AGRICULTURAL RESEARCH AND THE RURAL DEVELOPMENT PROCESS: SOME IDRC EXPERIENCE

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By E.J. Weber

Post-Production Systems

Agriculture, Food and Nutrition Sciences

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E.J. Weber
Associate Director
Post-Production Systems

Introduction

At its inaugural meeting in October 1970, IDRC's Board of Governors recommended that most Centre activities focus on improving the well-being of rural dwellers. Since then, IDRC staff have been making this wish a reality by support of a wide range of research projects on rural problems, mostly through third world institutions.

This has not been a simple task. Rural development touches every aspect of rural life. Agricultural production, technology, education, health, water supply, small enterprises, communication, and transportation all represent rural needs. To deal effectively with production issues, agricultural research investigates component technologies related to specific problems and environments, and then reassembles the elements according to local requirements. In many ways, the latter is the more difficult research because the number of uncontrollable variables is larger, precise measurement is often impossible, and application domains must be clearly specified.

IDRC believes that the people best able to define and overcome obstacles to socioeconomic progress in developing countries are the citizens of the third world themselves. An important criterion in the selection of projects is that proposed research meet a priority expressed by the developing country government or research institution requesting

support. It is important to note that most IDRC projects are identified, designed, and managed by third world researchers. While IDRC staff may assist in refining a research proposal, putting it into operational and supportable form, the essential ideas and objectives are those of the proposers.

Although most IDRC-supported projects are conducted within developing country institutions, Canadian institutions and researchers have also made significant contributions. Their input has taken three forms:

1. collaborative research with developing country institutions, funded by IDRC's Co-operative Program;
2. short-term consultancies dealing with specific technical problems and issues in which Canadian experience exists; and,
3. training of third world students in Canadian universities through the Centre's programs and Fellowship and Awards Division.

A primary thrust of IDRC's Agriculture, Food and Nutrition Sciences (AFNS) is to improve food production systems through plant breeding and selection; better crop agronomy, and plant protection; improved pastures and use of agricultural by-products for animal feed; improved fish culture techniques; and more efficient food storage, drying, and processing methods. Although development of improved component technologies is a major part of agricultural research, it is usually defined within the context of an integrated production systems approach. The internal dynamics of a farmer's total enterprise and external non-technological factors, such as markets, pricing policies,

financial resources and credit, and land ownership, all condition the response.

A few of the questions asked when identifying problems and defining research direction under a systems approach may be: Is a new technology too expensive for identified users? What crop residues can be used as animal feed? Can trees grown for fuelwood also serve as windbreaks to protect crops? Who will benefit from research results and in what way? As soon as feasible, the viability of alternative production systems or components or both is assessed on-farm under actual operating and management conditions. Farmer feedback and evaluation is essential.

Assembling a multidisciplinary, integrated systems approach is difficult. Many third world institutions don't have the structure, resources, or experience to develop a program involving both academic research on technological components and integrated on-farm type research. Projects are therefore adapted to the capabilities and needs of the participating institution. As this capability expands, increasingly complex projects are likely to be supported.

To assist national programs, IDRC has been actively involved with the Consultative Group on International Agricultural Research (CGIAR) and other donor agencies, including CIDA. The CGIAR supports thirteen International Agricultural Research Centres (IARC), each of which is dedicated to increasing food production in developing countries and has a particular regional or commodity mandate. The centres develop

improved crop cultivars, maintain germplasm banks, evolve agricultural research methodologies, and provide training facilties. Their clients are national research institutions and researchers. IDRC has made special efforts to establish links between the two groups; IARCs play an essential role in several AFNS-supported research networks.

Because networks encourage interaction among researchers and institutions of different countries, IDRC attaches much importance to their promotion and support. Some agricultural research areas, however, such as fisheries, forestry, post-production, and in part animal sciences, have no relevant major international research centre around which to build networks. In these cases, IDRC may use network technical advisors, experienced scientists who work on one project and regularly visit others with a common interest or technological theme. The advisors participate in research, provide technical advice, organize workshops for exchange of results and experiences, and thus help develop local research capabilities.

Inevitably in agricultural research, major problems are encountered which cannot be resolved by developing countries alone and require studies of a more fundamental nature. Approximately ten percent of the AFNS program budget has been allocated to such projects. Most grants have been given to Canadian institutions to work in collaboration with IARCs or national programs. IDRC's establishment of the Canadian Co-operative Program has expanded this activity.

AFNS is responsible for most of IDRC's agricultural research. Its projects fall within five main programs: Crop and Animal Production Systems, Fisheries, Forestry, and Post-Production Systems, and Agricultural Economics. Each program has further topic subdivisions relating to specific commodities, problems, or activities.

Crop and Animal Production Systems (CAPS)

Improving food crops adapted to varying ecological conditions and developing productive cultural practices are key research elements for increased rural food supplies and enhanced rural welfare. In addition, improved livestock, livestock nutrition, and animal husbandry techniques can augment food production and stabilize farm incomes. To meet such goals, the CAPS program supports research in the following subgroups: Cereal Crops, Grain Legume Crops, Oilseed Crops, Root and Tuber Crops, Perennial Crops, Pasture and Forage Crops, Other Crops, By-product Utilization, Minor Animal Species, and Land and Climate.

Emphasis is placed on research aimed at the technological needs of small-scale food producers, by far the largest group of farmers in most developing countries. Often lacking financial resources and access to information, fertilizers, and pesticides which would increase production of their land and efforts, these farmers face special problems not encountered by larger producers, and which require special solutions.

Systems-oriented projects are supported under three topic subgroups: Cropping Systems, Animal Production Systems, and Farming Systems. As with commodity-oriented studies, many systems-oriented projects are linked through specific research networks. One of the oldest and most successful, is the Asian Cropping Systems Network, for which IDRC supports a co-ordinator based at the International Rice Research Institute (IRRI). This network unites scientists from IDRC-supported projects in Bangladesh, Bhutan, China, Indonesia, Malaysia, Philippines, Sri Lanka, and Thailand. Other scientists in these and other countries participate in the network as well, supported by other donors or their own governments.

IDRC has been instrumental in establishing an animal production systems network for Latin America and the Caribbean. Projects in Chile, Costa Rica, El Salvador, Guatemala, Guyana, Panama, and Peru are investigating problems of a region where livestock is extremely important to many small farmers. A similar network on cropping systems encompasses projects in seven Central and South American countries.

For many farmers, the relationship between crops and livestock is intimate. Crops and crop residues provide feed for animals, which provide manure and power for crop production. To address these and other complex interactions, CAPS is experimenting with projects which examine the farming system as a whole. Farmers participate fully in these studies, and much of the activity is carried out by national scientists working with farmers on their own land.

Because farming systems research (FSR) is relatively new and highly complex, IDRC supports only a few such projects. One example is Andean production systems research, supported in Peru through several projects involving half a dozen institutions. These include work on crop and animal production systems, agricultural product processing and storage, forestry, economics, and links with IDRC's Social Sciences Division, through its science and technology policy program on agricultural research and technical change. Recently, IDRC developed a parallel 4.2 million dollar project with the Peruvian government, to be funded by CIDA, to implement earlier CIDA- and IDRC-funded research results. Farming systems projects are also found in East and West Africa; others will be developed over the next few years. CAPS' goal is to ensure that new, promising production technologies are adapted to meet farmers' needs and that research provides readily adoptable solutions.

Fisheries

The overall objective of the fisheries program is to improve poor people's income and nutrition by increasing fish and marine plant supplies. Priority is given to: aquaculture and mariculture, in which fish are cultivated in modified environments, and artisanal fisheries, small-scale operations in which wild fish stocks are captured close to shore.

The research considers many components including breeding and genetics, feeding and nutrition, disease and parasite control, integrated fish and mollusc culture, and exploitation of fish by-catch resources. In general, fish that feed low on the food chain receive priority over carnivorous species, which are more expensive to rear.

Fish culture is practiced at different levels of expertise in the various regions covered by the program, and research content and priorities are set accordingly. In Asia, culture techniques for various species have been used for centuries. Here, research focuses on improving elements of existing culture systems to increase overall production efficiency. Studies are conducted on production of young fish for seed, on diseases and their control, and on nutrition. Priority is also given to economics of aquaculture. Project networks have been organized, including a social sciences network, developed by the Social Sciences Division with input from the AFNS agricultural economics program. Future research will examine integrated agriculture/ aquaculture systems, where fish are reared as part of a farming system that includes crops and animals.

In Latin America, the Caribbean, Africa, and the Middle East, aquaculture is less advanced. Although some fish culture is practiced on a small scale, potential for development is great. Research is thus directed at developing culture systems which are adpatable and acceptable to rural communities. In Latin America and the Caribbean, culture methods of native species are being examined in several

projects while simple systems are also being developed and tested in Africa and the Middle East. The knowledge and techniques generated in Asia provide an important input to other projects. Canadian expertise has also been useful,particularly in oysterculture.

Artisanal fisheries in inland and marine waters contribute significantly to food supplies and human nutrition throughout the third world. They have received less support than aquaculture but remain an important concern. Focus has been on modifying components of artisanal fishery practice to improve yields. Projects have included a study of conch resources and their biologically efficient harvest in the Caribbean, and an investigation of fishery potential in Indonesia's inland waters.

Forestry

Without a viable, productive resource base, well-protected and responsibly utilized, rural development cannot occur. Over the past ten years, AFNS has supported more than sixty forestry projects in Afforestation, Integrated Production Systems, Forest Products Utilization, Tree Improvement, and Environmental Forestry.

Afforestation, principally in the form of forest plantations, is a priority in the dry zones of Africa and South America, where heavy demand for firewood is depleting natural forests. Small project networks exist on both continents.

Integrated production systems, or agroforestry, involves growing trees or shrubs in association with crop or animal production. This very complex approach, still in its infancy, is used when increased population pressures in areas of slash and burn agriculture have depleted soil and other natural resources. Through systematic combination of tree and annual crops, food, firewood, building materials, and animal products can be produced yet maintain soil fertility and productivity. The forestry program group has developed two agroforestry networks: in West Africa, where six projects in Cameroon, Ghana, Nigeria, and Sierra Leone have been supported; and the other, to develop pastoral forestry systems, on the Indian subcontinent. Anagroforestry project in Peru's Amazon basin is also being supported.

To improve forest exploitation, several forest products utilization projects have been conducted in South America to investigate little known hardwood timbers and promote their use in construction. More efficient use of trees and wood as major energy sources for cooking, heating, and agricultural product processing is the subject of another group of forest product utilization projects. In Tanzania, improved methods of charcoal production and designs for better charcoal-burning cooking stoves are being tested. A project in the Philippines is developing a small-scale energy system for electricity, based on wood gasification. This system will be applicable in small isolated rural communities or islands, where connection to central electric grid systems is uneconomical.

Tree improvement and breeding is a relatively new research area but, with development of tissue culture techniques for trees, progress will likely be impressive. More conventional methods, using selection procedures to identify trees exhibiting superior characteristics, have been used on a number of species in many countries. In Asia, for example, a network of ten projects is studying bamboo and rattan selection and improvement.

Environmental forestry research, has concentrated, mostly in Africa, on the effect of tree shelterbelts on agricultural production. In Nigeria, a project is studying the influence of shelterbelts on various rainfed food crops' growth and productivity. In Sudan, control of desert encroachment on valuable irrigated agricultural lands is being attempted. In Egypt, Casuarina species and varieties are being identified for use in shelterbelts and in Tunisia, the effects of shelterbelts on horticultural and fruit crop productivity are being examined.

Post-Production Systems (PPS)

The post-production systems program deals with all the stages through which agricultural commodities pass, from harvest to consumption or utilization. These activities provide employment and income to rural areas and small villages or towns and a grass roots industry base which can be further developed.

The technologies, suitability, efficiency, and nutritional implications of food transformation processes are the major concerns of PPS. Improving storage and handling, to reduce losses and maintain product quality, and simple equipment for tilling, seeding, harvesting, threshing, and processing is also important. The subject matter is complex, embracing a wide range of topics in agricultural engineering, food science and technology, economics and marketing, entomology, biochemistry, and nutrition. Emphasis is placed on applied research.

Development and management of small agroindustry enterprises is a major component of the program, which also seeks to encourage and build research and technical support capabilities in institutions providing extension services to agroindustry. Researchers from a series of projects involving "process improvement" collaborated to prepare a comprehensive research and development methodology to improve technical extension activities in Chile, Guatemala, Honduras, Thailand, Malaysia, and the Philippines.

Assessment of food quality and nutritional adequacy are major objectives in PPS projects developing and testing new or altered food products. While the program does not support pure nutrition research studies, it has a strong nutritional improvement bias in providing more, better quality food to low income consumers.

Emphasis is also given to marketing or needs assessment studies. In

advanced projects, market testing, manufacturing, service requirements and other factors relevant to technology introduction support systems are encouraged. Many PPS activities are conducted in close liaison with the CAPS, Fisheries, Forestry and Agricultural Economics programs.

The PPS program has three major research areas: food processing, utilization, and nutrition; food handling, storage, and drying; and, equipment design, adaptation, and testing.

In food processing, utilization, and nutrition, projects focus on stabilization and/or conversion of food to improved forms consistent with consumer tastes and incomes. Research often includes consumer preference and nutritional quality studies and test marketing of products. Emphasis is on improving traditional processes and products. Cereals, legumes, oilseeds, fish, and meat are common commodities on for processing research.

In food handling, storage, and drying, the objective is to reduce food losses. Storage structure and mechanical dryer design, adaptation, testing and efficiency are important topics. Research has been done on village grain storage, solar drying applications, root crop storage, fish drying, and fruit and vegetable storage structures.

In equipment design, adaptation, and testing, R&D is supported on machines, tools, and other equipment necessary to the first two subprograms mentioned. The research usually involves development of

associated operating and management systems as well. Activities include design, adaptation, prototype construction, lab testing, field testing, redesign and preparation of final engineering drawings. Equipment is generally small-scale, adapted to small village, rural, or urban food processing enterprises. to date, there has been strong orientation towards grain milling, crop drying, and food processing equipment.

Canadian co-operative projects have been funded in support of the PPS program. These involve: small-scale dehulling equipment; dehullability tests and apparatus for plant breeders dealing with traditionally dehulled crops; a simple, inexpensive fish deboner; procedures for utilization and assessment of consumer acceptability of hard-to-cook beans; and better understanding of biological changes that cause bean hardness during storage.

An example of the results of this collaboration may be of interest. In many parts of Africa and Asia, women of every rural and village household spend hours pounding grain to dehull and pulverize it into flour. More and more, the drudgery involved in this time-consuming task is leading women to choose ready-processed, often imported, grains given the option. This results in decreased consumption of traditional, local grains, such as sorghum and millet, which are nutritious and well adapted to local production conditions. To address this issue, IDRC supported research on a mechanical dehulling device and associated operating systems.

Research on this problem was conducted at the Plant Biotechnology Institute (PBI) of the National Research Council in Saskatoon, and linked to a grain milling project in northern Nigeria. PBI developed and tested a simple, inexpensive prototype machine capable of dehulling a variety of grains without major adjustments. This prototype was later refined in Botswana, where 36 of these machines are presently operating in 21 rural mills. The dehuller is now being used or tested in at least ten other African countries and some Asian countries as well.

When combined with a hammermill of matching capacity and a diesel engine, the dehuller, which processes between 1.5 and 2 tons of grain a day, can service the needs of 8,000-10,000 people living within walking distance. Because the system is uneconomical at a low level of utilization, a second, smaller machine, based on the same operating principles has been developed by PBI. This mini-dehuller handles 5-7 kg batches at a time and is appropriate for areas where 600-800 people live within walking distance.

Despite this progress, much remains to be done. To promote the milling systems' wide-scale dissemination and introduction, the following questions must be answered in many locations. Is the machine capable of producing an end product acceptable to the rural family?; Does the machine perform well on all commodities and cultivar variations found in the country or region?; Can the dehuller, with hammermill and engine, be managed successfully under local conditions?; Is the system the right size for the volume of grain to be processed?; How long will an

installation take to break even or make a profit?; What capitalization and/or subsidy is required to establish a small milling enterprise?; What training of local ownership and operator groups is required to make the business venture a success?; Are the machine operators capable of producing a consistently acceptable product, without major breakdowns?; and, Are they able to adjust operating variables to produce an acceptable end product with each commodity and cultivar? Answers to these and other questions are currently being sought in projects across Africa.

Agricultural Economics

The Agricultural Economics program works closely with other AFNS staff and projects. Its objectives are to support agricultural research and development activities that strengthen the auto-development capability of rural households and communities, to improve the effectiveness with which agricultural scientists and institutions conduct research to meet rural community needs, and to initiate and collaborate in research relevant to the needs of rural people.

IDRC's Social Sciences Division also has an economics program, which has supported rural development research at both micro and macro analysis levels. Principal study areas have included the economics of production, resource allocation, and employment. The agricultural sector has been a major focal point, but increasing attention is now given to such non-farm activities as fisheries economics and small-scale

industry. Projects investigating savings and asset acquisition, and informal and experimental lending operations are being conducted. Also of interest are markets, the broad impact of domestic pricing, market and storage policies, and the effects of these policies on producers and consumers of different socioeconomic backgrounds.

The Social Sciences Division's science and technology program is concerned with technology policies that meet rural needs. Examination of alternative energy sources, their cost, and likely social impact is an important aspect of the program. Also of interest are the effects of agricultural commodity production and processing.

Co-operative Programs

IDRC created the Canadian Co-operative Program to foster collaboration between Canada and the developing world in addressing research issues of critical development interest. It is designed to promote access, by third world researchers to Canadian research strengths and results, not to establish new research capacity in Canada or finance technical assistance projects. This collaboration is meant to promote researcher communication which will lead to joint research and the results of successful research in Canada being transferred to researchers in the third world. IDRC believes that transfer of research results from scientist to user, to be successful, must be done from developing country institutions. For this reason, fundamental studies, methodology development, and technical and scientific supporting research are

favoured for funding in Canada.

Some co-operative projects supported by IDRC have already been mentioned. Other actual or potential projects include: phytosanitization of potatoes and other root and tuber crops by tissue culture methods; nitrogen fixation by free-living bacteria in association with wheat; enhancement of rhizobial nitrogen fixation by soybeans in small farming systems; reproduction rate of water buffalo; veterinary care delivery; and, small ruminant breeding.

In fisheries, collaborative projects include: induced spawning and other fish seed supply technologies; fish nutrition; fish diseases and parasite control; genetics; stock assessment and management technigues; invertebrate and seaweed culture; and, plant-derived piscicides.

In forestry, physiology of and propogation techniques for nitrogen fixing tree species; rhizospheric phenomena; seed production and tree planting technologies; pest monitoring methodology; fire monitoring and control; timber utilization; and, village-scale biomass energy utilization technologies; and, in post-production systems, legume processing and storage technologies; consumer studies methodology; small-scale food processing equipment; grain quality assessment methods; specialized small-scale farm equipment development; and, physics of solar and wind energy capture devices to improve performance.

Canadian Participation

In third world countries, agricultural research for rural development must be done within an institutional structure and environment that provides continuity and well-defined research objectives. This usually means government institutions, which are more broadly based and have associated extension responsibilities. Universities, IARCs and regional research centres are best oriented to support government institutions in research, methodology, and training. NGOs and private research organizations also contribute, but the focus is usually limited to a single community or small region. IDRC collaborates with all of these institutions, working on problems in the real world of intended rural beneficiaries.

There is a role for Canadian researchers to play as well. In-depth studies on components of an agricultural production system often lend themselves to Canadian collaborative research with developing countries because they depend less on direct exposure to extension and farm groups and access to the production environment. Participation of a developing country's researchers, familiar with the rural environment and concerned with the application of research results, avoids, however, possible development of solutions for imagined or incorrectly-identified problems. The interaction and collaboration of Canadian and third world researchers in a colleaguial manner is a valuable tool in agricultural research and the rural development process. Its use is supported strongly by IDRC.