven orientation is based on food security rather than gaining a competitive edge in foreign markets. Within the globalization scenario, removing barriers on mobility on technology, will provide a greater push for applied research if the system would facilitate with funds and institutional mechanisms.

Table 1. Expenditure on Research and Development in Agriculture, 1970-2000

	Total Expenditure		Agricultural Research Intensity Ratio (percent)	R&D Expenditure as a percent of Total Government Expenditure
	Rs. million	US$ million		
1970	18.55	3.1	0.5	0.52
1977	43.76	2.8	0.4	0.5
1983	130.5	5.2	0.4	0.33
1989	200.6	5.6	0.34	0.24
1993	367.0	7.6	0.36	0.26
1997	351.5	6.0	0.25	0.13
1998	722.1	11.2	0.47	0.21
1999	654.9	9.3	0.40	0.20
2000	679.4	9.0	0.39	0.15

Table 2. Percentage Share of Expenditure on Research and Development in Agriculture

Crop Sector		1997	1998	1999	2000
Non-plantation crops:	Paddy/rice	9.7	8.7	3.5	5.4
Horticulture:	Vegetables	1.6	6.9	2.9	3.9
	Fruits	4.3	4.0	1.3	5.2
OFCs		3.0	4.6	3.4	4.2
Floriculture:	Flowers	-	0.2	0.9	0.1
Plantation crops:	Tea	21.8	15.7	21.3	16.2
	Rubber	17.4	11.8	13.8	9.5
	Coconut	16.4	13.3	15.8	16.5
	Sugar	6.0	6.3	7.0	7.4
Spices		9.1	2.7	3.6	4.2
Livestock		-	7.1	6.9	5.3
Fish		6.1	13.3	8.2	12.6
Forestry		-	4.2	1.3	1.3
Other		4.6	1.2	10.1	8.2

Source: Centre for Agricultural Research Policy, 2001.

CONCLUSIONS AND POLICY IMPLICATIONS

The agricultural R&D system in Sri Lanka comprises investment on plantation and non-plantation crops. Conventional, supply-driven R&D system in agriculture has been biased in favor of the paddy/rice crops within non-plantation sector with heavy emphasis on food security for the last 50 years. However, low emphasis and lower priority given to high

value tradable crops (e.g. horticultural and floricultural crops) created a vacuum in the agricultural research system for generating new technologies (e.g. hybrid seed, greenhouses and sprinkler and drip irrigation) for integration. Prioritization of research was done without a basis. It is advisable to prioritize agricultural R&D both in plantation and non-plantation crop sectors based on a long-term vision for the sector as well as the country, considering the new dynamism in demand-driven R&D systems, possibility of generating net foreign exchange and employment opportunities.

There is no coordination in R&D between plantation and non-plantation crop sectors in terms of allocating funds for R&D and designing target technological advancements for product and market integration. The national agricultural R&D system should be coordinated from one central institution as '**One Umbrella for R&D**' by changing the present institutional mechanism. It can be employed *ex ante* analysis to identify the possible mechanisms for strategic planning in future technological development in agriculture, financing R&D for generating appropriate technologies with efficiency, management of R&D systems and transferring new technologies through various extension mechanisms. The proposed institutional framework can also be adopted to prioritize the R&D within the demand-driven process, allocating funds for basic research, agro-based industrial research and socio-economic research, identify the effective mechanisms for transferring new technologies to the required targets either developed within the country or obtained from other countries under the scenario of globalization and monitoring and evaluation (*ex ante* and *ex post*) of the entire agricultural R&D. The greater and growing emphasis on issues such as environment, genetic diversity, food safety, poverty, human and plant health, the structure of agriculture, should be placed through the new institutional mechanism for research in agriculture. Further, the proposed institutional framework can be used to identify the efficient extension methods for transferring new technologies in each crop or product sectors.

New orientation will emerge by developing technology through research in one country to facilitating its acquisition and distribution in other countries. This would be facilitated with the removal of barriers in mobility of new technology and technological advancements in line with globalization. This will imply a paradigm shift in provision of technology for agricultural development either through private or state sectors in developing countries.

The positive impact of the agricultural R&D process in the economy is the main focus of the government, policy-makers, researchers, civil society and the general public. The criticism is leveled against the agriculture sector of the apparent failure to deliver expected results in time against the investment over the last several decades. One of the main issues raised in the policy analysis circles is inability to consider the *ex ante* analysis of the research projects and programs. The composite approach to decision-making in agricultural research (CADMAR) can be employed to address the above issues. Further, the CADMAR methodology can be adopted to identify, formulate, evaluate and prioritize research thrusts for agricultural development considering the benefits and costs of R&D.

The integration of agricultural research and extension should be organized considering the following aspects:

(a) Setting priorities in agricultural research should be based on short-, medium- and long-term vision of the sector for the next decade, in line with the National Agricultural Policy (NAP), – based on sectoral contribution of GDP;
(b) In terms of gaining efficiency, targeted demand-driven extension programs should be encouraged with the assistance of private sector extension organizations particularly

for export-oriented crops. The farmers in smallholder subsistence agriculture sector should be given state-sponsored extension, which may lead to cost effectiveness.

(c) State-sponsored agricultural research and extension organizations should perform the role of 'catalyst' in-between farmers and government and private sector research and extension organizations. There is need to assist farmers to identify problems at the farm level and refer them back either to state or private sector research organizations.

(d) The globalization process will open new opportunities for developing countries to obtain improved technology without any restrictions, including newly improved plants, which have higher productivity. The state research organizations should obtain these technologies, test their adaptability and distribute them to farmers either through their own distribution networks, or appointed agents or private sector nurseries. This will enhance productivity in the sector in particular and economic growth in the country in general.

REFERENCES

Central Bank of Sri Lanka, 2001. *Annual Report*, Colombo.

Coconut Research Institute, 2001. *Annual Report – 2000*, Lunuwila.

----------, 2001. *Corporate Plan*, Lunuwila.

Department of Agriculture, 1994. *Administration Report*, Peradeniya.

----------, 2000. *Administration Report*, Peradeniya.

Department of Export Agriculture, 2001. *Administration Report-2000*, Peradeniya.

Department of National Planning, 1992. *Review of National Agricultural Extension System*, Colombo.

Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI), 1999. *Corporate Plan*, Colombo.

----------, 2002. *Annual Report*, Colombo.

Rubber Research Institute, 1998. *Corporate Plan*, Ratmalana.

----------, 2001. *Annual Review – 2000*, Ratmalana.

Somaratne, W. G., 2002. "Macroeconomic Policies and Their Impacts on Food Crops Sector in Sri Lanka", paper presented the at the Workshop on Macroeconomic Policies and Their Impacts, organized by CARP, 25 January 2002, Colombo.

Somaratne, W. G. and R. M. G. K. B. Ratnayake, 2002. "Contract Farming in Sri Lanka: Potential and Problems in Market Integration", HARTI, Colombo (forthcoming).

Sugarcane Research Institute, 2001. *Annual Report – 2000*, Udawalawe.

Tabor, Steven R. and R. H. S. Samaratunga, 1994. *Structural Adjustment and Agricultural Research in Sri Lanka*, International Service for National Agricultural Research (ISNAR), the Hague, the Netherlands.

Tea Research Institute of Sri Lanka, 1999. *Annual Report*, Talawakele

----------, 2000. *Annual Report*, Talawakele.

World Bank, 1992. *World Development Report*, Washington D.C.

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2. PROGRAM OF ACTIVITIES

(18 - 22 March 2002)

Date/Time	Activity
Mon., 18 March	
Forenoon	Opening Ceremony Presentation and Discussion on Topic I: *Recent Development in Agricultural Research and Extension Systems in Asia and the Pacific* by Dr. Md. M. Rahman
Afternoon	Presentation and Discussion on Topic II: *Agriculture and Fishery Research and Extension Systems: Organizational Linkages* by Dr. Eliseo R. Ponce Presentation of Country Reports by Participants
Tue., 19 March	
Forenoon	Presentation and Discussion on Topic III: *Human Resources Development for Agricultural Research and Extension in the Philippines* by Dr. Aida R. Librero Presentation and Discussion on Topic IV: *Mechanisms for the Transfer of Agricultural technology Among Countries in Asia and the Pacific* by Ph.Dr. Tito E. Contado
Afternoon	Presentation and Discussion on Topic V: *Effective Networking of Research and Extension through Information Technology* by Dr. Rita Sharma Presentation of Country Reports by Participants
Wed., 20 March	
Forenoon	Presentation of Country Reports by Participants
Afternoon	Presentation of Country Reports by Participants
Thurs., 21 March	
Forenoon	Orientation at Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) at Los Baños, Laguna Orientation at Philippines Business for Social Progress – Center for Rural Technology Development (PBSP-CRTD) at Calauan,Laguna
Afternoon	Orientation at Southern Tagalog Integrated Agricultural Research Center (STIARC) at Marauoy, Lipa City Orientation at Magsasaka Siyentista Demo Farm at Brgy. Tipakan, Lipa City

Fri., 22 March

Forenoon	Workshop: Issues and Recommendations on Strengthening Linkages Between Research and Extension in Agriculture Presentation of Outputs
Afternoon	Summing-up Session Closing Session