IN-DEPTH REVIEW
OF THE
AGRICULTURE, FOOD AND NUTRITION SCIENCES DIVISION

SUBMITTED TO

THE AD HOC COMMITTEE OF THE BOARD

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EXECUTIVE SUMMARY

To review past performance and to set future policy direction, the Board of Governors of IDRC has requested an In-Depth Review of the Agriculture, Food and Nutrition Sciences (AFNS) division. This document, compiled to give a detailed overview of the operations of AFNS, indicates new opportunities and future directions, while at the same time asking for guidance on some important policy matters.

The world food situation is generally considered somewhat more positive than a decade ago as food production is increasing at about 2.6% per year, slightly faster than the growth of the population. However, a considerable proportion of the world population remains much below their minimal nutritional requirements. The success of technological innovation in food production has largely been concentrated in East Asia, and efforts have recently been made to duplicate this achievement in Africa. However, many of the prerequisites necessary for success have not been present in Africa and the achievements have been far less marked.

The original position paper that set out AFNS's mandate is as relevant now as it was 15 years ago. The program seeks to encourage and support research, development, and training designed to increase and improve the production, protection, preservation, processing, distribution, marketing, and utilization of agricultural commodities of plant, animal, marine, and forest origin. The scope extends to cover the transformation of these commodities and the development of related industrial technologies. It also embraces the production of food by synthesis or chemical modification of organic and inorganic substances.

The division's strategy is to support indigenous applied research carried out in close association with the rural communities who are to use and benefit from the research. Because of the often inadequate research facilities in poor countries, AFNS also supports more advanced research in international and regional research centres, as long as such work is directly relevant and complementary to specific research projects and networks.

The division is giving high priority to dissemination of research results and training of research staff in developing countries. On average, 2.5% of the project funds is presently allocated to aspects of dissemination; half of this is used to sponsor seminars, meetings, and workshops. AFNS produced 75 publications over the last five years, mostly focusing on technical reports and workshop proceedings. Most AFNS projects contain a specific training component, at an average level of 10% of the project budget. Approximately half this expense is directed toward formal training, largely at the level of MSc degree. A second important training component comes from the Fellowships and Awards Division (FAD) of IDRC, which allocates about one third of its training funds to AFNS-related subjects. Outside expertise is also used to complement training when the level of local capability is inadequate. On average, about 4% of project funds is for consultants and short-term advisors.

Highlights of past achievements and experiences are difficult to give because measuring success very much depends on a subjective appraisal. Scientific research is a time-consuming enterprise, and the pathway from research proposal to the widespread application of a new technology by farmers generally takes at least 10 years. It is not surprising that only now after 15 years of existence of AFNS, some significant results of the early projects become evident. Several successful projects are described in the report.

Aside from the mention of successful projects, a number of lessons have been learned, sometimes through projects that did not reach their goals. Work in developing countries is difficult at best; especially in the area of research the obstacles are sometimes formidable. This is often not taken into account when projects are too ambitious and too much is expected too soon. Since AFNS has to work in such a less than ideal environment, it stresses particularly its flexible approach and its openness to new methods. This way it can respond to the difficulties and the changes that take place, and continue the process of improving its performance.

Here is a summary review of the last five years and future directions of the division's five programs.

AGRICULTURAL ECONOMICS

The Agricultural Economics (AE) program was created in 1984 and, for this reason, an overview of the last five years is not possible. Instead the report focuses on the establishment of a solid base for its future operation. Three areas have specifically been identified for support:

a) economics of production and utilization systems based on natural resources, which is to include microeconomics of crops, livestock, fish, forestry, and food production and their processing activities, farm and agro-industry management, agrosystem analysis, and technology evaluation;

b) economics of technology introduction, especially the analysis of agro-systems technology introduction practices; and

c) economics of agricultural research resources allocation concentrating on the analysis of research management.

AE will put its main emphasis on supporting those projects which are an integral part of an institute's research program and will become directly involved in the generation of technology. The integration of social and natural resources systems concepts and the use of a methodology likely to be utilized by national research groups are other important characteristics that will be given consideration in project selection.

CROP AND ANIMAL PRODUCTION SYSTEMS

The overall objective of the Crop and Animal Production Systems (CAPS) program is to support appropriate research on crops and livestock production. Priority is given to research which will benefit small-scale subsistence farmers, who frequently lack access to adequate land, water, financial, and other resources, and who have been largely unaffected by the technological advances of recent years. The largest share of the budget is allocated to support research by national scientists working in their own countries, but projects with international or regional organizations are also funded when they support national projects. The production systems projects supported by AFNS have been grouped into cropping, animal production, and farming systems research. The latter projects address crops/livestock production systems in which the crop and animal enterprise are highly interdependent.

CAPS has from the beginning encouraged the development of a system's approach to the improvement of crop production. In Asia, cropping systems projects have focused on upland crops for dry-season cropping on paddy land, with emphasis on mungbeans, soybeans, and groundnuts. In Latin America, the major work is concentrated on root crops/banana farming systems and the improvement of the indigenous crops and cropping systems of the Andes region. In Africa, the move toward a systems approach has been slower, but recently more of the crop research has taken place in farmers' fields.

Livestock are an integral part of most small-scale farming systems, especially where vast natural grazing lands are the norm, and where ruminant feeding is based on by-products and crop residue. CAPS has put most of its support into improved feeding and management systems that are considered of more immediate benefit to small farmers than research into animal breeding or diseases. CAPS has given highest priority to ruminants due to their ability to convert pasture, forages, and crop residues into animal products for human consumption. Most emphasis in the animal productions systems sector has been given to pasture-based systems in the low- and medium-rainfall areas of Latin America, Africa, and the Near East.

CAPS has rapidly increased its support for farming systems projects in recent years. Most projects, especially in Asia, have evolved through the inclusion of an animal component into cropping systems research, a process that is now starting in Latin America. Although it is too early to expect a significant impact of such relatively new projects at the farm level, progress on methodological issues has been encouraging. The most tangible results come from an early systems project in Mali where on-farm trials with new crops and methods have resulted in the production of surplus food in the villages involved after a short period. The methodologies developed there are now being tested with national programs throughout West Africa. Although the systems approach has shown some promising results, it is still dependent on the availability of new component technologies. Consequently, a careful balance will be maintained in supporting production systems research and component technology research in the future.

Most of the research to generate new and improved technologies deals with breeding or selection of food and forage crops to provide cultivars for a wide range of growing conditions. In addition to annual crops, this research group includes perennials, particularly plantains and bananas for local consumption. Priority in animal research is given to minor species and research in this area comprises the improvement of pasture and forage plants and the utilization of agricultural and industrial by-products as animal feed. The last group on land and climate deals with the utilization and conservation of agricultural land.

Cereal crops supply most of the energy and a significant proportion of the protein to the diets of the less-affluent peoples of developing countries. CAPS has given priority to neglected minor cereals, particularly millet and sorghum, which are extremely important to a large number of people especially in the semi-arid areas.

Grain legumes are similarly neglected, yet they play an important role as a break crop in cereal rotations and are an important food especially where protein is in short supply. Support has concentrated on grasspeas in India and Bangladesh, cowpeas in West Africa, and mungbeans and soybeans in Southeast Asia. Future plans will emphasize more research on lathyrus by finding varieties with a lower neurotoxin level, the use of some improved cultivars in different countries, and a look at new grain-legume crops such as horsegram in India.

Oilseed crops such as safflower, nigerseed, linseed, castor, and sunflower have in the past received little research attention, and thus have a largely undeveloped potential. Their ability to grow on limited moisture and on poorer soils makes them particularly valuable in semi-arid areas. Over the next year, increasing resources will be allocated to oilcrops, due to their neglect, their nutritional importance, and the potential for improvements.

Root crops are dominated by cassava, a crop that has recently become an important animal feed, but also includes sweet potatoes, yams, cocoyams, and solanum potatoes. Many improved varieties are now at the stage of

distribution to farmers. Future root-crop research will emphasize work in Africa in cooperation with the International Institute for Tropical Agriculture (IITA), with special attention given to testing and evaluation by farmers, root-crop based systems and the selection of high-yielding disease-resistant materials.

Some locally or regionally important minor crops that do not fit into a distinct crop group have in the past received little support for research. Two such groups are the high-altitude crops of the Andean region and vegetable crops in Asia. A major contribution of CAPS has been to institutionalize research programs on Andean crops. The crops involved cover both root and grain crops that are frost resistant and adapted to a specific environment. Work on Asian vegetables has linked Chinese scientists with the Asian Vegetable Research and Development Centre (AVRDC), covering work on such crops as mungbeans, tomatoes, and Chinese cabbage.

Research on perennial crops has concentrated largely on bananas and plantains, and covered a few projects on coffee. Research on banana-based cropping systems has proven successful in the Caribbean, while disease resistance and high-yielding varieties are concerns in other areas. A recent development is the establishment of an International Network for the Improvement of Banana and Plantain (INIBAP). An important task is to make INIBAP fully functional, so that it can take over the support for banana-breeding work and the assembly and testing of different clones. New initiatives will involve research on other perennial crops such as cocoa, coconut, or fruit crops.

Support of research on animals has concentrated on the development of low-input technologies aimed at the improvement of the present resource base. In Latin America, this has meant the improvement of grasses and the introduction of legumes, while for land-short Asian countries high-yielding forage species for cut-and-carry management are important. New pasture projects will have more of a multidisciplinary approach with on-farm research as the key element.

By-products utilization is of importance to those animal production systems where abundant and cheap by-products are found either from crop production agriculture or from industrial processes. Despite the wide availability of

such materials, they are not generally used due to problems of storage, low digestibility, and the presence of antimetabolites. Aside from a number of projects on by-product utilization, CAPS has been instrumental in setting up the African Research Network for Agricultural By-Products (ARNAB), which is presently developing standard evaluation methodologies for this new field.

Minor animal species have a key role in many small-farming systems, especially in Africa and Asia, where they can easily adapt to local conditions, and are especially useful in some disease-infested areas where cattle cannot exist. Buffaloes and llamas also receive attention under this sector; both need increasing attention for the important role they play in their specific environments. While pigs, chickens, and ducks are of lower priority, the potential of increased productivity and income from beekeeping has led to some research projects. Research support in this sector has been scattered and efforts are now being made to achieve a better coordination. Sheep and goat research will receive more attention, as will beekeeping in Asia and Africa; work on Latin American camelids will continue, benefiting from the support of the Latin American Animal Production Systems Network.

Research on land and climate is concerned with the utilization and conservation of the basic resources on which the world's agriculture is based. Increasing pressure to cultivate land and increasing livestock numbers have led to the breakdown of traditional farming systems, which now poses a threat to the production system and its future ability to produce. The better utilization of water and the use of fertilizer are among the most effective ways to increase crop productivity and halt soil deterioration. Most support of this sector has gone toward research on the development of indigenous fertilizer resources, mainly phosphate. Results have shown that finely ground local phosphate rock can be applied without further treatment to produce considerable increases in yield. Over the next five years, emphasis will shift away from phosphate research, and will broaden out to cover soil- and water-management techniques and national irrigation research programs. Other areas being considered for futher attention include animal power, horticulture, and integrated pest management.

FISHERIES PROGRAM

Over 70% of the earth's surface is covered by water and major portions of this water mass are important for the production of fish. In earlier years, fisheries had been considered the great potential food resource, but in the 1970s it became apparent that most fish resources were already used near their potential. This situation together with limited manpower and financial resources has led AFNS Fisheries staff to give priority to aquaculture and artisanal fisheries. The basic objective of the Fisheries program is to increase the production of fish through applied research support in a manner to benefit the rural poor.

In Africa, most wild fish resources are exploited at or near their capacity: future developments will have to concentrate on optimum resource management and the introduction of alternative systems such as aquaculture. Previous projects designed to improve a variery of fish-culture systems have been severely affected by the economic decline of the region. In the future, it will be necessary to develop aquaculture systems of lower complexity and to give greater attention to social, cultural, and economic factors.

In Latin America, a large share of world fish production comes from the nutrient rich upwellings of the west coast, mainly Peru, Ecuador, and Chile. Due to the relatively low population density and the abundance of other protein sources, the aquaculture and artisanal fisheries are generally of low priority. Only the culture of high-value species for export has attracted the attention of private investors. AFNS input has largely been in the area of aquaculture, where research into different culture systems is still in progress.

In the future, the main activity will be on artisanal fisheries with emphasis on new gear technology, the use of alternative resources and improvements in handling, processing, and marketing. Mariculture will become more important and the culture systems of freshwater aquaculture projects will be based on known species with an existing local market.

Asia accounts for almost half the world fish production and the region has a long history of aquaculture. Artisanal fisheries have increased in importance but further development will necessitate a better understanding of social, cultural, and economic factors that hindered this sector in the past. Due to the sophisticated market demand in Asia, a shift toward more intensive production methods and higher-value species can be justified, while for captive fisheries the direction will be toward resource assessment, optimum utilization of present resources, and an increase in the efficiency of use of the catches. The sectors of aquaculture and artisanal fisheries will increasingly work together to provide an alternative income to fishermen, where resources are becoming depleted.

FORESTRY

During the past decade, there has been an increasing recognition in many developing countries of the important role forests and trees play in helping to increase agricultural productivity, to improve rural welfare, to alleviate the negative impact of the energy crisis, and to preserve the environment. However, the expenditure on forestry research is very small and mostly directed toward the industrial sector. About 70 countries have been identified as having insufficient resources to cover their needs. Despite the fact that 80% of the wood harvested is used as an energy source, this aspect has received minimal research inputs.

The major needs for forest research in developing countries have been identified as:

a) research related to the contribution of forestry to rural development, especially agriculture, with emphasis on productive and protective functions;

b) research related to energy production and use;

c) research on the more effective management and conservation of tropical forests; and

d) research on the utilization and marketing of lumber of secondary species and residues.

Establishing tree plantations is a top priority in the dry zones of Africa and South America, where expanding agriculture and the need for fuelwood have been destroying the natural forests. Aside from the selection of the best-suited species, research emphasizes the development of simple establishment and management techniques suited to village use.

The need for an interdisciplinary approach for agroforestry research has been realized, and will result in much closer collaboration with CAPS and AE. Trees can assist in maintaining soil fertility, reduce erosion, and protect crops, while providing firewood, forage, and fruit.

Research on forest products utilization was supported to determine the functional properties of secondary and unknown timber species for their use in construction.

Research support for tree improvement and breeding concentrated on bamboo and rattan in Asia and on propagation methods and cultural techniques for widely used multipurpose species such as Leucaena, Prosopis and Paulownia.

In the field of environmental forestry, the division has supported a network of four shelterbelt-research projects in Africa to measure the effect of trees on the microclimate and the production of food crops.

In the future, the Forestry program will continue to emphasize social rather than industral forestry, but there will be a restructuring of subprograms to reflect the changing research needs of the developing world, change in the environment in which we operate, and the lessons learned in the past five years. The aim is to achieve a balanced mix of projects with emphasis on recipients who can be relied on to deliver and disseminate their research results. In areas of higher risk, an attempt will be made to initially support weaker recipients in fields requiring a low level of research capacity.

POST-PRODUCTION SYSTEMS

The Post-Production Systems (PPS) program deals with the technology, appropriateness, efficiency, and nutritional implications of post-harvet activities for the benefit of low-income rural and urban people. It covers a wide range of disciplines in engineering, food science, nutrition, economics, and marketing. Much of the area of PPS is work commonly carried out by women; while there are no specific women's programs, all projects have to assess the impact of the proposed changes on women. PPS research priorities are on cereals and legumes, fish production, and economics, where it covers such areas as grain dehulling, milling, storage, and fish or crop processing. The main target of the program is the small farmers and villages.

The broad objectives of the program are to make more and better food available to poor rural and urban consumers and to augment employment and income in small agro-industry enterprises.

The major achievements for PPS have been in projects working with dehullers and drying problems. A Canadian-designed dehuller is now widely used in Botswana and a number of threshers, dryers, winnowers, and storage structures have been developed in several countries.

Nutrition-related projects have involved the processing of food mixes as infant food at the village level. Despite interesting results, their impact on local nutritional improvements has been doubtful. The lack of consideration for socio-economic conditions, agricultural practices, and food consumption habits has contributed to the poor performance of these projects. As a result, PPS is now undertaking an analysis of these experiences, and the report will be a guide to future research support in this field.

Future orientation of PPS will generally continue in the same direction, as the main problems have not been solved yet. A main goal will be to strengthen village enterprises in the food and agricultural sectors, that aside from producing better and cheaper products also generate rural earning opportunities and employment. High priority will continue to be given to the promotion

and dissemination of the dehuller system, the reduction of the moisture level in staple food crops especially in Asia, and the preservation of perishable foods, mainly fish. In all these areas, training and institutional development will be of considerable importance.

SPECIAL CONSIDERATIONS AND KEY ISSUES

Topics raised under Special Considerations have the purpose of informing the Board about the views and intentions of the division on these subjects. In the case of the Key Issues, the intention is to obtain guidance from the Board as to what the AFNS position should be on these issues.

Special Considerations

Support for the rural poor has been AFNS's emphasis since its inception. The lack of adequate food, shelter, and care is generally most pronounced in the remote areas of generally low production potential, where traditional subsistence agriculture does not provide even a minimal standard of living. The lack of institutions and scientists in the poorest countries has limited the contribution AFNS can make. In the past, the consideration of making the most effective use of the resources available to AFNS has forced the division to allocate a large proportion of funds to those countries that could make best use of this support. This approach has to some extent run contrary to the mandate of helping the rural poor, and in the next years AFNS intends to shift its support to poorer countries. Such a shift, however, requires projects of longer duration, less ambitious goals, a large training component, and close support and supervision by AFNS staff.

Multidisciplinary projects have resulted from the realization that often a number of other aspects not strictly part of a research project also influence its results, and even more the degree of adaptation. In the next years, the disciplines of agricultural economics and rural sociology will increasingly become integral parts of many projects. Such integration, considered highly desirable, is often difficult to achieve. Most developing countries have a

very rigid administrative system that divides related disciplines into different ministries and institutions. AFNS sees a special task for itself over the next years in demonstrating the value of multidisciplinary projects, but, especially in poorer countries, this will demand extra input in staff time, effort, and finance.

Research networks have proven very valuable wherever research projects of a similar nature have been funded. A network provides for the exchange of information and materials, and the projects provide mutual support and encouragement. AFNS plans to maintain its emphasis on networks, especially those concentrating on a specific topic or region.

The presence of a qualified and motivated project leader is a key ingredient to a successful project, thus AFNS strongly depends on maintaining high morale. A strong effort by AFNS will be required to encourage such scientists to continue their valuable work. AFNS will continue in this direction, and employ expatriate staff only when it is absolutely necessary. Emphasis will also be on mutual support through networks and specific network coordinators rather than expatriate staff.

International research institutions have been established at a rapid rate over the last 20 years, and absorb a considerable amount of the total research expenditure. Their success has largely been their access to physical infrastructure, highly-qualified manpower and a high level of financial support. The dissemination of results from the International Agricultural Research Centre (IARC), still largely depends on the national research and extension systems; however, the general lack of cooperation between the IARCs and the national systems has been a major concern of AFNS. Also, it is necessary to look at alternative models, that may be more cost-effective, more farm-oriented and have a quicker and broader impact.

Non-governmental organizations (NGOs) working in developing countries are generally characterized by a strong sense of dedication coupled with a determination to help those with the biggest need. NGOs are considered to be one of the most promising avenues to link scientists and research to rural farmers

and villagers. AFNS intends to make increasing use of a variety of NGOs to carry out on-farm research and extension tasks, to initiate field trials, and to act as a feedback mechanism for the definition of further research needs.

The growing number of bilateral and multilateral donor organizations has made attempts at coordinated aid increasingly complex. The present lack of such coordination, however, is a major cause of the confusion, duplication, and inefficient use of aid resources that characterizes the development situation. The time has now come to look into new ways of increasing the level of cooperation between AFNS and the other donors in the research field, as well as those development agencies which have the ability and means to apply the research results generated. One way to do this is through participation in larger projects, where AFNS would cover the research component.

The present motivation, ability, and dedication of the program officers of the division need to be maintained at a high level. Since direct financial incentives may be limited, AFNS will have to concentrate on such aspects as job security, training opportunities, sabbatical leave, and a career structure. Over recent years, the changing nature of projects has increased the work load of officers considerably, and as much as possible they should be relieved of administrative duties that can be performed more cheaply by locally-employed support staff.

AFNS has in the past largely concentrated on food crops, but even in subsistence situations surplus food is sold for cash. It is becoming increasingly obvious that over the next years smallholder cash-crop production will increase, and AFNS will pay more attention in the future to research on smallholder cash crops.

In the first years of IDRC's existence considerable importance was given to aspects of human nutrition which generally invoive several disciplines, among them agriculture, health, food science, and home economics. However, this topic has received relatively little attention by AFNS in the review period. The main rationale was that the primary importance for human nutrition was to increase the availability of food, which falls largely into the field of agriculture. A number of steps have recently been undertaken to take a fresh look at this topic.

In those countries where the level of institutional capacity and scientific staff capability were absent or inadequate, assistance has sometimes been limited. If these generally poorer countries are to receive a large share, there is a need to build up their capacity. Continuous attention will be given to research training in the future in collaboration with the Fellowships and Awards Division (FAD) and other organizations. However, the division feels that one of the best ways to increase local capacity to carry out research would be through small-grant projects. Such a small-grants program would help program officers to build links to a larger number of researchers, act as pilot projects, and evaluate the potential of project leaders for future full-scale projects.

Key Issues

Allocation of Resources - The declining share of IDRC resources allocated to AFNS is an issue of concern to the division. In the first 10 years, AFNS received about 45% of the total regular project appropriations in the four program divisions, but since 1981-1982, its share has decreased to 42% on average for the five-year period to 1985-1986, and a further decline to 39% is projected for the next five-year period to 1990-1991. The percentage annual allocation to AFNS in relation to total IDRC revenue is much lower due to additional funding that the Centre has received for new programs. Although AFNS is receiving a portion of the funds for the new programs, its share does not compensate for the expansion elsewhere in the Centre. Consequently, the AFNS share of the total IDRC budget had declined steadily from 31.1% in the initial five-year period beginning in 1971 to 27.0% for the latest period (1981-1985) and the trend is still very much downward. AFNS feels that further decline of its share of the overall IDRC budget should be arrested to maintain at least 25% of the overall IDRC budget.

A second concern is the relative allocation of resources to the different programs within AFNS. If the division were strictly to go by the projects submitted, CAPS would have an even higher share, but it is felt that some steering is necessary to strengthen the other sectors. A shift toward more emphasis on social and economic aspects of research will likely absorb more

funds for these areas away from the traditional programs. Given these developments, AFNS needs some guidance as to the relative importance of its programs and the percentage allocation to each over the next years.

The third aspect is the relative allocation of funds to regions and countries. While the division works on a regional rather than country-based allocation, it is interesting to note the concentration in countries where it is less a reflection of need than the ability to develop projects. If need becomes more of a consideration, funding priority would have to shift to Africa, and to poorer countries in the other regions. Such a shift, however, has major implications, as these countries are less capable of generating results. Strengthening of institutions and training will need more funds, and projects will need to be less ambitious and last longer. The division is looking for direction as to its regional priorities.

Responsiveness versus Initiative - Traditionally AFNS's mode of operation has been responsive in the sense that it expects requests from scientists of developing countries to fund projects. The submission of a project is thus taken as an expression of a need as defined by the scientists of the host country. While priorities can be set as far as program or regional support are concerned, the actual support of projects depends on their submission and may not coincide with AFNS priorities. The division feels that it could operate better, in some aspects, if it had more control over the type, number, and origin of proposals it receives, and that an option may be to consider ways to take more of an initiative.

Concentration of Support - Due to a number of reasons, the Southeast Asia region has seen a considerable input of AFNS support, where four countries received 60 projects costing in total over $10 million. At the other extreme, 24 countries had only one project over the last five years while another 12 countries had two projects each. The open access mode of operation thus has the effect that the resources of AFNS may not help the people of greatest need. However, a move away from this approach would imply the setting up of restrictive policies. Decisions would have to be made on where to concentrate the support and in which countries or regions to cease funding projects. One

benefit that a concentration of projects would bring is an influence by AFNS on host-country policy for scientific research and the establishment of an active support structure for research. The question of open access versus the concentration of inputs by AFNS is an issue that should be addressed.

Application of Research Results - AFNS has from its early experiences put major emphasis on applied research, on close links to the farmer, and on an integrated approach. The main rationale has been the cost-effectiveness and the advantage of immediate benefit to the rural farmer and his family. The division has had considerable success in influencing policy decisions of developing countries toward more appropriate and applied research. The next concern is now the dissemination of the technology created. In some cases, social and economic factors hinder the adaptation of technically sound innovation.

The question before AFNS is how the division can assure that the technology created by its research will be adopted, and to what degree dissemination and extension should be part of a research project.

AFNS Managing Projects for Other Donors - Two of the earliest AFNS projects were carried out in cooperation with CIDA, and the two organizations have since then frequently worked together. CIDA has recently become interested in AFNS becoming an executive agency to take over the research sectors of larger CIDA projects. AFNS has also made a contribution to establishing formal networks outside of CGIAR and has played a role in setting up new research organizations.

On a different level, several nonnational donor organizations have offered financial support to AFNS to expand their work. Until now, the division has had to respond in the negative to such requests, largely because the complexity of such tasks is beyond AFNS's present administrative capability. Although the potential benefits of such a new type of involvement could be substantial, AFNS would need additional manpower, space, and support. The division therefore needs guidelines as to its future policies toward closer work with other donors and the necessary support in financial and human resources.

INTRODUCTION

At the Board of Governors Meeting in 1980 in Cairo, a cycle of In-Depth Reviews of all International Development Research Centre (IDRC) program divisions was established. The first contribution of Agriculture, Food and Nutrition Sciences (AFNS) to this Program and Policy Review process was presented in October 1981. From that experience, it was decided that the process should be strengthened by incorporating an external point of view, and by a more uniform coverage of basic strategic planning elements. For this purpose, the Executive Committee decided to establish an Ad Hoc Committee of the Board to review the work of the division. The mandate of the committee is to review AFNS' mandate, past performance and strategic intentions, and to monitor the treatment of any specific policy issues suggested to AFNS by the President's Committee in January 1985.

The Ad Hoc Committee shall submit its report, together with its recommendations, to the Board of Governors at its March 1986 meeting (it being understood that this report, together with the division's In-Depth Review document, will constitute the basic documents for the Board's review of the division).

The original contributions of the division staff to the In-Depth Review document were rather extensive, and it was thus necessary to shorten considerably the original submissions. These reduced versions now form the core chapter of the overall In-Depth Review. Such a shortening process inevitably loses much valuable detail; therefore the original reports were edited and marginally shortened to form a background volume to go with the report. This document will be of help where more detailed information is required than the short report is able to provide.

This document has been organized in four parts both by scope, going from the general to the specific, and by timescale, from past to future.

The first chapter, therefore, tries to give an overview of the world economic system, with particular emphasis on development. Questions concerning population growth, interest rates, food production, or agricultural research all will have an influence on the emphasis and direction of AFNS. This overview is far from comprehensive, but rather highlights those topics that are part of the process of development, especially the ones that are of relevance to agriculture and food production. This sets the stage in which IDRC and AFNS are operating. The next chapter then focuses on AFNS and its history, mandate, and achievements, and looks especially at the program development and delivery of the division, its successes and problems. The chapter concludes with some highlights of successful projects.

Having thus set the background, the core chapter describes in some detail the work of the five sections within AFNS. It covers the last five years of operation, an analysis of the success of the various projects, and the lessons that have been learned. Based on this, a description of future program direction for the next five years is given.

The last chapter then looks toward the future. Under the topic of special considerations, the document outlines a number of problems and challenges, and shows how it will respond to them. There are however some basic questions of priorities and direction where the guidance of the Board is requested. These are the key issues described, and for each a set of options for future direction is given. At the end of the report, a short account to the past strengths and an outlook to the future conclude this In-Depth Review.

I. WORLD AGRICULTURE OVERVIEW

A. WORLD DEVELOPMENT ENVIRONMENT

This first section of this document is intended to outline some important factors that will have a considerable influence on development in general and on AFNS programs in particular in the next five years. While their future cannot be predicted, an account of the present situation and trends will at least show the complexity of the overall development process and the possible effects these factors will have on agriculture.

Factors Influencing Agriculture Development

Recession - Of overriding importance to the future of development is the relative health of the Western economy. The economic situation will control the general availability of financial resources to Western governments, and thus control the amount of finance available for development assistance. The state of the economy also influences consumer demand and the prices paid for raw materials and industrial crops. This can drastically reduce the income of most developing countries in times of recession during which they also receive less aid, forcing them to cut back on imports of goods needed for development. Retrenchment in Third World countries generally means that there is nothing to spare for new investment, expansion or development. Under such circumstances, the efforts of development agencies such as AFNS will be set back again.

The future of AFNS is particularly sensitive to the relative health of the world economy in several aspects. During a recession, scientific investigation and research institutions are often easy areas for cutting back on funding, and thus the in-country support for AFNS projects in such a situation is often reduced or totally discontinued. This leads to slower progress and reduced results, and

usually to additional funding demands for AFNS to cover these items. At the same time, the demand for internationally traded goods is reduced, and with it the interest in research projects that work with cash crops or marketed food crops will decline. During such a period of recession when the need of developing countries for assistance is greatest, Canadian funding resources are generally also reduced, and the availability of funds for AFNS projects declines or remains at the same level.

Protectionism - The difference between developed and developing countries lies largely in their level of industrialization. Here, Third World countries are in a situation of competitive advantage since their poverty means very low wage levels. Labour intensive industries have considerable advantages in poor countries, and this consideration has led to a move of labour-intensive industries from Western countries into the Third World. This development has contributed to unemployment and shrinkage of the traditional industrial base of many developed countries. While the principles of open trade and the free market are stressed, pressure is exerted to keep these Western industries viable through protection. This is especially the case in the semi-processing of industrial crops or the marketing of natural resources, where the self-interest of Western countries often overrides considerations of aid, and the conditions attached to aid can be more costly, although hidden, than the aid received.

Few AFNS projects deal with cash crops and export oriented commodities, and this topic is therefore at present of less importance. Smallholder cash crops, however, could play an increasing role in AFNS research projects, and the potential of related in situ processing methods could be developed. The possibilities of marketing these products would then need a careful analysis before a large effort is made in this area.

Energy - Expanding populations and their increasing standard of living have resulted in rapidly increasing demands for energy, just when the price of oil has also increased. Although oil prices have in recent years remained steady, energy costs drain a considerable amount of foreign exchange from most developing countries. At the same time, the recycling of oil revenues by countries of the Middle East has increased the total aid available by up to 25%. The price of energy influences such diverse development aspects as the size and range of fishing boats and the use of firewood as fuel for cooking. Due to the relatively low level of mechanization, direct fuel costs for agriculture are less important than the cost of those inputs that depend on fuel. The cost of fertilizers and agricultural chemicals for plant protection is closely related to the cost of energy, and even a small reduction in the price of these would lead to a big increase in use. This, in turn, will translate into a much higher production of food. As cheap energy and low fertilizer prices are unlikely, agricultural research needs to redirect its efforts in response. Specific areas of importance are the better utilization of those plant species that fix nitrogen, the wide use of energy independent rock phosphate fertilizers, and the use of nonchemical methods of weed, pest and disease control. However the complexity of the system makes predictions of future oil demand and price difficult, and even more so the impact any price move will have on each component of the economy of poor countries.

For AFNS, energy needs of the rural poor have become as important as their food needs. Demand for firewood has increased dramatically, leading to the destruction of woodlands particularly in semi-arid regions. The increasing cost of energy from oil and gas is creating increased demand for fuelwood in cities, adding to the problem. High fuel costs also affect the efficiency of fishing boats, and will accelerate the trend toward smaller boats fishing closer to the coast. Here, the coastal fish resource in many countries is already

overexploited, and assisting local fishermen to become more productive would have the opposite result. Higher energy costs will cause AFNS Fisheries program to put more emphasis on alternatives to capture fishing (such as aquaculture), and possibly on resource management. For crops, higher fertilizer and fuel costs may shift emphasis toward less intensive growing systems, while cheaper alternative energy sources for drying grain will become increasingly important.

Population Growth - Having to feed a rapidly increasing number of people from a limited agricultural resource base has been a particular worry for the agriculturalist. When development parameters are measured against population growth, most countries show little progress, or even a negative trend, especially in Africa. This is particularly the case in the area of food production, where the recent effort that has gone into agriculture has only allowed the system to keep pace. Thus, population growth is the other side of the equation for the agriculturalist, to whom fewer mouths to feed would be as much progress as more crops grown, and only progress in both areas can in the long term diminish hunger. Many of the poorest countries have comparatively lower population growth rates due to lack of food and the low level of health care, while it is generally the middle-income group that has the fastest growth rates. These middle-income countries also have the means to purchase more food, which leads to a rapidly increasing demand for food products. At an even higher income level, a dampening effect on population growth has been observed in many countries. Emphasis on helping the poor, therefore, may well cause an increase in their birthrate.

Programs of population control are undertaken by the governments of most developing countries and, as a result, many countries show encouraging progress. Agricultural scientists such as those supported by AFNS have to continue in the meantime to work in their field of

producing more food to feed the additional people. AFNS already puts its main emphasis on food production and can only continue to support research in the area of increasing food production, although a linkage of some of its projects with population control aspects could open a promising new field of cooperation.

Famine - Relief of suffering as an immediate measure of assistance has been an integral part of development aid. This is a very necessary humanitarian aspect of support to developing countries. Canada, for example, spent 16% of its aid budget on food aid (CIDA Expenditures 1983-1984). This aspect of aid, however necessary, unfortunately has minimal impact on the actual development of a country, or its future capacity to produce more food. The absence of the need for food aid would free considerable amounts of aid for other purposes, not least to increase agricultural production. After the long Sahel drought, the recent famine in Ethiopia and Sudan has demanded large specific food aid inputs, and there is no reason to believe that the future will see a decrease in the need for further food aid. Environmental problems will continue to cause fluctuations in the availability of food. While the worldwide scarcity of food in 1974 initiated discussions on a world food security system, little progress to achieve this security in food supplies has been made since then, despite the present surplus. The aid aspect of relief of immediate suffering will thus continue to divert aid funds from investment in increasing food production to meeting immediate needs. Recent recommendations emphasize the provision of food aid in such a way that it will stimulate rather than discourage local agricultural production. The income generated from the sale of aid food should be used for the stabilization of food prices in the cities while guaranteeing attractive prices as an incentive to farmers. Food aid can also be used in the form of wages, utilizing locally available labour to work on the long-term improvement of the agricultural production potential. One specific nonagricultural bottleneck identified is the lack of communications infrastructure especially

in poor countries. This not only makes it nearly impossible to provide food aid to remote areas, but it also hinders poor farmers' access to agricultural inputs such as seeds and fertilizers, and it denies the poor farmer the link to a marketing system to sell surplus crops and by-products.

AFNS from the beginning has concentrated on the type of research that will increase the availability of food to rural poor farmers. However, research in those countries affected by famine is often exceedingly difficult, and the long-term improvement of the food production capacity in these countries often has a lower priority for funding than immediate food purchases. As the realization by donor governments and private donors increases, that the short-term problems need a long-term, fundamental solution, more emphasis should in the next years be given to productivity, an area where AFNS already has the expertise and the potential to expand considerably, if the funds are made available. Its knowledge and past experience could play a leading role in establishing a more productive agriculture in those countries where famine is endemic.

Health and Education - Development in the area of social services, and especially in health and education, has been much more rapid than in the other sectors including agriculture. The rapid population growth is not unrelated to the early success in many aspects of health care, and the increase in literacy level in most developing countries is attribuable to the impact of the education systems established during the last 20 years. This situation, however, has created an imbalance since social services are costly and most developing countries do not have the means to afford them. The long-term positive influence of the progress made in health and education on the development of these countries on the other hand will be substantial. The availability of better local manpower at all levels of education will have an impact on such areas as research, administration and government policy. An improved health status should

increase the availability of labour into the production process, not least into agriculture. Thus, although the present burden of investment in social services is heavy, the returns in the near future should be great, although they may also bring faster population growth and unemployment of educated young people.

The role of AFNS in the health sector is an indirect one, focusing on nutrition as one of the most basic aspects of good health. As other health problems are brought under control, malnutrition is considered to remain one of the biggest health problems. The emphasis of AFNS on food production thus makes a direct contribution to better health, and better health in turn will help farmers to produce more. The ever increasing standard of education in developing countries is a particularly beneficial aspect to AFNS, as the pool of well-trained scientists capable of leading and conducting research is rapidly growing. The earlier investment in education by Third World governments as well as the AFNS training inputs are now beginning to show a return. The increasing contribution of these educated people in the fields of applied rural-oriented technology will in turn help to accelerate the output of technical improvements to the production processes, especially in agriculture.

Indebtedness - The rapid accumulation of debts by developing countries under easy terms has now reached a level where both the lender and the debtor countries are apprehensive about the future. The need for debt servicing and loan repayment by developing countries might be a top-level problem concerning only governments and banks, but policy decisions have to be made in response to this situation which affect every aspect of the economy. In order to pay interest and repay capital, the top priority among the debt-laden countries will be the generation of more foreign currency and thus funds will have to be diverted from other uses. This will make these countries expand the production of goods that have a market in the West, especially cash crops, natural resources, and minerals. The already

unstable supply-demand situation of these commodities can then quickly lead to oversupply and further reductions in price and thus income. To meet this repayment demand, resources will likely be diverted from such areas as food production, capital investment, and the improvment of services. Debt repayment will also limit the amount of foreign exchange present for the purchase of essential imports, especially manufactured goods, fertilizer, or machinery necessary to maintain or increase local production. One is therefore faced with a situation where the economy of a whole country is preoccupied with debt repayment at the expense of development, investment, and the needs of the local population. In such an atmosphere, agricultural research, education, and the concerns of the poor will have little place.

This relatively new phenomenon is expected to have a major negative influence on the future of AFNS. The preoccupation of many developing countries with debt repayment runs contrary to the mandate of AFNS, which stresses food production, subsistence agriculture, small-scale enterprises, and a focus on the rural poor. Policy decisions by debt-laden governments on the other hand will have to emphasize exports, and thus will be most interested in cash crop production on a large scale, on the export of raw materials and natural resources. Interest in AFNS-type research projects will thus be reduced and local support for agricultural research will have a low priority. This is anticipated to lead to increasing difficulties in conducting worthwhile projects in those countries that will be preoccupied with debt repayments.

Environment - One of the losers in the rapid development process has been the environment, where deforestation by logging or shifting cultivation, overfishing, and the expansion of arable land have had a severe negative impact. Similarily, the practices of overgrazing, tree cutting of firewood, and the excessive use of marginal land may have provided short-term benefits, but will produce long-term or

permanent losses. Many of these areas now require substantial inputs to reestablish what has been lost. On a larger scale, the pressure of the sheer number of people that need to feed themselves may change the environment globally to make it actually less productive. A number of fragile ecosystems have increasingly been destroyed or converted in order to produce food which has led to permanent damage of the land through soil erosion. The permanent degradation of marginal agricultural land and of watershed areas now demands a special effort to prevent further damage and restore degraded areas. Emphasis is now being given to the development of systems of optimum land use through watershed management, soil protection, and the combination of crop production, pasture, and forestry within one farming system. Thus, the stabilization of the environment, its improvement in some places, and halting its deterioration in others will become an increasingly important development aspect.

The realization that increasing pressure on the environment will cause a long-term reduction of the production potential has led AFNS to put increasing emphasis on environment-related aspects. The systems approach to agricultural research increasingly needs to take enviromental aspects such as soil and water into account. Emphasis is increasingly on trying to rebuild what has been lost, and here agroforestry projects to replace the destroyed vegetation and restore soil fertility are most important. Most "wild fish" resources are already overutilized and there is a need to protect and manage these resources while developing alternative methods for intensive fish cultivation.

This analysis, however brief, gave some of the major worldwide factors influencing development, and a look at shortcomings of the present development process is important for deciding future direction. IDRC, however small, is an integral part of the system and has to recognize the forces acting on the system if it wants to continue to make the impact that it has been able to make in the past.

B. INTERNATIONAL AID SITUATION

1. Donors

Before 1960, aid to developing countries was largely in the hands of the then colonial powers supporting their overseas possessions and the USA. At that time, aid amounted to USD 4.6 billion, of which the USA contributed almost 60%. Aid to developing countries only gained momentum after 1970--the amount doubled between 1970 and 1975--and again between 1975 and 1980. Since then, total Organization for Economic Co-operation and Development (OECD) aid has remained constant at about USD 27 million, but the contributions of different members have changed considerably. Countries such as the Scandinavian countries with no colonial history were not concerned with aid before 1960, but now make a considerable contribution, as does Japan. Since 1980, the aid contribution of a few countries has declined, especially the United Kingdom. This shortfall, however, was taken up by the increased contribution of Japan, the USA, and Canada, as well as many of the smaller donors, such as Italy, Finland, Australia, and Switzerland. With the advent of high oil prices, a new group of countries has been enabled to make a contribution to aid, and while many Organization for Petroleum Exporting Countries (OPEC) members are also developing countries, Saudi Arabia has become the second largest donor after the USA and several Gulf states make substantial contributions. Their sensitivity to the conditions of the world oil market, however, is affecting their aid which after reaching a peak of USD 9.6 billion in 1980, has dropped to USD 6.8 billion in 1982. (World Development Report, 1984).

The four major donor countries of the OECD--the USA, France, Germany, and Japan--together provide 68% of the total aid funds and thus play a major role in the development assistance of most developing countries. The role of OPEC development aid is less obvious and is

likely to be dominated by loans rather than technical assistance. The direction of aid flow is to a considerable extent controlled by traditional influence spheres of the main Western countries. Given these spheres of influence, the smaller European countries and Canada needed to find a place where the presence of the big four donors was not overwhelming. This has been the case especially in East Africa and the Caribbean, where the colonial influence was mixed, or where the former colonial power is not in a position to provide aid, such as in Zaïre or Mozambique.

Contribution to aid by OECD countries is often measured against their Gross National Product (GNP), and a somewhat optimistic original target set was to devote 1% of the GNP to aid. In 1983, the overall average was only 0.37%, influenced mainly by the low contribution of the USA (0.24%), which despite its high actual figure is rating poorly on this comparative basis. The only country to be above the target in 1983 was Norway (1.10%), while countries such as the Netherlands (0.91%) and Sweden (0.88%) are not far from it. Canada at 0.47% is above the average but far from the 1% target.

2. Aid Recipients

The Overseas Development Assistance (ODA) commitments of all sources to individual recipients reached a peak in 1980 with USD 44.2 billion, and has since been decreasing due to the stagnating contribution of the OECD countries and lower OPEC funding (Geographical Distribution of Financial Flows, 1984, OECD). This reduction was mainly felt by the "Upper Middle Income" countries, which received 27% less in 1983 than in 1980, and the "Lower Middle Income" countries which experienced a lesser reduction of 14%. In contrast the "Least Developed Countries" (LLDCs) and the "Low-Income" countries had relatively minor reductions between 1980 and 1981 and the amount of aid allocated to them has since leveled out. Regionally, the most marked decrease was in North Africa, the Middle

East, and South America. All other regions remained fairly steady, but considerable shifts occurred between the different countries of a region. The move away from aid to higher income developing countries in times of reduced availability of resources has thus made it possible to at least maintain the earlier input in the poorer countries.

3. Multilateral Aid

Aside from direct bilateral aid, country to country, there has been a growing contribution of multilateral aid. The main bodies here are the various programs of the United Nations concerned with development, such as UNDP, UNICEF, FAO, UNESCO, and WHO, and financial institutions, such as the World Bank and the several regional Development Banks, have also grown and make considerable contributions. Multilateral bodies that receive increasing aid have been the member institutions of the international agricultural research system (CGIAR), Food Aid, and the Refugee Programs. Much of this multilateral aid is utilized in such a way that the end results become tangible in individual countries, but is controlled by international bodies, who receive their operating funds from donors and distribute the benefits according to their specific mandate.

4. Canadian Aid

Canada started to become involved in development aid in 1965. The original allocation of USD 96 million, more than tripled by 1970 and tripled again by 1975, reaching USD 880 million. From then on, growth has been slower, leveling off at USD 1.2 billion in 1981, but has increased again to USD 1.4 billion in 1983. Canadian aid expressed as a percentage of the GNP reached a peak in 1975, at 0.54%, and has since dropped back to between 0.42% (1982) and 0.47% (1983). This places Canada in the middle ranks of the OECD countries, not as high as some of the smaller European countries, but well above the United Kingdom, Japan, and the United States.

Canadian aid in 1983-1984, largely allocated through CIDA, was $1,813.5 million. CIDA expenditures were largely directed through bilateral aid ($678 million, 37%), and to multilateral organizations ($675 million, 37%). Non-Governmental Organizations (NGOs) received $197 million (11%), IDRC funding reached $64 million (4%), and the remaining amount was largely taken up by administrative costs (5%). Direct food aid was part of several sectors, and amounted to $332 million (18%) of the expenditures (CIDA Annual Report, 1983-1984). Overall CIDA funding has kept in step with the increase of the GNP and after slower growth rates of around 5% in 1979 and 1980, the respective growth rate for 1981-1982 was 14.6%; 1982-1983; 12.2%; and 1983-1984, 7.9%. The allocation balance has shifted somewhat with a decrease of the government to government sector (from 43% to 37%) in favour of the multilateral sector (from 35% to 37%) and increases to both NGOs and IDRC. CIDA's multilateral aid component was directed to a considerable extent to contributions to international financial institutions (35%) and the United Nations (19%), while the rest supported several organizations for research, health, food aid, and refugees. CIDA's contribution to NGOs is distributed among over 100 different organizations involved in a variety of aspects of development, aid, or relief. Bilateral aid of CIDA, making the largest expenditure component, was largely directed to Africa (42%) and Asia (41%), with a lesser contribution to Latin America (14%).

C. CURRENT TRENDS IN FOOD PRODUCTION AND OTHER COMMODITIES

1. World Food Situation

The worldwide system of food production and consumption is influenced by a multitude of factors from climatic influences to the present state of the world economy. Despite fluctuations and regional differences, the overall world food production over the last 20 years has been increasing at a rate of about 2.6% per year, slightly faster

than the growth of the world population. For the individual person, this can be indicated as the number of calories supplied per capita per day, which has also increased, for the poorest countries, expressed in percent of the nutritional requirement; it rose from 91% in 1974 to 97% in 1981. For middle income countries, the same increase was from 107% to 111%, and for the Industrial Market Economies (IME) from 130% to 132%. These figures, however, cannot hide the fact that a considerable proportion of the world population remains much below the defined requirement, and that within each country a considerable segment of the population remains below the minimum level. Many of the poorest countries have remained static because the more significant gains were made among the middle income group. Thus, despite the encouraging trend of increasing food production, the inadequacy of these advances is evident, as is the fact that they are not made where they are needed most. While early increases in food production were largely the result of bringing additional land into production during the last decade, 50% to 75% of the increase in production can be attributed to the increase of yield, most pronounced in Asia and the North Africa/Near East region. This has been possible because of the better varieties and systems developed by the "Green Revolution" and to a lesser extent the increasing use of fertilizers, irrigation, and mechanization. This trend, however, has been less pronounced in Africa, and in Latin America is limited to wheat and maize.

Increased food consumption has not been based on higher local food production alone, but to a considerable extent on increased food imports. Net food imports by developing countries have expanded at an annual rate of about 15%. The largest growth has taken place in the North Africa/Middle East region, while net food imports in Asia have been declining. The increasing demand and use of imported staples is attributed to rapid urbanization, the significant availability of capital in oil-exporting countries, the financing of food purchases through aid, and the expansion of the availability of favourable long-term loans. This market demand has largely been met

by the producers of staple food commodities in the developed countries. Despite these new marketing opportunities, several Western countries continue to have unmarketable surplus food.

After the considerable success of the improvements through technological change that have been achieved in Asia, the area of major concern in food production has now shifted to Africa. The preconditions that made these advances possible in Asia, however, are not present in Africa, as infrastructure inadequacies hinder production, a poor marketing system reduces the prices to farmers, and labour productivity is low. Cheap food policies, competition of subsidized imported food, and the lack of inputs may be further disincentives to increased production. Despite this shift of attention to Africa, Asia continues to have the biggest incidence of poverty and malnutrition, indicating problems of access by the poorer segments of the population to increasingly available food resources. The trend to use more staples for animal feed to cater to a market demand for more expensive items also removes cereal from its use for direct consumption.

The world food situation is thus characterized by several serious problems:

a) the increasing production of cereals by Western countries to satisfy the demand of developing countries may well be a hindrance to indigenous increases in food production;
b) purchasing of this food has to some extent been based on credit that increased the indebtedness of Third World countries without improving their own future production potential;
c) the increasing use of marginal land for food production is further degrading this land, leading to a decrease in the global food production potential;

d) the poor performance of African agriculture and the success of technological innovation in Asia has shifted attention to Africa, but many of the preconditions that made inputs in Asia a success are not present in Africa; and
e) increasing food availability has not led to a more even distribution, and malnutrition has not diminished. Instead an increasing segment of cereal production is diverted into animal production.

To improve this situation there is a need for specific efforts to improve access to food for the poor. This is seen to be possible in a two-sided approach: on one hand, the answer is considered to lie in a decrease of the production cost of staple foods through improved marketing systems and better production technology; on the other hand, poor people can only gain access to food if they have the means to buy it, which can only come from the large-scale creation of employment. The present world food trade that seems to be of mutual benefit has some inherent weaknesses, not least that where loans are used. The increasing indebtedness will create future problems, and the use of foreign currency for food purchases prevents their use for investment into infrastructure or agriculture, investments that would improve the future internal production capacity. World food availability and especially the production of cereal staples are integral parts of the very complex world economic system and affect each person, especially the most vulnerable ones in the developing countries. The relative state of recession and recovery has an influence on tropical cash crops; oil prices and interest rates affect food availability and food prices. At the moment, the more positive economic situation, coupled with the significant strides in food production in some developing countries, especially in Asia, makes for a more optimistic outlook. The new challenge has now become Africa, where progress has been less marked, and the question of a more equitable distribution of the advances that have been made.

2. Cash Crops

Given the increasing demand for food in developing countries and some comparative advantage of production of these commodities by the developed countries, access to staple foods by poor countries depends to some extent on their purchasing power. Access to foreign currency to buy food is largely based on those commodities where tropical countries have an advantage, the production and sale of tropical industrial crops and the exploitation of tropical timber and fish resources. These commodities, however, are very sensitive to the supply and demand situation in their markets in the developed countries and thus on the relative vigour of their economies. The need for foreign currency for debt repayment, purchases of industrial goods, and further food purchases forces many developing countries into policy decisions that emphasize the expansion of cash crop production, that tends to lead to overproduction further depressing prices. However, especially in Latin America and Asia, the presence of a cash crop industry has been the driving force behind the establishment of a transport, marketing, and support system that then also benefited food production. The absence of such a support structure in Africa is considered one of the main limiting factors for increasing the production of food. Recent efforts in establishing a cash crop industry, for example cotton in West Africa, has proved to be a driving force to increase the production of food.

Thus, the strategy of purchasing food by selling cash crops is problemtic, and import substitution of food crops by expanding indigenous production would provide considerable long-term advantages.

3. Natural Resources

Natural resources, especially timber and fish, also depend on the international market situation, but their production is often under outside control. Poor countries generally do not have the means or

the expertise to make optimum use of their own natural resources and have to depend on industries outside their country, with the result that their own control is minimal and the bulk of benefits tend to accrue to the outside industry. This is especially the case with the new fishing opportunities provided by the Law of the Sea, which few developing countries are able to utilize to their own benefit. Many finite natural resources are now being overexploited; many fisheries resources are already fully utilized and further expansion will endanger the future availability of the resource. The world timber market is particularily sensitive to the world economic situation, as the construction industry, the major wood user, is vulnerable to an economic downturn. Competition in forestry is particularly strong, and although the resource is diminishing, exploitation of tropical forests will continue to be seen by many developing countries as a significant means of generating foreign exchange. The largest part of the natural resources utilization sector is large scale and industrial, and quite removed from the mandate of AFNS. Research here is of very low priority and the exploitative nature of these industries has in the past put little emphasis on resource management or resource replacement. There are, however, specific areas where poor rural people are affected. It is here that AFNS has concentrated its efforts and will continue to do so.

D. SUPPORT FOR AGRICULTURE

1. Development Assistance for Agriculture

Although the various statistics may not be compatible, they can still give some general overview of the situation. Total aid commitments, both loans and grants, by OECD in 1982 is given as USD 39.3 billion, while FAO gives USD 12.6 billion as the aid allocated to agriculture in the wide sense. Approximately one-third of the overall aid is thus directed toward agriculture. Advances made in the areas of

health, education, and communications may have allowed donor agencies to put more emphasis on agriculture. The growth rate of expenditure for agriculture was 10% per annum in 1978-1980, but slowed to 5% between 1980 and 1982. Between 1974 and 1981, the emphasis of agriculture-oriented aid has shifted, with increases for Asia (42% to 51%) and Africa (21% to 27%), and a large decrease for Latin America (24% to 13%). Food aid is included in these statistics and contributes about 25% of the total.

Although aid inputs to agriculture are substantial, developing countries also allocate part of their own budget to agriculture, and this amount is considerably larger than the aid component. In periods of recession, however, agriculture is one of the areas where cutbacks tend to be made. Between 1978 and 1982, expenditures for agriculture declined in 11 out of 21 African countries, but only in two out of eight countries in Asia. When budget cuts are inevitable, current expenditures tend to be maintained, with the result that little is left for capital expenditures. Thus, over the last five years, capital expenditures on agricultural development declined in most African countries. When the expenditures are compared on a per capita basis, few countries were able to increase their funding of agriculture faster than the growth of their population.

2. Agricultural Research

Agricultural research is generally only a small component of the overall expenditures on agriculture, as most funds are directed toward extension and new developments. Only six developing countries are considered to have a well-developed system of agricultural research infrastructure and staffing. A further 10 countries may be classified as reasonably staffed but poorly managed, while the other 40 countries that are of a size that would warrant a comprehensive national research system lack both the necessary manpower and infrastructure. There remain those countries that are too small to

justify their own programs, and these need at least adaptive research capability with links to larger research institutions in other countries.

The early efforts in the development of agriculture were generally directed toward establishing an agricultural extension service, with government officers allocated to specific rural areas or specific crops. Parallel to this, a system of farmer education evolved in many countries, be it through "Master Farmer Schemes" or demonstration farms. Even today, budgetary allocation to extension is almost double that agricultural research, especially in Africa. As the shortcomings of this approach have become apparent, considerable efforts have been made in the last decade to strengthen the research sector. There has been a rapid establishment of regional and international research organizations over the past 20 years.

These nonnational research centres have had notable successes in the production and release of high-yielding crop varieties that have made an impact on agricultural production where that crop was prevalent. As more centres were established, a level of cooperation and coordination has been called for, and this has led to the establishment of the Consultative Group on International Agricultural Research (CGIAR). In 1983, there were 68 agricultural research institutions in the Third World with an average annual budget of USD 9.3 million, the most prominent are the 13 agricultural research institutions of the CGIAR system (Non-National Institutions and Research for Third World Development, 1985, IDRC, OPE).

With the generation of these initial results, it was realized that if the new technology was to be adopted in other countries, then their national agricultural research systems were needed as an essential component both in localized adaptation research and in the dissemination of the new technology. Thus, increasing support has more recently been directed toward strengthening the national research

capability. Parallel to this effort, and despite the smallness of AFNS, it has been possible to influence the IARC system and, in conjunction with other organizations, to change their direction to a more applied and farmer-linked approach.

3. Consultative Group on International Agricultural Research System

The first international centre for agricultural research was established by the Rockfeller and Ford foundations in the Philippines in 1960, with its mandate for rice research. A similar institute working on maize and wheat in Mexico started as far back as 1943 and became an international centre in 1966. By the late 1960s, the World Bank, Food and Agriculture Organization of the United Nations (FAO), and United Nations Development Program (UNDP) decided to jointly organize their long-term support and to expand the international agricultural research system to cover other topics. This resulted in the formation of CGIAR in 1971, of which IDRC is founding member. The newly formed organization consisted of 15 donors providing a budget of USD 20 million to four research institutes. Aside from International Rice Research Institute (IRRI) and Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), the original institutes were the Centro Internacional de la Papa (CIP) in Lima, Peru, working on potatoes, and the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria. Since then the CGIAR system has expanded to 13 international centres; the latest one to be established was the International Service for National Agricultural Research (ISNAR) in 1980. The budget proposal for 1984 was USD 178 million, of which the original four institutes received an allocation of just over USD 20 million each, or 42%, while some of the newer ones have much lower budgets, especially the more pure science or administrative oriented ones.

The funding sources for the CGIAR organization are both individual Western governments and multilateral organizations and foundations. Individual countries contributed about 60% of the funds, of which the USA made up almost half. Several developing countries such as India, Mexico, Nigeria, and the Philippines have now also started to contribute modest amounts. Among the multilateral bodies, the World Bank is the major supporter with 11%, while UNDP, the European Economic Community (EEC), and OPEC provide lesser amounts. Under the more difficult economic conditions of the recent years and the slacking of initial donor enthusiasm, CGIAR may not be able to expand as fast in the future as it has in the past. Instead of starting new centres, a new concept of networks has been developed, where different centres with overlap in their work can assist each other. At the same time, many institutions have themselves become a centre of subsidiary organizations, specializing in one aspect or a specific geographical area.

The main achievements of the CGIAR system have come from the work of the first centres in the creation of high-yielding varieties of rice and wheat. These new varieties are now grown on over 30% of the production area of developing countries and have had a considerable impact on higher production and thus lower food prices and/or higher farm incomes. These new varieties however have mainly benefited those areas that had the benefit of easier access to inputs and support, such as an established transport system, farm credit and fertilizers, while a considerable segment of the population in the remoter areas was less able to profit from this new technology. The work of institutes that started more recently has not yet had a similar impact, largely because agricultural research may take 10 or more years between the initiation of a research project and the widespread adaptation of the new technology. At the same time, the earlier view that the successes with rice in Asia could be repeated in other parts of the world with any crop, if only the investment was forthcoming, was shown to be incorrect. It has been realized that rice in Asia

was only successful due to a number of factors that are not present in Africa. The approach therefore changed toward more emphasis on a systems approach, where a new technological introduction to be adopted needs a whole set of other conditions and therefore it is necessary to make these changes concurrent with the scientific work. Under this new approach scientists in many related research fields have increasingly started to work together to arrive at a joint solution. The system outside the scientific realm however has proven more complex and less progress has been made on including the farmer through the social sciences, the economy, and the political decision-making process.

4. National Agricultural Research Systems

The national research systems depend on several components if they are to be effective. In order to carry out cost-effective research, the agricultural research systems depend on linkages to scientists and organizations elsewhere to build on their knowledge and use their results. Within their country scientists need an extension system that links them to the farmers, both for the adaptation of new technology and as a feedback mechanism for evaluation and new opportunities. In their own research system there is a need for capital, infrastructure, staff, and recurrent expenditure to make it effective. Lack of results is almost invariably the result of a scarcity of these factors or a poor balance among them.

In most developing countries agricultural research is under the control of one ministry, but in some cases it is shared among several ministries, or several aspects of research relevant to agriculture are carried out under a wide variety of other ministries. This situation has induced considerable inefficiency in the use of scarce manpower, physical facilities, and equipment. The dispersion of responsibility has led to obstacles in adopting an intersectoral

approach and the neglect of research on farming systems. It also made it difficult to curtail the duplication of effort.

There is a wide range of research organization systems from full government control over a mixture of state and semi-autonomous institutes, to fully autonomous organizations. The main arguments in favour of delegating operational responsibility for research to autonomous organizations are that it provided for:

a) political independence;
b) involvement of all interested parties through a governing body, including representatives from research, planning, extension, farming, agroindustry, and politics;
c) simplification of bureaucratic controls and procedures;
d) management by objectives; and
e) more attractice terms and conditions of service for staff.

Although these systems did not always fulfill the expectations, on balance they appeared to be the most effective, despite a general reluctance by the Ministries to cede decision-making power to their governing bodies.

Aside from the government funded and/or controlled sector, some research in agriculture is also carried out by universities and the private sector. The latter has made a considerable contribution in the areas of fertilizer use, crop protection, farm mechanization, and veterinary care. Agricultural research by the private sector has been of importance in developed countries, although even there it has never substituted to any great extent for government-sponsored programs. It has had, as yet, little significance in most developing countries.

Where trained staff are in short supply, more efficient use could be made of available university staff and post-graduate students for

priority agricultural research which would help integrate them into the national research system. For example, in one situation the national university had three PhDs in Plant Pathology while the extensive national coordinated rice program had no plant pathologist. Many countries have more PhDs in the Faculties of Agriculture than in the agricultural research system.

The high-income countries of North Africa and the Middle East have 84.5 agricultural scientists per million population, while the same figure for middle-income countries is about 19, and the low-income countries of South Asia and Africa have only 13 scientists (Resource Allocations for National Agricultural Research: Trends in the 1970s, ISNAR/IFPRI, 1981). Expenditure on agricultural research shows a similar pattern, where per capita expenditure for agricultural research is lowest in South Asia with USD 0.15, while low-income African countries spend USD 0.44 and middle-income African countries USD 1.11. Comparable figures for high-income countries are USD 2.48 in Asia, USD 2.42 in North Africa/Middle East, and USD 1.38 in Latin America. The intensity of agricultural research in the national programs is therefore closely related to that country's relative wealth or GNP. A similar relationship exists for the allocation of technicians to scientists; it varies from 0.32 in Togo and Rwanda to 2.71 in Ghana and 3.61 in Malaysia, although labour cost and availability are local factors that influence the situation. Of more interest is the relationship between extension staff and scientists. A recommended ratio (World Bank) is 1:1, but in Africa it is 7:1, in South Asia 4.5:1 and in Southeast Asia 3:1. The Near East on the other hand has a ratio of exactly 1:1, while the figure for South America is 1:1.2, i.e., slightly more scientists than extension staff. The distribution of educational qualifications is another measure of the strength of national agricultural research. For example, Kenya has among its research staff 31% PhD, 33% MSc and 33% BSc degrees. Most other countries, especially the less-developed ones, would fit the pattern of Indonesia with 3% PhD, 5% MSc and 92% BSc. Reaching a high level

of education is less influenced by the relative wealth of a country than the emphasis on education going back to colonial times and early independence. Those countries where the general education system was slower or started later now note the fastest growth rates of the higher education level groups. The World Bank target of 20% PhDs, however, is a long way off, as the present overall distribution of education levels is 9% PhD, 27% MSc and 67% BSc.

In the national agricultural research systems the relative level of development, both in terms of economic strength and education, influences the strength of its present research capacity. This tends to become a reinforcing situation, where lack of finance and manpower for research means little progress in agricultural development, which in turn slows a country's overall development. However, the overall growth of the economy is generally not considered to be strongly related to the level of expenditures in research, but this is mainly attributed to the lag time of five to 15 years before the research results can be widely applied.

Direct funding by aid donors to national agricultural research has increased by about 13.5% per year, and has doubled from USD 250 million in 1975 to 500 million in 1980. The considerable funding needs of the new CGIAR institutions diverted some funds from the national research systems during their rapid expansion. With the recognition that the CGIAR research institutes depend on the national systems for adaptation research and dissemination of the new technology, funding has now regained a better balance. The growth rate of expenditures for agricultural research has been 7.3% for low-income countries between 1970 and 1980, while the figures for middle-income and high-income developing countries are 9.2% and 15.1%, respectively. The growth rate for the number of scientists on the other hand is most rapid for middle-income countries with a 8.5% annual increase, compared to 4.8% for the low-income group and 4.5% for high-income developing countries. While the overall expenditures on agricultural

research as compared to the GDP increased from 0.30% to 0.56%, several countries actually recorded a decrease, such as Zaïre (-5.2%), Sri Lanka (-3.8%), Peru (-4.5%), and Zambia (-3.2%). The five strongest countries account for 62% of the total research expenditures and 46% of the research manpower.

II. HISTORICAL PERSPECTIVES

A. MANDATE OF THE AGRICULTURE, FOOD AND NUTRITION SCIENCES DIVISION

1. Current Policy and Guidelines

When the International Development Research Centre (IDRC) was established through an Act of Parliament in early 1970, it was envisaged as something unique among international organizations. This uniqueness is still one of the main strengths of IDRC, and the approach of combining support for indigenous researchers with institution building and training is as appropriate now than it was in 1970. To fulfill the purpose for which IDRC was initially established, a hierarchy of guiding principles was set up, and Agriculture, Food and Nutrition Sciences (AFNS) developed its own guidelines set out in accord with the overall direction of the Centre. One of the main purposes of this document is the evaluation of the AFNS division's work over the last five years and a review of its policies and direction. Before this can be done, a brief review will be made of the mandate, mission, and objectives of the Centre.

The mandate of IDRC is "to initiate, encourage, support, and conduct research into the problems of the developing regions of the world and into the means for applying and adapting scientific, technical, and other knowledge to the economic and social advancement of those regions, and, in carrying out those objectives:

a) to enlist the talents of natural and social scientists and technologists from Canada and other countries;
b) to assist the developing regions to build up the research capabilities, the innovative skills, and the institutions required to solve their problems;

c) to encourage the coordination of international development research; and
d) to foster cooperation in research on development problems between the developed and developing regions for their mutual benefit".

IDRC's mission is to contribute to development through research and research-supporting activities. The Centre aims to assist in promoting the indigenously determined social and economic advancement of the developing regions of the world, with particular focus on the poorest people of those regions.

The principal objectives of IDRC are stated as follows:

a) to support research of direct relevance to Third World development and having direct demonstrable links to the basic needs of the poor; and
b) to assist developing countries to build indigenous research and research-supporting capacity, mainly at the national, but also at the regional level, and mainly in terms of human resources.

The guiding principles have thus been set out, and provide both the framework of the Centre's involvement in the development field and the reference against which the achievements of the Centre's work can be measured. These guidelines however are not absolute, and the degree of relative emphasis is left open. Decisions need to be made and continuously revised on such topics as the relative emphasis on applied versus basic research, emphasis on poor regions or nations versus poor groups within a nation, or relative emphasis on program and geographic distribution.

2. AFNS Mandate and Objectives

The original position paper that set out the mandate of the AFNS division dates from December 1971. Its content and emphasis are as relevant and important now as they were then:

> The program seeks to encourage and support research, development, and training designed to increase and improve the production, protection, preservation, processing, distribution, marketing, and utilization of agricultural commodities of plant, animal, marine, and forest origin. The scope extends to cover the transformation of these commodities and the development of related industrial technologies. It also embraces the production of food by synthesis or chemical modification of organic and inorganic substances.

The scope is intended to be vertically deep rather than horizontally broad. Rather than to dabble indiscriminately throughout the entire realm of agricultural, fisheries, and forestry commodities, AFNS is to concentrate upon comparatively few but well-defined ecological regions, agricultural commodities, and systems. The program seeks to encourage and support projects which are comprehensively integrated vertically and take equal cognizance of the consumer's need and the farmer's or fisherman's productivity.

Objectives - The specific objectives of the AFNS division were set out to be:

a) to identify and support programs in agriculture, food, nutrition, and consumer sciences destined to increase the income and improve the health and welfare of rural communities in the less developed world, and to promote research to this end by food and agricultural scientists and technologists in the less developed countries;
b) to provide food and agricultural scientists throughout the less developed world with improved opportunities and means to meet, to intercommunicate, and to cooperate in subjects of closely related research interest and activity;

c) to accelerate the rate at which the research findings of the international centres for food and agricultural research are translated into systems of technology relevant to the needs of and acceptable to rural communities, and to encourage and support studies on the impact of these technologies upon the material and physical well-being of the rural communities which endeavour to adopt them; and

d) to stimulate among Canadian food and agricultural scientists a greater awareness of and interest in international development and to mobilize relevant Canadian specialized knowledge and experience in support of programs and projects sustained by IDRC.

Objective a) places emphasis upon rural development, where the highest priority is assigned to projects in which scientific institutions in the less developed countries engage in operational and applied projects in close association with rural communities. Within all projects, a substantial training component is included, where under the guidance and advice of scientists and technologists from both Canada and the developing world, a wide range of practical training programs for technologists and technicians is made possible in the less developed countries, to enable them to more effectively apply new scientific knowledge and technologies to the greater overall benefit of their rural communities.

Objective b) seeks to increase the frequency and intensity of intercommunication and cooperation among food and agricultural scientists and technologists in less developed countries. The intention is to link a project with related projects in other countries, and to make it possible for the scientists in these projects to meet, observe, and discuss each others' activities. In this fashion, the division establishes a series of international networks of like projects. Intercommunication includes scientists from independent institutions not necessarily supported by IDRC, but known to pursue related research activities, and who, because of inadequate resources, are

unable to meet or cooperate in any systematic manner. By organizing meetings conducted in an informal atmosphere the scientists can exchange information relative to their research and identify opportunities and difficulties in their research field deserving a cooperative research effort.

Objective c) is concerned with the effective transfer of knowledge from the international research centres to the rural communities. Traditional, artisanal, and craft industries, the oldest of which relate to food and agriculture, are among those least influenced by modern science. Throughout the world, a considerable gulf of comprehension and credibility exists between the small rural farmers, fishermen, millers, and bakers on one side and the food and agricultural research scientists on the other. It is the purpose of the AFNS division to bridge this gulf by bringing scientists and technologists from less developed countries into close association with the international research centres, and to provide them with the resources they need to apply the centres' research findings to the benefit of their rural communities. Equally AFNS endeavours to interpret the needs of rural communities to the international centres and to evaluate the relevance of the centres' programs to these needs.

Objective d) relates to the greater involvement of Canadian food and agricultural scientists in international development. The primary aim is to give support to the initiatives and innovative skills of scientists in the less developed countries, and it is to them that AFNS assigns the major responsibility for defining, organizing, and managing projects. Nonetheless, applied research must often be preceded or sustained by specialized research studies, for which there are no facilities in the less developed countries. Scientists there often work in small and isolated groups, and need interaction with other researchers working on similar problems.

3. Program Strategy and Priorities

The strategy of the division is to support indigenous applied research carried out in close association with the rural communities who are to use and benefit from the research. Relatively few research institutions in developing countries possess the facilities and the resources to carry out research in adequate breadth and depth to make significant technological progress possible. Because of this the division is supporting more advanced research in international and regional research centres, research upon which national research programs can draw for new knowledge, improved techniques, superior materials, and training. Projects chosen for AFNS support at international and regional centres are directly relevant and complementary to specific research projects and networks, spread among several developing countries.

The division assigns its highest priority to the rural communities of the semi-arid regions of tropical Africa, Asia, and Latin America. Tropical Africa in particular, covering several anglophone and francophone countries, includes some of the poorest and most technologically underdeveloped rural peoples in the world. The Sahel drought and other more recent famines have made AFNS give even more attention to the semi-arid regions of the world, as the one specific environment where hunger and poverty are most prevalent. AFNS has thus put special emphasis on the sub-Sahara region, East Africa, and the northeastern part of the African continent. Yet the very poverty of these countries often hinders the actual successful carrying out of research and it is here that nonnational research centres are especially useful. Considerable work is now being done by IITA, the International Centre for Agricultural Research in Dry Areas (ICARDA), and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), being the centres with a special emphasis on semi-arid countries. The international centres have the ability to conduct very detailed, region-wide research, not feasible in most national centres.

The food and agricultural sciences in Canada are highly developed and many Canadian universities and government institutions can demonstrate an exceptional competence which spans a broad spectrum of knowledge and experience. The continued cooperation of universities and other centres of specialization provides the AFNS division and the projects with a more complete and comprehensive expertise than could be afforded by employing scientists permanently within the Centre. A decade ago, Canadian universities played a big role in training young scientists from developing countries. Now that the opportunities for training in developing countries have expanded, the role of Canadian universities in this aspect of development has been reduced. Instead their considerable experience and capacity in research and the contribution this could make to development is increasingly being recognized. The need to link more sophisticated research needs in developing countries with the proven capacity of Canadian universities has thus led to the establishment of the Canadian Cooperative Program. Under it, research is funded at Canadian institutions based on a recognized need from a research institute in a developing country. Often the work is shared and has frequently led to close cooperation between the scientists for their mutual benefit. Appreciating each others' contribution has in several instances led to the expansion of the original work and to the continued cooperation between such institutions outside of AFNS-funded projects.

Over the past five years, considerable changes have taken place in response to a shift in emphasis of the priorities within AFNS. The trend toward farming systems made it necessary to incorporate both the animal and the plant components into the new Crop and Animal Production Systems (CAPS) program, which has been a notable influence in changing the orientation of several research organizations toward farming systems. The realization that the objectives of AFNS are not automatically achieved through the generation of new technology has led to more emphasis on the economic aspects of research and the

application of research results. If technical innovations do not bring an economic advantage to the farmer, they may not be considered to have reached the set objectives.

B. PROGRAM DEVELOPMENT AND DELIVERY

1. Program Growth and Expansion

AFNS began with a philosophy of supporting research projects, led and managed by indigenous scientists in the developing world. Such projects were usually relatively small and their scientists often young, needing sympathetic encouragement and advice. The target population was the small cultivators of the developing world, especially its subsistence farmers, and the semi-arid tropics were identified as an area of special need. The key requirement was to identify project leaders, local scientists who would be both qualified and available to undertake projects. As a result, AFNS is responsive rather than steering, and its evolution over the past 15 years is thus as much a function of outside influence as internal decision making. AFNS had its mandate, objectives, and strategies well defined from the start and these have not essentially changed. They were, however, formulated to fit its responsive role and allow considerable flexibility in emphasis and direction. The requests from researchers to which AFNS responds reflect priorities and interests of the scientists themselves, as well as their institutions and their government. On the side of AFNS, one major influence on growth and expansion has been the resources made available to the division. A shortage of program officers in many programs and regional offices has resulted in fewer projects generated from these areas than would be desirable. Despite this, there are far more requests for generally very valid research projects than there are funds available to AFNS. This causes the refusal of many projects and restrictions on others. The growth and expansion of

the AFNS division has thus been a mixture of setting priorities, making best possible use of the limited resources, and responding to outside changes of emphasis and direction.

Crops and Animals - The concerns of agriculture have been central to the AFNS division from the start, where its initial involvement in research projects with IRRI on rice and CIMMYT on triticale set the direction for its crops research program. Livestock was the other discipline supported early, with emphasis on root crop/livestock projects and pastures. The program "Rural Development Systems" reflected the emphasis on a systems approach and the anticipated support of several new rural development systems projects. By 1973-1974, the three programs were almost the same size. The crop sector in the initial years was not only a participant in the founding of some new international agricultural research centres, but contributed to their operational funding. In 1975-1976, however, policy changes phased out direct support for the centres and replaced this with funding for specific project-oriented work. At the same time, the crops program defined its major areas of emphasis as the semi-arid tropics and neglected crops, moving away from rice and wheat. "Rural Development Systems" changed to "Rural Farming Systems" after an evaluation and the use of by-products for animal feeds became a new topic for the animal program. In the following year, the separation of crops and systems was no longer considered useful and the two became a new program: "Crops and Cropping Systems" in 1976-1977. This reflected the start of a continuing trend toward integration and away from single-crop research.

After five years of operation, AFNS saw new needs and was able to respond to them. The results achieved by the institutions of the CGIAR system were not being disseminated as anticipated; an important new task for AFNS was to focus on stengthening the national research systems and on assisting in the dissemination of the results achieved by the International Agricultural Research Centre (IARC). The

linking of scientists and institutions involved in similar work was another new need and AFNS responded through the establishment, support, or funding of several networks. When the "Animal Production Program" found that the animal component of its root crops/animal feed projects was diminishing, the root crops research was taken over by the Crops program, thus increasing its already considerable size further. By 1980-1981, the Crops program continued its move toward a systems approach and started to look at integrating some projects in crop production with animals, forestry, fisheries, or post-harvest technology. Emphasis on the major cereals continued to decline, while work was increasing on oilseeds, minor crops, and legumes. During this period, the Animal Production program kept concentrating on pasture improvement and the use of by-products, but shifted its emphasis away from the introduction of exotic breeds to the improvement of locally adapted animals. The animal health component had never been strong and only very few specific health-related products were funded. New areas of involvement were added to the Crops program in 1982-1983, with the inclusion of bananas and the specific crops of the Andean region, as well as a soil and water group. Animal production moved towards cooperation with Forestry in projects on fodder trees. Finally, in 1984-1985, in response to increasing overlap and systems emphasis the Crops and the Animals programs were joined to become "Crop and Animal Production Systems". This is now the largest program with over 60% of the division's budgetary allocation and 13 subgroups.

Food and Nutrition - The initial makeup of AFNS contained two food related programs, Food Processing, and Food Protection and Storage. In the last 15 years, they have evolved most and already by 1973-1974 the programs changed to Nutrition and Home Sciences. For several years, their budget allocation was very small, and few projects materialized, while the projects concerning post-harvest technology were at this time under the Crops program. In 1974-1975, these activities were taken over by the Food program, which changed its

name to "Food and Nutrition Sciences" reflecting the new component of post-harvest technology. During the following years the considerable problems of developing countries in post-harvest loss prompted a strengthening of these aspects. At the same time, the absence of research institutes, faculties, and scientists in home sciences and nutrition in developing countries made the generation of projects in these areas difficult, despite the increasing emphasis on women. Nutrition in its "Western" definition of quality, nutrient distribution, and food additives was also found less relevant to developing countries than simply the amount of food available, an area where CAPS and Fisheries were active. This led to the main involvement of the program in post-production aspects, until in 1978-1979 the name of the program was actually changed to "Post-Production Systems", which continued to include aspects of nutrition and home science. Here food processing, drying, and storage of agricultural produce became major topics, and more emphasis was put on the post-production food system as a whole, rather than on component technology.

By 1982-1983, this program was able to establish rural processing technology that provided not only food in a consumer acceptable form, but this new processing system became an incentive to increasing agricultural production and the establishment of a rural manufacturing and processing industry. In the last years, the program has continued to put more emphasis on energy topics related to the storage, preservation, and drying of crops.

Fisheries and Forestry - These two programs were established somewhat later than the initial Crops program and have remained relatively unchanged over the period, although emphasis on various subsectors has altered. The Fisheries program from 1973-1974 onward made aquaculture a main area of interest, and by 1976-1977 also was involved in the utilization of by-catch and fish processing. The main areas of aquaculture concerned the growing of molluscs and the

induced spawning of fish suitable for culture, the main bottleneck to aquaculture. Major breakthroughs in this area allowed a change of emphasis toward the establishment of better technologies for fish production systems and mariculture. Most recently coastal fisheries and a focus on high-priced species for sale rather than home consumption have become more prominent.

In Forestry, the early direction was toward the afforestation of semi-arid areas and the utilization of secondary and often wasted tree species. By 1975-1976, a new emphasis on the use of trees in agriculture was the start of involvement in an area of forestry research that has increased in importance since then, especially through the funding of ICRAF since 1979-1980. Further opportunities during this time involved the improvement of tropical tree species and the growing of trees for food and forage. By 1980-1981, the Forestry program saw its main activity in the area of social forestry to help poor rural communities with the provision of fuel, fruit, and fodder. Its links with agriculture became closer through work on agroforestry systems and more recently through projects on environmental protection.

Agricultural Economics - Concern for the acceptability, value, and profitability of newly generated technology became more prominent, once the early research projects had achieved their technical goals but still did not have results appropriate, economically and socially, to the production system. This led, in 1978-1979, to the establishment of the Agricultural Economics Group. This group had no separate budget, but was to be part of many projects of the other programs, covering aspects of project economics, project evaluation, and program analysis and planning. In 1983-1984, due to its main focus on post-production economics, the AEG became part of the Post-Production Systems program, within which funds were allocated to actual economics projects. In 1984-1985, the economic section became

the full Agricultural Economics program, but continued its former role of providing an economic component to the other programs at a much earlier point in the research process.

Canadian Cooperative Program - At the United Nations Conference on Science and Technology for Development (UNCSTD) held in Austria in 1979, the Government of Canada announced the adoption of a policy encouraging the application of Canada's domestic research and development capability to the solution of problems of developing countries. IDRC was invited to become the focal point of this new activity. In order to define the role and priorities of this new program in agricultural sciences, the AFNS division held a Symposium in Ottawa in November 1980. The symposium participants included Canadian scientists of disciplines related to agriculture and food from universities and government departments, together with researchers from developing countries and international agricultural research centres. An advisory committee was established to review all the research proposals submitted to the division for funding through this new program.

The Cooperative Programs were set up with these objectives:

a) to promote research collaboration between groups in Canada and those in the developing world, in the execution of projects that address problems of Third World development;
b) to develop the scientific and technological research capacity of the participating Third World institutions by improving their opportunities for collaboration with the Canadian part of the international scientific community;
c) to create channels of communication among scientists through which the results of successful research in Canada can be transferred to researchers in the Third World;
d) to influence the direction of Canadian research toward Third World concerns.

For the first two years, the Cooperative Programs' funds were administered through the AFNS Program Director's Office. A program officer was then appointed to be responsible for all cooperative projects of the division. More recently the Cooperative projects have been closely integrated into the regular programs of the division and the respective associate directors and program staff are closely involved in the development and monitoring of cooperative projects pertaining to their field of expertise. Through this program, Canadian researchers have excellent opportunities of making significant contributions to agricultural development in the Third World.

Networks - Initial research projects focused on a specific problem or a specific area, but with the establishment of the IARCs, with active support from AFNS, development research became much more intensive. The financial support of these centres was a specific item of the AFNS budget from 1973-1974 to 1976-1977, after which support for the centres became specific and project oriented, and linking them to farmers became more essential. By 1979-1980, it became clear that just supplying funds and materials to scientists in developing countries was not enough to achieve the anticipated results and that projects needed more support. To provide this, AFNS started to build networks between projects of similar work to enable mutual support and the exchange of information and materials. Several of the networks were provided with a full-time coordinator, but the program officers in field positions remained instrumental in supporting existing networks and establishing new ones.

2. Program Structure and Administrative Organization

Over the review period, AFNS has changed considerably in response to different needs and demands. The separation of Crops and Animals became less useful, and thus the two programs were merged into Crop and Animal Production Systems (CAPS). The increasing importance of

economic aspects of research led to Agricultural Economics (AE) becoming a new program. New opportunities for joint projects with Canadian institutions were opened with the establishment of the Cooperative Program. With these recent changes, the structure of the AFNS division now consists of five fully established programs, although their size and orientation differ considerably. While CAPS, Forestry, and Fisheries are largely the initial independent programs, PPS, AE, and the Cooperative Program have a considerable support component to those three other programs. The relative strength and regional orientation of the AFNS division can best be shown by the number of projects approved over the last five years by program and region (Table 1). Depending on its specific orientation, each program is subdivided into components. This is especially apparent in CAPS, where each group of crops or animals forms a program subdivision. To a lesser extent, the other programs have their own subdivisions as well, and within their program will allocate levels of priority to each for every region depending on need and importance.

The organizational structure of the division was changed in 1984-1985 and the division management group now consists of a director, a deputy director, an assistant director, an executive scientific assistant, and an operations group of five administrative staff and six secretarial staff (Table 2). The deputy director assists the director in all technical matters related to program planning and budgets; the assistant director assumes overall responsibility for office and project administration at headquarters and assists the director in personnel management and recruiting. Directly responsible to the director are the five associate directors in charge of the different programs. Of these, two are located in regional offices, two at the IDRC Vancouver office, and one in Ottawa.

In order to develop and manage the programs of AFNS more effectively, it was considered desirable to have a significant proportion of staff live and work in close proximity to the recipients. This serves not

TABLE 1

NUMBER OF PROJECTS BY PROGRAM

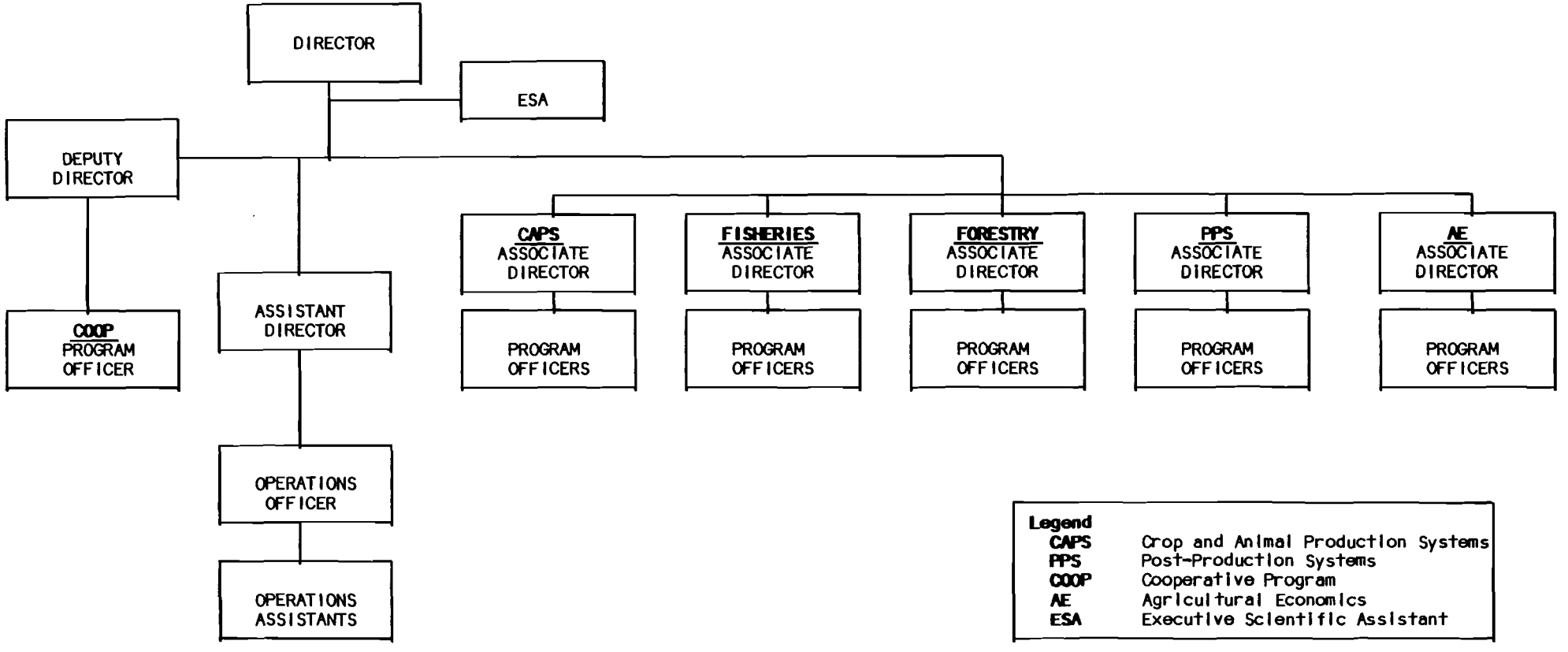
	1980-81	1981-82	1982-83	1983-84	1984-85	Total
CAPS	30	27	39	37	39	172
Fisheries	6	7	9	7	8	37
Forestry	10	8	13	16	16	63
PPS	21	13	13	19	14	80
AE	--	--	--	--	6	6
Cooperative Program	--	5	5	7	8	25
Energy	--	--	1	1	1	3
Total	67	60	80	87	92	386

NUMBER OF PROJECTS BY REGION

	1980-81	1981-82	1982-83	1983-84	1984-85	Total
ASRO	12	20	21	17	19	89
EARO	10	8	13	14	19	64
LARO	20	11	20	21	17	89
MERO	11	3	5	9	8	36
SARO	5	5	10	5	4	29
WARO	7	7	5	15	14	48
CANADA (Ottawa/ Vancouver)	1	5	5	6	9	26
GLOBAL	1	1	1	--	2	5
Total	67	60	80	87	92	386

TABLE 2

AFNS ORGANIZATION CHART, 1985-1986



only to increase project management effectiveness, but it also enables staff to better understand and follow developments affecting science and technology policy and the implementation of these changes in the less developed countries. The number of program staff based in the regions increased from five in 1980-1981 to 24 in 1985-1986. There are now growing demands for project support to improve research capability in West Africa and Southern Africa Development Co-ordination Conference (SADCC) region, and the division will give priority for staff expansion to the offices of these regions. CAPS as the largest program has 10 officers, of which eight are placed overseas, with two officers each in ASRO, EARO, and LARO regions. Forestry and PPS have five officers each in the field; both lack staff for the MERO region although several forestry projects are active there. Fisheries and the new AE program have only three staff each overseas and have thus had to place only one officer each in Asia, Africa, and Latin America. The Canadian end of the Cooperative Program is looked after by two officers in Ottawa, while in the regions it is in the hands of specific program officers. Thus, of the present 30 program officers, 24 are in regional offices, four in Ottawa and two in Vancouver.

Although the programs of IDRC are organized along disciplinary lines, regional offices constitute an integral part of the Centre's operations. Regional offices have a number of important roles and tasks, some externally oriented but others more related to internal management:

a) to be the Centre's representative in the region and to support and publicize the Centre's objectives and program activities;
b) to ensure for each country that procedures are followed and clearances obtained for the submission of AFNS proposals and for the sending of grant letters to recipients;

c) to assist in the day-to-day administration of projects and other program activities, and to assist in all aspects of administering AFNS project advisors located in the region;
d) to assist Centre divisions in tasks with a definite regional component such as screening of applicants for training awards, and identifying key institutions which could benefit from a co-ordinated Centre program; and
e) to advise Centre management of important matters of political, economic, or other geographical impact in their regions as they might affect present or future IDRC activities.

It is the Centre's policy to delegate administrative authority for program management to regional offices in order to improve administration, cost effectiveness, and overall efficiency. The pace of such devolution and the degree of autonomy of staff in regional offices may vary from location to location depending on size of staff, infrastructure, communications efficiency, and local regulatory practices. The Regional Office Fund (ROF) permits the regional director to respond promptly and independently to a broad range of important requests from individuals and organizations concerned with research and development-related activity in their region.

While AFNS does not allocate its funds primarily on geographic criteria, an overall goal is to allocate the appropriate levels of resources required for balanced growth and maintenance of the different regions. This has not yet been achieved, but hopefully the number of AFNS staff at each regional office will reflect the program priorities and the needs and characteristics of the region served.

3. Financial and Personnel Resources

From the beginning of IDRC in 1971, considerable emphasis was given to AFNS, which at that time received 34% of the overall budget

(Table 3). Within AFNS, the main activity was concerned with agriculture and CAPS had the major share of the AFNS budget (59%). Since then, a trend of diversification within both AFNS and IDRC has seen the expansion of various other programs. As a result, AFNS has, over the three five-year periods, seen its share of the overall budget diminish from the initial 31.2%, over 30.5% to the present 27.1%. A similar but more marked trend is evident within AFNS, where CAPS in the first five-year period received 61.0% of the AFNS budget, but decreased to 56.5%, and in the last five years to 45.7%. Although the last two years are budgeted figures rather than appropriations, they show a further decrease in the share of CAPS and the increasing allocation of funds to the Cooperative Program, in which, however, about half relate to AFNS projects.

Of more significance is the decreasing share of AFNS in the overall IDRC budget. Here the funding resources of IDRC have increased considerably over the recent five years, from $49.9 million in 1980-1981 to $104.1 million in 1984-1985, giving an annual increase of 20.2%, while the appropriations for AFNS for the same period only increased by 10.9%. This has caused the AFNS share to slip from 29.4% in 1980-1981 to 27.6% two years later. The two most recent budgeted figures show even larger decreases to 25.7% and 24.9%. If the regular programs of AFNS only are compared to the overall IDRC expenditure, the decrease is even more evident. In 1981-1982, the AFNS normal programs received 24.6% of the overall IDRC budget, but this share declined to 22.0% in 1983-1984, and the budgeted amounts for the financial years 1984-1985 and 1985-1986 show further declines to 18.3% and 16.8% respectively. This indicates that other sectors of IDRC are growing more rapidly than AFNS and that the division is in danger of losing the prominent position that it rightly held in earlier years. There are, however, a number of projects and activities of other divisions that support the work of AFNS, but they are more difficult to quantify. These include the production of AFNS publications by the Communications division, the energy projects,

TABLE 3

AFNS APPROPRIATIONS ($'000)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984*	1985*
CAPS**	1,147	3,006	4,050	4,775	8,307	6,520	7,553	7,861	6,928	8,556	9,188	11,318	12,502	11,500	10,100
Fisheries	441	--	635	1,180	577	1,179	1,915	969	1,191	1,454	1,708	1,975	1,895	1,660	2,000
Forestry	--	393	565	1,828	1,073	1,580	1,237	735	1,039	1,643	2,466	2,782	3,489	3,100	2,800
PPS**	11	--	693	392	948	1,201	494	1,458	1,866	2,238	1,573	1,978	2,694	2,290	2,100
AE	--	--	--	--	--	--	--	--	--	--	--	--	--	500	1,265
Total Programs	1,599	3,399	5,943	8,175	10,950	10,480	11,199	11,023	11,024	13,891	14,935	18,053	20,580	19,050	18,265
Cooperative Program	--	--	--	--	--	--	--	--	--	--	500	695	1,538	3,400	4,000
DAPs	64	238	456	417	658	333	217	205	185	224	289	305	517	725	725
Technical Support	--	--	--	--	--	--	--	--	1,137	1,325	1,607	2,084	2,397	2,800	3,100
Division Management	283	374	598	778	990	1,115	1,309	1,442	474	562	564	727	781	853	965
Total AFNS	1,946	4,011	6,997	9,370	12,553	11,928	12,725	12,670	12,820	16,002	17,895	21,864	25,813	26,828	27,055
Total IDRC	5,650	13,432	22,581	32,313	38,102	39,150	43,016	42,948	41,783	49,892	60,784	74,394	93,517	104,148	108,764

* The most recent figures are budgeted rather than appropriations.

** The components of these programs have been rearranged over the period, and had to be combined for the early years.

training support of various levels of staff in AFNS-funded projects by the Fellowships and Awards Division, and collaboration between AFNS and various sections of the Social Sciences division in a number of projects.

In its early years, AFNS concentrated its work in Latin America and East Asia, but increased emphasis more recently toward the semi-arid regions has seen a gradual decline of these two regions in favour of tropical Africa. Despite this, the five-year average allocation by region still shows LARO receiving 26.2% and ASRO 20.5%, while the two African regions EARO and WARO receive 18.2% and 11.6% respectively. If the regional offices, however, are combined, Asia receives approximately 33%, Africa 36%, and Latin America 26%, while the remaining support is funding global projects and the Cooperative program.

The professional technical staff of AFNS forms the pivot of the division, as they are the key to generating new projects and supporting existing ones. Their professional capability, dedication, and efficiency have a strong influence on the type, quality, and number of projects that AFNS supports. AFNS is proud to have such a highly motivated and qualified cadre of professional staff, with considerable experience in the different fields. Thus, 69% of AFNS staff have over 20 years of professional experience and 16% have over 30 years. Nineteen percent (6) of AFNS professional staff have over 10 years service with IDRC and another 10 betweeen five and 10 years. Like the professional experience, the education level shows the same high calibre, where 22 staff have a PhD (69%), six are at the MSc level and four have a BSc. Work in an international environment also demands proficiency in languages, and here all staff speak a second language, while 21 can also work in a third and 10 in a fourth language. Seventeen, or 53% of AFNS staff are Canadians, while nine are citizens of a developing country, and six come from other developed countries. This picture of the AFNS professional

staff shows the high level of experience and professional competence which is even more notable because the number of staff has increased recently. The list of AFNS personnel in 1984-1985 with their position and location is given in Table 4.

In the first full year of operation, 1971-1972, AFNS had a total staff of 16 of which just over half were management and technical staff (Table 5). Periods of relatively constant staffing levels were followed by rapid staff expansions in 1976-1978 from 30 to 37, and in 1983-1985 from 43 to 52. Thus, the staff total in the present financial year, 1985-1986, is 52, of which 35 are at the management and technical level. Staff expansion thus mainly focused on an increase of technical officers, from eight in 1971 to the present 34, a fourfold increase, while support staff rose at a much slower rate, from seven to 17. The main recent change has been the placement of project officers nearer to the recipients by stationing them at regional offices. This was achieved by closing the Edmonton office where four PPS staff were located, and reducing the technical staff based in Ottawa. During the first 10 years of AFNS, the number of staff in positions in developing countries was limited to around five, or about one quarter of the technical staff. Over the last five years, however, each year saw the placement of additional technical staff in the field (Table 6). Today of 34 technical and management staff, 24 are placed in the various regional offices, which means that 77% of technical staff are now in field positions, including two of the five associate directors. The largest increases were in CAPS from six to 11 and the Forestry program from one to five, while the newly created AE program has now four officers.

The success of any project depends very much on the technical staff in the field and the amount of encouragement, supervision, and

TABLE 4

AFNS PERSONNEL
POSITION/NAME/LOCATION

Division Management

D	H. Zandstra	OTT
DD	G. Lessard	OTT
ASD	R. Hallam	OTT
ESA	L. Wagner	OTT
OO	M. Beaussart	OTT

Support

OA	S. Dillabough	OTT
OA	D. MacDonald	OTT
OA	K. Daley	OTT
OA	L. Ormsby	OTT
S	J. Cardin	OTT
S	D. Lapointe	OTT
S	J. Allard	OTT
S	J. Feyes	OTT
S	B. Ruddy	OTT
S	K. McNeil	OTT
C	B. Lalonde	OTT

TOTALS

Division Management:

Professional Staff	5
Support Staff	11

Division Programs:

Professional Staff	30
Support Staff - Canada	7
Support Staff - Overseas	29

LEGEND

D	Director
DD	Deputy Director
AD	Associate Director
ASD	Assistant Director
SPO	Senior Program Officer
PO	Program Officer
ESA	Executive Scientific Assistant
OO	Operations Officer
OA	Operations Assistant
S	Secretary
C	Clerk

Division Programs

Agricultural Economics

AD	G. Banta	VANC
PO	M. Collion	WARO
PO	G. Escobar	LARO
PO	C. MacCormac	ASRO

CAPS

AD	G. Hawtin	VANC
SPO	A. Ker	OTT
SPO	R. Kirby	EARO
SPO	H. Li Pun	LARO
SPO	N. Mateo	LARO
PO	C. Devendra	ASRO
PO	J. Kategile	EARO
PO	K. MacKay	ASRO
PO	G. Potts	MERO
PO	K. Riley	SARO

Cooperative Program

PO	A. McNaughton	OTT
PO	P. Stinson	OTT

Fisheries

AD	B. Davy	ASRO
PO	R. Buzeta	LARO
PO	H. Powles	WARO

Forestry

AD	D. Webb	LARO
PO	R. Ayling	EARO
PO	K. Oka	SARO
PO	C. Sastry	ASRO
PO	A. Zaki	WARO

Post-Production Systems

AD	E. Weber	OTT
PO	M. Bassey	WARO
PO	D. de Padua	ASRO
PO	B. Edwardson	LARO
PO	O. Schmidt	EARO
PO	R. Young	SARO

Support

S	M. Fernandez	VANC
S	M. Kovesi	OTT
S	J. Sawatzky	VANC
S	C. Lafoley	OTT
S	M. Turner	VANC
S	K. Stubbs	OTT
S	Vacant	OTT

TABLE 5

AFNS STAFF BY EMPLOYMENT LEVEL AND POSTING LOCATION

(STAFF UNDER DIRECT AFNS BUDGET ONLY)

Staffing Level	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Division Management	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Technical Staff	8	9	12	16	12	17	21	23	20	19	23	26	27	34	34
Support Staff*	7	8	9	11	7	12	15	12	17	17	18	16	15	17	17
Total	16	18	22	28	20	30	37	36	38	37	42	43	43	52	52
Professional Staff															
Overseas	4	5	5	5	3	6	9	9	8	7	9	14	20	22	24
Canada	4	4	7	11	9	10	11	12	10	11	11	10	6	7	6
Total	8	9	12	16	12	16	20	21	18	18	19	24	26	29	30

* Excludes support staff in the regional offices, who are funded through the regional offices' budget.

TABLE 6
AFNS PROFESSIONAL STAFF APPROVED POSITIONS IN 1980-1981 AND 1984-1985
BY PROGRAM AND REGION

	H.Q.		VANC		EDMONTON		ASRO		EARO		MERO		LARO		SARO		WARO		TOTAL	
	1980-1985		1980-1985		1980-1985		1980-1985		1980-1985		1980-1985		1980-1985		1980-1985		1980-1985		1980-1981	1984-1985
CAPS	2	1	-	1	-	-	-	2	1	2	1	1	2	2	-	1	-	1	6	11
Fisheries	-	-	1	-	-	-	1	1	-	1	-	-	-	1	-	-	-	1	2	4
Forestry	1	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	-	1	1	4
PPS	-	1	-	-	4	-	-	1	-	1	-	-	-	1	-	1	-	1	4	6
AE	-	-	-	1	-	-	-	1	-	1	-	-	1	-	-	-	-	1	1	4
Cooperative Program	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1
Research	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	4	0
Total 1980-1981	5		1		4		2		1		1		3		0		1		18	
Total 1984-1985		3		2		0		6		5		1		5		3		5		30

Total Canada 1980-1981: 10 (55.6%)
1984-1985: 5 (16.7%)

Total Overseas 1980-1981: 8 (44.4%)
1982-1985: 25 (83.3%)

support a project receives from the relevant program officer. The closer contact that decentralization has brought should thus have a beneficial influence on the performance of all projects. With the placement of program officers in the regional offices, support staff for them was also needed in the new locations. Support staff in Canada come under the AFNS budget, but the regional offices are funded under a separate budgetary item. Under this budget, there are now support staff for AFNS project officers in the regions comprising five project administrative assistants and 24 secretaries. This changeover has removed part of the support staff funding from the AFNS budget and is providing employment in the developing countries where the regional offices are located.

The workload of each staff member has to be a balance between looking after the active projects in his field and the generation of new ones (Table 7). Overall, the 27 present staff are looking after 346 active projects and thus have the responsibility of 12.8 projects per technical staff, a considerable increase from 8.8 in 1980-1981. This average figure, however, varies considerably: each CAPS officer looks after 16.4 projects, while for PPS the equivalent figure is 10.7. AE, having just started, does not have many projects yet, and is concentrating on setting up new ones and making a technical input to current and new projects in other groups. Among the regions, ASRO, EARO, MERO, and SARO have about 15.5 active projects per officer, while LARO with 11.8 and WARO with 8.7 are lower.

The generation of new projects is an important task of project officers. The 27 officers submitted a total of 114 new projects in the last financial year, an average of 4.2 new projects per officer. This has also increased over the level five years earlier, when 3.7 new projects were generated per officer. Forestry and PPS have lower rates (3.3) than CAPS and Fisheries (4.7). EARO generated the most new projects per officer with 5.3, while the equivalent figure for MERO and ASRO is 4.0, LARO 3.8, and WARO 3.7. In general, the

TABLE 7

PROGRAM STAFF AND PROJECT GENERATION BY PROGRAM
FINANCIAL YEAR 1984-1985

	Staff	New Projects	Average/ Staff	Active Projects	Average/ Staff
CAPS	9	42	4.7	148	16.4
Fisheries	3	14	4.7	37	12.3
Forestry	5	17	3.4	60	12.0
PPS	6	19	3.2	64	10.7
AE	3	8	2.7	10	3.3
Cooperative Program	1	14	14.0	27	27.0
Total	27	114	4.2	346	12.8

PROGRAM STAFF AND PROJECT GENERATION BY REGION
FINANCIAL YEAR 1984-1985

	Staff	New Projects	Average/ Staff	Active Projects	Average/ Staff
CANADA	6*	31	5.2	64	10.7
ASRO	5	20	4.0	78	15.6
EARO	4	21	5.3	61	15.3
MERO	1	4	4.0	15	15.0
LARO	6	23	3.8	71	11.8
SARO	2	4	2.0	31	15.5
WARO	3	11	3.7	26	8.7
Total	27	114	4.2	346	12.8

* Of six technical staff in Canada, three are associate directors with global responsibilities.

workload has shifted toward more active projects per officer, while the generation of new projects has increased less rapidly. The increase in both shows a considerably higher overall workload per officer now than five years ago.

4. Dissemination of Research Results and Publications

The dissemination of research results provides a vital link between the scientist and the farmer in the adaptation of new technology. It can take place on a personal level through meetings and workshops bringing together scientists, technicians, and civil servants. Publications of results through pamphlets, handbooks, and manuals tend to address mainly the extension service as the main linking organization between scientist and farmer. Field days and short courses are often the means used for the dissemination of research results.

AFNS projects have in the past been largely concerned with the generation of new technology and dissemination has been a lesser concern. As more projects move into Phases II and III and start to generate results, the aspects of dissemination are becoming more important. From an analysis of 73 project documents over a 12-month period, it was shown that of a total appropriation of $20.9 million for projects, $496,000 (or 2.38%) allocated to dissemination (Table 8). Of this amount, more than half went toward the funding of meetings, seminars, and workshops. Direct involvement with the end user, the farmer or fisherman, received only $85,000 (17%) of the funds for dissemination or 0.4% of the overall project costs. Among the programs there are technical reasons for variation, as PPS has quite a different task disseminating its new technology than has CAPS. Allocation for dissemination is highest for CAPS and Fisheries, with 2.9% and 3.0% of the overall appropriation respectively. PPS is lower with 2.1% and Forestry records 1.7% of its project funds for dissemination. Naturally Cooperative Program

TABLE 8

PROPORTION OF AFNS PROJECT APPROPRIATIONS BY PROGRAM BUDGETED FOR DISSEMINATION ACTIVITIES

OVER A 12-MONTH PERIOD FROM JULY 1984 TO JUNE 1985

($'000)

Program	Number of Projects	Workshops/ Seminars	Publications	Farmer Training	Total Dissemi-nation	Total Project Cost	Percent Dissemi-nation
CAPS	35	219.6	56.5	57.6	333.7	11,337.8	2.94
Fisheries	8	29.2	11.9	14.9	56.0	1,853.7	3.02
Forestry	11	15.7	24.4	-	40.1	2,271.5	1.69
PPS	10	12.5	20.7	12.8	46.0	2,219.9	2.07
AE	1	-	-	-	0	166.0	0
Cooperative Program	8	-	20.0	0.5	20.5	2,941.7	0.70
Total	73	277.0	133.5	85.8	496.3	20,890.6	2.38
Percent	-	55.81	26.90	17.29	100.0		

projects, involved in more pure science oriented research, has a very low component of dissemination. CAPS and Fisheries have a high component of their funds allocated to workshops and seminars, while Forestry and PPS emphasize publications.

Publications are an important part of the dissemination process, and while most projects have their own small publishing component, the more formal types of publications are the responsibility of the Communications Division (Table 9). Over the past five years, this division has published 75 documents, with a total volume of over 6,000 pages (see Appendix III). The main two types of publications that AFNS and its staff make use of are manuscripts and proceedings (Table 10). The latter are mainly the documentation resulting from the various meetings, seminars, and workshops organized by the different AFNS programs; 27 were produced over the past five years. Manuscripts with 24 publications are almost as important. They are generally internal reports and preliminary technical reports and are not normally reviewed by peers nor edited. Monographs are more sophisticated documents of scientific research results; AFNS has published 15 such documents as well as nine technical studies.

Most AFNS publications are originally written in English (51 out of 75). Many of the more important ones are then translated. Some original documents are also produced in Spanish (9) and in French (15). The total number of documents produced per year has remained fairly constant between 12 and 17, but with the increased emphasis of the division on networking, the number of workshops and conferences has increased, and therefore, the proceedings-type documents also increased. The production costs remained fairly uniform, but the difference in type and length makes the budgeting difficult. Over the five years the Communications Division has spent $564,000 on AFNS related publications, but the annual amount has fluctuated between $78,000 and $148,000.

TABLE 9

AFNS PUBLICATIONS BY THE COMMUNICATIONS DIVISION

EXPENDITURE BY AFNS PROGRAM ($)

	1980	1981	1982	1983	1984	Total	%
CAPS	32,187	43,505	53,955	28,300	60,207	218,154	38.7
Forestry	18,910	7,065	3,356	3,850	42,675	75,856	13.4
Fisheries	21,230	14,005	84,653	20,570	7,825	148,283	26.3
PPS	330	16,600	3,250	21,750	1,700	43,630	7.7
Other	29,019	13,565	650	--	3,100	46,334	8.2
(Nutrition)	16,645	115	--	--	--	16,760	3.0
Other Expenses	200	500	2,000	4,120	8,200	15,020	2.7
Total	118,521	95,355	147,864	78,590	123,707	564,037	--

Most AFNS publications reflect the specific fields of involvement and show some of the important work being done. CAPS publications are concerned with tropical root crops and with farming systems, while Forestry's emphasize shelterbelts and bamboo. Fisheries publications mainly cover fish breeding and oysterculture and PPS has produced publications on sorghum milling and crop drying. These are all areas where AFNS for some years has made a concentrated effort and where considerable results have been, and are still being, produced. These publications thus are a record of this work and serve to make these topics more generally known and the newly developed technology more widely adopted.

TABLE 10

AFNS PUBLICATIONS BY THE COMMUNICATIONS DIVISION
NUMBER OF PUBLICATIONS FOR THE CALENDAR YEARS 1980-1984
BY TYPE OF PUBLICATION, LANGUAGE, AND PROGRAM

	1980	1981	1982	1983	1984	Total
Monograph	2	6	4	1	2	15
Technical Study	2	4	--	--	3	9
Proceedings	4	5	6	7	5	27
Manuscripts	4	2	3	9	6	24
TOTAL	12	17	13	17	16	75

BY LANGUAGE

	1980	1981	1982	1983	1984	Total
English	11	9	9	10	12	51
French	1	7	2	4	1	15
Spanish	--	1	2	3	3	9
TOTAL	12	17	13	17	16	75

BY PROGRAM

	1980	1981	1982	1983	1984	Total
CAPS	4	1	7	4	7	23
Fisheries	2	4	2	4	2	14
Forestry	3	2	--	4	2	11
PPS	3	2	3	5	4	17
Other	--	8	1	--	1	10
TOTAL	12	17	13	17	16	75

5. Research Training

The funding of scientific investigation of problems of developing countries is the primary mandate of IDRC, but an integral part of this task is the training of staff of their institutions. It is important that local staff and institutions have the ability to carry on the work after the initial support of a project by IDRC has come to an end. The actual carrying out of a project provides valuable on-the-job training, but more formal training often proves indispensible, especially in those developing countries that do not have a cadre of capable scientists. This can take place as a first step in the preparation of a project, to bring project staff to the level of competence that is necessary for successful executionist. More commonly, periods of formal training take place during the project and sometimes after completion in order to solidify the practical experience gained. Aside from the formal degree or post-graduate training there are a multitude of less formal training needs, ranging from courses for technicians and extension officers to short-term visits by senior staff to other institutions involved in similar work. Two channels within IDRC support the training aspects of AFNS projects. The division usually supports the training component included in research projects, while the FAD supports a variety of generally more formal training through awards and fellowships. It also supports group training and pre- and post-project training related to the research activities of AFNS division.

Training as a Project Component - An important part of the project assessment by AFNS project officers is the level of expertise the work requires and the levels presently available. To assure the success of a project it is generally necessary to include a training component in project proposals. This has in recent years largely been aimed at middle-level staff rather than the project leader, as most developing countries seem to have a small cadre of highly

trained scientists, but lack depth at the levels immediately below. A similar shortage of training and ability often exists at the technician and supporting staff level. The two groups, however, have considerably different needs; so while the upper levels usually receive training at the academic level, technicians often are supported though a series of short courses on specific topics. In its second or third phase, when a project starts to disseminate its new technology, training needs also change and increased training inputs are necessary for staff involved in farmer teaching, extension, and even for farmers' courses.

Information on training has only been formalized on project documents during the last year and earlier data is difficult to extract. Where the training costs indicated are very low, it is likely that the costs are shared between the AFNS project and other donors, the research institution or the host government. Because information on such cost-sharing arrangements is not available, training cost figures tend to be lower. Analysis of this recent information shows that the training component in these projects was budgeted at $3.05 million on a total project cost of $30.1 million for AFNS in that period, giving an average of 10.1% of the funds that are budgeted for training (Table 11). Among the programs, Fisheries has the highest training component with 14%, followed by CAPS with almost 12%, while Forestry and PPS rank lower with just over 7% each. Overall, AFNS budgeted for 1,675 trainees receiving a total of 3,516 man-months of training, or an average of 2.1 man-month of training per trainee. This figure, however, is an average between a small number receiving formal training of between 12 and 36 months and a large number of participants in workshops and courses usually only lasting from days to a few weeks. The man-months of training per trainee reflects closely the relative progress of the different AFNS programs from its earliest phases of project establishment to later phases of dissemination. CAPS with 1.8 man-months of average training and PPS with 1.9 are evidently at a stage where long-term formal training is

TABLE 11

AFNS TRAINING AS PART OF PROJECTS BY AFNS PROGRAM

	Number of Trainees	Man-Months Training	Training Costs ($'000)	Project Costs ($'000)	Percent of Project Costs for Training
CAPS	1,293	2,280	1,885.6	16,007.3	11.8
Fisheries	116	340	400.3	2,832.6	14.1
Forestry	79	353	409.5	5,702.1	7.2
PPS	143	271	239.1	3,135.1	7.6
AE	17	124	52.7	778.7	6.8
Cooperative Program	27	148	62.4	1,595.7	3.9
TOTAL	1,675	3,516	3,049.6	30,051.5	10.1

NOTE: This information is based on project documents covering one calendar year (July 1, 1984 to June 30, 1985), and the expenditures are estimates to be used over the period of the project, usually three years. The actual figures, however, can be considered annual, as each following year will have a training component of a similar size.

less important than short courses for larger numbers of trainees. The opposite is true for the newer programs of AE and the Cooperative Programs, which have an average training duration of 7.3 and 5.8 man-months respectively, while Forestry with 4.5 and Fisheries with 2.9 rank intermediate.

Formal training among the AFNS projects accounts for 45% of the total training expenditure, of which the largest part (80%) is directed towards MSc degrees, while PhD's, BSc's and post-doctoral training make relatively minor contributions (Table 12). Nonformal training is less easily classified due to its diversity. "Other Training" is generally intensive but shorter, not leading to a degree and often

TABLE 12

AFNS TRAINING AS PART OF PROJECTS BY LEVEL OF EDUCATION

Level	Number of Trainees	Man-Months of Training	Training Costs ($'000)	Costs Per Man-Month	Percent of Total Cost
Formal Training					
Post-doctoral	6	28	37.6	1.34	1
PhD.	6	174	100.5	0.58	2
MSc	56	991	1,159.5	1.16	37
BSc/Diploma	8	162	122.9	0.76	4
Total	76	1,355	1,420.5	1.05	44
Non-Formal Training					
Other Training	409	619	682.7	1.10	22
Short Courses	849	1,106	987.0	0.89	31
Field Work/ Seminars	174	357	76.3	0.21	3
Total	1,432	2,082	1,746.0	0.84	56
Overall Total Training	1,508	3,437	3,166.5	0.92	100

NOTE: This information is compiled from project documents giving training appropriations over the period of the project, usually three years. The actual figures, however, can be considered annual; as each following year will have a training component of a similar size.

directed at the technician level. Here, the average training time is 1.5 man-months per trainee and this sector is using almost one-quarter of the funds. "Short Courses" reach the largest number of trainees (56%) and cost 31% of the budget, while "Student Field Work and Seminars/Workshops" cost relatively little (2.4%), but reach

a larger number of trainees. Costs per man-month of training range from BSc ($760/man-month), over short courses ($890), to post-doctoral work with $1,340/man-month. Travel cost, however, can be a big component, increasing especially the figures for shorter courses, and in several instances the training costs were shared distorting the figures.

The regional distribution of project-funded training shows that ASRO and LARO have the largest number of trainees, but relatively low costs per trainee and man-month (Table 13). This indicates the relatively higher level of nonformal training in those regions due to the advanced stage of many projects, which necessitates a shift from long-term degree training to shorter extension and farmer training. The opposite situation exists for MERO and EARO, with an average of only 6.6 and 3.4 trainees respectively per project. These however have much longer training periods, in the case of EARO an average of 9.8 man-months, indicating the shortage of trained manpower here and the fact that fewer projects have reached the dissemination stage. The remaining regions SARO and WARO are intermediate. While they also have high numbers of trainees per project, training time per trainee is longer. ASRO and LARO thus use a lower percentage of their project budgets for training, while EARO and particularily SARO have large training components. Allocations of total funds for training to the different regions shows that EARO with 28.7% receives the largest share, while the other regions range between 12.6% and 16.5%. Training needs as reflected by the size of the training component of AFNS project proposals fairly well reflect the needs of the different programs and regions. The more developed regions and those where AFNS programs have been active for some time need to pay less attention to long-term formal training and shift emphasis to lower level shorter training that is more important in the dissemination of the results. The poorer and less developed countries need better trained staff and here emphasis by most projects has been on training at the MSc level, especially for newer projects.

TABLE 13

AFNS TRAINING AS PART OF PROJECTS BY AFNS REGION

	Number of Projects	Number of Trainees	Trainees per Project	Man-Months of Training	Man-Months per Trainee	Training Costs ($'000)	Cost per Man-Month ($'000)	Percent of Total Cost
ASRO	21	417	19.9	509	1.22	449.9	0.88	13.4
EARO	20	68	3.4	666	9.79	931.2	1.40	10.5
LARO	30	710	23.7	1,185	1.67	477.0	0.40	11.2
MERO	10	66	6.6	191	2.89	409.6	2.14	11.5
SARO	8	168	21.0	583	3.47	533.9	0.92	13.4
WARO	13	286	22.0	382	1.34	442.7	1.16	10.5
Canada	3	0	-	-	-	-	-	-
Total/ Average	105	1,715	16.3	3,516	2.1	3,244.3	0.92	10.5

NOTE: This information is compiled from project documents giving training appropriations over the period of the project, usually three years. The actual figures, however, can be considered annual, as each following year will have a training component of a similar size.

Fellowships and Awards Division - FAD oversees the allocation of training awards for all divisions of IDRC, but only in relation to projects of the divisions. There is, however, a small component of training awarded on recommendation by AFNS for a candidate from an involved institution, who is not actually working on the project. Projects of AFNS provide the main screening mechanism to award further training and some of the post-project awards are aimed at giving further education to project staff that have shown a high level of performance. The annual expenditure for individul awards in 1984-1985 was $2.54 million of which $869,000 (34.2%) was allocated to AFNS-related training. Before 1980, a considerable component of the FAD awards went to Canadians studying aspects of development, but this has more recently declined. The distribution of awards to the different regions shows that awards have tended to decrease for Latin America, South Asia, and MERO, while the EARO and ASRO regions are now receiving a larger share.

Support for formal education shows that over the last five years FAD has supported 13 PhD degrees and 40 MSc degrees in the AFNS field. The trend here has been a decrease of PhD awards, but a dramatic expansion of awards at the MSc level. Among the other awards a considerable increase in project-related awards is evident, which were hardly considered up to 1980, but have since gained in importance to make up 25% of the awards. This type of training is generally shorter and is an integral part of a project. The opposite trend is shown by the research awards, where both Professional Development Awards and Research Associate Awards have declined.

Up to 1978, training took place almost exclusively in developed countries, mainly in Canada. Major shifts have taken place since then, as training in developing countries, nonexistent a decade earlier, now constitutes over 40% of the awards. The main study preference now is for other countries of the same region, a trend which is both a policy decision and based on financial considerations, as it is

considerably cheaper to train in a Third World institution than in Canada, although there may be a trade-off in quality. At the same time, there are advantages to have a scientist train in a similar environment to this own country. Awards to study in Canada have remained static between 30% and 40%, but awards to other developed countries have decreased from a peak of 45% to a present 18% of the total FAD allocations to AFNS.

Consultants - When the level of local capability is not adequate, a project has the opportunity to gain access to special knowledge from outside for short time periods through the hiring of consultants. Analyzing 106 project documents showed that 64 or 56.6% had a consultant component in their budget (Table 14). Of the total project costs of $30.6 million, consultant fees made up $0.9 million (2.98%). A consultant component is of particular value to Fisheries, which in its 10 projects allocated an average of 6.2% to this item, and to the Forestry with 5.4%. CAPS and PPS on the other hand have less use for consultants, and their allocation is 2.2% and 1.1% respectively. The use of consultants is thus important for many projects, and is influenced by the level of capability of project staff, and the need and availability of specific consultant skills.

C. HIGHLIGHTS OF PAST ACHIEVEMENTS AND EXPERIENCE

1. Measuring Success

Research by its definition is a process of finding something new, better, or different, and the process of investigation and gaining knowledge takes time. This is especially the case for the disciplines in the natural sciences, wherein AFNS is largely involved. The process often needs to start with the gaining of a basic understanding of the system, or collecting a wide variety of germ plasm which has to be evaluated, later cross-bred, and tested. Only once

TABLE 14

PROPORTION OF PROJECT APPROPRIATIONS BY PROGRAM BUDGETED FOR CONSULTANCIES OVER A 12-MONTH PERIOD FROM JULY 1984 TO JUNE 1985

Program	Project Number	Costs Consultant ($'000)	Costs Project ($'000)	Percent of Appropriation Consultant 1984-1985	Percent of Appropriation Project 1984-1985
CAPS	49	348.2	15,932.3	2.2	1.9
Fisheries	10	175.5	2,832.6	6.2	8.2
Forestry	23	307.0	5,702.2	5.4	6.7
PPS	15	40.6	3,771.2	1.1	5.4
AE	2	12.8	778.7	1.6	--
Cooperative Program	7	27.6	1,595.7	1.7	--
Total	106	911.7	30,612.7	2.98	3.50

the new material or technolgy has been proven superior to the present system can dissemination begin. From the start of a project to the widespread use of its technological results may well take 10 to 20 years. It is, thus, not surprising that only now, after 15 years of existence of AFNS, some significant results of the early projects are becoming evident. Most projects, however, have started in the last five years and are still in an early phase. Here, impact on a rural farming system is many years down the road and measuring success has to be limited to the more immediate first steps that the work of the project is concerned with now. The attainment of specific project objectives is the easiest and most direct measurement, concerned with such largely technical parameters as the number of lines of a crop tested. In the subsequent phases of testing the performance of the new technology, increased yield or higher growth rates can also be measured to indicate the success of

the work. However, the mandate of AFNS is not just the production of higher yielding varieties, better crop drying systems or faster growing trees. These are only a means to an end. The technology must fit the production system technically and economically. Ultimately, success has to be measured in terms of impact on a target group, which, although an agricultural technology is involved, falls more into the realm of economics, measuring the benefits the technology produces, and the area of social sciences, evaluating the benefits in terms of improvements to the living standard. This evaluation should be as much concerned with who is to benefit and how the benefit is to be realized, as with technical achievements. The dissemination phase will increasingly pose new challenges to AFNS staff. Although the majority of projects are still in their early phases and may show considerable technical success, much more time and a different type of input will be needed before the rural poor can start to benefit from these research inputs.

The measurement of success is also complicated by the dual approach of AFNS in achieving technical results on one hand and training and institution building on the other. Immediate research results are more tangible, but the long-term benefit of a project may lie in the establishment and improvement of indigenous research capability where an institution or a motivated scientist may carry on research long after AFNS support has ceased. The development of the human resource base is the foundation for any research; therefore the development of personnel is an important component in most projects. To analyze the scope of a training program in a project, attention must not only be given to the number of personnel trained and the type of training programs, but also the activities of trainees who have completed formal training and the relevance of the training program to the project. These potentially large, long-term benefits are not easily measured, and the component of institution building, that every project has, is therefore more difficult to evaluate than its technical results.

In most cases, an AFNS project does not stand on its own but may be involved in only one specific, but important, aspect of a larger enterprise, where several other organizations also make a contribution. Although the overall success of such a project is of primary concern to AFNS, it has little control over the work of the other participants and must limit its evaluation to the component on which it is concentrating. There are, however, many projects where AFNS did not have to start from the beginning, but where a scientist or a national program have already laid the groundwork. Here AFNS inputs are needed more for expansion or intensification, and this later-stage input is often crucial to the adaptation of a new technology. But the amount of credit for these projects that is due to AFNS is not easily established. In other cases, AFNS projects start from the beginning and do much of the groundwork. The often impressive early technical results are then enough to convince an institution, a larger donor, or a government of the value of this type of research and they take over the work. AFNS is thus not able to complete the task itself, but it may be an indication of success if such a project is taken over. Here AFNS only plays the role of a catalyst, starting in a new area of research, or supporting early phases, while the responsibility for the ultimate success of the technology which AFNS initiated lies in the hands of other institutions.

2. Representative Successful Projects

Cropping Systems Research in Asia - Since the early 1970s, IDRC has supported pioneering research on rice-based cropping systems. Funds were provided through IRRI for the Asian Cropping Systems Network (ACSN) and directly to the six member countries: Philippines, Indonesia, China, Thailand, Bangladesh, and Sri Lanka. A good example of the growth and development of the cropping systems research within this network is provided by the national program in the Philippines. Starting in 1972, the University of the Philippines at Los Banos (UPLB), with support from IDRC, conducted research on

multiple cropping and its adoption by farmers in six selected communities. The farmers' response was enthusiastic and adoption of the recommended multiple-cropping technology was rapid, resulting in substantial improvements in both productivity and the nutritional status of the target communities. Between 1972 and 1976, the number of cooperating farmers rose from 29 to 656, their crop-intensity index rose from 1.65 to 2.1, and their multicropped area rose from 48% to 75%. This project was renewed for three phases and the Philippines has now developed its own internal network for cropping-systems research, with more than 100 national research sites in 1984.

As a result of the holistic research approach adopted by ACSN, the scientists quickly came to appreciate the importance of livestock in the rice-based systems, both as a source of power and in contributing 20%-40% to the farm income. By 1982, ACSN scientists were confident enough in their methodology to start the involvement of animal scientists. As a result of a meeting held at IRRI in 1983, the network launched a series of combined crop-livestock projects, and the ACSN became the Asian Farming Systems Network (AFSN). The first crop-livestock project to receive AFNS support started in 1984 in the Philippines, in which scientists from the Animal Research Institute of UPLB work together with cropping systems scientists from IRRI to develop improved farming systems to increase the total farm productivity and enhance the well-being of the farming communities. Similar IDRC-supported crop-livestock projects, based on earlier successful cropping-system projects, have since started in Thailand and Indonesia.

Improving Pastures in Latin America - Pastures and forage constitute the most abundant and cheapest source of feed for ruminant livestock. Although almost 80% of the land in Latin America is used for grazing, productivity per animal is low, approximately one-third of that in North America. Improvements can be achieved by the introduction of more productive, palatable, and nutritious grasses, legumes,

shrubs, and trees, and their better management. Because of the cost and complexity of conducting grazing trials, these are rarely carried out in developing countrie; IDRC therefore has allocated considerable resources for pasture and forage research. Currently, funds are provided to five national pasture and forage research programs in Latin America and the Caribbean, linked to the Tropical Pastures Network (TPN) coordinated by the Centro Internacional de Agricultura Tropical (CIAT) in Colombia.

Successful results have been produced by several of the national programs in the network. The forage program at the Universidad Catolica de Chile, which IDRC has supported for the past five years, has selected eight of the best accessions out of the more than 500 that were evaluated on the basis of high productivity. Two late-flowering cultivars of ryegrass (Lolium perenne) were selected for their superior nutritive value and good association with clover; over 30 t of seed have now been produced and sold to farmers in the Osorno region. Better agronomic management techniques have been developed resulting in improved sward quality, and new silage-making techniques have resulted in reduced effluent losses and considerably lower production costs per kilogram of metabolizable energy.

The Universidad Agraria La Molina in Peru has received IDRC support for pasture research since 1978. A ryegrass-clover association has been identified which under irrigation yields up to 18 t of dry matter, at 15.2% crude protein. This association has been used as the basis of sheep fattening production modules in which stocking rates of up to 25 head per hectare have been achieved, with daily liveweight gains of up to 200 g. This compares with one animal per hectare and daily gains of only 100 g on native unirrigated pastures. This project has also provided a very valuable training ground, as 15 students have submitted theses under the project.

The Oilcrops Network in East Africa and Asia - Vegetable oil is an essential component of the human diet, but one that is in very short supply in many developing countries, and large amounts of scarce foreign exchange have to be spent on importing edible oils. Despite this, oilseed crops, other than groundnuts and soybeans, lack international research backing. In order to help promote collaboration and thereby strengthen national oilseed research programs, IDRC established an international network in 1981 with an advisor based in Ethiopia. The network, which covers countries in Eastern and Southern Africa, the Middle East, and South Asia, covers 12 IDRC-supported projects in India, Sri Lanka, Egypt, Sudan, Ethiopia, Tanzania, Mozambique, et Malawi.

In India, two IDRC-supported projects on the important, but generally neglected, oil crops sesame and safflower have proven particularly successful. One is centred in Tamil Nadu State, where a collection of more than 2,000 germ plasm accessions of sesame have been assembled from different countries, including 400 locally collected lines. A large number of crosses have been made among these accessions and promising lines have been selected with yield increases of 20-30% over the commonly grown cultivar TMV4. These new lines are now in adaptive research trials with farmers. The other project is concerned with the improvement of safflower, based at Indore in Madhya Pradesh State. Several new lines have been developed which significantly outyield the earlier released cultivar JSF-1. These are now at an advanced stage of testing and adaptive trials on farmers' fields. Research into spineless cultivar has led to the development of JSI-7, which has a yield level comparable to the national check cultivar A-1 in Indore. Other promising spineless lines are expected to make an impact in nontraditional safflower regions, where the normal spiny nature of the plant now is a deterrent to its production. A recent addition to the Oilcrops network is a cooperative project linking scientists at the Ottawa Research Station of Agriculture Canada with network scientists in Africa and

Asia. The project aims to develop reliable anther/pollen or ovule culture methods for the production of dihaploids in sesame, safflower, and niger seed. The development of tissue culture techniques, to be used by oilcrops breeders in developing countries, will help to substantially increase the efficiency of their efforts.

Root Crops Research in Cameroon - IDRC's involvement in the Cameroon National Root Crop Improvement Program (CNRCIP) is an example of the type of support that IDRC tries to provide to national research programs, with assistance from the IITA at Ibadan, Nigeria through operational support. IDRC support for the CNRCIP started in 1977, with early strong emphasis on training Cameroonian scientists for the program. The first year of the program consisted almost entirely of training, as a number of Cameroonian scientists did their Masters or PhD degrees, at IITA, while others were sent to North American universities. With strong support from the Cameroon government, the CNRCIP was established as a strong and stable institution for root-crop research with its headquarters at Njombe Research Station and collaborative activities at Ekona Research Station and Nkolbisson near Yaounde. In addition, the program has moved to carry out a considerable amount of its research off station, mainly in farmers' fields.

The main root crops grown in Cameroon are cassava, sweet potatoes, yams, and cocoyams. The CNRCIP has made considerable progress in the selection of cassava for resistance to cassava mosaic disease and cassava bacterial blight, as well as for high yield and the type of root that is acceptable to farmers and their families. The most impressive progress however has been made with sweet potato selection, using seed material provided by IITA. Starting in 1982, some of the best sweet potato varieties were compared with a local variety in on-farm trials managed by the farmers themselves. The farmers planted a row of each variety, and at harvest neighbouring farmers were invited to come and compare the results. Some tubers were also

cooked and eaten on the spot to compare their taste. The farmers then took cuttings of their preferred varieties home to plant on their own farms. Since the improved varieties produced between one and four times the yield of the local variety, had a good taste and some resistance to sweet potato virus and weevil, farmers responded enthusiastically. Two of these improved varieties are now being multiplied with IDRC support and distributed to farmers throughout the country by the extension service, which was also part of the on-farm trials. Similar progress is expected soon in the cassava program, and the yam program is also multiplying planting material for distribution to farmers.

Aquaculture Research in Turkey - In 1975, the State Hydraulic Works (DSI) of the government of Turkey completed the construction of a major dam on the Firat (Euphrates) River at Keban on the central Turkish plateau. This is the largest of 70 dams built in Turkey to date, creating a reservoir of 700 km^2. Flood control and irrigation, as well as power generation, are achieved by the Keban dam. The fisheries potential of these new lakes is enormous, but there are problems with the indigenous fish species that were adapted to river conditions. Dams also interrupt the migration routes of these river species and cause fish mortality by their passage through turbines or irrigation pumping stations. IDRC was approached by the Turkish government in 1975 for assistance to manage the building up of a fish resource at the Keban reservoir and in particular to assist in expanding capabilities of the DSI fisheries group. The first phase of the project became operational in 1977, a year after the filling of the reservoir was complete. Eleven Turkish scientists were trained on short courses in Canada (Freshwater Institute, Winnipeg and the University of Toronto) and in Eastern Europe in 1981. A complete limnological and fisheries survey of the reservoir was completed by 1981, and the results were used to set up a management regime for the reservoir, in particular the calculation of target stocking rates. Seven fishing cooperatives were licensed to exploit

the reservoir in 1977, and increased to 14 by 1980. Catches of food fish were 1,300 t in 1983, and a total of $18,000 was returned to the State in rents. Stocking of carp began on a small scale in 1982 with 60,000 fingerlings transported from hatcheries elsewhere in Turkey. By 1984, 300,000 young carp had been released and this scale will further increase with the construction of the Keban hatchery in 1985.

A Canadian consultant surveyed several other dams in Turkey in 1984 to assess their impact as barriers to fish movements and possible causes of mortality. His advice will help DSI engineers to build fish barriers and fishways to mitigate the negative impacts of dams. Studies on cage culture of carp began in 1983, but winter water temperatures were found to be too low to permit growth, although the survival of carp through the winter was excellent. Studies in the summer of 1984 focused on fish growth and production in relation to stocking densities. IDRC was instrumental in transferring fishery development and management techniques to local agencies in these areas, and has contributed directly to the establishment of a fishing industry supporting 300 fishermen and their families. Further benefits from cage culture and reservoir stocking programs should become apparent during the course of the second phase.

Dehullers and Grain Milling - Small grinding mills are common in the rural areas of many countries and have significantly reduced the work in preparing traditional foods by hand grinding. Before milling, the grain is often dehulled, a task still largely done by hand, where women and children of every village household in semi-arid regions spend hours pounding grain. Increasingly, this task is being avoided by the use of processed and often imported grains. A decline in the consumption of local grains, such as sorghum and millet, is the result, even though these crops are well adapted to local production conditions and are preferred by rural consumers. To seek a solution to this growing problem, IDRC has supported work on the development

and introduction of efficient and economical village-level dehullers for use alongside small village grinding mills. This work which was initially carried out in Canada at the Plant Biotechnology Institute of the National Research Council (NRC) in Saskatoon and later in institutions of several developing countries, has resulted in two dehuller types suitable for village use. Both work on the same principle and differ mainly in capacity--one has a daily throughput of 2.0 t of grain, while the other dehulls 500 kg daily in small batches of 5-7 kg considered an ideal size for village dehulling. Record keeping systems, maintenance schedules, installation designs, and operator training manuals have also been produced.

In Botswana, a large proportion of the sorghum produced is now processed in these machines, where 36 large dehullers now operate in 21 mills. Various versions of this dehuller have been tested in 15 other countries, and over 80 have been manufactured in Canada and Botswana for testing and commercial use. The smaller, or mini-dehuller, has also been tested in different African countries, and local manufacture, servicing capabilities, and operator training are being developed in Senegal, Gambia, Tanzania, Zimbabwe, Botswana, and Uganda. The dehullers have the potential for not only reducing the women's workload of pounding grain, but also are increasing the production of those traditional crops that have an ecological advantage. In addition, they are the basis for developing small rural enterprises and local employment.

Farming Systems in Mali - The food production problems affecting small farmers throughout semi-arid Africa are well known, and after the drought of 1968-73, the Mali Government looked for ways to reduce the vulnerability of its small farmers to the factors that limit their food production. Mali approached IDRC for assistance in establishing a division for farming-systems research within its Institute of Rural Economy, which is responsible for agronomic research in the country. This was the first IDRC-supported farming-

systems research project in Africa and as little African experience was available, two IDRC advisors were provided to work with the division of farming-systems research. Gradually, a strong team of Malian researchers was built up and an extensive program of on-farm experiments was conducted on the major food crops--sorghum, millet, maize and cowpeas--in three villages, representing three different stages of development. Sakoro was selected because it was typical of some of the least-developed villages in the Southwest of Mali. These are permanent villages, but the farmers practice shifting cultivation around the villages. The effect of cropping for many years on the poor soils of this area has reduced the soil fertility, causing soil exhaustion and erosion, made worse by overgrazing cattle, goats, and sheep. In Sakoro, land within a radius of six kilometres from the village had not been used for crops for many years, and the crops grown further away gave very low yields, averaging around 370 kg/ha. At these levels of production, farmers were not able to feed their families and 80% of the households were short of food. As a result, most of the young men left the village to obtain work in Ivory Coast, from where they sent money back to their families to buy additional food. Southern Mali receives adequate rainfall of between 700 mm/year and 1400 mm/year, therefore, villages like Sakoro were less affected by drought than the more Northern Sahelian areas of Mali.

The farming-systems research team made a careful analysis of the soil fertility problems of the village and, in cooperation with the farmers, conducted a number of experiments on the main crops, including sorghum, millet, maize, rice, cowpeas, groundnuts, and cotton. The Malian Textile Development Company (CMDT) provided maize seed and fertilizer to a number of farmers on credit. The farmers participated in the experiments, using some of the manure which had not previously been used, and soon realized that a combination of manure and fertilizer would give them yields of up to 4.3 t/ha of maize. They previously had only used hand hoes for cultivation, but they now pulled out some old ploughs, started training their oxen, and grew

maize and other crops on the land around the village, which had previously remained uncultivated. Several farmers quickly achieved more than self-sufficiency in food production and were able to sell their surplus. Where the production of maize was only one ton for the village in 1981, there was a rapid increase to 20 t by 1983, grown by 13 farmers. Sorghum, millet, groundnut, and cotton production also increased, especially when these crops were grown in rotation with adequate manure and fertilizer. Improvements in animal production were also apparent with dry season feeding of the livestock and better disease control.

Neighbouring villages are now starting to copy the techniques begun in Sakoro, and the farming systems research team has selected four more villages to conduct simple trials of the techniques to determine if these new methods can be extended widely. In this part of Mali, soil fertility appears to be the principal problem, but other constraints also limit agricultural production. The new research methodology used by the farming-systems researchers is designed to identify the principal constraints, whatever they may be, and to introduce, test, refine, and improve technologies designed to reduce those constraints. IDRC experience in the Asian Rice Farming Systems Network (ARFSN) and in farming-systems research in Latin America indicates that this type of research can make a major contribution to increased food production in most locations. IDRC is therefore expanding its financial and technical support for farming-systems research projects from developing countries throughout semi-arid Africa.

Tree Plantations in China - IDRC is currently supporting research on Paulownia in China, a fast-growing tree of great interest to the rural communities. The long-term objective of this project is to increase timber and food production through the planting and intercropping of Paulownia trees with various crops in 23 provinces, autonomous regions, and municipalities where Paulownia can be grown.

Less than five years ago, China had only 3,000 ha of land planted with Paulownia trees, but since then the project has transformed many parts of China literally into a Paulownia forest by intercropping 1.5 million ha of farmland, and thus involving the rural peasants in one of the largest social forestry development projects in the world. This dramatic afforestation program of the People's Republic of China, a country faced with a serious shortage of timber, was achieved through an IDRC-funded project led by Mr. Zhu of the Chinese Academy of Forestry. IDRC's contribution was central to the successful launching of the nationwide forest planting program and concentrated on the specific areas of personnel training, technical guidance, seed material development, and the provision of extension services to rural communities. The early successes that this AFNS Forestry project demonstrated helped in securing the support of various levels of government in China for the implementation of a massive afforestation program that was carried out simultaneously with the research phase. Under this program, Chinese farmers in all parts of the country were motivated to intercrop Paulownia with a variety of crops. Four specific clones which resulted from the research work of the Paulownia scientific team have now been introduced on a wide scale. This project will go a long way to to alleviate the timber shortage in the country and to increase the income of rural peasants.

Although a native tree in China, Paulownia is now also sought after in many other parts of the world as a potential plantation-grown cash crop. Its timber is worth more than walnut and, because it is a fast-growing tree, it has been found valuable in strip-mine reclamation and for intercropping with agricultural crops. In spite of the tremendous impact of the first phase of his work, now in the final stages of completion, project leader Zhu believes that more can still be achieved through further research. He would like to develop superior clones and advanced growing techniques to optimize the quality of usable timber. Mr. Zhu also forsees that the results of his

research and the unique experience gained through China's afforestation program will be useful to other countries interested in adopting the Paulownia tree. For the dissemination of this technology, information and materials are now being made available by IDRC outside China. Mr. Zhu and his staff have received many citations and national and local government awards for their work on Paulownia afforestation, foremost among them the "Man of the Trees" award by Richard St. Barbe, Baker Foundation of Canada. His research has been widely quoted by journals in China, Taiwan, Japan, France, and Australia, and a booklet on Paulownia in China is being prepared for global distribution by IDRC. Mr. Zhu has gained respect and recognition as a scientist and forester by his colleagues, peers, and the top leaders of China, including the President and the Party Secretary, but through his work he has also become a friend of the peasants everywhere.

3. Factors Limiting Project Success

The evaluation of failures helps the future direction of a program more than the success stories. However, failure is relative and not easily measured. Total failure is rare, but a certain degree of failure is probably part of most projects. This is not unrelated to the setting of the project objectives, against which the success of a project is to be measured. If the objectives are unrealistic then the failure is built into the project from the start. Of more importance is the actual environment of the developing countries in which a project operates. While it is a project's aim to improve one certain aspect of technology, it should not be forgotten that there are a multitude of other facets that are not developed either, and thus hinder the project. The more developed a country is, the more developed are its institutions, its communications, its staff, and its administration, all conditions that help to bring a project to a successful conclusion. However, with the mandate of AFNS to help the poorest countries or population segments, AFNS has chosen a specific

environment that is not particularly supportive of a research project. The very approach thus has a built-in mechanism to reduce the number of successes and to make failure more likely. This in turn may lead to a temptation to do more work where it is more likely to succeed, in the better off countries. A similar situation exists with the deliberate choice to support local scientists. They have to live and work within their own frame of reference, where political interference, career considerations, personality clashes, or lack of incentives are major negative influences on their work, whereas an expatriate scientist may not be subjected to in the same constraints. With its mandate, AFNS has chosen a specific environment that by its definition contains numerous factors that hinder the successful completion of the work. The listing of some of these will help to illustrate the often underestimated difficulties that are the reason why many projects do not reach their stated objectives.

Project Leadership - This has been the key to some of the notable successes of AFNS projects, but it has in many others been a source of problems and delays. The quality and dedication of the project leader is a component that is built into the project from the start, but his potential and character are sometimes not evaluated carefully enough. More often the shortcomings of a leader may be recognized, but the lack of alternatives and the hope of on-the-job learning may give a project the go-ahead despite some doubts. Thus, project officers may have to take a chance with a new project leader, which obviously can lead to failure, or at least to problems and delays.

Attitude of Government - Success of research is largely dependent on the political will and the priority of agriculture and agricultural research within a country. Due to the recent recession and increasing indebtedness, many governments are in a situation of diminishing funds and increasing demands, and their commitment to agriculture and research is less than was expected. At the same time, political

instability and frequent changes of government negatively influence political commitment and may bring changes overnight that affect a project.

Timeframe - Agricultural research is by its nature a long-term undertaking, and the amount of time it takes is often not considered. Young scientists are overly optimistic, expect the quick achievement of results, and then find themselves part of a system that imposes one delay after another. As the research progresses they realize that the work before them is more complex and therefore needs more time. Donors, politicians, and senior civil servants on the other hand are under pressure to show results. When these are not forthcoming within the initially promised time, the project leader comes under pressure, and support for his work may be reduced or withdrawn.

Unrealistic Expectations - As most scientists supported are young and inexperienced, the complexity of their work is often not fully apparent to them. They are overenthusiastic, set high goals and aim to undertake too much. When the difficulties, set backs, and disappointments start to become part of the work, discouragement sets in. If overly optimistic expectations have also been raised in their superiors or political leaders, then the task in hand may become too difficult.

Administration and Finance - Bureaucracy can be found at its worst in developing countries, where the simplest transaction becomes a major enterprise needing extraordinary amounts of time, effort, and patience. A recent survey showed this to be considered the largest factor hindering a project. This is especially the case with financial transactions, where a shortage of foreign exchange imposes limitations, and where the danger of mismanagement has led to the most complex systems of financial allocation. Many projects find a similar situation concerning equipment and supplies, which are often very difficult to procure and maintain, and can delay work for months.

Personnel - Many projects face considerable setbacks due to problems of personal relationships among scientists, between scientists and civil servants, or between institutions. Here personal considerations of advantage can override the overall long-term goal of a successful project. Related to this is the level of motivation in a situation where difficulties, lack of incentives, and better opportunities elsewhere cause frequent staff changes that have a detrimental effect on the project.

Applicability of Results - In some cases, the actual usefulness of a project, especially its economic viability and competitiveness with alternatives has not been thoroughly considered, being overshadowed by scientific/technical considerations. Only once a project reaches an advanced stage do these aspects become more prominent, and it can then happen that although the technology is technically feasible, it is too costly to use. This is particularly dangerous when a project is aimed at the rural poor, but it becomes apparent that that very target group can least afford the extra inputs the new technology demands.

Orientation - It has been found that sometimes the goals and aims of AFNS, the host government, and the research team are not the same. This may have been glossed over while the project was negotiated, but once work starts, the diverging interests become apparent. IDRC's orientation toward the rural poor, toward farm-based research, and integration may run contrary to the thinking of the team leader and his staff, or may be in conflict with host-government policies. Such different goals and expectations can put considerable stress on a project.

Only the major points can be mentioned here, and it would take a much more detailed analysis of specific projects and project groups to arrive at more detailed factors. Such analyses are carried out periodically however, and are usually undertaken to look at a

specific type of project. The more detailed problems and shortcomings in such reports are then utilized to evaluate specific project components and help senior staff of AFNS to make changes, adjustments, or reorientation where necessary.

4. Learning from Experience

The effectiveness of an organization to a considerable extent depends on the quality of the feedback system of making new experience available to the decision-making process. AFNS, therefore, puts much value on learning, based on the experiences in the field, experiences that will then lead to a more sensitive approach and greater accomplishments. One general concern of the recent past is that the AFNS system has a number of bottlenecks that reduce the level of achievement. AFNS may give the funds, supply materials, and provide training, but these physical inputs do not automatically guarantee success. Since the generation of useful results is the mandate of AFNS, the time has come to go beyond the immediate concern of funding projects, and to look at the research for development as a whole. A wider understanding of the limitations, problems, and concerns that influence projects will be an important step toward a higher degree of confidence that the material inputs do produce the expected results. A few of the recent learning experiences are summarized here.

Corporate Memory - The considerable experience of the more senior staff members in development is a much appreciated strength of AFNS. The recent expansion of the number of program officers has made the division realize that the long process of each individual learning through his own experience on the job can be a wasteful approach. More emphasis thus needs to be placed on using the experience of the more senior members to help accelerate the learning process and bring more junior staff quickly to a higher level of experience by building on the capacity that is already present.

Formalities - Each project necessitates a request from a developing country which leads to an agreement between IDRC and the host government. Acceptance of a project by the government's coordinating agency often takes a very long time, and unfortunately seems worst among the poorest countries. This difficulty has tended to cause program officers to give preference to countries where the procedures are less complex, which by nature have been some of the wealthier developing countries. Such a tendency, however, may be contrary to general AFNS priorities. IDRC is unlikely to be able to make the bureaucracies of developing countries more efficient, and thus has to learn to find ways to work effectively within a rather ineffective system. Helping a poor country or the rural poor within a country, therefore, can hinge on how well a project is supported by a number of civil servants, politicians, or administrators. Project staff may have to learn that there is a need to build more personal contacts here too, not just within the scientific community.

Competition - AFNS with its modest project cost of an average $300,000 is finding itself more and more among the lesser donors. When integrated development projects by large donors and regional development banks reach several hundred million dollars, then an AFNS project becomes a rather modest affair. In some cases, even if an IDRC project starts to show success, a large donor comes along and buries it under a huge, new project based on the original IDRC-supported approach. While a few countries have expressed quite outright that they are not interested in small research projects, most others might accept them, but find it not worthwhile giving it priority or support. In this environment of donor competition, it will be increasingly necessary to show that "small is beautiful", or, more likely, that a relatively small input in a key research topic can pay considerable long-term dividends. The success of one project may well open the eyes of the decision makers and assure their future support for other projects.

Advice and Encouragement - The need for research is greatest among poorer countries, but most lack both the trained manpower and the infrastructure to carry out research. As increasing emphasis is being placed on helping poorer countries and on focusing on the rural poor, it has become evident that this approach is hindered by the lack of capacity in most of these countries. To build up capability here increasingly demands a new approach, and the use of outside expertise can be of considerable help to a project. Though resident project advisers have been few, a greater number of specialist consultants have been employed on short-term assignments to advise on specific research methods and technologies. Specialist consultants offer a number of advantages over resident expatriates. IDRC's international consultant roster includes mature, experienced people from universities, government, the private sector, and retired senior scientists. Scientists of international reputation are generally held in high esteem and their advice is usually taken seriously by those who formulate and administer projects.

The limitations of consultants in terms of cost and time have now led to a more appropriate approach; the formation of networks with a coordinator has been found to be an effective alternative to consultants. Here, emphasis is on mutual support by various scientists in different countries and aside from better cost-effectiveness such mutual support is often more relevant and appropriate to a given environment. The most valuable support for projects, however, has been from AFNS program officers. Backstopping, encouragement, moral support, and problem solving have become increasingly important, especially in poorer countries where a program officer is compelled to spend more time advising existing projects. Given the wide geographical spread of projects, this approach, however, does put additional demands on the already overloaded time schedule of the program officers. Increasing support for poorer countries has thus led to an increase in the workload of staff and will result in the need for further increases of staff at the regional offices.

Location of Research Projects - AFNS grants are given to specific projects; rarely is support offered to core budgets for unspecified activities. This chosen form of support requires an existing institutional structure and some trained staff and, therefore, builds upon institutional foundations created by others. Thus, a greater number of AFNS projects are found in countries where scientific competence and research organizations are well established. As a result of this more achievement-oriented type of funding allocation, the concern for the rural poor has sometimes had to be compromised. Nevertheless, AFNS has maintained its original concern for the rural poor of the semi-arid tropics and a substantial investment has been made in the Sahelian countries. There are, however, some countries in which the lack of political will and interest, combined with negligible research facilities, prevent AFNS from being able to offer the help it would wish. An alternative to research in better off countries has been to support work at international agricultural research centres, specifically aimed at a problem in a neighbouring poorer country. At the same time increased support to poorer countries during the project is being given through consultants, project advisors, networks, and the AFNS project officers themselves. This new approach has opened up opportunities to carry out projects in less developed countries, bringing AFNS in closer accord with the policy of helping the rural poor.

Project Scatter - Institutional capacity and professional capability vary extensively among the 65 countries in which projects have been undertaken and project emphasis depends on deciding what is possible out of all that appears desirable. The choice of research priorities is more difficult among the least privileged nations, where there is also danger of attempting so much that little is achieved. To guard against the latter, it is the practice in every proposal to request a timetable of activities, which enables all concerned to balance what is to be attempted against the human and material resources available. Given the wide diversity of need among countries,

communities, and projects, within program limitations, it has been necessary to maintain flexibility in style and organization. Though sympathetic consideration is accorded every project request, by giving priority to a limited number of research areas, AFNS staff have been better able to offer specialized advice and to build networks among projects in different countries that share a common interest. Though specific emphasis has changed and will continue to change, the division has not tried to be all things to all people. Close contact with researchers and rural communities has been found essential in keeping up to date with the changing needs and in identifing specific topics of research that have potential, are neglected by other donors, and are of immediate benefit to rural poor farmers. Faced with a multitude of demands, the division has to prevent excessive scattering that would reduce its overall achievements.

Weak Research Institutions - Since IDRC support is aimed at scientific research being carried out by indigenous scientists, the capacity of research institutions and their staff is of crucial importance to the success of AFNS inputs. Unfortunately, the poorer a developing country is, the weaker are its research institutions and thus the badly needed research results are least likely to be generated there. AFNS has been looking at this situation, and has identified several dominant reasons why these research institutions are so weak:

a) The existing research institutions, stations, equipment and scientific personnel are products of the planning and implementation of development projects. Many research stations were planned by nonresearchers, and in most cases were set up by donor agencies, who installed sophisticated equipment which worked only as long as there was an expatriate team present. Equipment was purchased from the donor agency's home country, irrespective of the traditional market and repair services and frequently spare parts can no longer be obtained;

b) Due to a lack of local training programs at the MSc and PhD levels, most developing countries had to train their scientists in North America and Europe. The initial research experiences by these scientists have thus been within the context of developed countries and not necessarily development oriented. This situation leads to a vicious circle, where local institutions and scientists do not like to employ young staff with local training because it implies a lower standard. The types of research proposed for study and the methodologies and equipment to be used are also reflected in the training background of a scientist. The lack of development focus and absence of effective links to farmers and extension workers is due to a lack in broad, relevant training in development research;

c) Training in research planning, administration, and management has been neglected and is actually nonexistent in some regions. This results in the inefficient use of IDRC contributions, excessive vehicle wear, unacceptable financial reporting, excessive red tape, and the absence of long-term research goals. One of the essential requirements of planning is the capacity to foresee the institutional needs in the medium and long-term and to propose adequate measures to meet those needs. There is a consistent difficulty to do this in countries where the future financial situation cannot be established in view of political instability and staggering inflation rates.

d) Many countries in the least developed group, especially in Africa, are very small and characteristically lack financial resources. It is inappropriate for them to establish experimental stations, equip field stations and laboratories, support the recurrent costs of research institutions, and pay scientists adequately to retain or motivate them. Lack of local financial support also results in very large requests to IDRC, sometimes

with special emphasis on expensive capital requirements such as vehicles or laboratories;

e) Lack of support for researchers results in their demoralization and their attempts to leave cause an inflated demand for further education, especially where there are chances of obtaining an MSc or PhD in a foreign institution, that will lead to better paid positions in their own country or especially abroad. Short, specialized fellowship to upgrade the expertise of personnel, on the other hand, are not in demand, although these may be the most cost-effective way to improve the professional capability of research institutions. Other incentives are also generally lacking, such as housing assistance, contact with current research elsewhere, travel, recognition, and support; and

f) In most developing countries, the past pattern of expatriate teams to conduct research with the financial support of donor agencies was usually successful at least in generating technology but one of the key factors in their success is the sustained financial support by the donor. After the teams have withdrawn and financial support has ceased, research activities by the institutions decline rapidly, institutional infrastructure deteriorates, and the generation of results comes to a standstill. From the outside, this is seen as a reflection of the ineffectiveness of the local scientists, which demoralizes them and opens the door for more expatriate conducted and funded research.

The big negative influences that weaken many research institutions and the fact that most are caused by factors beyond the control of AFNS are of considerable concern. Despite this, there are a number of areas where a different approach can be of assistance. One main area is training. Support for upgrading professional skills is especially necessary in Africa and is increasingly aimed at those

institutions that have a high potential to do relevant research. Special emphasis is now on lower academic levels (MSc), preferably in an institution of the same region, and a focus on on-the-job training. Training, however, should not be limited to the technical field, increasing attention needs to be paid to areas such as administration, planning, and financial management. Here, character qualities need to be developed as much as knowledge, and leadership ability can be furthered by network coordinators and program officers.

Financial aspects are more difficult to influence than training, given the limitations of the AFNS budget. The most important concern here is to tailor research projects to the level of long-term local financing that can be expected after the end of AFNS support. This generally will mean less ambitious projects at a lower level of technical complexity, requiring less financial support and more IDRC staff time. Projects need a local financial component that is increasing over time, to assure that support will continue. This may free some financial resources, which can be utilized for incentives for project staff and an emergency fund for unforeseen problems, which would hinder the progress of a project. Motivation is now also being helped by linking different scientists and institutions, and AFNS has in this field made considerable progress decreasing the isolation through networks and network coordinators. Also, through the IDRC library, scientists can access world literature. Overall, however, it is quite clear that work is dependent on the capability of the institution involved and that strengthening such institutions will be of considerable future benefit. The actual methods of strengthening institutions are only now being tried out; this topic needs to receive considerable attention in the near future.

Linking Projects to Decision Makers - Given the complicated administrative structure of many governments in developing countries, it is often easiest to work through direct contacts between program officer

and scientist. This provides a quick and efficient way to develop a project and have it accepted for AFNS funding. Experience, however, has shown that in some cases the early efficiency has been followed by later delays, largely caused by administrators and civil servants that were left out earlier on and are quite capable of hindering a project. Although it may be time consuming, it is essential to identify in the early stages of a project the decision makers that are connected with the subject or location of the project and to include them in the process. Such an approach can pay dividends later on if these officials know about the project, or even give it their active support. These linkages are important not only within a research institution, but even more so to government officials in various ministries, and in some cases to political leaders. Such public relations tasks have recently become a more important part in the setting up and carrying out of many research projects in AFNS.

Alternative Project Formulations - The standard IDRC project provides funding support for a time-limited activity which has as its objective the generation of technology which, when implemented, improves the welfare of farmers and communities in developing countries. The more applied research projects deal directly with the provision of food, health, or shelter, whereas less applied projects deal with factors that increase a developing countries' capability to improve such welfare components. The typical project delivers to the recipient (institution or researchers) funds for supplies, staff, equipment, travel, feedback from peers (IDRC staff included), technical advice on research methods design in a development context, on-the-job training in research techniques and management methods, and formal training for self or staff.

The recent limitation on the budget and on staffing levels has led AFNS and its senior staff to focus more on how best to use the available resources. A careful look at the present mode of operation, especially in project format and support has led to a search for

alternatives that would achieve the objectives more effectively without higher inputs. Ways to reduce costs or make better use of the same amount of financial input are looked at, as well as the better use of manpower resources and labour-saving alternatives. There is, however, often a trade-off between the two inputs, where a reduction in cost tends to increase the workload, and conversely many work-saving approaches end up being more costly. Several new approaches, nevertheless, are now being tested and depending on their success may change the type and format of the typical project of the past.

Longer Projects - Most AFNS projects are for a standard three-year period, but the majority then need a Phase II or even a Phase III to bring the work to completion. Each phase, however, needs completely new documentation for approval and funding; this demands considerable staff time, and contains much duplication of work. Where the research time is expected to cover two or three phases, it would, therefore, be an advantage to submit a project of five or six years rather than the present three. This would not only save staff time, but it would bring project proposal and actual project duration more into line. Financial commitments can be better forecast over a longer period and expenditures and research phases can be spread out by the project. Uncertainty over the long-term financial capacity of AFNS, however, may limit this approach.

Short Projects - Financial constraints have at the same time pushed the project mode towards a number of shorter projects. Obligations to fund subsequent phases have left some programs with very limited means to fund new projects. One response has been to reduce the first phase in length of time and funding level to remain within the budgeted allocation. This tendency increases the workload of staff, and can be detrimental to the project making a good start, since most of the capital costs occur at the beginning.

Envelope Projects - A number of projects in recent years have been involved with very similar work in different countries, especially on crops such as millet and oil seeds. Other project groups have been concerned with the adaptation of a specific technology in different countries and environments. Much of the documentation for these different projects has thus been very similar and a new approach has been tried in grouping several such projects to form an "envelope" project. The documentation is then produced for the whole group and the individual country projects then become components. Funding a group of projects may, however, lead to the misconception that it is one very large project.

Small Grant Projects - In the past, some divisions of IDRC have used this approach to fund small research projects independent of the normally funded larger projects. An evalution of small grant projects has recently been carried out by the Office of Planning and Evaluation (OPE). The main justification for small grant projects comes from the observation that a large number of young scientists have very limited experience in carrying out research. Before such a researcher is able to submit, participate, or lead an AFNS-funded project, he should have a chance to gain experience in smaller types of research. This is where small grant projects can be a valuable contribution to training and building up the capacity of young scientists. It is expected that many of these AFNS-funded small projects will later lead to larger research undertakings and will establish a good working relationship with a number of young researchers. Small projects, thus, do not only have a function in research and training, but can also be seen as an investment toward future projects that is considered well worth the additional input in staff time.

Network Coordinators - Consultants and project advisors have in the past provided valuable support to projects. As most of them, however, are expatriates, their use has put a financial burden on

projects and alternatives needed to be looked at. The most promising new approach has been the use of a project scientist in one of the projects to act as network coordinator. In this role, he visits other projects of a similar nature to support, guide, and evaluate their work. The first network coordinators have fortunately been excellent candidates and this new approach has thus shown much promise. Not only are these coordinators less expensive, but they also provide better advice since they themselves work on similar research and thus are more specialized. They are also more familiar with the specific conditions of neighbouring countries of the region. This new approach should therefore continue to reduce the role of consultants and project advisors, but it will not take over the work of the program officer, who has total responsibility for the projects.

III. OVERVIEW OF THE LAST FIVE YEARS AND FUTURE PROGRAM DIRECTIONS

A. AGRICULTURAL ECONOMICS

In 1984, the Agricultural Economics (AE) program was made a full subprogram in AFNS with its own budget to develop and support research projets. Prior to 1984, agricultural economics had been a service and support group. Since AE has no real history, this report will focus on the future in terms of objectives, priorities, and criteria for its program.

1. Objectives

The greek word "oikonomilos", from which the world economics originates means "household management". The AE program is basing its direction on this original meaning. It will concentrate on the production, distribution, and consumption of goods and services, primarily in the rural household where 70% of the population of developing countries live.

The overall objectives of the AE program are:

a) to support agricultural research and development activities that strengthen the capability of rural households and their community to meet their development goals;
b) to increase the efficacy with which agricultural scientists and their institutes are conducting research to meet the needs of rural communities; and
c) to initiate and collaborate on new research relevant to the needs of the rural community.

Since AE could not possibly support all the research that would meet these objectives, three subprogram areas have specifically been identified as the main areas of support:

a) rural economics which is to include microeconomics of crops, livestock, fish, forestry and food production, and their processing activities (resource allocation of a firm or industry, marketing studies relating to the decision making of such a firm or industry; farm and agro-industry management (operational procedures for a firm); agro-system analysis (analysis of food forestry, and production processing and utilization systems); and technology evaluation (ex-ante, ongoing, and post-analysis of technology generation related to agro-systems research);

b) economics of technology introduction, particularly the analysis of agro-systems technology introduction practices; and

c) economics of agricultural research resource allocation, concentrating on the analysis of research management (analysis of research capacity, procedures, and resource allocation in agricultural and food research organizations).

2. Project Selection Criteria

Even these subprograms could not be supported effectively on a global basis, therefore AE will put its main emphasis on supporting those projects which have the following characteristics:

a) is or will become an integral part of an institute's research program in the future;

b) is or will become directly involved in the generation of technology;

c) accept and integrate social and natural resource systems concepts into their research program;

d) consider both distributive justice and allocative efficiency in the design of the research proposed;

e) increase the amount of interaction with other scientists working on the same problem areas through networks and associations;

f) employ a methodology likely to be utilized by national research groups in the future; and

g) have a planned end product that will have a realizable return to the poorer groups of the community.

One of the most important factors influencing AE are the activities of the other programs in the AFNS division, where a number of joint projects are underway. This approach which will introduce an economic component into the technology generating projects of other programs, is considered a more valuable initial approach than setting up numerous independent AE projects. Since AE is part of the AFNS division, it is in a position to integrate social science with technology development from planning to adoption, and so will become responsible for all agricultural economics research. Outside the AFNS division, it is mainly the Economics and Rural Development Program (ERDP) of the Social Sciences division with whom AE has collaborated. The emphasis of the two programs will be complementary, as most projects will have components of institutions, which is the ERDP area, and technological change (AE). It is planned to develop projects that focus on better infrastructure to support new technology, and so improve national institutions' capability to meet rural needs.

3. Future Activities

Due to the newness of the program, there is a need to accurately define the role of AE and to build up its staff and finances. The positioning of a staff member at a regional office can only be justified if at least $300,000 in project funds are available. Linking with other funding agencies and taking advantage of technical and training support from international centres will help in this building process. Opportunities under the Cooperative program are still limited, but the first task is to build up a roster of Canada-based agricultural economists that have a proven record of achievement for future collaboration.

4. Regional Analysis

Africa - Agricultural stagnation here has been the result of a general tendency to extract agricultural surpluses in support of industrialization and import substitution, as well as policies that are urban consumer oriented. African governments realize that economic development will not be achieved as long as agriculture remains neglected. The aim of AE is to help build a core of African agricultural economists with research capabilities to provide the base for the planning and implementation of new, agricultural oriented development strategies. Due to the limited resources of AE, a focus on specific countries is inevitable and is still being decided. Recommendations of a recent meeting of African economists are a cornerstone in the definition of more specific objectives in Africa. The main topics of concern defined in the meeting were:

a) the lack of quality and the limited relevance of the education system in agricultural economics;

b) poor pay and limited support, which in turn are the cause of low morale and a rapid staff turnover;

c) that even the present low level of activity in the field of agricultural economics could not be maintained without continued external support; and

d) graduate training takes place almost exclusively in developed countries; their lack of understanding of the rural farmer is a big handicap.

Other areas of concern are the weak links between research and development partly due to the lack of interaction between researchers and extension workers, the lack of feedback mechanisms, the lack of research relevant to the farmers' problems, and the poor integration of research results into the political decision-making process.

Of importance to agricultural economics in Africa is also the dominant presence of the United States Agency for International Development (USAID). Since 1970, this organization has drastically reduced its earlier considerable inputs into agricultural research, and although they have now recognized the problems this has created, their funding has not significantly increased.

The Eastern/Southern Africa region will not have its own project officer for some time to come, but one early task here is to integrate agricultural economics with technology generation and universities with research institutions. Once a staff member is in EARO, networking activities and short-term training will become more important; for the latter the University of Zimbabwe has been tentatively selected. Due to the confusing and contradictory direction of the numerous donor agencies in the region, it is important that IDRC and AE remain close to their mandate of emphasizing support for national needs and rural improvement.

In West Africa, support is planned for interdisciplinary research, which will bring scientists within and among countries together, and

it is here that the much needed research objectives and strategies to meet rural needs will be set out. The number of scientists is very limited in many countries in this region. It is essential to increase the research capacity of staff and institutions and to get young researchers into the field to interact with the people who have the problems. Recent joint projects with Social Sciences division have focused on support for research at Centre ivorien de recherches économiques et sociales (CIRES) and it is expected that graduating students will continue their work at home and submit further projects for AE to support.

To interact with CAPS, linkages are planned with the socio-economics group at IITA, but their direction and overall funding levels need to be established first. Linkage with ICRISAT should be important, but poor cooperation in the past will make us cautious on future joint work. An economic component will be introduced in fish-processing research and agroforestry to further support these programs once the project officer is placed.

Asia - The Southeast and East Asia region is characterized by strong institutions and the strength of its scientists. It will thus be possible to assist them through networks with a training component. What is missing is a research system that will encourage agricultural economists to become directly involved in the development of new agricultural technology. Support is thus aimed at those institutions that have an interdisciplinary orientation. Building linkages and information systems between scientists will be a major activity in the region. Specific attention will be given to Burma, but the greatest challenge and opportunity is China. Under its more open policy direction, this country can benefit from AE inputs in agricultural economics. Since our resources are small, AE involvement will be restricted to joint ventures with other AFNS programs or regional networks.

India as the major country of the South Asia region actually has a surplus of economists and strong agricultural institutions. Here, support will be limited to joint activities with other AFNS programs. All other countries of the region are not nearly as strong and here AE could play a useful role.

Middle East - The small number of AFNS staff in this region does not justify an AE program officer until at least 1989. In the meantime no major activities are foreseen, unless they are suggested by and linked to other IDRC programs.

Latin America - The Latin American area can be characterized by the strong differences among countries and regions. This diversity is then also expressed in the relative degrees of development of agricultural economics, in the level of professional expertise, the strength of the agricultural institutions, and the complexity of the research. In general terms, the region can be grouped into the Andean countries, the relativly more developed South, Central America, and the Caribbean. Emphasis for project funding and support will be given to the Andean countries, Central America, and selected countries in the Caribbean, but each group will need a different approach in terms of technical assistance, program scope, and network formation.

B. CROP AND ANIMAL PRODUCTION SYSTEMS

1. Objectives and Priorities

The overall objective of the CAPS program is to support appropriate research on crops and livestock production and, thereby, contribute to improving the welfare of people in developing countries. Priority is given to research which will benefit small-scale subsistence farmers, who frequently lack access to adequate land, water,

financial, and other resources, and who have been largely unaffected by the technological advances of recent years. As an adjunct to this main objective, the CAPS program seeks to strengthen the indigenous research capability of scientists and institutions in developing countries. Strong national research programs are considered essential if the continuing problems confronting agricultural development are to be adequately addressed.

The largest share of the budget is allocated to support research by national scientists working in their own countries. CAPS is reluctant to employ expatriate advisors as they frequently tend to suppress local scientific and administrative talent. Most of the CAPS projects can be grouped into clusters based on subject matter. These clusters are generally located in a single geographic region or adjacent regions, for example animal production systems projects in Latin America and oilseed projects in Eastern and Southern Africa and South Asia. The choice of projects for CAPS support depends on:

a) the importance of the subject to small-scale subsistence farmers with priority being given to neglected, but important subjects;

b) the priority given to the subject by the national government concerned;

c) the prospects for impact at the farm level;

d) the importance of the subject regionally and internationally;

e) the amount of support provided by other donors; and

f) the interests, expertise, and location of CAPS program staff.

Although priority is given to national governments and institutions, projects with international and regional organizations are also

funded when their activities support national projects. AFNS has taken a leading role in the establishment of some international institutions such as ICARDA and the International Network for the Improvement of Bananas and Plantains (INIBAP). CAPS gives special emphasis to the semi-arid tropical regions, where many of the poorest people live, and where the results of past agricultural research efforts have had the least effect. As a result, sub-Saharan Africa accounts for a higher proportion of the CAPS budget than the other regions. Africa is the only continent in which per capita food production is declining and research infrastructure is the least developed there.

2. Historical Perspectives and General Overview

At the start of the review period, CAPS was actually two separate programs--Animal Sciences and Crops and Cropping Systems--but due to the increasing importance of farming systems the two were combined in 1983. The AFNS program began with the philosophy that support should be given to national scientists working in their own program. Strong support and backstopping is provided by the program officers, but only in a few cases have advisors been employed. In retrospect, four specific founding projects have specifically influenced the direction of the Crops section within CAPS: the project on rural development and farming systems in Caqueza, Colombia; the crop-improvement projects on cassava and triticale under CIAT and CIMMYT, respectively and the multiple-cropping project in the Philippines. The success of these projects was the basis for expansion into other countries and into other commodities. New areas of research included the grain legumes crops, sorghum and millet, root crops, bananas, and oilseeds. This diversification in turn increasingly demonstrated the need to emphasize institution building as an important component of the projects, and showed the need to establish research networks to facilitate the interaction among researchers nationally and internationally.

In the Animal Sciences program, the main emphasis was from the start on the main limiting factor, the supply of feed. Thus, initial projects were mainly on forages and pastures, later ones were on by-products for animal feed. Work soon expanded to cover Animal Production Systems, originally in Latin America and later in Africa. Emphasis has been on ruminants, which are able to make use of low-quality feeds and thus compete less with humans for food. Increasingly attention has been given to small ruminants (sheep and goats), which are well adapted to a variety of harsh conditions, and are especially appropriate in the small-farm situation.

During the review period, the number of projects increased from 103 to 148, and funding rose from just over $27 million to $45 million, an annual increase of somewhat below 10% (Table 15). Slight changes in emphasis during the period took place with a decrease of funds for research in cereals and root crops and increases in grain legumes, perennial crops, and animal production systems. In the same time, emphasis shifted to farming systems and the allocation for all systems research increased from 26% to 38%. Approximately 20% of the projects involved international or regional research organizations, and with the advent of the Cooperative Program, the number of projects in this sector has grown from four to 11 and further expansion is anticipated. For the regional distribution of the CAPS programs, the fastest growing areas have been Southern/Eastern Africa and Latin America, while South Asia showed a decline (Table 16). At present Africa (WARO and EARO) receive 33% of the total budget and the larger part of the MERO budget is also allocated to African countries. The Asian regions receive now approximately 25% and Latin America/Caribbean 28%, this being the highest figure for one regional office.

The past five years have seen some significant organizational changes within AFNS. With the amalgamation of Crops and Cropping Systems and Animal Sciences to form the CAPS programs, a new internal

TABLE 15

NUMBER AND BUDGET OF ACTIVE PROJECTS AND PERCENTAGE OF THE TOTAL CAPS BUDGET

BY PROJECT GROUP, AS OF APRIL 1, 1979 AND MARCH 31, 1985

Project Group	April 1, 1979			March 31, 1985		
	No. of Active Projects	Total Budget of Active Projects	% of Budget	No. of Active Projects	Total Budget of Active Projects	% of Budget
Cropping Systems	17	5,684,210	21	18	5,802,200	13
Cereal Crops	21	5,423,475	20	10	3,182,200	7
Grain Legume Crops	16	3,897,440	14	25	8,773,620	19
Oilseed Crops	6	979,500	4	11	3,014,340	7
Root Crops	17	3,699,146	13	12	3,508,500	8
Perennial Crops	1	162,000	1	8	1,807,800	4
Other Crops	3	510,300	2	6	2,236,320	5
Land and Climate	4	1,600,800	5	6	1,590,060	3
Animal Production Systems	2	839,500	3	17	5,279,750	12
Pasture and Forage Crops	8	2,357,400	9	9	2,203,800	5
By-Product Utilization	6	1,516,500	5	8	1,649,900	4
Minor Animal Species	--	--	--	4	559,200	1
Farming Systems	2	616,100	2	14	5,588,600	12
TOTAL	103	27,286,371	100	148	45,196,290	100

TABLE 16

NUMBER AND BUDGET OF ACTIVE PROJECTS AND PERCENTAGE OF THE TOTAL CAPS BUDGET BY REGION, AS OF APRIL 1, 1979 AND MARCH 31, 1985*

Region	April 1, 1979			March 31, 1985		
	No. of Active Projects	Total Budget of Active Projects	% of Budget	No. of Active Projects	Total Budget of Active Projects	% of Budget
ASRO	14	5,692,500	23	27	8,933,110	20
EARO	12	2,854,870	12	31	9,396,460	21
LARO	21	4,914,170	20	38	12,460,960	28
MERO	15	4,100,750	17	18	6,101,840	13
SARO	14	3,209,850	13	11	2,591,000	6
WARO	13	3,689,460	15	19	5,464,820	12
TOTAL	89	24,461,600	100	144	44,948,190	100

* Table does not include interregional or global projects.

organizational structure was necessary. Staffing has expanded and now comprises four senior program officers and five program officers. CAPS is subdivided into 13 project groups to best provide the necessary technical advice and backstopping:

a) Cereal Crops;
b) Grain Legume Crops;
c) Oilseed Crops;
d) Root Crops;
e) Perennial Crop-Based Systems;
f) Other Crops;
g) Land and Climate;
h) Pasture and Forage Improvement;
i) By-Product Utilization;
j) Minor Animal Species;
k) Cropping Systems;
l) Animal Production Systems; and
m) Farming Systems.

The main functions of these groups are to:

a) help develop priorities for the particular subject areas in terms of scientific content, geographical or ecological focus, and institutions to be supported;

b) assist in project development and technical monitoring through appraisal of proposals and technical reports; and

c) encourage network activities.

Each group comprises three or more people and each officer is a member of four or five groups. The groups provide technical advice and backstopping to the program officer who develops the project and who retains overall responsibility.

3. Special Considerations and Constraints

Funding - The budget cuts announced in 1984 have resulted in a considerable loss of flexibility. Funds are now insufficient to cover the needs of phase II and III projects already in the pipeline for 1985/86, let alone to initiate new activities. Consequently, many new projects were dropped and the budgets of most phase II and III projects have been drastically pruned to allow a few new initiatives to be retained. The situation is unlikely to improve in the following year as more projects are due for renewal and of necessity several projects will have to be carried over. The net result will be that projects will be funded for a shorter duration or for only one or two phases, average project budgets will be reduced, and expensive projects are less likely to be supported. The total number of CAPS projects may have to be reduced and the waiting period from first contact to project approval will be substantially increased.

Because of the long project development time and the understanding that projects will normally be supported for a second or even a third phase, it is difficult to make responses to budget cuts at short notice. Thus, the composition of the program over the next years will be determined as much by the inertia of the system as by the reasoned arguments presented in this document. The trend for projects to get smaller in terms of funding and shorter in duration will have serious consequences because agricultural research is inherently long term and frequently expensive. A point is rapidly reached where many types of projects traditionally funded by CAPS might no longer be viable. If the funding situation does not ease, a more realistic solution would be to reduce the total number of projects rather than decreasing mean project size across the board. In this case, it may be necesary to further reduce and refine the CAPS program priorities outlined in this document to avoid a scatter of projects across too many subjects.

Division Activity Projects (DAPs) - Although program flexibility has been lost due to the budget cuts, a greater measure of freedom and an ability to respond quickly could be achieved if larger budget allocations were made to DAPs. In addition to providing flexibility, such funds help to provide opportunities for program officers to become more directly involved professionally.

Administration - The amount of the program officer's time spent on project administration is more a function of the number of projects than their total budgets. Thus, the percentage of resources allocated to project administration will increase as project size is reduced. Program officers are already overburdened with routine administration when many of these administrative tasks could be handled by well-trained assistants. Such assistance will become especially important if the trend toward smaller projects continues or if additional funds are made available for DAPs.

Program Officers - There is a sense in which the program officers are IDRC. They are the people who interact with the men and women of the developing world. They judge the potential value of a project, the areas in which it is worth trying to work, and assess the potential project leaders, exploring their interests and creating together the project outlines. It is the success of those projects in the view of the leaders of the countries where they are located which govern the overall success or failure of IDRC. It is thus essential that IDRC continue to recruit program officers of very high calibre. The opportunities for professional involvement and advancement provided by IDRC are clearly of prime importance in attracting and retaining the best scientists for its front-line work.

4. Future Directions

The future plans and priorities for each of the project group areas are reviewed individually, but a few general issues not related to any particular project group will be touched upon first.

Geographic Regions - Almost 40% of CAPS projects are in sub-Saharan Africa. While this represents a large proportion of the budget, it is justified in view of the continent's current crisis in agricultural development. The productivity of the land is deteriorating, and large areas in the semi-arid regions are suffering famine at the present time. Per capita food production is declining as is the production of export crops, which are also important for Africa's prosperity. National agricultural research programs are still very weak, but there are encouraging signs in some countries of the development of the indigenous capacity for research and development. CAPS will continue to support this trend over the next few years, and to allocate a substantial percentage of its total resources to projects in Africa. However, the needs of the other regions must not be forgotten. Of the seriously malnourished in the period 1974-1976, only 16.6% were in Africa and fully 70% were in Asia. These proportions will not have changed substantially since then in spite of the recent drought in Africa.

Irrigation - A large percentage of increased food production will come from the irrigated sector and the area under irrigation in the developing world is expanding rapidly. "Life-saving" irrigation, as a supplement in predominantly rainfed systems, is a technique which has an enormous potential for stabilizing production in uncertain environments. Irrigation not only results in higher crop yields, but it enables cropping intensity to increase. Appropriate techniques for water delivery are generally available and little further research is needed. However, the management of irrigated cropping systems and the optimum use of water are areas which require

attention, especially in small-farm situations. For these reasons, CAPS will look for project opportunities to support appropriate research on irrigation, especially in Africa. Projects may be included in the cropping systems, farming systems, individual crop project groups, or in the land and climate group.

Agroforestry - As a result of increasing population pressure, trees have almost disappeared in some areas and the gathering of firewood can place demands on local labour comparable to those of agriculture. Shrubs and trees are also valuable in many farming systems as sources of timber, animal feed, mulch, fencing, and food. Agroforestry has received little research support in the past, although IDRC has played a leading role in the establishment of the International Council for Research on Agroforestry (ICRAF). There are many promising new areas for research in agroforestry such as alley-cropping. The role of fruit trees and other shrubs and trees in the agriculture of developing countries needs to be studied in greater depth and appropriate interventions designed. Over the next year or so, the CAPS and Forestry programs of AFNS will together define priority areas and find ways to support research on agroforestry systems appropriate for small-scale farmers in the tropics.

Animal Power - Labour bottlenecks during critical farming activities frequently limit the adoption by small farmers of new technologies and more intensive production systems. Key operations such as ploughing, seeding, weeding, and harvesting must be carried out at the optimum time. The use of animal power and appropriate mechanization can can reduce labour constraints and may also lead to increases in productivity through better seedbed preparation, more uniform plant stands, etc. A wide range of farm tools has been designed in numerous projects throughout the world, and in many instances there is probably little to be gained from further equipment design. However, the introduction of existing appropriate tools and machinery for testing within a farming-systems context is an area which could

have a substantial impact. For example, many of the bullock-drawn implements currently manufactured by village industries for small-scale farmers in India could play an important role in parts of Africa.

Horticulture - Only two projects, both in Asia, are supported by CAPS on vegetables, yet from a global perspective vegetables account for 8% of the total value of all foods. Although their dietary contribution is less crucial, they are important everywhere as a source of vitamins, minerals, and fibre. Vegetables are an important source of cash income for those small holders with access to urban markets and the large majority of subsistance farmers grow vegetables at least for home consumption. With increasing urbanization, the demand for vegetables will rise and their importance is likely to expand in many countries. Over the next two years, CAPS will carry out a study of vegetable production in small-scale farming systems to establish priorities for research support. The possibility of establishing a separate project group on horticultural crops may be considered.

Small Ruminants - The importance of small ruminants (sheep and goats) demands that support of further research on these animals is given a higher priority. A small-ruminant specialist will join the CAPS program in 1985, at which time the creation of a new project group on this subject will be considered.

Integrated Pest Management - The CAPS program structure emphasizes the importance of commodity-based rather than factor-oriented research. As a result, subjects such as integrated pest management have been relatively neglected, and only a few projects such as those on striga, cassava mites, and coffee berry borer have looked for alternative control strategies for specific pests. Rarely has an attempt been made to take a broader look at the management of pests within a systems context. The widespread and dangerous misuse of

pesticides in many developing countries, and their unavailability in others, strongly suggests the need for more research aimed at developing ecological and economical pest control alternatives. CAPS will continue to stress the importance of factors such as host plant resistance, crop management, and biological control in commodity-based research, but in addition the creation of a project group on integrated pest management is now being considered.

Biotechnology - The CAPS program allocates most of its resources to support research which is likely to have an impact at the farm level within a short time. This means a heavy emphasis on conventional research and on "downstream" research activities especially those involving farmers, while "upstream", or more basic research has largely been ignored. A few of the more advanced biological techniques have now reached the stage where they are able to make a contribution to enhancing research effectiveness and efficiency in developing countries. Support has therefore been given, mostly through Cooperative projects, for research on topics such as tissue culture for the storage and disease-free transfer of germ plasm (roots, tubers, plantains), anther/ovule culture for the production of haploids and dihaploids (lentils, sesame, safflower, niger), and the use of electrophoretic protein/enzyme banding methods for classifying and "finger-printing" germ plasm collections (cassava, beans, forages). In each case, similar techniques were already known for other crops and IDRC support was given to modify and adapt these techniques to new situations and for use in developing country institutions. No support has been given yet for more fundamental aspects of "biotechnology" such as protoplast fusion or recombinant DNA techniques. Since this is a rapidly evolving field, future support can be anticipated for those techniques which pass from the realms of the "academically interesting" to "practical and useful".

Research Management - The management of national agricultural research systems is frequently suboptimal and can impose severe

limitations on the effectiveness of the research. Although the improvement of research management is not an area of concern for CAPS alone, the program anticipates allocating some limited resources to this issue in the coming years. In many cases, support for strengthening research management will be provided in association with the International Service for National Agricultural Research (ISNAR).

Balance Between Commodity and Systems Research - At the beginning of 1979, 26% of the total budget was devoted to systems research, but by the end of 1985 this sector had risen to 37% and this proportion is expected to rise still further as work on farming systems receives more emphasis. This will occur as a result of existing commodity projects developing a systems perspective in later phases and as a result of new project initiatives on systems research. It is anticipated that by 1990 between 45% and 50% of the budget (excluding Cooperative Program funds) will be allocated to systems research projects.

Cooperative Program - The Cooperative Program has in the past only made a minor contribution to the overall AFNS support for crops and animal production research. At the end of 1984, there were seven active cooperative projects under CAPS, with a further four in the pipeline for the remainder of the financial year. In the future, Cooperative projects are expected to play an increasingly important role, and during 1985-1986 approximately $2 million will be allocated for CAPS cooperative projects, representing 16.5% of the total resources available to the program. The increase in cooperative project funding is a welcome addition to the overall resources available to CAPS. As national programs become stronger and as more Canadian scientists become involved in the international dimensions of their research, more areas for cooperation are becoming apparent. Links between Canadian institutions and those in developing countries are being established and strengthened and these links in turn are expected to lead to the identification of new project areas. For

example, a collaborative project between ICARDA and the University of Manitoba on faba bean diseases began in 1980; as a result of the links developed, a second project between these two institutions was initiated on Rhizobial carrier systems. With frequent exchange visits by the researchers, scientific contacts developed further leading to a project on dihaploidy in lentils in 1984, and one on faba bean pollination by insects. Such experiences have shown that the benefits of "twinning" institutions can go far beyond the immediate results of the present research.

Cooperative project opportunities are many and varied, and research proposals recently received include anther culture in oilseed crops, apiculture, yam tissue culture, banana nutrition, rapeseed improvement, and native swine. All are in areas identified as being of priority by CAPS program staff and many have arisen from existing projects in developing countries and link with existing networks.

5. Crops and Cropping Systems Overview

The great majority of people in the Third World depend on agriculture, where in many countries over 80% of the population make their living from the land, often on a subsistence basis. The basic strategy for development must, therefore, continue to focus on building a more productive agriculture all the more so since in many countries the population is rising faster than agricultural output. While livestock is an integral part of agriculture, crops represent 80% of the total value of agricultural production. In the crop sector, increasing productivity will not only continue to depend on improved cultivars with higher and more stable yields, adapted to local cropping systems, but also on better management practices, improving soil fertility, efficient marketing systems, stable profitable prices, and the availability of the necessary inputs.

The IARCs have made a big contribution to crop improvement and to cropping and farming systems research. However, they depend heavily on the national programs to ensure that their research results reach the farmers. The emphasis of CAPS support for crops and cropping systems research has been built on the perceived needs of the small farmer and on the benefits that his direct involvement in research can bring.

6. Cropping Systems

Small farmers in developing countries have to ensure adequate food production to feed their families, and to generate a surplus to cover cash needs for essential purchases. Yet their resource base is very limited, in terms of shortage of productive land especially in parts of Asia and South America, and in terms of the limited productivity of land and labour in much of Africa. Difficulties are caused by the unpredictable weather and pests, as well as limited labour and lack of access to inputs. Under these generally adverse conditions, farmers have developed cropping patterns and have selected crops and production methods that make them least vulnerable. While this slow process of adaptation continues, other changes that also affect the production environment have been much more rapid. Better health care and changes in social organization have led to expanding populations forcing rural people to subdivide land, cultivate less fertile areas, and remove the protective tree cover.

Until about 15 years ago, almost all crop research was compartmentalized along commodity or disciplinary lines and was mostly confined to research stations. To this day, most training continues to conform to this pattern. Yet such research has little chance to fit into the complex set of conditions faced by the small farmer; the results have often benefited only the few farmers that have the means to adequately duplicate the conditions of the research stations. To overcome this impediment, CAPS has from the beginning encouraged the

development of a systems approach to the improvement of crop production.

Of the 19 cropping systems projects active in 1985, eight are located in Asia, eight in Latin America, two in Africa and one in the Middle East. Emphasis has recently shifted to Latin America from Asia, where IDRC originally started these projects and where its most comprehensive experience comes from. Since 1975, support has been provided through IRRI to the ACSN, with emphasis on workshops, training, and the provision of a network advisor. Specific assistance was also given to five member countries--Sri Lanka, Thailand, Bangladesh, Indonesia, and the Philippines. Most of these projects have now completed their third phase and each country has developed its own internal network for cropping systems research. IDRC has thus been able to phase out some of its support and to give greater emphasis to farming systems research in Asia. An evaluation of the programs within ACSN took place in 1983. Attempts were made to measure the direct impact of the research on the farmer. The absence of adequate baseline data for comparison made this difficult, but this has been corrected in the new projects. Farmers' acceptance of the new technology increased rapidly for each program, once it reached the pilot production stage. In Kalimantan, Indonesia, the number of cooperating farmers increased over the first three years of experimentation from 40 to 650 and the area from 20 ha to 650 ha. In Sri Lanka, rice yields at one site increased from 1,290 kg/ha to 5,200 kg/ha. The high-yielding IRRI rice variety IR36 has now been adopted on more than 10 million ha in Asia, and double-cropping of this and other early maturing varieties has been an important factor in reaching a level of per capita calorie production well above the FAO/World Health Organization (WHO) standard in four of the five countries where IDRC first supported ACSN activities. The development of upland crops, especially legumes, for dry season cropping on paddy land has been a particular opportunity for cropping systems research in Asia. Work is concentrating especially on soybeans

(Indonesia), groundnuts (Thailand), and mung beans (Philippines). In the latter, one project site achieved a doubling of the yield in mung beans.

In Latin America, attention has been devoted to root crops/banana-based systems in Central America and the Caribbean, and the improvement of indigenous cropping systems in the Andean region. In both regions the cropping systems approach has been able to move the interest of many scientists into this field, where they have started to understand the constraints of small farmers first hand. Increasing collaboration has taken place in the last several years, and the Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE) has played a key role to achieve this, especially in Central America.

In Africa, a first step was to achieve a shift of researchers and policymakers towards a better understanding of intercropping and traditional cropping practices. Unfortunately, little of the early work has been useful to farmers, but the original intercropping research has now evolved into cropping and farming-systems projects, with most of the research conducted directly on farms. Through these, new projects have been generated with more emphasis on the introduction of a farming-systems perspective into crop improvement projects. Another approach in Africa has been the shift of many crop-improvement projects towards a systems approach, with much more of the research being conducted on farmers' fields. But national programs answering the needs of small farmers are only starting to emerge now in Africa.

Linkages between research and extension have been strengthened everywhere, as extension staff have become involved in preproduction evaluation, while researchers act as resource persons in the training of extension staff. The type of institution supported varies with area and country. Government research institutions receive most

support in Asia, while in Africa, where government research institutes are generally weaker, universities are predominant. However, the training of a future generation of researchers is considered at least as important as direct technology transfer, especially in Africa.

Future Plans - In the near future, no major changes in program emphasis are foreseen, but the trends that have started in the last years will continue. More work is expected in Latin America and Africa, while in Asia the shift from cropping systems to farming systems is expected to continue. In Africa, a gradual move of funding from universities to government research institutions is anticipated. In West Africa, special attention will be given to the needs of francophone scientists and increased support is necessary for the Portuguese-speaking areas. Agricultural-systems training at the post-graduate level is still only possible in North America, thus the establishment of relevant training capability in Africa needs to be considered. Cropping-systems methodology, as it evolved in Asia, needs certain adaptations to make it appropriate to Africa. Lack of labour and low labour productivity are major constraints in the semi-arid environments of Africa and this makes a different disciplinary balance necessary; for example, more emphasis needs to be placed on factors such as animal-powered cultivation and resource-efficient systems, especially for the management control of insects, weeds, and diseases. Soil-related research will also become more important and, as crop researchers and forestry scientists start to come together, research in agroforestry may also become an important part of the overall cropping-systems program. The principal methodology improvements to be sought over the next years will be in the area of trying to forge a closer collaboration between researchers and farmers in designing and evaluating technology, because up to now despite the rhetoric relatively few projects have been able to fully overcome the "top down" orientation of most researchers.

7. Cereal Crops

Cereals supply most of the energy and a significant proportion of the protein to the diets of the less-affluent peoples of developing countries. About half the cultivated land in the world is devoted to cereals. Wheat, rice, and maize are the major cereal crops accounting for almost 80% of world cereal production. These crops have received strong research support as both national planners and donors have recognized the importance of increasing the production of these crops to increase the amount of food available and its nutritional level. Higher yielding and disease-resistant varieties of wheat and rice suited to intensification have formed the basis of the Green Revolution, in which several international agricultural research centres, especially CIMMYT and IRRI, have played a major role.

Sorghum and millet are widely grown in Africa and Asia as a staple food for some of the world's poorest communities under conditions that make the growing of other cereals unsuitable. In view of the resources devoted by others to the major cereals, CAPS has decided to put its priority on the support of research for the minor cereals, which are nevertheless extremely important to a large number of people especially in semi-arid areas. During the first 10 years of AFNS, sorghum research received considerable support, especially in association with ICRISAT. Sorghum was the basis of six projects during the past five-year period, but of these the projects in Ethiopia and Senegal have now completed three or four phases and have been taken over by the national governments. A cold-tolerant sorghum project in Mexico was taken over by another donor and sorghum work in Papua New Guinea was discontinued. Sorghum projects in Rwanda and Uganda performed well and have developed some promising new lines and varieties. New projects have been started in Zimbabwe and Somalia,

the former with emphasis on subsistence production, while the latter is especially focusing on the dry and difficult conditions in that country.

The millet project in India, which has developed excellent Setaria and Proso millet material will soon be taken over by the Indian Council of Agricultural Research (ICAR). A new project in Bangladesh has started well. Millet here is used as a short-term crop in cropping sequences: Proso on the temporary islands left after flooding and Setaria in temporarily dry areas. In the Uganda project, finger millet is now receiving greater attention and the new male-sterility is proving useful in the breeding work. The pearl millet lines from the same project are showing great promise in the Karamoja region. Finger millet projects are being planned in India and Nepal, while work on this crop in Sri Lanka has been set back by the political situation.

Striga, a parasitic weed prevalent on sorghum and millet is a major menace for the small farmer in Africa. Good progress has been made in finding resistant varieties in a project in Burkina Faso; material from there is now being used in a project in the Sudan. For rice, the period of support for the West African Rice Development Association (WARDA) project in Senegal is ending. The results are promising and rice has a big future in Africa. Support for this crop from other donors means that CAPS can limit its role here, but may look at other situations in Africa. Triticale support has now ended except for a minor component in the cereals project in Ruanda, where triticale outperforms other crops on acid soils and is consumed as porridge.

Future Plans - The ICRISAT/Semi-Arid Food Grains Research and Development (SAFGRAD) network expects to be able to pick up more of the funding for the sorghum work, especially workshops that provide a channel for communication and cooperation among national scientists.

CAPS will continue to support the present sorghum network in Africa, but does not intend to expand the total number of sorghum projects. Finger millet is the next neglected crop to be developed. In the proposed project in India it is expected that research will cover a range of latitudes and both high and low altitudes. The project in Nepal will reinforce the Indian work on high-altitude varieties. Project opportunities in Tanzania, Malawi, and Zambia will be explored, together with the possibility of creating a finger millet network. Hybridization between Indian and African material, together with the availability of male-sterile material has yielded excellent results and promises a bright future. Support for other cereals will be limited, but some new areas to consider are the use of Indian minor millets in Africa, barley in North Africa/West Asia, and possibly further research on triticale within a farming-systems context.

8. Grain Legumes

Grain legumes are important in the cropping systems of many developing countries. They are often grown as a break crop in predominantly cereal rotations, help prevent the build-up of pests, diseases, and weeds, and are able to supply most of their own nitrogen. This ability of legumes to fix nitrogen is the main reason for using them in crop mixtures, as the companion crop tends to benefit from the fixed nitrogen. Food legumes are a valuable food, especially in regions where protein is a limiting component of the diet. They are particularly valuable when eaten with cereals in traditional diets, due to the complementary amino acid profiles of food legumes and cereals. The sale of food legume seeds provides a cash income in many parts of the world, while hulls and straw are used as animal feeds.

There are two major ecological groups of pulses: warm season/lowland (summer) types, such as phaseolus beans, cowpeas, pigeon peas, mung

beans, and black grams; and cool season/highland (winter) types, such as peas, chickpeas, faba beans, lentils, and grasspeas (lathyrus). IDRC tends to treat groundnuts and soybeans also as pulses, although they are included in the oilseed group when appropriate.

CAPS has aimed its support at projects in national programs, where it has little competition from other donors and to IARCs for aspects of their work linked to national program projects. Only IDRC supports work on grasspea (lathyrus), a valuable grain legume of the poor, that is widely grown in northern India.

Localized production of legumes legumes leads to specific requirements for new germ plasm, which is difficult to acquire in countries where national legume research programs are only just developing. Thus, the use of new legume varieties is still very modest, especially in comparison to the extent of usage of new cereal varieties. Despite the modest growth in overall legume production (0.4% annual growth rate 1970-80), there have been noticeable decreases in the areas under production for specific legumes, especially in parts of Africa and West Asia. Labour costs and lack of appropriate mechanization contributed to this decline. Legume researchers find it difficult to develop improved varieties and agronomic practices with significant yield increases for crops which are intercropped and which have an essentially nitrogen-independent status.

The projects on cowpeas in Burkina Faso, Niger, Sierra Leone, Mali, and with IITA have made good progress. A good photosensitive, virus-resistant cultivar with a wide adaptability has been released and good striga resistance has been identified. Bruchid-resistance work is assisted by a small project with the University of Ouagadougou. A determinate cowpea with virus, striga, and bruchid resistance has reached the stage of national trials. In "Food Grains, Sri Lanka" several cowpea varieties have been released. In Southeast Asia,

support has been provided for breeding and testing of food legumes which fit into rice-base cropping systems. Advances have been made on mung beans from the Philippines and soybeans from Indonesia. In Thailand, the groundnut project has been testing a large number of lines and segregating populations from North Carolina State and ICRISAT. A major achievement of this project has been the bringing together of government scientists, university researchers, and extension workers.

Excellent progress has also been made in "Food Legumes, Pakistan" in a well-integrated national program. The Chickpea CM72, produced by irradiation at the Nuclear Institute for Agriculture and Biology (NIAB) in Faisalabad, has been widely tested and found to have a good level of field resistance to Ascochyta blight, a disease which in the past has devastated the crop. There are now plans to have 90% of the country use this cultivar by 1987.

Grasspeas (Lathyrus) are being handled in "Grain Legume, Bangladesh", where several productive lines have been obtained. A unit to analyze the factors responsible for causing the paralyzing disease Lathyrism is identifying new lines with low neurotoxin levels.

The disease-resistant mung and black-gram lines selected in the project are catching on well as summer crops, when there is no competition with wheat. The "Pigeon Pea, Kenya" project is now at the stage of farm testing of wilt-resistant varieties with better yields. Seed of improved early maturing types is being multiplied and is sought by farmers for growing under irrigation as a vegetable.

In the West Asia and North Africa regions, a cluster of projects has been supported in national programs around the food legume program at ICARDA. These include projects in Pakistan, Sudan, Jordan, and Turkey, and a regional project, through ICARDA, in support of national programs in Algeria, Tunisia, and Morocco. The projects in

Egypt ("Food Legumes, Egypt" and "Orobanche, Egypt") and Algeria have now terminated as did IDRC's support of the core program at ICARDA. However, the Information Sciences division of IDRC continues to provide core support for the faba bean and lentil information services.

Good progress has been made especially in Egypt and at ICARDA, identifying and incorporating resistances in faba beans to major pests and diseases.

A new Orobanche-tolerant faba bean cultivar has now been released in Egypt and major advances have been achieved in the development of Aschochyta blight-resistant chickpeas which are tolerant to cold. The new cultivars can be planted in winter rather than spring, a change in practice which results in yield increases of up to 100%. A resistant cultivar has been released in Syria and is being tested in Jordan. The lines also appear promising for winter planting in North Africa and Turkey.

A major constraint on lentils in the MERO region is the high cost of labour for harvesting. Work on mechanization and agronomy is promising and a taller, more erect cultivar has been developed at ICARDA. Arising from this research a Post-Production Systems (PPS) project on harvesting has recently been approved to serve the national programs in West Asia.

The "Groundnuts, Malawi" project with ICRISAT has also made good progress. Types with excellent resistances and adaptation are in multilocation testing and there has been good interaction with national projects including "Groundnuts, Mozambique", a project which continues the testing of improved types with farmers. The "Groundnuts and Pulses, Tanzania" project has identified Tamnut-74, Spanhoma, and 1/30 as good-yielding types with a growing season of about 87 days.

Future Plans - CAPS will continue to devote a significant proportion of its resources to food-legume research, although as a percentage of the total budget it will diminish slightly. In addition to the current range of food legumes, support may be provided for new species such as horsegram in India and soybeans in Pakistan. Greater resources may be devoted to research on peas (Pisum sativum), which are the world's second most important pulse crop, but which have been neglected by the IARCs, the international research community and donors.

Consideration will be given to further support for grasspeas especially for the development of stable, high yielding cultivars with low neurotoxin levels. Grasspeas are the most widely grown pulse in Bangladesh and are common throughout northern India, Nepal, and Ethiopia. Lathyrism occurs only rarely, yet there is a widespread fear of the crop, especially among scientists and policymakers. For many of the poor farmers, however, there is no substitute.

Support to national programs will move away from overall crop improvement programs to more narrowly focused research on specific crops or constraints, and/or to research with a greater on-farm or cropping-systems perspective. Research on legumes for use within rice-based cropping systems is an example of this shift in emphasis. Networks will continue to be an important means of linking researchers among national programs and to the research in the IARCs. The possibility of developing networks on legumes for which no IARC has a mandate will be explored.

9. Annual Oilseed Crops

Vegetable oil is an essential component of the diet, but oilseeds and, thus, food oil is in short supply in many developing countries, where much foreign exchange is used up to import these oils. Cotton and groundnuts are the two major annual crops of the semi-arid

tropics used for oil production and these have received considerable international research support in the past. Other oilseeds that are widespread, but mainly used in subsistence, have received much less attention and have a largely undeveloped potential. These include safflower, sesame, niger, linseed, castor, and sunflower. Niger seed is a crop that grows well on difficult soil conditions, while safflower and sesame can grow on residual moisture and safflower in particular can penetrate deeper soil levels.

Due to the considerable success in developing high-yielding cereals and the neglect of the other crops in the system, there is now a danger that these latter crops are being phased out to the detriment of both the diet of the people and the balance of the cropping system. A series of oilseed projects has been developed in Eastern Africa and the Indian subcontinent, but these crops lack the backing of an international centre of research, and thus much work was done in isolation. IDRC has now been able to establish a research network, with an advisor based in Ethiopia, that conducts workshops for the researchers, provides a literature service and a newsletter, assists in the exchange of germ plasm and offers the backup assistance of an experienced scientist.

Sesame is a traditional oilcrop that is widely grown and provides an oil of excellent quality. Under the present cultivation system yields are low, pest and disease problems are serious, and the capsules shatter as soon as they are ripe. The first oil-crops project supported by IDRC in India was concentrating initially on assembling a wide range of germ plasm and on breeding. Advanced lines have been tested for adaptation to specific conditions; the most promising have shown increased yields of 20%-30% over the local check variety. These are now being field tested with farmers. The project in Egypt has a sesame component, where hybridization, selection, and testing have resulted in the identification of several improved lines outyielding the local variety on experiment stations

by 50% to 80%. Selection work in Sri Lanka is aimed at adaptation to the two specific seasons there. In Ethiopia, crosses have been made between good local types and nonshattering lines from the USA.

Safflower is widely grown in parts of India, where a project has developed good spiny cultivars and is now also working on smooth types that are easier to harvest. Progress has also been made in the crop's resistance to aphids and leafspot. The lowland oilcrops project in Ethiopia has up to now concentrated its safflower research on screening and selecting a large population maintained by the University and on evaluating some recent introductions.

Groundnuts are usually grouped by CAPS with pulses, but several oil projects have a groundnut component. In the Sudan, 28 cultivars of Arachis hypogaea Sp. fastigiata (Spanish types) chosen from the original 400 introductions have now reached the stage of advanced field trials. Selection continues in 46 crosses in which fastigiata was one parent. Special selections are aimed at producing lines for the drought-prone rainfed farming system of the West and Central regions. In Ethiopia, groundnuts are a new crop and there is scope for considerable expansion. Germ plasm from ICRISAT was introduced to find varieties with resistance to leafspot and rust under local conditions. In Sri Lanka, spreading type groundnuts possessing seed dormancy have been found suitable to grow during the northeast monsoon in the eastern areas. For the other regions, bunch types have been selected for short maturity, kernel size, and disease resistance.

Brassica oilseeds (mustard and rapeseed) are important in northern India, where they are grown at higher altitudes or in the cold season. The rapeseed project in India has produced short duration toria types that can be grown without delaying wheat planting. Mustard research has also produced some excellent new cultivars and the project at Hissar has made progress in developing varieties with

larger seeds, disease resistance, and stable improved yields. In China, the second most important oilcrop is the Brassicas. The primary objective of IDRC's new project there is to improve quality by reducing the unfavourable components of the oil and cake. This project is not funded under the Cooperative Program, but considerable collaboration with Canadian scientists has taken place in breeding, pathology, and chemical analysis. In Ethiopia, Brassica carinata is a traditional crop of the highlands; selections from local germ plasm have been tested and crosses have been made to low erucic acid lines of rapeseed (B. napus). The local selection Dodolla-1 has been released as have the B. napus varieties Tower and Pura from Canada.

Niger seed is grown on heavy poor draining soils at high altitudes in Ethiopia. Local collections were made and of 450 selected lines the best eight are now being tested before release. Niger seems to have "cleaning" qualities in suppressing weeds while it grows and in the following crop. Linseed is also important in Ethiopia, and frost-tolerant and wilt-resistant lines have been crossed with high-yielding lines. Three varieties are now under farm testing before release and have shown up to 25% yield increases. Sunflower was shown to be a promising crop on newly reclaimed lands in northern Egypt, where extensive testing of hybrids and open pollinated varieties is under way.

Future Plans - Because of the importance of annual oil crops and the lack of resources directed to these crops nationally and internationally, CAPS will devote an increasing proportion of its budget over the next years to oilcrops. The activities and scope of the network will be evaluated and ways sought to develop it in a more sustained way. Links with Canadian institutions will be strengthened via the Cooperative program especially for Brassicas, to provide a strong research base as a resouce for national programs. A new project on Niger seed is under discussion in India and, if established, will link closely with the Ethiopian project, so that both

can benefit from an exchange of germ plasm. The possibility of supporting more oilseed projects in Africa will be examined, especially on sesame and safflower in the Sahel, and the network may expand to other parts of Africa and Asia, and possibly Latin America.

10. Root Crops

The division has supported a large number of research projects on a range of tropical root crops, mainly sweet potatoes, yams, cocoyams, and solanum potatoes, but its largest contribution historically has gone to cassava. The reasons for this emphasis include the fact that the crop has one of the highest potential yields in terms of energy production and the fact that, when IDRC started to support research on the crop, it was receiving comparatively little research attention. While over 80 countries contribute to the total world production of 100 million t, 80% of this is produced in only five countries: Brazil, Indonesia, Nigeria, Zaïre, and Thailand. The crop has become important as an animal feed, with 15 million t traded annually internationally, and in the production of industrial starch and alcohol. Cassava grows under semi-arid conditions, is easy to grow, and is a main stand-by against crop failures. It is limited by a range of pests and diseases, including mosaic bacterial blight, green mite, and mealy bug.

Sweet potatoes are better adapted to wetter conditions, but are subject to much loss from virus disease and potato weevil damage. A whole range of other minor root crops such as yams and cocoyams are grown in almost every garden in the higher rainfall zones of the tropics, but these have up to now been largely ignored by researchers. Solanum potatoes are in great demand and are widely grown in the subtropics, the tropical highlands, and during the tropical winter. IDRC has given funds to the CIP to support the Andean Cooperative Program for Potato Research (PRACIPA) network in Latin America, which has laid the foundations for a significant

program of collaborative and complementary research among the five Latin American countries: Bolivia, Colombia, Ecuador, Peru, and Venezuela.

The first involvement of the program in root crops was in 1971 when IDRC was asked by CIDA to manage grants allocated to the CIAT and Canadian institutions for cassava research. IDRC also supported national cassava research programs in Peru, Ecuador, Brazil, and the Caribbean, but once these programs had grown sufficiently in strength, the funding was largely taken over by the national programs. This progression has enabled CAPS to focus more on root crop research in Africa and Asia. For cassava, a major achievement has been the setting up of new projects in the African countries of Cameroon, Liberia, Congo, Rwanda, Uganda, and Zanzibar linked to IITA. Support to the Rwanda national project included the allocation of an IITA scientist who also acted as network coordinator to strengthen root-crops research in other national programs of the Eastern Africa region. In Zanzibar, cassava is an important staple food, and the small project there has developed high-yielding varieties resistant to green mite, which are now being distributed to farmers. As green mite is now spreading to other African countries, the IITA material identified in Zanzibar is potentially very important to other countries for its resistance qualities. Since both the green mite and the mealy bug originated in Latin America, support was provided for a project with the Commonwealth Institute of Biological Control (CIBC), which has the goal of collecting biological control agents in South America and testing them in Africa.

In Cameroon, a national root-crop research program has been created with links to IITA and funding from CAPS. The project is successfully building national research capability, and improved varieties of cassava and sweet potato are now distributed to farmers. Yam varieties that combine high yields with higher levels

of resistance to several diseases are now at the stage of field trials.

In Asia, CAPS provided early assistance to start several national root-crop research programs and those in India, Thailand, and Malaysia have now been taken over fully by their governments. In Sri Lanka a main concern is that freedom from virus diseases is maintained, while importing the germ plasm needed for work on cassava and sweet potato. In the Philippines, work on cassava has now been taken over, but CAPS continues to support sweet-potato research there. The work on sweet potato has been very successful and has resulted in promising high-yielding varieties with good levels of resistance to pests and diseases. An IDRC project in Indonesia is looking at locally developed grafting techniques for increasing and stabilizing cassava yields.

Cooperative projects have included the University of Saskatoon, where systems of meristematic and single-cell culture were developed for storing and transporting cassava germ plasm, and the University of Calgary which, in conjunction with the University in Costa Rica, is working on tissue culture and diseases of yams and cocoyams.

Future Plans - The CAPS policy of giving consideration to proposals for root-crop research will continue, especially if these fit into existing networks and complement the activities of other research programs. Special consideration will be given to Africa, where the national programs still are less developed. Cassava is becoming increasingly important in Africa and projects that take advantage of the technology generated by IITA are expected. One task for these projects will be to select resistant, high-yielding progenies from IITA material. Another priority is to develop farmer testing and evaluation of this improved material and to improve root crop-based cropping systems, especially intercropping practices. The possibility of developing an information network of researchers on yams and cocoyams will be explored.

11. Perennial Crop-Based Systems

In the humid and subhumid tropics, perennial crop-based systems (PCBS) are common. The dominant species in such systems are generally trees or shrubs which may have growth cycles of up to several decades. While such species are of importance to large-scale plantation production, they are also vital to millions of small-scale farmers and are often grown in combination with other crops. Three main cropping types involving perennial species are distinguished:

a) perennial field crops--this class includes sugarcane, pineapple, sisal, bananas, and others, which do not have the characteristics of shrubs or trees, and where a considerable degree of cultivation is required;

b) shrub crops--coffee and tea are typical shrub crops, where the vegetative cycle lasts longer than that of the perennial field crops and a high input of manual labour is normally required; and

c) tree crops--including cocoa, rubber, coconut, and oil palm have particularly long vegetative cycles and normally require a lower labour input for maintenance and weeding.

Four phases can usually be found in the evolution of small-scale farmer plantations:

a) perennial crops are planted around the house (this usually slows down the rotation cycle of shifting cultivation);

b) cleared plots with arable crops are interplanted with perennial plants;

c) perennial crops predominate in the mix-cropping systems and young stands of tree crops are usually interplanted with arable crops; and

d) as the perennial crop creates more shade, intercropping becomes less important.

To date, CAPS support has mostly concentrated on systems involving bananas, plantains, and to a small extent coffee. World production in bananas and plantains is estimated to be about 62 million t, but world trade is only about 7 million t, thus by far the largest component of the crop is used as a locally consumed foodcrop.

In many African countries, bananas and plantains are an important staple, where average national daily per capita consumption may exceed 0.5 kg providing between 300 and 600 calories. The production of dessert bananas for export is largely in the hands of multinational companies, but, in the Windward Islands, it is a smallholder crop produced on farms with areas under 10 ha and a capacity of under five tonnes per farm. In recent years, several serious diseases such as black sigatoka have appeared and are spreading, making research into control mechanisms and breeding for resistance necessary. This is especially true for the small-farm situation, where growers are unable to afford expensive chemical control measures.

Coffee is a very important cash income source for small-scale farmers in many countries of Africa, Asia and Latin America. World production is around five million tonnes, and is increasing due to expansion in India, Uganda, Brazil, and several other African and South American countries. Coffee is suited to small farms in remote areas because of its relative ease of transport, and has the advantage of growing on steep slopes on land unsuited for other crops, where its vigorous growth also helps prevent erosion. Coffee

is also of major interest to a number of Third World governments as an earner of considerable foreign exchange.

Coffee and bananas have been chosen as targets for CAPS support mainly because of their importance to small farmers and the lack of research support that they receive compared to many of the plantation crops such as tea or oil palm. One of the first projects in this sector was on banana cropping systems in the Windward Islands of the Caribbean. Cultivars were gathered, evaluated, and the best were multiplied and distributed. A high-yielding cultivar has proved to be especially popular. Crops interplanted with bananas have also proved to be very well accepted. In a banana project in Cameroon, a collection of local and West Indian varieties was assembled and tested. Two very productive clones have been multiplied for distribution. In the Philippines, a banana project was started with the long-term goal of setting up a banana network in the region. Funding has also been provided to the Jamaica Banana Company to ensure the maintenance of its cultivar collection until an international network could be set up. This network, INIBAP, is now being established.

The only project so far in coffee research is on the control of the coffee berry borer and aims at finding biological control agents.

Future Plans - The immediate task is to get INIBAP fully operational and active in its support and backstopping of banana breeding work, the international testing of different clones, and the development of improved banana cultivation systems. Expansion into other crop systems will be considered for coffee and possibly other perennials such as cocoa, coconut, and fruit crops. To establish more detailed guidelines, PCBS will be analyzed in detail over the next two years involving the Forestry and AE programs as well as CAPS. Special attention will be given to those perennial cropping systems

that are most important to small-scale farmers, and to identifying their major constraints.

12. Other Crops

There is a large group of locally or regionally important minor crops that do not fit into other crop groups and generally have received little support for research. The crops covered by CAPS fall into two categories, the Andean crops and vegetables in Asia. The Andean crops consist of several root and grain crops especially adapted to the specific conditions found in high altitudes. They are usually quite frost resistant, often grow in areas unsuitable for other crops and can be used in a number of different rotations. These include quinoa, kaniwa, tarwi, oca, ulloco, and mashua. These crops have in the past had little research input and yields are generally poor. Vegetable crops have ranked low on CAPS research funding priorities, but the importance of vegetables to the small farmer is well recognized, both as a source of cash income and to supplement the diets.

A major contribution of IDRC has been the institutionalization of research programs on Andean crops, where originally Peru and more recently Bolivia and Ecuador have been moving toward granting more recognition and support to the Andean crops. The development of the Andean Crops Network has contributed to the exchange of results, experiences, and germ plasm. In Peru, cultivars of potato, oca, and faba beans introduced by the project are now widely used. In Bolivia, initial research concentrated on quinoa with cultivar collection, selection, and breeding, and from this work six improved varieties are now ready for release. Since other crops and animals interact with Andean crops such as quinoa, the whole production system is now being studied with the participation of farmers. The more recent project in Ecuador on tarwi, quinoa, and root crops has made good progress in the collection, evaluation, and selection of cultivars.

The vegetable project in China has as its main aim the linking of local scientists to the Asian Vegetable Research and Development Centre (AVRDC). Cooperative research is being carried out on mung bean, soybean, tomatoes, sweet potatoes, and chinese cabbage. In Thailand, good varieties of several vegetables have been developed, and work on seed-production technology is in progress.

Future Plans - The main goal of this sector is to maintain the support of work on Andean agricultural research for at least five more years, but at the same time the trend of national governments and regional institutions to assume increasing responsibility is expected to continue. It is planned to soon hold a meeting of scientists from high altitude environments worldwide to exchange information and germ plasm. A new assessment of the needs and potential for vegetable research in Asia, and elsewhere, is being planned.

13. Land and Climate

This section of CAPS is concerned with the national utilization and conservation of the basic resources on which the world's agriculture is based, land and climate. It has been estimated that in 1980 only 40% of the developing world's potential arable land was under cultivation although this figure varied widely from one region to another. Expansion of land use could contribute to the overall increase in food production in some areas. Expansion into new areas however brings risks, as most are into extremely fragile environments, with the inherent dangers that range from loss of topsoil to damaging effects on the climate. Soil erosion, leaching, and runoff are among the major reasons for the decline in agricultural production in Africa and have contributed to famine and a stagnant economy. It is, therefore, imperative to adopt measures under these pressures to conserve and enhance the productive potential of the soil.

After land, water is probably the most important input for agriculture. Water resources globally are expected to become increasingly scarce; it will be important to use them more efficiently in both rainfed and irrigated systems. The area under irrigation is expected to increase dramatically. While much work is being done on large-scale irrigation, systems for individual farmers and small groups have been largely neglected. Of considerable potential is the ability to give a single "life-saving" irrigation that can make the difference between a harvest and crop failure. While technical aspects of irrigation such as water delivery systems are generally understood, the effectiveness of many irrigation systems is limited by inadequate investment, lack of training, and poor management of the irrigated cropping systems.

The use of fertilizers is probably one of the most effective ways of increasing crop productivity and it has grown rapidly. Despite this, the amount used in developing countries is still very low at about 24 kg/ha of plant nutrients compared to an average of about 115 kg/ha in developed countries. One major barrier to its increased use is the need for foreign exchange for imports and the high cost to the farmer. Developing countries produce only two-thirds of their present requirements internally, yet many countries have the potential to become self-sufficient. Research into indigenous sources of fertilizers, especially phosphate, is therefore of special significance.

Most support of this sector has gone into research on fertilizers. Many developing countries have valuable deposits of phosphate rock and CAPS contributions have supported research into its use as fertilizer. Results have shown that the finely ground rock without further treatment can produce large increases in yield on several soil types in Latin America. This technology is now being used commercially by two companies in Colombia and is expected to be adopted by several other countries in the region. Further work is

now being carried out to find what treatment is necessary to make rock phosphate useful in other soils, particularily those with a lower acidity. CAPS support in a similar project in Mali has shown the benefit of phosphate rock in African conditions; similar work is under consideration in several other African countries that may lead to the establishment of a network. Research in Egypt has developed a technology for reducing phosphate fixation in calcareous soils through the addition of sodium pyrophosphate to super phosphate fertilizers. Small land survey projects in Zimbabwe and Malaysia were also supported, and CAPS has provided funds for the establishment of the International Board for Soil Research and Management (IBSRAM).

Future Plans - The subject of land and climate is very important and will receive additional attention in the future. Continued limited support will be given to promising research on the use of indigenous rock phosphate. Other projects on soil management will be supported, possibly in association with IBSRAM. Special consideration will be given to supporting irrigation research by national programs, possibly in association with International Irrigation Management Institute (IIMI), aimed at the specific irrigation needs of small farmers, with priority given to Africa. Overall, CAPS will move toward more support for well-designed soil and water management projects at two levels:

a) on-farm research, within existing and new farming systems research projects, on soil and water management techniques useful to small farmers; and

b) back-up research by national and international soil and irrigation research services.

14. Animal Sciences Overview

Livestock is an integral part of most small-scale farming systems. Animal products often play a major role in the diets of farming families and are a source of cash income. Animals are also a source of draft power, skins, hides, manure for fertilizer or fuel, and in many society they act as a symbol of wealth and provide insurance against bad times. Throughout Africa, the Near East, and Latin America livestock production relies heavily on natural grazing lands. Ruminants in particular are able to make use of the vegetation in the vast areas that are unsuited for crop production. In South Asia, on the other hand, the scarce land and dense population have resulted in the predominance of systems where ruminant feeding is based on by-products, crop residues, especially grown fodder. In order to keep pace with the needs of an increasing population and improve the nutrition of the rural poor, the number of livestock and their productivity per unit need to increase rapidly.

Recognizing this situation, CAPS supports animal research within four main project groups:

a) animal production systems, which recognizes the interdependence of crops, livestock, and social factors in small-scale agricultural systems and attempts to find relevant solutions through a systems approach to research;

b) pasture and forage improvement, which aims at improving the production of feed from natural pastures and from forage crops, the most limiting factor in livestock production in the tropics;

c) by-product utilization, which focuses on finding efficient ways to utilize agricultural residues and industrial by-products in animal feeds; and

d) minor animal species, which looks at ways to increase the productivity of livestock species other than cattle.

To date, CAPS has given little support to research in animal breeding, because livestock improvement is an expensive and very long-term undertaking before results reach the farmer. Improved management and especially improved feeding systems are considered to provide a greater pay-off in a shorter time. Similarily, the provision of funds to research on livestock diseases has been kept low, although progress in this field could lead to considerable expansion and increased productivity. Due to the complexity of the research and the presence of considerable funds from other donors and pharmaceutical companies, IDRC input has mostly been limited to the field evaluation of appropriate health interventions where they are components of an animal production system.

15. Animal Production Systems

In spite of the large number of animals in tropical areas, production and productivity are low, especially on small farms. Yet, the search for improvements is complex, because close interactions exist among the different components of the system and outside factors such as marketing and resource availability influence it. Understanding these complex systems and generating improved ones requires a holistic and multidisciplinary approach. Unfortunately, most research, training, and development institutions are not oriented toward such an approach, as they have traditionally been organized by discipline or commodity. At the same time, the novelty of such an integrated apprcach means that little past experience exists in this research field and animal production research is long term and expensive. Ruminants have the unique ability to make use of pastures, forages, and crop residues, and convert them into foods for human consumption. CAPS has therefore given priority to ruminant-based systems; among them cattle have received the largest emphasis.

Recently, more attention has been given to sheep and goat production systems, animals that are especially important in Africa, the Middle East, and parts of Asia. Their smaller size, higher prolificacy, shorter generation interval, and lower and varied feed requirements make them particularly suitable for the small-farm situation throughout the tropics and subtropics.

Monogastric species have received less attention because they are often raised in large commercial enterprises and to some extent compete with humans for the same food sources. One exception is the rearing of pigs on household leftovers and crop residues.

The systems approach to research in animal production takes into account the many and varied facets of production and attempts not only to understand them individually, but to look at their interactions and interrelationships. Beyond the technical aspects, animal production system research takes into account social and economic factors, which are often equally important in limiting productivity. The relative importance of different animal production systems varies in different environments, depending on the climate and crops grown as much as on the actual species of animal. About 80% of the ruminants in developing countries are kept on mixed animal/cropping systems on small farms. The CAPS program has given priority in the past to pasture-based systems in low- and medium-rainfall areas of Latin America, Africa, and the Near East.

The work on animal production systems started in 1979 with projects in Costa Rica and Panama. Since then this sector has increased to nine projects in the LARO region alone. New projects were also started in Africa, where at present seven are active. Of the total of 16 projects, 13 are concerned with cattle, two with sheep and goats, and one each with swine and South American camelids.

A main achievement has been the establishment of the Latin American Animal Production Systems Network, where members meet and discuss experiences, agree on common methodology, and design and test alternative interventions. This approach helps to increase efficiency, prevents duplication, and avoids costly mistakes. Of the many specific achievements of the various projects, two are highlighted as examples. A project in CATIE has designed a methodology for the systematic evaluation of the nutritive value of agricultural by-products. Feeding subsystems have been designed for the utilization of previously wasted materials such as sugarcane tops and banana stems and leaves. Seventeen MSc and one PhD theses have been conducted under the project. In a second project with Instituto de Investigacion Agropecuaria de Panama (IDIAP), the national agricultural research institute of Panama, production modules were designed and tested in which milk yields per hectare increased by 50%. The project has also improved the methodology for farm monitoring, thereby increasing the precision of such research.

Future Plans - The CAPS program will continue to stress the importance of adopting a systems approach to animal production research. Many projects that have started by looking at a single component of animal production are expected to develop into animal production systems projects in a later phase. Likewise, some animal production systems projects will find that if they are to be effective they have to take into account the interactions between crop and livestock enterprises, and thus will develop into true farming-system projects.

As a result of the success of the Latin American Animal Production Systems Network the establishment of a similar network in Eastern Africa will be considered. West Africa will remain relatively neglected until a program officer can be placed to take on the responsibilities for this area. With the appointment of a small-ruminant specialist in ASRO, greater emphasis on livestock develop-

ment can now be given to the Asian region. Particular attention will be given to the support of more research on sheep and goats worldwide.

16. Pasture and Forage Improvement

Pastures and forages constitute the most abundant and cheapest source of food for grazing animals, and pastures allow the use of extensive areas that cannot be utilized for any other type of agriculture. Productivity from pastures is generally low, but improvements can be achieved mainly by better management and the introduction of improved grasses, legumes, or in certain cases, shrubs and trees. Because pasture research is a long and costly endeavour and because funds and experienced researchers have been short, the results generated have generally had a low rate of acceptance by small-scale farmers. At the same time, only about 11% of pasture research on a worldwide basis has been conducted using animals for evaluation because of the high costs involved. Of these only a very small component has used dairy animals.

In view of the limitation of resources for the small-scale farmer, CAPS puts emphasis on the development of low-input technologies aimed mainly at the improvement of the present resource base. The choice of grasses, legumes, or trees is highly dependent on the specific ecosystem and the animal production system used under these conditions. In Latin America, importance is placed on the improvement of grasses and the introduction of legumes, while for the land-short Asian countries, there is a need to concentrate on higher-yielding forage species for cut-and-carry management, and the use of trees and by-products as feed.

The pasture and forage improvement group has established the following objectives for CAPS program support:

a) to promote the systematic selection of appropriate species of grasses and legumes to improve animal production systems while preserving the natural resources;

b) to encourage the development of improved methodologies for pasture and forage evaluation; and

c) to train scientists in pastures research and production.

To achieve these objectives, CAPS supports research to improve pasture- and forage-based animal production systems at national, regional and international centres. It also encourages and supports the formation of research networks to promote germ plasm exchange; outreach activities of centres of expertise; the exchange of information; and the development and standardization of appropriate research methods.

From the initial emphasis on support for pasture-based systems in Latin America, increasing importance is now given to Africa and to lesser extent Asia and the Middle East. During the review period, projects in Mexico, Peru, and Chile have been completed, and new projects in Ecuador, Colombia, Indonesia, and Nigeria were started. CAPS support for the CIAT-coordinated Tropical Pastures Network has linked 17 Latin American countries, who have established standardized methods of pasture evaluation and have evaluated a wide range of germ plasm. A recent workshop in Zimbabwe has led to the creation of the Pastures Network for Eastern and Southern Africa (PANESA), where the initial objectives are training, technical backup, and the exchange of information and germ plasm.

The achievements of two projects are highlighted here. CAPS has supported a forage program at the Universidad Catolica de Chile, where eight forage species have been selected for their high productivity out of more than 500 accessions of grasses and legumes.

Two late-flowering ryegrass varieties were selected for their high nutritive value and good association with clover; some 30 t of seed has now been sold to farmers. Better management techniques for cultivated forages and improved silage-making techniques have improved the quality of the feed, reduced losses, and cut down production costs. In Peru, the Universidad Agraria La Molina has received CAPS support and has produced a ryegrass-clover association that yields 18 t of dry matter per hectare under irrigation with a crude protein content of 15%, compared to 1.5 t DM/ha and 6% C.P. for rainfed native pasture. Based on these results, sheep fattening modules were developed that produce a daily gain of 200 g/animal/day under a stocking rate of 25 sheep/ha, compared with dry land native pasture that produces 100 g of gain/day with a stocking rate of one animal/ha.

Future Plans - New projects will put more emphasis on multidisciplinary research involving plant, animal, and social scientists. Such a systems approach will identify target populations from the start and will involve on-farm research as a key element. Most new projects will be in Africa and Latin America, but some involvement is foreseen in the Middle East, possibly linked to ICARDA or to the Arab Centre For Studies of Arid Zones and Dry Lands (ACSAD), and research on forage systems in the East Asia region. Support for the Latin American Tropical Pastures Network will continue, with emphasis on the development of on-farm research methods and forage seed production. PANESA will also receive support through a coordinator based in the region and directly to the national research programs on pasture and forage in Eastern and Southern Africa.

17. By-Product Utilization

Agricultural by-products constitute important feed sources in many animal production systems in developing countries. Their

significance is increasing with the expansion of arable cropping and the degradation of grazing lands due to overgrazing. The use of farm-produced by-products as animal feeds represents an efficient use of farm resources and is a desirable practice from an ecological standpoint. Different cropping systems produce different crop residues; thus, rice straw is most important in Asia, while maize stover is abundant in Africa. Although the residues from pulse crops are small, they contain a higher concentration of protein than most other residues. Besides crop residues, there are in some areas a variety of agro-industrial by-products available, such as bran, oilmeals, and molasses. These often contain high concentrations of energy and/or protein and could be used locally to increase the productivity of livestock, yet developing countries are net exporters of these by-products. Many countries are almost totally dependent on by-products for the dry season, while in some regions residues are stored for strategic feeding of draft oxen and milk cows. The use of crop residues as livestock feed is not without problems. Limiting factors include the difficulties in procurement and storage, poor feed intake, low digestability, low nutrient content, and anti-metabolites. As a result, animal production systems that use a high level of by-product feeds generally show low productivity. Some by-products have a wide range of competing uses. Straw compost, for example, adds nutrients to the soil and it has been estimated that half the commercial fertilizer could be replaced by straw compost. By-products are also used as fuel and the technology exists to convert them into hydrocarbons, although for the present at too large a cost. The production of paper, packing materials, rope, bricks, and insulating materials use a variety of by-products and mushroom production uses straw and maize cobs. Despite these many alternatives, their overall utilization capacity is generally small and localized, leaving the largest part for potential use as animal feed.

The first projects of CAPS in this sector were in Guatemala and Mexico, later followed by projects in Indonesia, Thailand, and the

Philippines. Work in Africa is located in Egypt, Sudan, Kenya, Tanzania, Cameroon, and Nigeria. In 1981, ILCA, with IDRC funding, set up the African Research Network for Agriculture By-Products (ARNAB). A major aim of ARNAB is the development of standard evaluation methodologies and standard terminology to facilitate information exchange between scientists. ARNAB also plays an important role in supporting and strengthening national research organizations on the utilization of crop residues and agro-industrial by-products through collaborative research.

Future Plans - The main focus of research on by-product utilization over the next few years will remain in Africa, where support will continue to be given to innovative efforts within the national programs. At the same time, ARNAB will continue its coordinating and supporting role. The training of African scientists will also remain a priority. With the appointment of a livestock officer in ASRO, it will be possible to give greater attention to research on by-products in Asia.

18. Minor Animal Species

Although cattle and buffalo are by far the most important livestock species with an annual meat production of 13 million t, smaller livestock species also make a significant contribution: sheep and goats with 3.2 million t, pigs with 4.3 million t, and poultry with 4.7 million tons. These latter animal species have a key role to play and are dominant in many agricultural systems in the Third World. Sheep and goats are vital to many pastoral systems and can thrive in some disease-infested areas where cattle cannot exist. The world population of sheep and goats has increased and these animals are particularly important in Asia and Africa. The production of meat from them has also increased, but overall productivity per animal is still very low.

The domestic buffalo has received little attention up to now. While the buffalo is generally kept as a draft and meat animal, in India where almost half the world population of buffaloes is found they produce 70% of the milk. Llama and alpaca, the South American camelids, are generally kept by small-scale farmers for wool, meat, skin, and transportation. Their main value lies in their adaptation to the high altitudes and their ability to utilize land not suited to other agricultural uses. Minor species such as pigs, poultry, ducks, rabbits, and guinea pigs also play a role on small farms throughout the developing world. Among the special attributes of these species are their low requirements for land and capital inputs and their adaptability to a variety of management conditions. The importance of bee keeping among small farmers and the landless is well recognized, but in the tropics is largely carried out along traditional lines, where poorly constructed hives and a low level of management limit productivity. Apart from the wide variety of domestic species there are wild animals that might have the potential for rearing in captivity and might find a productive niche in some agricultural systems.

Research support by CAPS has mainly been given through the animal production systems group to sheep and goat projects in Peru, Swaziland, and Zimbabwe, camelids in Peru, and pigs in El Salvador. Within the minor animals project group, support has been given to research on bee keeping in Malaysia and Colombia and goats in the Philippines.

Future Plans - Research in this field has been scattered and efforts will need to be made to achieve better coordination. There are plans for developing a cluster of projects on bees in Asia and Africa, linked to work in Canada through the Cooperative Program. With the appointment of a small-ruminant specialist more attention can now be given to sheep and goats, and the desirability of establishing a separate project group for small ruminants will be explored. Projects in Latin America on camelids, pigs, sheep, and goats have

benefited from the Latin American Animal Production Systems Network; it is anticipated that an African network could generate similar benefits. The potential of microlivestock will be explored. The National Research Council of the USA is at the moment undertaking a detailed study of minor animal species with a view to identifying those with the greatest potential for resource-poor farmers and the landless. CAPS support for research on minor animals will be reviewed over the next year and the results of this American study are expected to be of help in determining future priorities.

19. Farming Systems Research

The introduction of new, high-yielding and input-responsive cultivars of wheat and rice in the early 1960s led to dramatic increases in the production of these crops in many developing countries. This phenomenon, often referred to as the Green Revolution, gave rise to widespread optimism that similar "revolutions" could be achieved in other crops. It was believed that if sufficient international research resources could be mobilized, a scientific "breakthrough" could be achieved in almost any commodity and substantial increases in production would almost inevitably follow. Since then, however, few other dramatic increases in productivity were achieved, in spite of the numerous new improved cultivars and "packages of practices", which were developed by national and international agricultural research institutions. These packages have simply not been adopted by the large majority of small-scale farmers in developing countries. Many studies have been carried out to analyze the reasons for the success of wheat and rice and the comparative failure of other species. It has become evident that the new wheat and rice technology was only adopted by farmers who had adequate water, were able and willing to provide the necessary inputs (especially fertilizer), and were living in areas where the infrastructure for marketing and the supply of inputs was good. These preconditions were found in many wheat- and rice-growing regions of the developing world.

However, most small farmers living in the tropics and subtropics do not have these advantages. Even wheat and rice farmers in disadvantaged areas, such as those living in dry, rainfed areas, were often not able to adopt these new technologies.

Research has shown that small farmers in developing countries are economically rational and are generally willing to adopt those innovations which they consider to provide advantages. However, most live in highly unpredictable environments where input and marketing infrastructures are undependable or nonexistent. They simply cannot afford to take risks. Recognizing this situation, an awareness of the importance of research being determined by the farmers' explicit needs has developed over the past 10 years, rather than the traditional approach of basing research on preconceived ideas of scientists, who themselves are often from urban backgrounds. Increasing attention has now been given to what has come to be known as Farming Systems Research (FSR). Although there are diverse definitions of FSR, the approach supported by CAPS is holistic and "bottom-up". It aims, through close interaction with the farming community, to identify constraints and to test and introduce appropriate new technologies. Even though it may concentrate only on one or two subsystems, it involves a multidisciplinary team approach, and fully involves the farmer in the research.

Earlier sections on cropping systems and animal production systems have clearly shown the validity of systems research and several of the successes, especially of the Cropping Systems Research (CSR) projects, have been highlighted. But for a large number of small farms in the tropics and subtropics, crop and livestock enterprises are both important and frequently interdependent. Livestock may consume crop residues or grown feed and in return may provide manure and power for the production of crops. To fully understand such a farming system and to identify appropriate interventions, it is necessary to look at the interactions between crops and livestock.

Only projects which take both aspects into account can be regarded as being truly farming systems.

The number of farming systems projects supported by CAPS has grown rapidly in recent years. At the beginning of 1979, there were only two such projects, one in Mali and one in Colombia, but by the end of the present financial year, there will be 14. However, a few of these do not cover both livestock and crops; for example, the two Latin American projects are concerned only with crops and have not yet evolved to the stage of also looking at livestock and crop-livestock interactions, a process which is now well advanced in Asia.

In 1971, IDRC funded a multiple-cropping project at IRRI in the Philippines. With continued support from IDRC and other funding agencies, and increasing assistance from the national agricultural research programs, 12 countries became involved with the ACSN. As a result of the holistic approach adopted in CSR, the researchers soon came to appreciate that livestock is an important component of the rice-based systems, contributing between 20% and 40% to the overall farm income.

By 1982, ACSN scientists were confident enough in their methodology to start seeking the involvement of animal scientists. Data on the role of livestock in the farming system were gathered and in 1983 IDRC supported the first crop-livestock meeting of the ACSN. Five countries sent crop and livestock scientists to discuss how to begin farming systems research. The results of the meeting were impressive:

a) the ACSN changed its name to AFSN to reflect the expanded area of interest and IRRI changed the name of its program from cropping systems to farming systems;

b) the crop and livestock scientists found they had large areas of common interest and immediately began developing interdivisional research activities;

c) having no expertise or mandate in livestock, IRRI initiated a dialogue with UPLB to develop a joint program to support the AFSN; and

d) each of the five countries, Indonesia, Nepal, Philippines, Thailand, and Sri Lanka, began to develop a crop-livestock project, focusing a methodology which would tie into the AFSN.

Although it is too early to expect any significicant impact of these new FSR projects at the farm level, progress on methodological issues has been encouraging. FSR projects elsewhere are also new and as yet have had little impact on production. One of the more advanced is the first IDRC FSR project in Africa, which started in Mali in 1977 and is now in its third phase. Considerable progress has been made in developing the indigenous research capacity and in institution building. As a result of this project, the Institut d'économie rurale (IER) created the Division de recherches sur les systèmes de production rurale (DRSPR). A program of on-farm trials on cotton, groundnuts, and maize started in 1981 in three villages and later trials on sorghum, millet, and rainfed rice were added. In one village, farmers who were provided with maize seed and fertilizer on credit, obtained yields of up to 4.3 t/ha. Several farmers soon achieved self-sufficiency in food production and were able to sell a small surplus. Farmers in neighbouring villages have now asked to participate in the program. In another village, where there is a severe shortage of animal feed in the dry season, some promising results were obtained in on-farm trials of feeding a forage variety of cowpea with the addition of local rock phosphate. In an effort to encourage FSR in West Africa in general, a grant was provided to IITA in 1984. Research under the project aims at developing methodologies

that are appropriate in West Africa and testing them in cooperation with national programs and through the West African Farming Systems Research Network.

Future Plans - Over the next years, it is anticipated that several more of the CSR and Animal Production Systems Research (APSR) projects will evolve into true farming systems projects. But as FSR projects are considerably more complex from a conceptual, technical, administrative, and organizational standpoint than either CSR or APSR projects, this trend will need to be closely monitored. It is expected that most new FSR projects will continue to develop out of CSR and APSR projects, rather than being initiated from scratch. There is a need to take stock of the effectiveness of FSR compared to CSR and APSR. Within the next few years sufficient experience should have accumulated within the CAPS-supported FSR projects to undertake a comparative evaluation. Following the success of the Asian Farming Systems Network, CAPS will look for opportunities to assist the development of FSR networks elsewhere, especially in Africa. Consideration will be given to supporting a research network on alley farming, a new technology which holds considerable promise as an alternative to shifting cultivation in the humid and subhumid tropics.

Although the systems approach has been shown to be a promising avenue for agricultural research and development, it is still dependent on the availability of appropriate new component technologies. When these do not exist they must be developed and more conventional commodity-oriented research, albeit with an on-farm bias, probably remains the best means of achieving this. It is thus intended that the overall CAPS program allocate funds to both commodity and systems research; however, the proportion allocated to systems research will be increased from its present level of 38% of the CAPS budget, to a figure of about 45% to 50%, not including the Cooperative Program funds.

20. Training

A major contribution of the CAPS program over the past five years has been in training and institution building. An average of 11% of the IDRC budgetary contribution to new projects was devoted to training. This percentage varied widely from only 5% in LARO to 17% in EARO (a very high figure of 30% in SARO is due to a single project). Training within CAPS projects is normally either formal higher-degree training (MSc and PhD), or informal, usually short-term training.

Post Graduate Training - A total of 63 higher degree (mostly MSc) scholarships were supported within the 67 projects approved during the last two years. By far the largest number of scholarships were in Africa, with 27 in EARO, 10 in WARO, and the majority of the 15 in MERO from Egypt and Sudan. This reflects the recognition by CAPS of the great need for such training in Africa. The other regions (LARO, ASRO, and SARO) all have a better level of trained scientific manpower, and there is less need for IDRC to provide scholarships. Wherever possible, post-graduate students are supported for their studies at universities in their own countries, especially at the MSc level. If no suitable training is available locally, preference is given to providing the training elsewhere in the region, or at least in another developing country. Frequently, this is done in association with an international or regional research centre. Only when no suitable training is available at institutions within the developing world, does CAPS normally support post-graduate students for studies in Canada or in other developed countries. Such a policy aims to provides a saving in the costs per scholarship, result in a lower failure rate and a higher percentage of return after training, and help build institutions of higher learning in developing countries.

Training of Senior Researchers - The capacity of many of the project leaders, and other senior scientists, to undertake research has been

enhanced as a result of involvement in IDRC projects. Funds are provided in most projects for scientists to attend relevant national, regional, and international meetings and to visit other research centres working on related problems. Frequent interaction with CAPS program officers may contribute to the professional development of project scientists, while the writing of technical reports and the involvement in project management helps to develop self-confidence and provides an important contribution to strengthening research capacity in national programs.

Training of Technicians - In many parts of the world, the lack of well-qualified technicians is a major constraint to research. Thus, many CAPS projects include a component for training technicians and junior scientists. Of the projects which started in the last two years, over half included nondegree-related training, a large proportion of which was for technicians. Many international and regional research centres offer appropriate short-term courses and some courses are conducted in-country as part of project activities. Even in projects which do not include a specific item for training, an upgrading of skills is often achieved through on-the-job involvement of technical staff.

Training of Farmers and Extension Workers - Many projects include a component for training farmers and/or extension workers. The association of extension workers in on-farm research and the training of subject-matter specialists are important ways to strengthen extension services and contribute to the transfer of technology to the farmers. Field days especially help to stimulate farmers' interest and provide researchers with an opportunity to interact with the farming community.

21. Conclusions

In view of the increasing food deficit in many developing countries and the fact that at least 800 million people are malnourished, more than half of them to a serious degree, there is absolutely no room for complacency in the field of agricultural research and development. Although it may be argued that people are malnourished more because of poverty and political ineptitude than because of overall world food shortages, the fact remains that the world is moving into an increasingly dangerous situation of imbalance between the ample supply in comparatively few countries and an increasing need in most other countries.

IDRC's philosophy of encouraging national scientists to conduct their own research to solve their own problems is probably the most rational and effective approach; every effort is made to help ensure that the programs that AFNS supports are well adapted to the regions and countries where they operate. It is necessary to continue to evaluate rigorously all projects to assess their cost-effectiveness and to predict their long-term impact. One of IDRC's strongest points has been its flexibility and it appears highly desirable that CAPS should be ready and able to respond to new needs and initiatives where these appear and to shift its emphasis of support as necessary.

Although many projects, such as those involving plant breeding, require long support periods, a number of the early projects of CAPS have now been handed over to national governments or to larger donors. A few have terminated, most upon successful attainment of their objectives. The next five years are likely to see a wide range of new opportunities. The program must remain vigilant to ensure that its resources are used to maximum effect for the benefit of its primary target, the poor rural populations throughout the developing world.

C. FISHERIES

1. Introduction

Over 70% of the earth's surface is covered by water and major portions of this water mass are important for the production of fish. Fish is a high-quality protein source which can be produced cheaper than any other type of animal protein. Fisheries resources had earlier been considered as the great potential future food resource where increased yields were thought to be unlimited. In the 1970s, it became apparent that this was not the case, at least not to the extent predicted, but despite this fisheries still offers important options for increased food production in developing countries. It was during this optimistic period that the IDRC Fisheries program came into existence; this review looks at the developments of this program in the light of available IDRC resources and the evolution of fisheries issues. Based on our experiences to date and the predicted development of fisheries in developing countries, future directions of the program are then suggested.

This review has been organized into three regions: Asia (ASRO and SARO), Latin America and the Caribbean (LARO), and Africa and the Middle East (WARO, MERO, EARO). At present, each of these is covered by one Fisheries staff member. It is recognized that many fisheries issues are common to all regions, but the emphasis of subsector priorities at the country and regional level is often very different. This is brought out in this review, as each officer has written the section for his own region.

With the limited funds and particularly the small program staff available, it was inevitable that selectivity in the type and areas of support took place. The program chose to emphasize aquaculture (which includes mariculture) and artisanal fisheries as the two main subsectors, while the commercial and industrial fisheries sectors

were rarely supported. Geographically, Asia and Latin America were the main areas of support, with less involvement in Africa and the Middle East. In retrospect, this wide geographical coverage may have been too broad given the staff limitations.

Most IDRC support came from the Fisheries program of AFNS, but since fisheries is often part of a multidisciplinary problem, important inputs have also been made by the SS, IS, and HS divisions, as well as FAD division, the Cooperative Program, and the Communications divisions. Within AFNS, almost all fish-processing activities are now handled by the PPS program, including some fisheries-processing activities related to the use of fish by-catch. Economical aspects related to aquaculture in the past were carried out with Fisheries funds, but have now been taken over by the AE program, which has been established with its own separate budget.

A variety of proposals are received and a diverse set of projects developed, based on the type and level of criteria chosen; suggestions for future revision of these criteria therefore need to be discussed. A number of projects were developed from IDRC-funded workshops and many of these produced publications. This type of research review and focusing is described and recommended as a very useful method for continued IDRC project development. Table 17 gives an overview of the projects and appropriation of the different areas.

2. Program Objectives

The basic objective of the Fisheries program is to increase the production of fish in the world through applied research support in a manner to benefit the rural poor. In addition to the direct benefit of producing more fish or fish products, each project seeks to develop institutional and human research capabilities. While not the major priority of IDRC support, this institutional and staff development objective is recognized as a major element in the long-term

solution for the many problems of developing countries. Other underlying objectives include developing and highlighting new fisheries opportunities for future large-scale development or implementation via extension services on a national or regional level. Regional exchange of all information and technology developed with IDRC support is always sought and open access is assured.

TABLE 17

FISHERIES PROJECTS ACTIVE IN REVIEW PERIOD

Region	Country	Projects	Appropriations ($)	Regional Percent Allocation
ASRO	5	16	3,629,590	26.6
SARO	2	4	876,520	6.4
LARO	13	19	4,579,310	33.5
EARO	2	2	544,000	4.0
MERO	3	4	1,602,000	11.7
WARO	3	3	1,498,000	11.0
TOTAL	28	48	12,729,420	93.2
Cooperative Projects	(4, Asia)	(4, Asia)	923,000	(6.8)
Overall Total	28	52	13,652,420	100.0

These objectives were established earlier and have basically remained the same since the beginning of the Fisheries program. What has changed is the relative emphasis on fisheries subsectors in time and between geographical regions. Initially, the priority for Fisheries support was set as "food for the poor" with major emphasis on aquaculture and some support for artisanal fisheries, including fish processing. At the beginning of the period under review Fisheries was subdivided into Aquaculture and Fish Processing, but this changed in 1980 to Aquaculture and Mariculture, and Artisanal Fisheries, where by-catch projects are included in Artisanal Fisheries.

3. Review of Fisheries Development

An initial analysis of supply and demand in the fisheries sector shows that world fish consumption is projected to increase, generating a demand that will outstrip the supply, with consequences of higher prices and probably in less protein being available to the poorer segments of the population.

The major technical issues that concern the IDRC Fisheries staff are:

a) the economical harvest of fish is thought to have reached a level that is near the capacity that the ecosystem can sustain;

b) although aquaculture production from traditional systems is high in some areas (Asia), the scientific understanding of production processes and input/output relationships is at a very early stage;

c) increasing production from developed aquaculture systems may require intrusive research on specific components (breeding, genetics, diseases, nutrition) while a more general approach may be required where aquaculture does not exist;

d) artisanal fisheries has been based on the relatively easy access to a food resource and the lack of alternative opportunities; the problem of increasing the use of a diminishing resource will demand greater inputs of resource management, but because scientific information on tropical species is particularly weak, a significant research effort is required (the specific allocation of what has traditionally been a common property will also have to be addressed);

e) the new Extended Economic Zones (EEZ) established under the Law of the Sea have allocated new resources to many developing

countries, and removed some from others. Neither group is prepared to adjust to these challenges and opportunities and regional cooperation is slow to materialize; and

f) commercial fishing is very sensitive to oil price levels and possible future price increases will again alter the industry, forcing it to adjust to a new set of economic conditions.

IDRC Inputs - The program has mainly concentrated on the Artisanal Fisheries sector and on Aquaculture, because of the closer fit of these areas to the aims of IDRC. Industrial fisheries on the other hand have not received much attention, because research here is very costly, most of the industry's produce is reduced to animal feed, and a number of large donor agencies provide inputs into this subsector.

4. Regional Review: Africa

Overview - Although Africa produces only 5% of the total world fish catch, fish is a very important dietary source of protein for many poor rural people, and fisheries provide employment for some two million Africans. Earlier forecasts of the potential of fisheries development were overoptimistic, and have created expectations of rapid growth of the productivity of an underutilized resource. It is now recognized that most African wild fish resources are exploited at or near their capacity and future developments have to concentrate on optimum resource management. Africa imports a considerable although diminishing amount of fish, thus the substitution of these imports with a locally produced commodity is a high priority. The introduction of fish-culture techniques from Asia continue to be a promising field, but progress has been disappointingly slow. Research generally takes place in an environment of poor research infrastructure and lack of trained manpower.

In this region, nine fisheries projects were funded by IDRC, of which seven dealt with research oriented toward developing, adapting, and improving a variety of fish-culture systems. In addition, there were fisheries-related projects funded by PPS, SS, and HS. A number of other donor agencies are also involved in the field, but most of their input was directed toward industrial fisheries and development rather than research in artisanal fisheries and aquaculture.

The economic decline of the region had a considerable effect on project results, but as this situation is likely to continue, the program has to adjust to this more difficult research environment. Infrastructure degradation, especially in communications, has made monitoring and project contact more difficult. Useful research results have been produced in most projects but their extension to users has been limited. To deal with this problem, two new aspects have been given much more importance. These are to emphasize aquaculture systems of a level of complexity appropriate to the target group; and to carry out well-designed pilot studies where the interactions between the potential beneficiaries and the new culture system are examined at an early project stage.

Lack of government support has been another source of problems. Confirming government support is more difficult under conditions of recession, where government funds are scarce and the allocation to institutions and research often have a low priority. There is thus a need to make a continuing effort to ensure that these projects remain a high priority.

Future Direction - The new EEZ and the opportunities they offer have not yet been fully utilized because investment capital is not generally available and dealing with foreign fishing interests is often difficult. The poor economic outlook for Africa is expected to continue, with a further decline of export revenues and resulting import restrictions. This will likely have the effect of decreasing

fish imports, while the demand for fish by a large and growing population will increase. Despite the needs, funds from several multilateral agencies have also been declining. One positive result of this difficult situation is an apparent new interest in supporting and expanding existing opportunities based on small producers, as the large, expensive, and complex projects of the past can no longer be afforded and often have not produced the expected results.

Infrastructure in Africa has traditionally been poor and is now declining parallel to the economic decline. Rural and small-scale production was generally discriminated against; with the continuing economic recession this will be even more the case. There is a continuing poor situation in the number and quality of trained staff. The general atmosphere of discouragement in their work created by the lack of funds, the low priority given to their work, low salaries and political conflicts may result in outmigration or the loss of motivation.

Given this difficult situation and at the same time the need to increase nutritional and economic benefits from fish production, support for fisheries research in Africa and the Middle East must continue and, if possible, increase. Priority areas for support will be in aquaculture, which has the potential of increasing the supply of fish, and traditional fisheries (artisanal and subsistence), which supply food and employment to large numbers of poor Africans. An important conclusion to be drawn from the decline in infrastructure quality is that fish production systems based on well-organized government support services may not always be the most appropriate. Many past research and development efforts were built on the existence of such systems, for example, fry production on government hatcheries or well-organized enforcement systems for regulating fisheries. While the maintenance of such systems may be within the capability of some countries, it should not be assumed that these exist and will continue to exist. The conclusion is that "self-

contained" production systems appropriate for local conditions may have better success than systems based on outside support for essential components.

A major question for aquaculture is why this sector has developed so much more slowly than anticipated, given a situation of high demand and considerable inputs. It appears that many systems that are technically feasible have come up against social and economic problems. More attention must be given to develop systems that are appropriate to a particular sociocultural milieu and to include the potential users early in the development process. Assessment of the acceptability of every aspect of these systems could then be carried out and the systems modified as required. Simplicity and robustness appear important characteristics of fish-culture systems to be developed for African conditions, with low initial investment, the use of native species, and simple fry production and transport methods.

Major themes for capture fisheries will be increasing the efficiency of the use of catches and the limitation of fishing pressure, based on the assessment of the present state of fisheries resources and the future sustainable potential yield. Limiting effort, particularly in dispersed multiunit fisheries, is perhaps the toughest fisheries problem of present times; several original approaches have been proposed for African countries but fieldwork on these has not yet been done. Recent conceptual advances in stock assessment in multispecies, multigear tropical fisheries are available and need testing in a variety of situations.

Full descriptions of the widely varied fisheries systems operating in Africa are lacking in many areas. Descriptive research of this kind, although not particularly glorious, may be essential in focusing development efforts on aspects of the fish production and marketing system which are most amenable to improvement.

5. Regional Review: Latin America/Caribbean

Overview - The total fish production of Latin America and the Caribbean area amounts to roughly 11% of the world total. A large proportion of this production comes from the Pacific region where the Humboldt current runs along the west coast of the continent and creates nutrient-rich upwellings of subantarctic waters in Chile, Peru, and Ecuador. The major marine production in the Humboldt system is the capture of small pelagic fish for the reduction industry. The predominance of this system is expressed in the annual catch statistics which show that the two main beneficiaries (Chile, Peru) account for 70% of the total aquatic production of the continent. Other ecosystems of importance in the region are the Caribbean basin with tropical characteristics that are also relevant to the Atlantic Coast from Colombia to Northeastern Brazil, the Argentinian shelf, and the inland fluvial ecosystem of Amazon, Orinoco, Magdalena, and Lake Titicaca which provide most of the fresh-water species consumed in the continent.

Latin America is not densely populated, and has abundant natural resources and alternative protein sources to fish. Fisheries, thus, is of low importance within the economies of these countries, where even in Chile, the fourth largest producer in the world, fisheries only contributed 2% to the GNP.

In such a situation of a relatively low population and the relative abundance of other protein sources, fisheries, especially artisanal and aquaculture, are of low priority. Aquaculture especially has had very limited importance due to the considerable potential of the marine waters and only the culture of highly valuable species directed to the export market (prawn, oysters) has attracted the attention of private investors. Freshwater (inland) fisheries are not significant in terms of overall production, amounting to only 3% of the total catch for the continent. Research under these

conditions has largely focused on aspects of national interest and industrial fishing, with the setting up of many institutions. But the present economic difficulties have now reduced their funding and caused a decline, made worse by the outmigration of many of the professionals.

Concentrated input by IDRC has been in the field of aquaculture studies under controlled conditions. The main aim was to research the production of larvae and to rear them to adults. Up to now two projects (Peru, Jamaica) have been moderately successful, but in Peru experimental work had to be suspended due to ecological changes (El Nino). Different culture systems were experimented with in several projects, with differing degrees of success and most studies are still in progress. Most projects have not involved economic studies as many of them have not yet reached a stage where extensions and demonstrations can be carried out. Concentrating on aquaculture has not produced the anticipated results; progress is very slow due to isolation of projects and the need to emphasize the development of local capability in the early stages of a project. The particular lessons learned from the experiences of the last years were discussed in 1983 and adjustments have been made.

Future Direction - The future direction of the program in Latin America is strongly influenced by the demand situation, characterized by a need to respond to the increasing demand of an expanding population under conditions of economic crisis. A special problem of the region is the heavy external debt burden of most countries and their need for high interest payments, causing high inflation, currency devaluation, and shortages of money for development.

The research situation under these conditions is very difficult, because due to lack of funds and support there are now fewer research activities, reductions in staffing, and more emphasis on teaching or administrative tasks than on research. With the heavy emphasis on

export, there is now considerable overexploitation of natural resources resulting in an undersupply of local markets, high local prices, and a general lack of government funds to correct this situation. Some new initiatives by the artisanal fisheries sector to organize, monitor the resource, and improve their efficiency have been a positive aspect in this not very hopeful situation, and may generate new opportunities for assistance.

For the IDRC Fisheries program to remain effective in Latin America, it is necessary to streamline the scope of the program by concentrating on some crucial areas where our activities can have a multiplicative impact. The main emphasis of the Fisheries program in South America will be on artisanal fisheries as the main supplier of local food, with emphasis on new gear technology, alternative resources, and improvements of handling, processing, and marketing. Mariculture will become more important in response to overexploited resources as an alternative to the declining catches and this input will be aimed mainly at artisanal fisheries communities. One future area of involvement may be in the establishment of the Aquaculture and Artisanal Fisheries Network.

Landing statistics show that freshwater species represent only 3% of the total aquatic production in Latin America; thus the importance of freshwater aquaculture will continue to be marginal. In particular cases, where the potential exists our priority should be to support the development of culture methods for local species (Colossoma, Chame), especially where there already is an existing local market, rather than basing work on imported species (Carps, Tilapia) that have to be introduced to the local population. Most projects will include a strong local personnel component in the staffing, to employ underutilized local manpower and build up expertise and institutions.

6. Regional Review: Asia

Overview - Asia is the major fish production area of the world and accounts for 46% of the total catch, although the figure includes catches made by Asian distant-water fleets in other parts of the world. In aquaculture, parts of Asia have a long history but the scientific base of the many aspects was poorly understood and this has limited the wider application of the methods used in the past. Newly trained young staff have been eager to work in this field, and the potential local demand and a lucrative market have provided the economic incentives. But more recently the further expansion of aquaculture has been limited by little understood social and cultural aspects.

Artisanal fisheries was increasingly being recognized by national governments and donor agencies as an important regional issue. Development efforts to date had often been disappointing; socio-economic and sociocultural issues were suspected to be constraints but little detailed information existed. Resources available to the artisanal sector proved to be limited and increasing incidents of competition and later confrontation between artisanal and industrial fisheries were occurring. Many governments of the region gave priority to the development of their industrial fisheries despite their increasing interest in the artisanal sector. Major financial and infrastructure support continued to be directed toward rapid industrial development and the desire to export high-priced fisheries products.

The main initiative in Asia, aside from the programs supported, has been the establishment of regional networks, some of which are now in their first steps toward establishment, with full-time or part-time coordinators. One of the biggest problems hindering the performance of the Fisheries Program in the Asia region is the excessive workload of supervision and project formulation and more staff is a priority.

Further efforts will be aimed at setting up a CGIAR style fisheries centre, to be endorsed and/or funded by IDRC. Other donors have recently become more active in the fisheries field, but are largely concentrating on development, with little interest in research.

Workshops have proved to be a valuable help in bringing scientists together and have become the starting point of many new project submissions. Aquaculture workshops proved a very worthwhile means of furthering exchange and cooperation between projects and need increasing attention. Training in the region is inadequate; more and better institutions and training programs are needed to cover the demand in the field of fisheries, especially in aquaculture.

Future Direction - Demand for fish and fisheries research is expected to increase in Asia. This can only be met through the proper functioning of regional fisheries organizations and their input. The importance of a socio-economic analysis for each project from the start has been recognized, but this is often difficult in a new technology field. A shift of emphasis toward more projects with species of high market value and higher production costs can be justified in the context of Asia, where a lucrative market for specialty products assures a good return and where access to loans make a more capital-intensive operation feasible. For captive fisheries, the direction should be to establish optimum arrangement of the present resources, based on an assessment of potential and to increase the efficiency of use of the catches. More emphasis will need to go toward aquaculture especially in countries that have lost traditional fishing rights through new Law of the Sea boundaries.

Increasing support should also be considered for artisanal fisheries as new socio-economic data are indicating directions for further biological research. This will likely concentrate on an improved understanding of tropical fish species and their response to improved management systems. The two sectors of aquaculture and artisanal

fisheries are expected to work increasingly together as coastal aquaculture is being tested as a new employment and fish production system for coastal fishermen. Fisheries should now give more attention to resource allocation related issues. Quantitative data are lacking that would demonstrate the value of the fisheries resource, the number of people involved, and the related level of fisheries research and researchers involved. These data are necessary to compare fisheries with other sectors, such as agriculture, and will show that some sectors are underfunded or understaffed relative to the resource. Continuing IDRC support should go to both university and government departments, building linkages wherever possible. Identification of strong national and region centres should continue, and IDRC Fisheries should begin a program rather than project support on a trial basis with some of these institutions.

Finally, one area that may offer new options for increased fish production is inland fisheries, especially in areas where reservoirs are being built. Current projections show an increase in reservoir construction in many countries, but the topic is still controversial in terms of their positive versus negative effects. Reservoirs offer good potential for large-scale fish production through natural stocks caught in the reservoir, or through culture in cages or similar structures. This is not a new area for IDRC support, but due to the reservoir construction boom it is suggested that research support be expanded soon for this sector to allow a more rapid development of site-specific data and overall research methodologies for the region.

D. FORESTRY

1. Introduction

During the past decade, there has been an increasing recognition in many developing countries of the important role that forests and trees play in helping to increase agricultural productivity, to improve rural welfare, to alleviate the negative impact of the energy crisis, and to preserve the environment. There has been a major shift in forestry development toward these areas of concern, but this change has not yet been matched by an expansion of forestry research to cover these new areas of interest.

Of the limited research expenditure, more than 90% has been directed toward the utilization of natural forest resources, the creation of new industrial plantations, and examining the potential for better industrial utilization. By contrast, research into fuelwood, charcoal, and other wood-based energy products, which account for almost 80% of total wood consumption in the developing world, has been minimal. While industrial forestry research will remain important to those countries that do possess a major resource, it is clear that a fresh look at research priorities is needed. Only about 40 of more than 100 developing countries can claim to have significant areas of closed high forest, while about 70 countries were identified as having insufficient wood to meet their domestic needs. For the majority of these, the main thrust of forestry during the coming years will have to be on afforestation with fast-growing species. Special emphasis will need to be on fuelwood and the planting of multipurpose trees around homesteads, along farm boundaries, in village woodlots, and in uplands watersheds. The research priorities of these countries and the inputs that AFNS can make should reflect this situation.

2. Forestry Background

Because of the IDRC's mandate to direct its efforts toward helping the rural poor, some elements of socio-economic research need to be an integral part of the forestry program. This is necessary to identify the needs, constraints, and the acceptance of changes of the target group and to foresee developments and understand future needs. In response to pressures from outside and from within, Third World governments sometimes have different priorities from IDRC, but it has been a strength of this organization to achieve results within its mandate in sometimes difficult circumstances. Some of these achievements have been the ability to foresee changes, to respond to them, and in the process to reorient government priorities in these directions. Examples are the pioneer work of IDRC in the areas of agroforestry, woodstoves, and bamboo/rattan. The major needs for forest research in developing countries can be identified:

a) research related to the contribution of forestry to rural development, including productive and protective functions of trees and forests, with greater emphasis on research into farming systems which are incorporating trees and watershed protection;

b) research related to energy production and use, into ways and means of increasing the productivity of trees to produce the maximum biomass energy yield per hectare in the shortest possible time, and into conserving wood resources by more efficient wood use, for example through improved wood stoves;

c) research related to the more effective conservation and management of tropical forests with special reference to their regeneration and enrichment; and

d) research related to the utilization and marketing of timber from secondary species and the utilization of woody residues.

Notwithstanding these new areas of research, the more traditional work on industrial plantations and forest utilization should continue, although the relative emphasis may change.

The problem areas in the forestry program largely involve the sometimes difficult working conditions in Third World countries. Most of the national research institutions are experiencing a serious shortage of operational funding and the general lack of trained scientists is made worse by the drift of staff into administration and industry. A considerable number of research institutions do exist both in the developed world and in developing countries, but often they are not used to capacity and the lack of communication among them and with projects and research organizations, causes a considerable wastage. This lack of communication and coordination is also present between the multitude of international and bilateral research and development programs.

It is in this field that considerable changes are taking place as the number of agencies supporting forestry research has dramatically increased in the last years. An important initiative recently has been the establishment of a semipermanent secretariat by the International Union of Forest Research Organizations (IUFRO), which has the mandate to identify forest research needs in the developing world and to stimulate the input by researchers from institutes in developed countries.

Of the $2,500 million provided by sponsoring agencies for forestry development during the past decade, only $200 million (8%) has been spent on research activities. The largest single sponsor, the World Bank, allocated only three percent of its investment to research. Yet even this low figure gives an inflated picture, since in many programs pilot projects are described as research. Nevertheless, there is a notable trend for more agencies to spend more on research,

in many cases because of the costly failures in technically unsound development projects of the past.

On reported statistics, IDRC currently occupies seventh place, in financial terms, in the league of forestry research sponsors. Our $8.2 million in grants over the past decade represent some four percent of the overall research expenditure. However, in terms of direct financing of applied forest research, our contribution has undoubtedly made a greater impact than these figures indicate. IDRC is, thus, a relatively small but distinctly significant agency in the field.

Within this international framework, the IDRC Forestry program must now redefine where it can play its most useful role. Our identification of the target beneficiary, with its implication of socio-economic content, helps define the selection among the possible research enterprises and interventions. Equally, the identification of priorities must remain flexible and allow for changes in direction when other agencies move into a field in which we have been pioneers, as was experienced with cooking stoves.

To date, the vast majority of projects supported by the forestry program have been with government research institutes or forest services. University research departments have received little support because of their tendency to work on basic, rather than applied, research. The strengthening of these national research institutes is one of the priorities and may be achieved with the provision of adequate operational funds as much as the provision of encouragement and moral support by IDRC staff to the scientists who often work in difficult environments. The level of institutional capacity, the quality of the scientists, and the capacity of local training institutions all are generally lowest in Africa; while Latin America is somewhat higher, Asia tends to be best in all three areas.

IDRC has in forestry, as in other fields, a rather special identity, based on its emphasis on involving professionals in research projects, its intermediate size, and its considerable flexibility. This approach also imposes some limitations, for example, IDRC is reacting to proposals rather than suggesting them. Especially in forestry, the magnitude of the problem is often beyond the time scale and the financial capacity that IDRC can offer.

3. Review of the Forestry Activities

The stated goal of the Forestry program was to concentrate on social rather than industrial forestry. This goal has been wholly achieved. Only minor components of a few projects could have an application in industrial plantations (tree-seed improvement research), while all projects have addressed themselves to a considerable level to social forestry.

The program has had some success in the early recognition of research needs in fields like wood stoves, agroforestry, bamboo/rattan, and Paulownia. In certain areas, however, the identification and development of research has not lead to the delivery of expected results, for example, the afforestation and integrated production systems subprograms in West Africa. The Forestry program in its early years made a decision to concentrate its efforts in this region, although both research capacity and infrastructure were extremely weak here. The difficulties of carrying out research in West Africa however were underestimated. In the Middle East, results have generally also been poor.

During the period, the program staff of the forestry group grew from one in 1980 to five in 1984, allowing the location of program officers in five of the six IDRC regions. The distribution of allocations and projects by region is given in Table 18.

TABLE 18

REGIONAL ALLOCATIONS 1972-1989

	1972-1979 Actual			1980-1984 Actual			1985-1989 Projected		
	Alloc. $'000	%	No. of Projects	Alloc. $'000	%	No. of Projects	Alloc. $'000	%	No. of Projects
EARO	697	11	4	2,890	23	11	3,100	17	12
WARO	2,291	35	12	1,505	12	11	2,800	15	11
MERO	1,090	17	6	957	7	4	1,400	8	6
SARO	-	-	-	920	7	5	2,800	15	12
ASRO	470	7	2	2,292	18	13	3,600	20	17
LARO	1,996	30	6	4,173	33	17	4,500	25	18
Total	6,544	100	30	12,737	100	61	18,200	100	76

In general, the program has followed its original plan, but the most notable divergences have been:

a) a greater emphasis was given to tree improvement, with a consequent reduction of activities in forest-product utilization, mainly due to the rapid development of a large number of projects in the field of bamboo/rattan; and

b) a substantial switch in emphasis toward Latin America was a result of the recruitment of program staff to work in the region, which allowed a better appreciation of the needs and the potential of this region.

The forestry program has been divided into five subprograms, which are described in more detail here.

Afforestation - Establishing forest plantations is a top priority in the dry zones of Africa and South America, where expanding populations in their need for fuelwood have been rapidly destroying the natural forests. Countries that once had abundant forests now can no longer meet even their minimal requirements for fuel and building materials. The depleted natural forests have survived fire, browsing, etc., only by developing a hardiness that paid its price in lower productivity; the surviving species as a result are very slow growing. These depleted forestry resources must now be augmented by plantations and woodlots. Fast-growing exotic species can be grown with careful cultivation and can increase wood production 50-fold, an increment that will offset the increased risk of losses caused by pests and diseases to which the indigenous species are resistant.

The afforestation subprogram has concentrated on research aimed at the establishment of forest plantations in the dry zones of Africa and the upland zones of South America. Research is being supported into the selection of fast-growing exotic and native species, as well

as techniques for their establishment and management. The emphasis in all projects is on developing simple techniques suited to use by villagers in small-scale plantation programs.

In Eastern and Southern Africa, four projects deal with the establishment of woodlots on dry, marginal lands, and are aimed at lessening the critical shortage of fuel. These projects are now producing practical results; the project in Malawi has been selected for an OPE impact study, while the Tanzanian project has been described in a recent publication of the IDRC manuscript series. In West Africa, a network of projects in Mali, Niger, Senegal, and Burkina Faso is carrying out similar research in the Sahel, but aside from fuelwood production, they are also concerned with the role of tree foliage and fruit as a source of animal fodder, a particularly important use of trees in this zone. In Latin America, two sets of problems for tree growth are being investigated. In the high altitude areas of the Andes in Bolivia, Colombia, and Peru, drought, low temperature, and high light intensities present special difficulties. The Peruvian project has now largely solved the technical difficulties and is proceeding with pilot demonstration woodlots. The second field of research is similar to the one in Africa, concerned with the establishment of plantations in the arid zones of the continent, where projects have recently started in Chile, Haïti, and Peru.

In general, support for afforestation research has been rewarding, partly because it does not require high technical input or a high research capacity and is thus within the reach of national researchers in Africa and Latin America where the need is greatest. The subprogram will continue to receive priority support in these regions.

Integrated Production Systems - Shifting cultivation, or slash-and-burn agriculture, is still the predominant form of land-use

throughout the tropics. The system works well when periods of bush fallow are sufficiently long to allow the replenishment of soil nutrients. Increasing population pressure, however, has resulted in reduced periods of fallow and a progressive depletion of the soil. Agroforestry systems, the growing of trees on the same land as agricultural crops or animals, offer a more efficient use of the land. Trees or shrubs can assist in maintaining soil fertility by fixing nitrogen; the nutrients are later returned to the soil in the form of organic matter. They also provide firewood, building materials, shade, forage for animals, and sometimes fruit. By generating even a small nonagricultural crop income for farmers, they help to relieve pressure on the land.

The forestry group built up a network of West African agroforestry projects, but the results have been disappointing due to the lack of an interdisciplinary approach by the foresters leading the projects. These projects have now ended and a second regional network is supported with projects in Nigeria, Sierra Leone, and Zaïre, working on the incorporation of nitrogen-fixing trees into agroforestry systems in the humid tropics. On the Indian subcontinent, projects in India and Nepal focus on developing pastoral forestry systems in semi-arid conditions.

The forestry program has maintained its support of the ICRAF which offers guidance to national research institutes. With ICRAF's assistance, two projects in the semi-arid zone of Kenya and in the Peruvian Amazon have recently received IDRC funding. The lesson of the need for an interdisciplinary approach to agroforestry research has been well learned. Future support will emphasize this by developing and monitoring projects in collaboration with the CAPS and AE programs. Agroforestry research requires a high research capacity and it is clear that considerable technical assistance and more support are required to produce the expected results, in Africa in particular.

Forest Products Utilization - In the humid tropics, loggers have damaged or destroyed the hardwood forests for centuries, in their search of a few marketable species. Most other potentially valuable species were discarded or burned in the subsequent clearing for colonization. This waste was largely caused by the lack of knowledge about the properties and uses of noncommercial timbers. In an attempt to correct this situation, IDRC has supported a number of projects in South America, where the largest of these has involved the five countries of the Andean Pact (Bolivia, Colombia, Ecuador, Peru, and Venezuela). The aim has not only been to investigate the properties of lesser-known hardwood timbers, but also to promote their use through the publication of design manuals for the construction industry.

The lack of grading systems in many countries of the developing world leads to the inefficient or sometimes even dangerous use of timber in construction. Projects in Mexico and Zimbabwe are carrying out research in this field, with the objective of publishing grading standards and design-stress values. Wood-energy utilization is another research area that has received support. One project in the Philippines is focusing on the new concept of developing a small-scale energy system for electricity generation based on wood gasification. Small projects in Tanzania are investigating improved methods of charcoal production and designs for charcoal-burning cooking stoves. Other IDRC-supported projects are carrying out research into wood adhesives and the production of raw materials for tanning.

African research capacity in this field is also very weak. Without high inputs in training and facilities, it will be difficult to justify Forest Products Utilization (FPU) research in Africa in the next few years. On the other hand, the results from projects in

Latin America and the available capacity in Asia are seen as justification to continue the support in this field and to concentrate on these regions.

Tree Improvement - Research into tree improvement and breeding is relatively new compared to the similar activities on agricultural and horticultural crops. Although enormous strides have been made in the past 30 years, much work remains to be done at all levels - from improved methods of collection, storage, and treatment of seeds, through the testing and selection of suitable species, to the genetic selection of improvements of individual strains to meet particular site requirements. The principal and highly successful activity in this subprogram has been the establishment of a strong network of 10 Asian projects, working on the selection and improvement of bamboo and rattan. Propagation methods and cultural techniques are also being studied, as are the properties of the presently unused species. Projects of a similar type on different species are being supported in China (Paulownia), Costa Rica (Erythrina), Philippines (Leucaena), and Sudan (Prosopis).

The development of tissue-culture techniques as a valuable tool for speeding up tree-improvement programs has also been recognized and projects in Malaysia and Senegal are receiving support. Tree improvement, particularly through tissue-culture techniques, is a sophisticated field of research, requiring a high level of skill and infrastructure. These are available in Asia, where the efficient operation of the program will be assured. At a lower level of scientific refinement, research into improved collection and storage of seed does have the potential to be carried out successfully in Africa and Latin America.

Environmental Forestry - Years of research have led to an understanding of shelterbelt design and good aerodynamics under the conditions of the temperate zones and the Mediterranean region, but

in Africa south of the Sahara little or no research has been carried out in this field. Although some countries, notably Nigeria, have large-scale programs for establishing shelterbelts, the concepts and designs derived from temperate and Mediterranean research are not necessarily suited to Africa. IDRC has, therefore, supported a network of four shelterbelt-research projects in Africa, each with a different emphasis. In Nigeria, the project addresses the influence of shelterbelts on rainfed agricultural crops. In Sudan, the problem is the control of desert encroachment on agricultural land under irrigated conditions. In Egypt the objective is to identify the most suitable species and varieties of Casuarina for use in shelterbelts. Finally, in Tunisia, the project is investigating the effects of shelterbelts on horticultural and fruit crops.

Unfortunately, these projects have been slow in producing results due to the long period required to establish shelterbelts permitting the subsequent cropping research, the inaccessible locations of most trials, and the low scientific capacity of local researchers.

Support Activities - Several program activities have also been carried out which are designed to provide a level of support for national institutions and researchers. The forestry group has organized and sponsored regional courses on forest-research methods and design at the Universities of Los Banos (Philippines) and Morogoro (Tanzania) and a course at the National University of Singapore to train senior scientists in the management of research, development, and applications of technology in forestry.

IDRC-sponsored workshops have generally been based on regional project networks. They are designed to promote contact and exchange of information between researchers working in similar fields and to highlight research needs and priorities, which in turn often lead to the identification of new projects. Recent workshops have been held in Singapore on Leucaena research, in Bogota on high-altitude

afforestation, and in Tunis on shelterbelts in Africa. The Forestry program has also supported initiatives of the IUFRO to promote research in LDCs. Major support has been provided by financing prelimianry fact-finding studies and sponsoring a large proportion of the LDC participants at workshops held in Sri Lanka and Brazil. Continued support is proposed for similar future workshops. During the five-year period, the Forestry program collaborated with the Communications division in producing 11 publications and also assisted in the production of a film on the topic of the African fuelwood problem. Further films are planned dealing with multipurpose tree species and bamboo/rattan research.

The principal lesson learned over the past five years was the recognition of some critical factors in the design and development of projects. These include:

a) overoptimistic assessment of local research and institutional capacity;

b) choice of research sites that were too remote or had difficult access and, as a result, were hard to control;

c) complicated organizational structure and the splitting of administrative and operational responsibility; and

d) insufficient monitoring.

Factors that adversely affected the success of some projects have been mainly due to the lack of staff continuity, poor institutional and administrative support, an inefficient program of work, the failure to disseminate the results, and failure of the recipient to understand and follow the IDRC mode of support.

4. Identification of Research Needs

The future direction of the Forestry program is a result of a careful evaluation of all these options and the priorities each are given in accordance with IDRC overall policies and guidelines set up for the Forestry program. Forestry staff have gone through a process to establish priorities between the different fields of research to be supported. The factors considered in establishing this classification were:

a) national program priorities;
b) other possible supporting agencies in this field, etc.;
c) response time;
d) point of intervention in terms of the beneficiaries;
e) leverage on the system;
f) level of national capacity present and required;
g) ratio of research input needed to benefits expected; and
h) regional impact.

The research activities considered and their relative ranking are shown in Table 19.

Among these options, Wildlife in Rural Welfare, Resources Survey, Industrial Forestry, and Industrial Utilization have in the past for a variety of very valid reasons been of low priority for IDRC support and will continue to be so.

For the evaluation of the remaining enterprises a system was used by allocating points, to arrive at the ranking of priorities. This way an objective classification was possible as to where IDRC should give priority support. This classification then leads to the conclusions that enterprises ranked high are to receive full attention, while medium- and low-ranking priority projects will only be supported if certain other conditions are met.

TABLE 19

POSSIBLE FOREST RESEARCH ENTERPRISES

Problem Area	Enterprise	Point Score	Priority* Ranking
Integrated Production Systems	Sociological aspects	16	Medium
	Farming systems using trees	18	High
	Watershed and range management	12	Medium
	Wildlife in rural welfare	0	Low
Fuelwood and Energy Production	Silviculture of fuelwood species	18	High
	Yield, harvesting, and marketing	20	High
	Village technology	20	High
	Wood-based derivatives	17	Medium
Management of Natural Forests	Resources survey	0	Low
	Conservation	14	Medium
	Silvicultural systems	20	High
Industrial Forestry	Silviculture	0	Low
	Management	0	Low
Forestry-Product Utilization	Use of secondary species	17	Medium
	Minor forest products	16	Medium
	Industrial utilization	0	Low
	Utilization of residues and waste	20	High

*See table in the full version for the detailed evaluation of these priorities.

5. Program Objectives

The objectives of the forestry program during the next five years have been based on the priorities established in the previous chapter:

a) to concentrate on social rather than industrial or forestry development;

b) to concentrate resources into the four major research fields:
   i) Integrated Forest Production Systems
   ii) Fuelwood and Energy Applications
   iii) Management and Regeneration of Natural Forests
   iv) Forest Product Utilization;

c) within these fields to support the solution of problems by the development of low-input technologies and to develop faster and low-cost applied research methodologies;

d) to strengthen national research capacities by supporting national institutions and the training of local research scientists, with particular emphasis on Africa;

e) to encourage increased communication and collaboration between institutes and researchers by networking and sponsoring of relevant meetings and travel; and

f) to further the twinning of Canadian and national research agencies of Third World countries via the IDRC Cooperative Program.

6. Future Directions

Overall priorities have thus been established. As far as regional priorities are concerned, emphasis will be on building up the program in the South Asia region. The Latin American and Southeast Asian programs will be consolidated after their rapid growth over the past years, while the Middle East and North Africa region will remain of lowest regional priority, at least until improvements in project efficiency and delivery can be demonstrated. The ability of African institutes to absorb additional research funding is limited by their poor levels of staffing and infrastructure; thus this proportion of their allocation will remain fairly constant. Proposed priorities by

subprogram and region will be presented in the form of projected allocations for the period 1985-1989, based on a notional total allocation of $18.2 million for the period.

The strategies to be applied within this framework of priorities over the next five years will emphasize:

a) project networking within priority enterprises;

b) the development of lead projects in new priority fields and/or regions, in which past experience has been poor;

c) the inclusion of NGOs to improve the dissemination of results;

d) the encouragement of twinning with Canadian centres via the Cooperative Program in certain research fields; and

e) the support of regional training centres in Africa.

Thus, although the program will maintain the past policy of emphasis on social rather than industrial forestry, a major restructuring of subprograms and the relative priorities between them is necessary. Recognition of the variation in levels of research capacity between different regions and countries will be given greater importance in selecting appropriate enterprises and levels of support. The aim will be to achieve a mixed basket of projects, but with emphasis on recipients who can be relied on to deliver and disseminate their research results. In areas of higher risk, an attempt will be made to initially support weaker recipients in fields requiring a low level of research capacity.

The overall formula proposed for the next five years is thus not wholly one of "more of the same". Certain priorities and strategies will remain constant, but in others changes are recommended. These

are made on the basis of a recognition of the changing research needs of the developing world, changes in the environment in which we are operating, and the lessons learned in the past five years. To achieve the proposed program, two main resources are essential: funds and staff. Funding has been assumed to be on a level of $18.2 million total allocations for the next five years and one new program officer will be required for 1987-1988 in LARO to bring the program staff up to a total of six.

E. POST-PRODUCTION SYSTEMS

1. Introduction

The present world situation is characterized by widespread food shortages and the future is likely to be worse as populations grow and the means of production diminish and/or become more expensive. Increased production is usually seen as the answer and less attention tends to be given to preserving what has already has been produced. It is estimated that up to half the world's food is lost or wasted. The Post-Production Systems Program (PPS) of IDRC deals with the technology, appropriateness, efficiency, and nutritional implications of post-harvest activities for the benefit of low-income rural and urban people.

PPS covers a wide range of disciplines in engineering, food science, nutrition, economics, and marketing. Most research by the established food-technology research institutions is aimed at the larger-scale processed food industry, while academic institutions tend to be less interested in applied research. Research is often undertaken in isolation in one specific discipline, without contact with similar or related work by colleagues in related disciplines. It is rare to find a systems approach in this field. Most developing countries depend on a large number of small-scale industrial enterprises with

less than 25 employees, to provide their post-harvest processing and a major component of PPS is support for research on development and management of these enterprises.

Much of the area of PPS is work commonly carried out by women and while there are no specific women's programs, all projects have to assess the impact of the proposed changes on women. PPS research priorities are focused with other AFNS programs on cereals and legumes, fish production, and economics where it covers such areas as grain dehulling, milling, storage, and fish or crop processing. The main target of the program is the small farmer and village people, but often urban situations are also affected. Post-production systems researchers and their institutions are also benefiting by carrying out effective research projects.

Program Objectives - The broad objectives of the PPS program are to make more and better food available to poor rural and urban consumers and to augment employment and incomes in small agro-industry enterprises. More specific objectives are:

a) to reduce food losses through the development and promotion of improved storage, handling, and drying technology and associated management systems;

b) to improve food quality and quantity by developing, testing and promoting better processes for stabilization of perishables and creation of new products reflecting consumer preferences and needs;

c) to promote research and development of food saving and enhancing technologies beginning with traditional processes and products;

d) to promote small agro-industry enterprise improvement and to create through them a new source of local employment and income and a service to agricultural production and consumers in rural areas; and

e) to promote improvement of post-production research capability and institutional development by encouraging the concept of integrated "food systems" systematic problem definition, training, and teamwork amongst researchers of various disciplines.

2. PPS Activities Review

Over the last five years the original office in Edmonton was wound down and staff were placed overseas in the regional offices. For a time, the AE group was associated with PPS, until its own program was formed. The earliest objectives of the PPS program were in processing and working on improvements and loss reduction in staple crops. As the program developed, PPS activities were subdivided into cereal and legume systems, rice systems, other food systems, and agro-industry. A revision in 1983 regrouped the disciplines because the range of commodities increased and the systems interactions broadened:

a) food processing, utilization and nutrition which covers food technology, utilization and nutritional quality improvement and small food-processing enterprise development;

b) food handling, storage, and drying which encompasses technology and management systems for more efficient food handling, grain storage systems, drying procedures, and the range of operations from harvestng, field handling, and transportation to quality control, grading, and packaging; and

c) equipment design, adaptation, and testing which involves the equipment needed by the first two groups, especially the design adaptation, construction, and testing of small machines in the milling, crop drying, and food processing areas applicable to small communities and enterprises, including their operating and management systems.

Over the review period the largest segment of total expenditure went to the area of food handling with 43% of the total and regionally to Asia with 42%. Food processing was most important in Asia and Latin America, while Africa absorbed little support in this category due to the general weakness of its research capability in food technology. For the equipment development and testing category, on the other hand, 62% of the funds went to Africa, mainly for dehulling, drying, and threshing equipment.

Variation in spending over the last five years is most noted in Asia, where, due to program staff changes, input has dropped after two years of very high allocations. This was offset by higher spending during that period in Latin America. Proportional spending on the different subprograms has remained stable, as has the average cost per project, although the recent trend has been toward increasing funds per project due to more integrated projects.

3. Program Content

Loss and waste reduction are major objectives of the PPS program. Progress in agricultural research has generated better varieties and techniques, which in many countries have led to increased production, only to find that post-harvest losses have also increased, partially counteracting the initial gains. The losses are caused by the overloading of an already stressed post-production system, wet season harvests, and the need for different treatments for new varieties. Loss evaluation, measurement, and documentation are inadequate, but

PPS does not consider this a priority area, because many other organizations are active on this topic. Many post-harvest problems originate from delays in processing and drying, which result in excess moisture, insect infestation, and spoilage. While simple mechanization could solve some of these problems, machinery sold by industrialized countries is often unsuitable and expensive. PPS supports applied work on the development and testing of equipment for cultivation, planting, tilling, and reaping specifically oriented to small farms.

The drying of crops and other produce has traditionally been done by exposing them to sun and wind. Increased production or a second harvest during the rainy season have made this practice more difficult, but most of the alternative drying methods rely on expensive fossil fuel, making the process uneconomical. As a result, the "wet grain problem" is either absorbed by farmers or handed along the marketing chain, especially to government food warehouses as buyers of last resort. The main PPS aim is to dry crops on or close to the farm as soon after the harvest as possible with minimal energy costs. IDRC has supported a number of produce-drying projects involving the development and application of fish dryers, paddy rice dryers, and mechanical crop dryers using a variety of fossil and renewable fuel sources. Of specific interest are two proposed Canadian cooperative research projects, the vortex wind machine and free convective solar dryers. Several requests have been received for research into mycotoxin infestation that are a result of poor drying in maize and groundnuts. PPS is of the opinion that its efforts are better applied to improved drying that will largely prevent such infestations. Storage problems occur, even if the harvest is adequately processed, if the structures are not properly designed. Most traditional structures and treatments do not provide an acceptable storage environment and loss, contamination, and deterioration as well as rodent infestations occur. Since most of these storage structures are on-farm, solutions are often constrained

by social, traditional, and cultural components. This demands location-specific problem identification and survey-type methodology. An important area therefore remains the testing of traditional and improved storage structures under local conditions. Linked to this are entomological studies to evaluate traditional local materials and chemicals, because increasing insect resistance, health hazards, and environmental pollution have made chemicals less attractive. Large-scale storage facilities imported from developed countries have shown many problems in tropical environments, but because several other research organizations are involved with this problem, PPS does not consider it a priority.

Packaging and cooled-atmosphere storage for perishable items such as fish, meat, fruit, vegetables, and roots is also an area of involvement of some projects. Fish is a major commodity in the area of primary processing, as estimates indicate that up to 20% of the world fish catch does not reach the consumer. Projects, especially in Asia, have been involved with better on-shore handling, such as drying, smoking, icing, deboning, mincing, and packaging. Another waste-reduction activity has been the better utilization of fish by-catch of shrimp trawlers. The production of oil from a wide variety of oilseeds is an area where PPS sees a need for research into the development of more efficient and hygienic extraction processes and the development of hand-operated oil presses for village use.

The dehulling and milling of sorghum, millet, and cowpeas is one of the more time-consuming tasks of women in the villages of Africa and Asia. Better transport and new markets have made milled imported substitutes attractive alternatives, which now leads to the decline of these traditionally grown and locally adapted crops. This development has adverse effects on national economies as it increases imports and reduces home production and self-sufficiency. IDRC has thus put much emphasis on developing dehulling equipment and milling

systems suitable for the village level; this is seen as a major factor to help reverse the trend.

IDRC-supported research has resulted in two dehulling machines: the RIIC/PRL dehuller, the large one, which needs a daily throughput of 1.5 t to 2 t to be economically viable, and the mini-dehuller which has a capacity of 500 kg per day and is suitable for smaller communities. The system now moves into a dissemination phase where action teams are needed to assess the feasibility for individual communities, to assist in setting up and testing pilot installations, and to provide backup services and training. Considerable interest is evident in many countries and guidelines are being prepared for the promotion and dissemination of the system.

Food processing involves the conversion of a raw commodity into a usable food, or the extraction of specific useful components. Many foods in tropical areas are unstable and thus cannot be stored, but have to be prepared daily. This lack of convenient, stable, processed food forms demands extra effort for food preparation and limits the availability of nutritious foods. PPS projects have focused on product development, small food enterprise process improvement, and property analysis of crops. The latter helps to identify consumer preferences and nutrition standards which are useful not only to food-product development, but also to plant breeders as selection criteria for crop-improvement programs.

Surveys of food utilization practices, consumer preferences, and product acceptability are usually an integral part of research projects. Marketing studies are generally done in collaboration with other AFNS programs and are an important component in the establishment of management and support systems for process-improvement projects. A second role is the generation of feedback to the researcher on difficulties encountered with new processes, equipment, and products.

Nutrition-related projects have involved cereal/legume mixes processed at the village level and their use as a supplementary infant food. While some interesting results were produced, impact on local nutritional improvements has been dubious. Lack of consideration of agricultural practices, food consumption habits, and socio-economic conditions, as well as researchers working in isolation, seem to be the main causes for the nonviable results. Before supporting any additional work of this type, PPS is undertaking an in-depth analysis of the experiences in this area. Two well qualified consultants are presently preparing a report, which will be used to guide decisions on future PPS research support in this field.

Energy is required at all steps of the post-production system. Of particular importance are more efficient small-scale drying processes and equipment and more efficient systems using solar energy, fossil fuel, and biomass fuel. Solar energy applications are still a promising research area, while the IRRI multipurpose dryer concept may represent a breakthrough for areas where there is inadequate sunlight for sun drying. Cooperative projects are being set up for fundamental studies of free convective solar dryers and refinements to a unique component of the IRRI dryer.

4. Program Evaluation and Future Directions

The main achievements for PPS have been in projects working with dehullers and with drying systems. The original dehuller, designed in Canada and adapted in Botswana, has become one of the most successful projects. To date some 36 of these machines operate in 21 mills in Botswana, where they are now built, and a further 17 have been exported. Over 250 jobs have been created in rural Botswana related directly to these mills. With the dehuller, a system of management, maintenance and accounting was also established to form an integrated package. Now a smaller version is in the process of

development, aimed at small rural communities where the original model was too big and thus uneconomical.

Under the general area of wet grain post-harvest systems and technology, a number of threshers, dryers, winnowers, and storage structures have been developed, but the extent to which they have been adopted is not well documented. A flatbed dryer design originally developed in the Philippines with IDRC support has become widely used by grain authorities in Thailand, Malaysia, and the Philippines. IDRC projects in this area have helped to establish a much clearer understanding of how to dry and handle cereals, legumes, fish, and other food products under humid tropical conditions. Much has also been learned about technologies that have been shown to be inviable and about the need to evaluate problems in a broader context than individual operations.

The PPS program has made a valuable contribution to institutional development and research capability in national programs. Because of a lack of post-production training programs in all regions, the program focused on encouraging researchers to learn by doing, coached by program officers specialized in key areas. Training awards were viewed as a reward for consistent participation in a project and some 15 MSc were supported. Most projects also include short-term training opportunities for project participants. Within the multi-donor Association of the South East Asian Nations (ASEAN) crops post-harvest project alone, more than 150 people have participated in technical seminars and workshops. FAD has also supported a number of trainees in the PPS area.

IDRC has provided support in the creation of the Philippine National Post Harvest Institute for Research and Extension. More recently it has become a partner with CIDA in supporting the Southern Africa Development Coordination Conference (SADCC) in a program concerned with post-harvest problems in Southern Africa. Over the past five

years, the PPS program has put together a methodological approach for systematic problem definition, the organization of research, and solution application in small enterprises. Practical solutions needed in agro-industry aimed at an improvement of their efficiency have called for a new approach, where researchers observe operational problems first hand and are able to find solutions based on this experience. Ten such projects have been supported and some have shown marked improvements in the manufacture of such produce as soy sauce, noodles, and a minced fish product.

A number of lessons have been learned in the process of finding technological answers to post-harvest production problems. Narrowly defined technical problems tend to be easier to solve, but if the needs of the end user in a complex system are disregarded, the work is often of limited use. But many researchers are unfamiliar with other aspects of the system and need much time and effort to understand the specific problem in its wider context. This represents a difficult task and a challenge to both the researcher and the PPS program officers where much involvement and encouragement is needed to get this new systems approach applied. Problems are generally crop and site specific, and can only be solved through a comprehensive approach taking these specific local factors into account.

Some of the post-harvest problems originate before the harvest, and solutions can only be found in close cooperation with plant breeders, entomologists, and other agricultural scientists. Overall it has been too easy for researchers to work with minimal attention to the farmer, processor, or consumer, and this has produced some poor results. More attention has to be placed on the definition and identification of research problems. At the same time, there should be some longer-term research in the field on more generalized problems that promise later benefits.

Future orientation of PPS will continue in the same direction, as many of the main problems identified in the past have not yet been solved. Commodities of importance will continue to be the common cereals, legumes, root crops, and fish, but the preservation of fruits and vegetables, edible oilseed processing, and the utilization and processing of animal products will receive increasing attention. A main goal will be the strengthening of small rural and village enterprises in the food and agriculture sector with the main aims of producing better products and generating additional rural employment opportunities.

High Priorities - Further refinement, promotion, and dissemination of the dehuller system is an area of top priority. Here, more research is needed on the economics of the system and the role it will play in the village environment at different scales and levels of throughput. Compiling and evaluating existing knowledge from at least a dozen countries and a document on introduction strategies will provide the necessary background information for the dissemination of the system. Trials are to take place in a number of countries in East and West Africa and the main objective for PPS will be to put together local promotion packages with training for installation, operation, management, and support. If this step proves successful, the local manufacture of dehullers will be encouraged. Other components of the grain post-production system will be worked on as required.

The problem of reducing the moisture content in staple food commodities to storable levels continues to be a major task in Asia, where rice losses in the wet-season harvest are now high, where aflatoxin contamination is a concern, and where fish is an important component in the local diet. The same problems will also be of concern in Africa and to a lesser extent in Latin America. Under the Canadian Cooperative Program, both the IRRI dryer and solar convective dryers are being worked on; as soon as prototypes become available these

will be field tested and operating and management systems evolved. Evaluation will specifically look at crop-drying activities as part of a farm family's need for food and income. The support of the AE program is necessary on such topics as grading and pricing policies, and the overall economic impact of the new technology on the intended beneficiary.

For fish processing, the research aims at improvements in drying, smoking, handling, and marketing, and small-scale surveys will be used to identify organization, marketing, and technical problems. Storage of food commodities remains a major problem, and PPS's main focus will be toward on-farm and communal storage systems. A further need identified is finding the optimum storage conditions for seeds in order to maintain high germination rates especially for legumes.

A continued high priority will be the area of training and institutional development. Aside from training young researchers, emphasis is put on improving problem-identification skills, a broader perception of post-production problems, and the encouragement of a more integrated and applied approach. In Asia, the ASEAN project involvement is expected to generate more specific project funding opportunities. The emergence of a similar program in Southern and Eastern Africa is encouraging, but its shaky start points to a need for long-term encouragement and support.

Second-Level Priorities - In response to a general shortage of edible oils in rural areas and the generally low yield and quality where these oils are produced, PPS will continue its work in this area. Specific projects are on rice-bran oil production in India, while oil-palm processing in Sierra Leone is near the application stage. Requests from Pakistan, India, and Bangladesh are under development.

A growing number of requests may come from the field of fruit and vegetable preservation, where time-specific harvests and high

perishability are the main storage problems. Past projects have covered drying, cooling, handling, and packaging of various horticultural commodities and a new area of promise is the topic of intermediate products such as banana puree, that can be stored and later sent to more centralized processing.

In the food-processing area, key components of future work will be consumer preference and marketing studies to identify the potential of specific local needs. These may be found in fruit processing, small-scale bakery improvements, fish processing, composite flour production, and formulated foods. Although malnutrition is a major concern to the program, past inputs have not produced the anticipated results. A present study into the subject will provide recommendations that are to guide PPS in its priorities on future project support in the nutrition area.

The development and application of implements and tools for crop production will be considered, where CAPS identifies the constraints and problems which represent limitations to increased food production. More sophisticated design requirements may provide opportunities for Cooperative Program projects. Energy-related projects will only be considered if they are relevant to applied research especially in the areas of drying and energy-intensive food technology.

Finally, increased overall attention will be directed at a more careful evaluation of problem identification, before moving into technology development research and at working closely with the staff of other divisions in the regional offices. To achieve the expected impact in terms of benefits to the defined target groups, location-specific research will be inevitable and much of the PPS project support will be allocated this way.

F. COOPERATIVE PROGRAM

1. Background

The Cooperative Program (COOP) had its origin in Canadian commitments made to the United Nations Conference on Science and Technology for Development (UNCSTD) in Vienna in 1979. Yet even prior to that date, up to 4 or 5% of AFNS program funds had been spent to enable Canadian researchers to contribute their abilities in support of our objectives. Research on the hybrid cereal triticale, on in vitro propagation of cassava meristems, and on the reproductive hormones of cultured fish are salient examples. Furthermore, basing some AFNS staff in Canadian universities and engaging some leading Canadian researchers in AFNS-supported projects as consultants had given the division a real constituency and informal network of professional contacts in the Canadian scientific community.

Thus, with the advent of significant Cooperative Program "A" budget funds to AFNS in 1981, the division was able to move very quickly to identify worthwhile projects. However, it should be noted that additional staff resources, commensurate with the new funds, were not made available under the "A" budget. In the first year or two the funds were administered from the AFNS program director's office with the director's executive scientific assistant acting unofficially as program officer. For the past three years, the division was able to assign only one full-time program officer to AFNS-COOP activities.

It was, therefore, appropriate at the outset of the program for AFNS to emphasize projects seeking answers to "basic" or fundamental scientific questions, projects which could be entrusted to selected Canadian institutions, with minimal staff effort expended in nurturing substantive collaborative relationships. The problems to be addressed were of course carefully selected, in consultation with divisional program staff and with the international scientific

community, so that the results would have utility for applied research in the Developing World. Nonetheless, an element of opportunism is evident in the selection of some of the early AFNS-COOP projects. The Cooperative Program initially responded to available Canadian expertise and the presence of substantial funds which could only be used in association with Canadian researchers, rather than to the core of our program priorities. However, this has permitted the exploration of certain areas, such as the use of plant products in pest management and the genetics of aquaculture stocks, which now may become somewhat more central to AFNS program concerns.

More recently, the division has moved to allign itself more fully with Centre-wide policy in respect of the collaborative nature of projects supported with COOP funds. All AFNS-COOP projects now have significant participation of developing-country scientists, or those based in international or regional research institutions, not only in problem identification and definition but in ongoing strategic planning and actual performance of the research. These projects tend to be rather complex administratively, both in development and in execution, as program and operations staff try to harmonize objectives and bureaucratic procedures of partners in quite different political, academic, and research environments. Under these operating constraints, the division aims to maintain its traditional attention to scientific merit and developmental potential as criteria for project selection. Proposals for collaborative research are assigned priority by the respective associate directors within the framework of the division's regular program subject areas. Where possible, administration of AFNS-COOP projects is split between the concerned regional office and headquarters in Ottawa. AFNS program officers in the regions now play a leading role in guiding the life cycle of these projects.

2. Current Program Status

The present distribution of active AFNS-COOP projects is presented by program area and region in Table 20. Projects with multiple recipients are listed only once (the 23 projects indicated comprise a total of 44 IDRC grants).

Some projects have only Canadian recipients because the developing country partners' participation is supported from regular program funds or from non-IDRC sources.

TABLE 20

AFNS-COOP ACTIVE PROJECTS (AS OF JUNE 1985)

BY SUBPROGRAM AND BY REGION

	ASRO	SARO	MERO	WARO	EARO	LARO	TOTAL
CAPS	1	--	4	1	1	6	13
Fisheries	4	--	--	--	--	2	6
Forestry	--	--	1	--	--	--	1
PPS	1	--	--	--	1	2	4
AE	--	--	--	--	--	--	0
Total	6	0	5	1	2	10	24

The table reveals concentrations in Southeast Asia, Latin America, and the Middle East regions. The former two reflect the early emphasis of the AFNS-COOP as outlined above, those regions tending to have more advanced scientific capability than the others. All the CAPS projects in MERO link researchers at the University of Manitoba with those at ICARDA, a long-standing institutional relationship which AFNS was instrumental in creating in the early 1970s. Ten of

the 24 projects are in association with international or regional research institutions, both within and outside the CGIAR system. As AFNS program officers in the regions increase their use of the COOP mode in their programs, it is expected that the regional distribution of AFNS-COOP support will become more balanced and, perhaps more importantly, the participation of national program scientists from developing countries will be increased. To encourage program officers to make themselves familiar with this new approach, AFNS-COOP funds have been provisionally allocated to each of the sub-programs in proportion to their share of AFNS regular program funds. Program officers can now operate with a better idea of the magnitude of COOP resources available to them.

The COOP funds are primarily intended to benefit Third World institutions. The extent by which such projects can or should be used to maintain Canadian capability which is judged by AFNS to be of importance to our program has not been established yet. Here one key question is how Canadian researchers can be rewarded by the system for devoting substantial parts of their careers to practical problems in the Third World, which are less likely to yield notable publications. The use of project funds to pay salaries of key research personnel who are not members of a faculty and the amount of overhead costs for the Canadian institution will need to be more clearly defined as the new program expands.

IV. SPECIAL CONSIDERATIONS AND KEY ISSUES

The initial two chapters of this In-Depth Review gave an overview of the development situation and the specific role IDRC and especially AFNS have in this environment. Chapter III then presented a detailed account of the activities over the past five years and future directions of the research programs. This last chapter is concerned with specific issues and future options of the division.

Policy statements for IDRC as a whole have been outlined at the beginning of Chapter II and are considered by the division as both adequate and appropriate to serve as the overall guidelines that will determine the work of AFNS over the next five years. They, nevertheless, merit critical evaluation by the Board of Governors and endorsement or change as the Board may consider appropriate.

Of equal importance is the relative emphasis of the various subsectors within the division. Here it is a question of what will be done and how much importance should be given to each aspect. Several issues have been reflected in the Review reports of the associate directors, while others have been brought up at staff meetings or among the division management staff. This In-Depth Review provides a valuable vehicle to establish medium-term guidelines for AFNS. To facilitate this, some of the topics that have arisen are presented under the subheadings Special Considerations and Key Issues.

It is the purpose of topics listed under Special Considerations to inform the Board about the views and intentions of the division on these subjects, for which AFNS does not specifically request policy directions from the Board. In the case of the Key Issues, the intention is to present some of the major policy topics and offer various alternative options with the specific aim of obtaining guidance from the Board as to what should be the AFNS position on

these issues. The options indicated under Issues may not be choices that have to be made, but rather what is sought is an indication of relative emphasis or overall direction. It should, however, be noted that a given choice or emphasis may well call for certain commitments, without which the new guidelines could not be followed to the extent desired.

A. SPECIAL CONSIDERATIONS

1. Support for the Rural Poor

From its inception AFNS has put its main emphasis on the "rural poor," based on two main considerations. One could be called humanitarian. The provision of adequate food, shelter, and care made it imperative for AFNS to work where the need was greatest. This need is generally found to be most pronounced in remote areas, where the type of subsistence agriculture practiced is rarely adequate to provide enough food in the generally unproductive natural environment, or in densely populated regions of smallholder agriculture where land resources are severely limiting. This has led to a special emphasis on smallholder agriculture, particularly on countries in semi-arid environments, and on food crops that provide the staple nourishment of specific underprivileged population groups. As a result of this set of priorities, research into aspects of industrial crop production and large-scale farming systems have not received much attention. However, where the rural poor can gain greater economic benefit from the production and sale of a cash crop in an environment where food can be purchased, this rule may find justifiable exceptions.

The other consideration is that economic development, especially industrialization, depends on the generation of capital to fund it. Development economic theories clearly establish the importance of an effective agricultural base for capital generation to drive further

industrial development. Without effective use of the land and labour resources in rural regions, economic development cannot take place at the required pace and scale. Here the rural poor play a major role as the labour force of a developing country, one of the resources that can be utilized for development. The rural poor also control the other major resource in many Third World countries, the land. Therefore, the support of these existing resources to make them more productive is seen as essential to generate the means of financing industrial development. By doing so, the standard of living of the rural poor is also raised and a higher income translates into purchasing power that becomes the consumer base for the newly established manufacturing and service industries. AFNS has focused on the rural poor by supporting research on those crops they traditionally produce, on combined production systems (including animals, fish, or trees) which are within their economic reach, and on technologies which utilize small-farm resources to assure that smallholders are the beneficiaries of the research. AFNS proposes to continue to focus its support on the improvement of land-use techniques for smallholder farmers with special consideration to ensuring that the results of research and the benefits thereof reach the farmer.

2. Support for Weak Institutions.

This specific focus of AFNS is concerned about the situation where most governments of the poorest countries have regarded the development of strong indigenous agricultural research as a low priority and local research leadership is difficult to obtain. It is thus particularly difficult to provide help here, because the least developed countries also have very weak research institutions, with poorly qualified research workers. The result is that IDRC receives few good project submissions from these countries and they compete very poorly with countries in the middle-income categories that have stronger institutions and more capable scientists. To support research in the poorest countries often necessitates the involvement

of expatriate staff, as a much higher cost for the Centre. The results here also tend to be less satisfactory than those obtained in wealthier countries and, unfortunately, the benefits of much of the AFNS-funded research may not reach the people in need.

In the past, under considerations of making the most effective use of the resources available to AFNS, the division was therefore forced to allocate a large segment of its support toward research in better developed institutions and countries than it would have liked. Arrangements were then made for the technical staff of poorer countries to acquire the research results and participate in some meetings and network activities.

In the future, AFNS will increasingly emphasize the importance of identifying trained capable individuals to lead projects, so that a higher percentage of projects can be carried out in the poorest countries. The additional difficulties of working in the least developed countries, will, however, demand a much larger technical input, and much "hand holding" will be required from the division staff. This will be reflected in an increase of projects with a longer duration, higher cost, and a greater tendency to intervene institutionally. Such a shift in emphasis, considered highly desirable by the division, will mean additional input for each project in funding, training and support by AFNS staff. The degree of change will therefore largely depend on the availability of increased project funding and on the manpower present in the field.

3. Multidisciplinary Projects

Clearly defined simple projects have in the past generally been the most effective, yet often their usefulness was reduced by factors outside the scope of the project. Therefore, AFNS during its brief history has consistently tried to look at all the influences affecting a specific research project. Within the division, this has

led at several points in time to integration, for example, of the Crop and Animal Sciences programs into CAPS. Even where cross-disciplinary plinary project were not desirable, the degree of cooperation between programs has increased steadily. This has been further facilitated with the placement of project officers of difference programs in regional offices. Special interaction is evident between many of the crop-production projects and PPS, where new crop varieties and harvesting sequences have called for new and better technologies in drying, storage, and marketing. Similar cooperation has gained momentum between CAPS and Forestry, in the discipline of agroforestry. Here the mutual benefit derived from a combination of crops and trees in a farming system has gained in importance. More recently, the different disciplines have gone beyond the purely technical aspects, to relate technology more closely to the user. The disciplines, agricultural economis and rural sociology, will in the next years increasingly interact with the more technically oriented programs.

Within IDRC, a number of divisions cooperate with AFNS: for training, for example, the FAD makes a valuable contribution to AFNS projects; and the various information and publication needs are catered for by the Information Sciences and Communications divisions. In recent years, a number of projects have been developed and funded jointly with the Social Sciences division. In fact, one of the main strengths of IDRC has been the harmonious relations between program staff of the various divisions to a degree rarely found among other donor agencies and recipient institutions. Responding increasingly to the opportunities and necessity of larger and more integrated projects, however, has certain repercussions. These projects are complex to develop and to administer, required more staff time, and are more costly. They are, therefore, only justified if the added benefits from cross-disciplinary research are substantial.

While integration within AFNS and IDRc is to a large degree effective, it is hindered from another angle. Most recipient countries have setup that rigidly separates its administration into a number of ministries, divisions, and faculties along disciplinary lines. Research in various closely related disciplines, therefore, can fall under the responsibilities of different institutions and ministries, making the administration of such projects extremely difficult if not impossible. In many cases, countries have little experience in the execution of projects involving several disciplines; this makes the establishment and successful completion of multidisciplinary projects very difficult. There are, however, a few exceptions where agricultural research institutions have been organized to allow cooperation among disciplines.

Acknowledging the value of multidisciplinary projects, but also realizing the difficulties of making them a reality, AFNS sees a special task for itself in this field. Aside from setting an example within its own organization, the support of integrated projects can be used to help developing countries to see the value of such an approach. Given the rigid structure of most administrations especially in the poorer countries, however, will make this a major challenge to AFNS staff and demand extra inputs in time, effort, and finances.

4. Research Networks

Whenever research projects of a similar nature have been funded in the past, linking them has proven to be valuable support. This has allowed for division of work among projects, the exchange of experience and materials, and generally mutual encouragement and support. Out of such informal links, better established networks with a coordinator have grown. Projects have been specifically designed to fit into such a network to provide one specific aspect of the overall work. Most networks are centred around a specific

commodity or research methodology. To provide the necessary focus, they are often linked to an international research institute. Over half the AFNS projects are connected or associated with a specific network and the majority of participants are scientists from developing countries.

The value of networks was recognized in an evaluation by IDRC in 1980 and the concept has grown in importance since then. The importance of the function of the coordinator, recommended in the document, has increasingly been recognized. In many cases, this is now a scientist from one of the associated projects. He thus has first-hand experience in the work and is in an excellent position to provide support, assistance, and encouragement to the other projects. This way, AFNS staff do not dominate the network and it has also proven the most cost-effective approach. Network coordinators have been able to provide the type of support that program officers could not offer to the same extent. This has helped to lessen their workload in this field, allowing more time for developing new projects and monitoring existing ones.

Over the next years, AFNS intends to maintain its emphasis on networks. More of these networks will be concentrating on a specific region, a strategy that is considered to be of more immediate benefit than the global networks. To further improve the linkage the projects of a network, the coordinator and possibly other staff might be rotated among the different institutions carrying on related projects funded by AFNS.

5. Project Staff Motivation and Local Research Support

Scientists in developing countries work under difficult conditions, and need a high degree of motivation to remain in research, rather than seeking employment in administrative functions, with the private sector, or in international or foreign institutions, where more

lucrative salaries are offered. A qualified and motivated local scientist as project leader goes a long way in ensuring project success; dedicated and well-trained individuals as project leaders are thus one of the most important factors contributing to the achievement of results. The involvement, and even more so the completion of an AFNS-supported research activity often qualifies a project leader for more lucrative employment elsewhere. Recognition of work well done is a strong motive and an indication of how much AFNS appreciates the good work can be of value to maintain high morale. The possibility of contacts with peers and other countries for exchanging ideas and information, and visiting projects in other research institutions are ways which help to keep project leaders and research staff in their positions. The continuing and intellectually intimate relation between AFNS program officers and project staff is another valuable means of maintaining the motivation and it is important to maintain this close relationship to discuss problems and find suitable solutions.

Direct and indirect local government support for agricultural research is of prime importance for ensuring project success. It is recognized that research has a higher risk when projects are undertaken in an environment where local government support is not probable. AFNS thus needs to become more aware of government attitudes and policies related to the scientific institutions, the individuals, and the technology the research is supporting. Countries where agricultural research has clearly paid off in quantitative terms, such as some Asian countries, have continued the funding of research projects which were started originally with IDRC support. In response to incrased pressures on AFNS budget and and IDRC management demands for successful projects, future allocation of AFNS support will be more clearly selective of agricultural policy and development environments which are conducive to national support for research and to the implementation of research results. In the project development process, more emphasis will have to be placed on the avoidance of institutional risk in AFNS-supported projects.

6. Expatriate Involvement

In many of the poorer countries, the indigenous capacity to submit, lead, and carry out the much-needed research is not present. Here, the use of expatriates as project advisors was one attempt to get some research done. Extreme caution is, however, required for an advisor in such a position not to dominate or direct the work, with the result that the junior local scientists have only to follow instructions. Such projects can be of much value to a poor country, as better cultivars or methods are produced, and tangible benefits for the farmers are evident. A great amount of learning and training is a further valuable contribution of an advisor. AFNS has gained insight into the way advisors should be included in a project. This has greatly reduced the potential dangers of this approach to the formation of leadership, project-management, and decision making-ability in the recipient institution.

The role of an AFNS project advisor, without decision-making power and primarily as a resource person and co-worker, places very strict demands on incumbents of these positions. This mode of support is also costly. For this reason, advisors should only be used where demanded by the recipient and where they are necessary to assure success. Project advisors should be phased out as soon as possible, but a means should be found for intermittent follow-up, preferably by the same individual. Occasional visits by a reputable consultant often have more beneficial influence than a resident technical advisor or project manager who tends to be taken for granted, or regarded as employee of the government. The best use of expatriate assistance has been found to be in the form of a technical network advisor or coordinator, providing a specialized technical service to a number of similar projects. This reduces the chance of the expatriate taking over the leadership of the AFNS projects, while making best possible use of this person's specialized skills over a wide region and a number of projects.

In the immediate future, AFNS intends to continue to limit the use of advisors to projects in very weak institutions or to networks. The intention of AFNS--expressed elsewhere in this report--to focus multiple-project support on selected institutons, may also require the employment of a project advisor, possibly with some liaison responsibility. Advisors will continue to be placed under the supervision of the national program-based project leader, and will not be given decision-making power over project directions or approaches. The use of regional scientists for the coordination of research networks will continue.

7. International Research Institutions

There has been a rapid establishment of nonnational (regional and international) institutes over the past 20 years. Over 72 new institutes were formed between 1970 and 1975, and 49 in the following five years. Since 1980, however, this expansion has slowed. There are now 68 agricultural research institutions with an average annual budget of USD 9.3 million, the most prominent of which are the agricultural research institutions of the CGIAR system. These new research institutes initially concentrated on one specific crop such as rice, wheat, maize, or potatoes. More recently, the orientation has broadened into a more systems-oriented approach, focusing on a specific environment. While some of these organizations have been grouped into the CGIAR system, a number of independent regional or commodity-based institutions have also been established. The main advantage that many nonnational institutions offer is that they have both the scientific manpower and the physical infrastructure necessary to achieve results, requirements that are largely lacking in the poorer countries.

AFNS funding directed to nonnational institutions is largely for specific projects, where the beneficiary is often another country. Examples might be the projects for Rwanda or Cameroon undertaken by

IITA in Nigeria, or projects for North Africa carried out by ICARDA. Of the $26.4 million (28%) of AFNS funds that were allocated to nonnational institutes over the last five years, $14.8 million (or 55.9%) thus was directed at this type of project. Another 28.8% of appropriations to nonnational institutions were for managing a specific project in a poor country, for example, the rice farming systems project in Bhutan where funds were channelled through IRRI.

One of the main concerns of AFNS has been the limited cooperation between nonnational and national research institutions, with the result that national programs have become marginal to some research in their own country. AFNS sees itself therefore in a role of helping to redirect and improve the international research system, and a main objective is to change the focus of nonnational institutions toward more of a service role for national centres, and toward the establishment of an effective working relationship. Funding for nonnational centres is thus limited to inputs that further the changes AFNS considers desirable. One of the main strategies has been to link institutes of the CGIAR system with national systems by supporting an on-going dialogue between them, through meetings and the more formal creation of specific networks. Another approach of AFNS has been through its emphasis on a systems approach, where it has helped the research institutes, which generally only concentrated on one crop, to widen their horizon and to see their commodity as part of a whole cropping system. This process has now evolved further into farming systems, and increasingly will involve not only technical staff, but also economists and social scientists.

AFNS has in recent years taken a different viewpoint from the IARCs on many issues, and has often been proven right. It has, however, realized that to make the present system more effective, AFNS has to work on the inside; this has meant making a financial contribution to influence the decision-making process. Support however is limited to projects that conform to AFNS objectives, and has focused on work

that is more farm-oriented, more cooperative with national institutions or more inclined toward integration into systems. This approach, despite modest resources, has produced considerable response, and increasingly, IARCs are formulating programs in a network context with real participation by national-program scientists.

With its considerable experience, AFNS found that it could make a contribution by helping to set up new organizations that were being established. Recent new nonnational organizations have often grown out of regional or commodity-oriented networks, several of which were supported by AFNS. In recent years, AFNS has contributed to new organizations in forestry (ICRAF), soils (IBSRAM), fisheries (Southeast Asian Fisheries Development Centre--SEAFDEC), bananas (INIBAP) and to SACCAR (Agriculture Research in Southern Africa). These may be followed by cash-crop institutes (coconut or cocoa), as well as forestry and fisheries, but limitations on manpower and funds will restrict the involvement of AFNS in many of these fields.

At the same time, it is now necessary to look at alternative models that may be more cost-effective, have a quicker and broader impact, and are more systems and on-farm oriented. This present policy on the involvement of AFNS with nonnational institutions will guide its action and inputs into the nonnational research system for the next years.

8. Non-Governmental Organizations (NGOs)

NGO staff working in the Third World are generally characterized by a strong sense of dedication coupled with the determination to try to help people in need. Longer-term NGO staff usually learn the local language and live close to the people, and thus, come to understand their customs and culture. Most NGOs place emphasis on helping people to help themselves; their main activities are concerned with

community development, especially rural development. NGOs were often the precursors of official government assistance, and several of the early crop introductions to Africa were made by NGOs. Many NGOs devote a large part of their budget to rural development and within it agriculture has been receiving increasing priority. NGOs often operate cooperatives to provide mutual help. Joint endeavours and informal cooperation among NGOs are frequent.

AFNS staff are aware that their research efforts achieve little until the results are adopted by local farmers: yet they can generally not get involved with extension activities. NGOs seem to offer an additional prospect to provide a direct link to the person in the village and the farmer, primarily by their mode of operation living and working close to the village--rarely the case for scientists and researchers. At a time when the generation of new technology is overshadowed by a concern for how this new technology is applied, such links to the farmer are becoming increasingly important. NGOs could play a role in carrying out simple trials with farmers, linked to AFNS projects, and at the same time they could identify further interventions in the existing system in the village. This approach may delay the transmission of the messages to a wider audience, but there would be many small, tested nucleii of farmers from which in due course the message can spread.

Because of the wide variation of organizations, several distinctions should be made. Overseas volunteers are usually characterized by considerable expertise, enthusiasm, and good will, but the overwhelming majority will only stay for two years. Enthusiasm can achieve a lot in two years, but often the outlook is short term and does not assure training and continuity beyond the contract period. Church and mission-oriented groups have the advantage of a long-term commitment, and thus can work on a time horizon better suited to the conditions of developing countries. Their staff however tend to be less trained and depending on the specific orientation may place more

emphasis on missionary aspects than on development. There have been a growing number of indigenous NGOs in developing contries, that are often led by enthusiastic young educated villagers. They combine long-term commitment and local knowledge, but have their own limitations. After an exciting start the educated leader often wants to be rewarded by a highly paid government position, and many groups have to work against a number of social constraints that affect the expatriate less.

Due to the increasing importance of linking the research results generated by AFNS-supported researchers to the farmer, there is a need to look at the options for how this can best be achieved. The NGOs are in a favourable position to work on the dissemination of results. AFNS intends to make increasing use of a variety of NGOs to carry out on-farm research and extension tasks, to initiate or conduct field trials, and to act as a feedback mechanism for the definition of further research needs. Where possible, such NGO-based activities will be formally linked to government programs such as commodity and farming systems research. AFNS will be cautious in its selection of NGOs, to assure that they have a financially sound basis and a widely recognized record of performance.

9. Research Training

The success of a research project supported by AFNS to a large extent depends on the capability of the project leader and his staff. A country needs to reach a certain level of institutional development and staff ability before it is able to submit a project to AFNS, and provide reasonable assurances that it is capable of concluding the project successfully. Such a prerequisite is not generally present in the poorer countries, and thus AFNS support is limited where it is most needed. This constraint needs to be overcome if AFNS is to be true to its mandate. The lack of trained staff is the main cause of the low number of projects submitted, and the poor results of some of

those carried out. Increased emphasis on training of staff is seen as the main approach to improve this situation, especially in the poorer countries. As the main responsibility for the success of a project lies with the project leader, he will need specific support. In many cases, this must start with the identification of his formal training needs, even before a project can start. Once a project has started, training for the project leader can be achieved through constant support by AFNS program staff, network coordinators, and, if necessary, consultants. Major areas of weakness have been research design and management. A project leader rarely has training or experience in administration and management, yet the success of a project can depend as much on effectiveness in these areas as on the actual scientific field. Because of serious constraints, AFNS may not be able to develop its own input in this area, it will support training by third-party organizations in agricultural research management in collaboration with FAD. Such an approach is especially relevant for poorer countries, but it will also demand an increasing input of staff time and financial support.

The area of research design involves the careful analysis of agricultural and food production, handling, and distribution sectors of a nation. This analysis, in combination with insight into the biological and agronomic aspects of farm production has to be used to arrive at research objectives and priorities. This will be reflected in future land-use changes and in the staffing patterns pursued by NARCs; further expansion of AFNS support is intended to include land-use research. AFNS has considerable expertise in the microelements of these decision-making processes through its experience in farming systems research. These elements, together with AE will provide a promising basis for future AFNS support in the area of national research planning and the design of research.

The project leader in turn depends on the "tools" given to him to carry out this task. Aside from financial support, his support staff

is a major input, and their level of training is generally inadequate to cope with the complexity of the tasks on hand. This is why a majority of AFNS-supported formal training is on the MSc level. This more formal training will in the future be increasingly augmented with short courses and group training, not only for scientific staff, but equally for technicians and extension staff. Here, flexibility is necessary to tailor the training to the specific needs of a project.

10. Collaboration with Other Donors

The growing number of bilateral and multilateral donor organizations has made the attempt at coordinated aid increasingly complex. The lack of such coordination is a major cause of confusion, duplication, and the ineffective use of aid resources; therefore a closer working relationship among donors is highly desirable. This, however, has proven exceedingly difficult and frustrating in most cases, because of the many different administrative procedures of individual donors and recipients and the lack of flexibility in adapting to the needs of the recipients. Until now, AFNS has cooperated with CIDA in the development of a few projects and it is administering one large research project which is totally financed by CIDA. The time has now come to look into ways of increasing the cooperation of AFNS with other donors, and particularly with those development agencies that have the means to apply the results obtained from previous AFNS-supported research on a much larger scale. Participation in larger projects, in which AFNS would only support the research aspects, and where other agencies contribute much bigger components, could also have a significant impact on development.

There is, furthermore, a need to improve and extend relations of AFNS with other donors in the research field. This is necessary to avoid duplication of efforts and refrain from overextending recipients with a limited absorbing capacity. Several examples exist where a

developing country has received aid beyond its capacity to use it and where, despite the considerable inputs, little lasting progress was achieved. AFNS in the next years will increase its communications with other donor organizations, in the hope of being able to provide the research component in large development projects and to coordinate its research efforts with other donors.

11. AFNS Staff

AFNS program officers are a highly motivated group who are really the cutting edge of IDRC operations in the field. Their qualifications, ability and dedication has a major impact on the effectiveness of the division. Maintaining their high morale and further improving their ability, is of utmost importance. The move of the majority of the officers from Canada to postings in developing countries is having a remarkably beneficial effect both on the presently active projects and on the generation of new ones. These overseas postings also submit staff to difficult working conditions which are further exacerbated by frequent travel. This puts additional stress onto the families of these officers, who have to cope with more difficult living conditions and security problems.

The expansion in the number and scope of international and national research organizations has led to increasing needs for qualified personnel. It is thus not surprising that there is considerable competition in the field to attract the most capable scientists with development experience. Many of these other organizations have considerable means at their disposal to make employment with them attractive, and thus offer more than the means of IDRC would allow. Under these conditions, it is very important for AFNS to keep its present very high calibre of staff, and to attract new people who will be an asset to the division. It is not just a matter of remuneration, but of a general attitude of appreciation and support toward the staff. This may be reflected in further training

opportunities and sabbatical leave, in job security, and in career structure. It is thus important for the Centre to have enlightened policies for its staff, if AFNS is to keep those highly qualified and highly motivated people who are dedicated to their work.

Several recent developments have increased the workload of program officers to a point where it is starting to affect the quality of their performance. Due to the scatter of the projects and their need for close supervision, officers travel far in excess of what is considered an acceptable norm. More emphasis on poorer countries has increased their workload due to the difficult administrative situations there and the less-qualified staff that demand more support and attention. In the future, several recommendations within this document will further increase their workload, such as the Small Research Grants, increasing emphasis on networks, multidisciplinary projects, and the increasing emphasis on poorer countries. Under these circumstances, it will become essential to make optimum use of the highly qualified program officers by having them concentrate on those tasks where their expertise is needed. This is not the case at present.

Much of the contribution of AFNS program officers lies in the technical support and research-design capability they provide to recipients at the time of project development and execution. To continue to play this role and to ensure continued relevance of the choices AFNS makes in project support, our program officers need to be kept up-to-date in their research fields. The frequency with which AFNS staff go on study leave or staff development is between one and two each year. This means that each program staff person will have the opportunity to refresh capabilities approximately once every 20 years. This is clearly an untenable situation. AFNS intends to raise the number of program staff on study or staff development leave to between three and four per year.

The IDRC policy of limiting the number of person-years for locally employed support staff in the regional offices has largely been counterproductive. A time-allocation study indicates that on average 55% of the work time of program officers is spent on administrative matters. Much of this routine work could be done more effectively and much more cheaply by staff with lower academic qualifications. It is thus of special importance to the AFNS division to relieve the program staff of routine administrative tasks by increasing the support staff. This will free a considerable segment of the program officers' time for their more important tasks, especially for the additional work that will be encharged to them through the various attempts to make the division more effective, more responsive, and more appropriate.

12. Food vs Cash Crops

Many crops grown by small-scale farmers cannot be easily classified into food or cash crops. From the farmers' perspective they frequently serve a range of purposes. Even in predominantly subsistence situations, small surpluses are normally bartered or sold for cash. Straw, a "by-product", can be utilized on-farm, but a significant proportion is being sold by farmers, and returns per hectare may exceed the returns from the sale of grain. There is also no easy definition of an industrial crop, which is generally considered to be a crop for which the primary product is intended for processing. Such crops may be grown for home processing, village level processing, or large-scale processing in factories. They may provide the raw materials for food-based or nonfood-based agro-industries.

Many developing countries depend on agricultural exports as their major source of foreign exchange. Examples from Africa show that agricultural exports provide over 90% of the total exports in Burundi, Ethiopia, Malawi, Senegal, Sudan, and Uganda. Often one predominant cash crop makes up the bulk of the agricultural exports,

such as in Rwanda (coffee, 93%), Malawi (tobacco, 55%), Sudan (cotton, 65%), or Ethiopia (coffee, 69%). It is thus hard, if not impossible, to "judge" most so-called industrial crops in terms of their contribution to development and their role in improving the well-being of a rural poor farmer.

AFNS has in the past given priority to research aimed at the small-farm situation. The commonly held view that industrial crops are of no concern to smallholders because they are primarily produced on large-scale plantations is, however, far from the truth. For example, the majority of coffee produced in Mexico is produced on farms of less than 5 ha; in Africa, coffee is increasingly becoming a smallholder crop; in Rwanda and Burundi, more than half a million farmers own only 50 to 100 trees each; in Kenya, two-thirds of the tea crop is accounted for by small farms with an average land area of 0.4 ha, and Pyrethrum, once produced on large farms, is now almost entirely grown by smallholders. Almost the entire Egyptian cotton crop is produced by small farms, as are many other fibre crops elsewhere and even traditional plantation crops such as rubber are becoming important in smallholder situations in many countries.

It is difficult to get accurate information on the worldwide allocation of resources to research on food crops versus industrial crops. It is common, however, to find specific research institutes on industrial crops in many developing countries, while food crops are more likely neglected. Most major export crops have thus a reasonably sound research base, and are often given top priority by governments, while international institutions and marketing and processing organizations also support research. It is for this reason, rather than any "moral" superiority of food crops per se, that AFNS policy in the past has been emphasizing food, rather than industrial crops, in its research projects. On the other hand, it is becoming increasingly obvious that industrial crops play an important role in the cropping or farming system of rural small farms. The

scarcity of food in poor countries has led AFNS to put emphasis on food crops but, seen from a different angle, a poor farmer who has ample cash would in most situations be able to buy all the food his family needs. This alternative pathway is now being recognized by AFNS, especially in situations where a cash crop may actually produce more return per unit input, and thus can be a better option to the small farmer than producing his own food. The fact that many cash or industrial crops are shrubs or trees furthermore opens opportunities for close interaction between the Forestry and CAPS programs to look into mixed food-cash crop farming systems. AFNS support to research on industrial crops will, therefore, stress opportunities to use improvements in production of these crops to benefit the rural poor and their ability to invest in food production and other farm enterprises for which they have comparative advantage.

13. Human Nutrition

In the first years of IDRC's existence, considerable importance was given to aspects of human nutrition and this was reflected in the fact that AFNS had two-food related programs, "Food Processing" and "Food Protection and Storage". These were combined in 1974 to become "Nutrition and Home Sciences", but as a program, it had for many years few project submissions and a only a minor role within AFNS. While the aspects of food processing and food protection gained in importance and became the "Post-Production Systems" program, nutrition continued as a rather small part of PPS. The underlying forces that led to this present distribution of emphasis are many-fold. Human nutrition is generally spread over several disciplines, where agriculture is concerned with the production of food, health with deficiency and disease aspects related to the lack or imbalance of food, food science with preparation and consumption parameters, and economics with the marketing of food and access to it.

This fragmentation has led AFNS to concentrate on those two aspects of human nutrition that it considered to be within its realm and which were found to be of greatest necessity. The overriding concern for human nutrition was defined as making enough food available compared with which considerations of specific nutrients and their balance are minor. The largest single emphasis of AFNS is thus the production, handling, and processing of more food. It has over the years had considerable success in helping farmers to increase their output of food crops, and through this increased availability of food, has had an impact on the level of nutrition of the rural poor.

Increasing the availability of food is also the major concern of PPS which has, especially with its milling and crop-drying work, contributed to reducing food losses and making staple foods more marketable through processing.

Another reason why AFNS involvement in aspects of human nutrition has been limited is the absence of institutions and scientists involved in this field. Probably with justification, most developing countries have large ministries of agriculture and universities have faculties of agriculture, and both devote considerable resources to research. In comparison, there are few institutions carrying out nutrition-related research; the limited work is generally done through the ministries of health or social services. The responsive mode of operation of AFNS, therefore, has the result that few research projects are submitted in the field of human nutrition. The lack of institutions and the low calibre of scientists in this field has also been reflected in the projects that AFNS supported. The subsequent results of this focus of AFNS-supported research have generally been unsatisfactory, which has led to a further reluctance by AFNS to support nutrition projects. In addition, many aspects of nutrition are educational, or focus on the modification of traditional behaviour rather than scientific investigation.

These are among the reasons why, despite the mention of nutrition in the name of the division, this topic as such has not received much emphasis. Since this concern was represented at the March 1985 Board meeting, several steps have been undertaken to review the situation. During 1985, PPS commissioned a consultancy to evaluate the projects in nutrition it has funded in Asia, the conclusions of which will become the guidelines for future policy in human nutrition. The main conclusions of this study focus on the lack of expertise in this field, the narrowness of approach of nutrition scientists, the poor management of the projects, a lack of appreciation of the existing rural situation, and a tendency to abandon the original objectives during the projects. Under these circumstances, the funding of similar projects does not seem advisable, and a different approach is necessary. Aspects of training are indicated as the most pressing area in the recommendations, both in project management and in a broader outlook, including economic aspects and social parameters. Given these difficulties of the past, AFNS will take a very hard look at the potential benefits before it will commit itself to a larger extent. To achieve this very substantial change in research objectives and approach, it may be essential to employ project coordinators and consultants, and to have a much more intensive system of project monitoring and evalution. The PPS program will follow these recommendations in evaluating the need and potential benefit of a more active human nutrition section. The other approach to overcome the present difficulties lies in much closer cooperation with those divisions in IDRC that also have an interest in human nutrition, mainly Health Sciences and Social Sciences. Such closer cooperation is at the moment being established, and will help define the objectives and purpose of AFNS human nutrition activities, and establish what roles Health Sciences, Social Sciences, and PPS can play within a cooperative framework.

14. Small Research Grants

The emphasis of AFNS on producing useful and appropriate research results has in the past led to a large number of research projects being undertaken in countries and institutions where a degree of success seemed assured. In cases where the capacity of indigenous scientists was not at the necessary level, they either were supported by resident advisors or consultants, or preproject training was arranged for them through FAD. Both approaches have had their shortcomings, the former because of the particular problems with expatriate staff and their cost, the latter because of the several years preparation time that such training requires. The search for new and effective alternatives was thus essential if a larger share of AFNS-funded projects is to be carried out in countries and institutions that presently lack the necessary capability.

In recent years, FAD has provided some $300,000 per year to the International Foundation for Science in Sweden, which is administering a multidonor program of small grants in various research areas, among them many that fall under the mandate of the AFNS division. Hundreds of small grants were provided, but very few of the recipients continue their research work on a larger scale in a way that would make project funding by IDRC possible. Although this program has been appreciated by the recipients, AFNS feels that these funds could be better spent by supporting small projects which are directly related to the research priorities of the division. A number of small projects would be funded under a regional network and administered by the division with the aim of developing research expertise in institutions that do not have the capacity yet to manage larger projects.

Other divisions of IDRC have had small-grant progams, especially the Social Sciences division, the Health Sciences division, and FAD. Funding these programs has steadily increased to $2.4 million in

1984, representing some 150 small projects of an average $12,000. A recent evaluation of these small-grants programs by OPE has highlighted several shortcomings. It was found that a considerable number of supported projects did not produce a final report, and that the dissemination aspect was not very strong. This is linked to a lack of supervision and monitoring. Small grants have had a positive impact in building indigenous research capacity, but were less valuable as a means of institution building and generation of applicable results.

Using the experience and the results of the OPE evaluation, AFNS is now in a position where a small-grants program could produce major benefits. Linked to the consideration of increasing support to poorer countries and their need to reach a level of competence, the small-grants approach offers considerable promise. Aside from the provision of experience for junior scientists, this approach will identify scientists, institutions, and new research interventions that would merit the support of AFNS for larger projects in the future. The funding of small projects will also allow AFNS program officers to build links with a larger number of scientists and institutions, and in this way establish a base of contacts that will lead to project submissions in the future.

A second and different use of small grants would be in the area of dissemination of results, a main topic of concern to AFNS at present. Here small grants could be made available to NGOs for extension work, to apply the research results obtained from IDRC-supported projects on a larger scale. The division feels that it could administer directly several small-grants projects from the regional offices under the guidance of program officers, although this will increase the workload of staff further and could create a need for additional staff in the future. Alternatively, admittedly at a higher total administrative cost, these projects could be administered by third parties in the country or region in which they

are active. The widespread utilization of relatively small amounts, however, is considered a very cost-effective method of increasing the capacity of scientists to conduct larger research programs later, and thus is to be seen as an investment toward the submission of more and better project requests from the poorer countries in the future.

B. KEY ISSUES

1. Allocation of Resources

To be able to look at this first important topic in detail, it has been necessary to subdivide it into three sections: the overall allocation of funds to AFNS, and the distribution of these funds by AFNS to its programs and its geographical regions.

The declining share of IDRC resources allocated to AFNS is an issue of concern to the division. Table 21 shows the AFNS share of regular project appropriations and of the total revenue of the Centre since its establishment. In the first 10 years, AFNS received about 45% of the total regular project appropriations in the four program divisions, but since 1981-1982, its share has decreased to 42% on average for the five-year period to 1985-1986, and a further decline to 39% is projected for the next five-year period to 1990-1991. The percentage annual allocation to AFNS in relation to total IDRC revenue is much lower due to additional funding that the Centre has received for new programs. Although AFNS is receiving a portion of the funds for the new programs, its share does not compensate for the expansion elsewhere in the Centre. Consequently, the AFNS share of the total IDRC budget has declined steadily from 31.1% for the initial five-year period beginning in 1971, to 30.5% for the following five years (1976-1980), to 27.0% for the latest period (1981-1985). The percentage for the last fiscal year 1985-1986 is about 25%, which indicates that the trend is still very much downward.

TABLE 21

AFNS SHARE OF PROGRAM DIVISIONS' PROJECT APPROPRIATIONS AND OF TOTAL IDRC BUDGET

	Five-Year Average (%)			
	1971-1975	1976-1980	1981-1985	1986-1990 (projected)
Project Appropriations AFNS/Program Divisions*	44.5	45.3	42.2	39.1
AFNS Budget/IDRC Budget	31.1	30.5	27.0	N/A

* Total of AFNS, HS, SS and IS divisions.

Table 22 shows the average AFNS share of Centre project appropriations for the regular programs and special programs since their introduction in 1981-1982. Over the five years 1981-1985, AFNS received 36.0% of regular program appropriations and 33.7% of all project appropriations for regular programs, cooperative programs, and the energy program. The respective projected percentages for the next five-year period, 1986-1990, are 30.3% and 29.5%. This downward trend indicates that the division is losing ground to other activities of the Centre and is a matter of concern at this particular time in view of declining per capita agricultural production in several regions of the world. In all fairness, AFNS recognizes the contribution made by other divisions, particularly SS and IS, to the overall effort of the Centre in the agricultural sector. The porportion of this contribution has, however, not changed significantly over the years.

TABLE 22

AFNS SHARE OF CENTRE PROJECT APPROPRIATIONS FOR REGULAR AND SPECIAL PROGRAMS

	Five-Year Average (%)	
	1981-1985	1986-1990 (projected)
Regular Program Only	36.0	30.3
Regular Program Plus Cooperative Programs and Energy Program	33.7	29.5

Although AFNS does not consider no increase in funding to be an option, different choices of how this should be achieved can be evaluated. One is to consider the AFNS budget as a whole with respect to future levels, while another could specifically concentrate on the funds spent directly on projects. The following main options should be given consideration.

a) **That the further decline of the AFNS share of the overall IDRC budget is arrested, and that AFNS is assured of maintaining at least the present allocation of 25% of the overall IDRC budget.**

b) **That the actual amount of funding for AFNS's regular programs is stabilized rather than its total budget to assure that at least 30% of the Centre's project appropriations for regular and special programs is allocated to AFNS.**

c) **That a long-term commitment be made to retain the overall importance of AFNS within IDRC at the level of the first**

10 years, and thus to bring, over the next five years, the share of the total AFNS budget back to the original level of 30%, representing the long-term average share of the division.

Allocation of Resources Among AFNS Programs - AFNS has strongly emphasized, and will continue to do so, the careful selection of criteria for setting priorities for the subject matter areas to be supported. In this choice, factors such as biological efficiency of the production process, the effectiveness of that process to contribute to human nutrition and the welfare of rural poor, or environmental issues such as land protection and the stability of the production system are considered. The areas of intervention are thus very much a function of the specific shortcomings and needs of an agricultural production system in the framework of a nation's development. If the division were to allocate its budget purely on the basis of demand from developing countries, there would be much more input into the various CAPS programs. These needs are specifically defined by the scientist submitting the project, and are endorsed by the political and/or administrative leadership of that country. Considerations of the importance of a specific technical field also guide the AFNS program officers in their emphasis on inputs of time and effort into different topics, where they generally follow the specific policies set for their program. Table 23 shows the relative share of the AFNS programs in their funding.

The Fisheries program has had a period of slow growth and difficulties in program development because of the study leave and subsequent resignation of the previous associate director. Given the potential of coastal fisheries resources in tropical regions, and the contribution that can be made from the rapidly developing field of aquaculture, there is a need for this program to grow more rapidly in the next years.

TABLE 23

PERCENT SHARE OF AFNS PROGRAMS

1980-1981 to 1984-1985

	Financial Year					Five-year average
	1981-1982*	1982-1983*	1983-1984*	1984-1985**	1985-1986**	
CAPS	60	60	56	52	45	55
Fisheries	11	10	9	7	9	9
Forestry	16	15	16	14	13	15
PPS	10	11	12	10	9	10
AE	-	-	-	2	6	2
Cooperative Program	3	4	7	15	18	9
Total	100	100	100	100	100	100

* Actual appropriations
** Budgeted amounts

The overall picture that emerges from this data is that over the past five years, the increase in funding to the Cooperative Program has been compensated by decreases in the other programs. This is especially apparent for CAPS which decreased from 60.4% to 45.4% of the total project funds, and to a lesser extent for Forestry and PPS. If the funds for energy and cooperative projects are excluded, the relative share has remained fairly constant, with CAPS receiving approximately 60% of AFNS funds for regular programs. Forestry with 16% tends to be a bit larger than PPS (12%) and Fisheries (10%).

The large majority of projects the division supports are in the field of experimental research. However, when the task has been limited to the identification and hopeful solution of a problem, the new technology generated, although practical, was sometimes not economically viable. The recently established AE program was thus set up within AFNS in response to the lack of an economic component in many projects. Social science support to agricultural research continues to be a neglected area and the AE program is expected to make some improvements. The shift in recent years has thus been away from the strictly technological approach toward more appreciation of other components that have to be solved to make a given technological innovation useful to the farmer.Aside from social and economic concerns, we are also witnessing a rapid deterioration of land in a number of important food production regions of the world. Concerns for this erosion in developed countries have recently led to a considerable increase in research and legislation. It is foreseen that AFNS will need to respond to this increasing concern by national organizations of developing countries about the protection of land. Existing program activities in "climate and land", agroforestry, and farming systems research will need to be particularly strengthened to reflect these concerns.

The choice of project subject within the different programs is to some extent guided by the overall mandate of AFNS with its emphasis

on food production, the rural poor, and smallholder agriculture. Chapter III has given a detailed account of the type of project with each program, and the relative importance given to the various subject matters. The division will need some overall guidelines for the relative importance of these different programs. Consideration should given to these options.

a) That the direct production of food remains the top priority of AFNS, thus CAPS will retain its large share, while funding for the Fisheries program should increase. Forestry, PPS, and AE then would play a lesser role largely in projects that support food production of the CAPS and Fisheries programs.

b) Since the bulk of international aid is now directed toward production agriculture, many of the equally important supportive functions are neglected. AFNS could give more support to these other areas not directly related to agricultural research. This way, it could compensate for this imbalance by increasing its funding for PPS, especially on post-harvest technology, for Fisheries for aquaculture and artisanal fisheries, and for Forestry with emphasis on agroforestry and environmental protection.

c) A continuing shortcoming of much of AFNS-supported research is the neglect of social and economic parameters associated with the generation of technical innovations. Less emphasis should therefore be given to the purely technical areas. Instead the economics program should be strengthened so that all projects will contain an economic component to ascertain that the technology will be economically beneficial to the end user.

d) That the linkage of Canadian scientists and institutions with research needs in developing countries will provide benefits far beyond the projects AFNS can fund. The Cooperative Program

should thus become a far more important sector of AFNS, and will not only provide the type of results that developing countries have neither the expertise nor the facilities for, but it will also guarantee the optimum use of the financial inputs of AFNS.

Relative Allocation of Resources to Regions and Countries - The responsive mode of operation has a considerable influence on where projects come from. While AFNS can emphasize its own priorities, and program officers may have preferences of area, many requests for support come from a large number of countries. Because AFNS has not put restrictions on geographical origin, projects have in the past five years shown both concentration and spread. Thus, Thailand had 22 projects funded and the Philippines 17, while countries such as Peru, Indonesia, Egypt, Tanzania, and Malaysia each had 10 or more projects. On the other hand, 23 countries had only one project. Considerations of specific country allocation, however, have been of less concern than the region, since new scientific technology is generally useful to several countries within a similar physical and social environment. Over the past five years, the largest shares were received by LARO, with 26.2% of AFNS project funds, and ASRO with 20.6% (Table 24). The lowest regions on the other hand are SARO with 6.6% and WARO with 11.6%. This distribution still reflects the earlier emphasis of AFNS to support a number of projects in those regions and countries that had the capacity to achieve results. This approach has led to considerable results in East Asia and to a lesser extent in Latin America. This distribution of funds reflected the food deficiency encountered in Asia and the concerns for the rural poor. Scarcity of food, however, is most pronounced in Africa. Thus, over the recent years a shift has taken place away from LARO and ASRO, to the benefit of Africa.

Regional allocations of support, however, are not only a function of need, but also of ability. Both LARO and ASRO have many well-established research institutions, and ASRO and SARO have a general

TABLE 24

SHARE OF ALLOCATION BY PROGRAM AND REGION
OVER A FIVE-YEAR PERIOD IN PERCENT
1980-1981 to 1984-1985

	ASRO	EARO	LARO	MERO	SARO	WARO	CANADA	GLOBAL	TOTAL
CAPS	7.7	12.8	15.5	9.2	3.6	8.1	0.1	0.2	57.2
Fisheries	4.8	-	3.5	0.9	0.9	0.2	-	-	10.3
Forestry	2.1	3.6	4.0	1.0	1.2	1.5	-	0.8	14.2
PPS	4.6	1.7	2.2	0.9	0.9	1.6	-	-	11.9
AE	0.1	-	0.1	-	-	0.2	-	-	0.4
Cooperative Program	0.4	-	0.5	-	-	-	3.8	-	4.7
Energy	0.9	-	0.4	-	-	-	-	-	1.3
TOTAL	20.6	18.1	26.2	12.0	6.6	11.6	3.9	1.0	100

political climate that supports research. More local funds are also available in these regions as well as a cadre of capable scientists. Making best use of the limited inputs of AFNS has led program officers to concentrate on countries and regions where it is also much easier to generate worthwhile projects.

In the poorer countries, especially in Africa, the situation is different. Here, the commitment toward research is less and ranks low in the funding priorities where the resources are already scarce. As a result, there are fewer research institutes, and these are less well supported and their staff are less qualified. The same can be said for poorer countries of the other regions, such as Haïti and Guyana in Latin America, or Nepal and Bangladesh in Asia. A shift to Africa and to poorer countries thus has specific implications. Projects will need to last for a longer time. Training of project staff at all levels will have to become a priority, and strengthening weak institutions will absorb more funds. The unfavourable research environment will need more input in AFNS staff time and effort and more financial support, yet with a much lower rate of success and achievement. This must be accomplished against increasing IDRC demands for successful projects with measurable impact and a continued insistence on scientific excellence. The choice of options will thus have implications on staffing and funding levels, as well as on the degree of achievement of the set goals.

a) **Continue to allocate the bulk of project support to those regions and countries where AFNS is well established and where the scientists and institutions are well enough established to guarantee a high degree of achieving the goals set, and supplement this with support for applications of the results in poorer countries.**

b) Return to the emphasis of AFNS projects toward those regions on which the division had originally focused: the semi-arid tropics, i.e., the geographic or agroeconomic zones of the subSaharan countries, Southern Africa, and the Indian subcontinent. This will imply a different approach than the type of support given at present.

c) Follow the mandate of emphasis on the rural poor, with the possibility of linking support to a definition of the type of interventions that can provide benefits to rural poor, both smallholders and the landless and thus concentrate project support in the poorest regions and in low-income countries. This may necessitate a large initial investment to bring their capacity up to the level needed to be able to carry out research projects.

d) To combine the efficiency of the more developed countries with the need of the poorest ones, concentrate on research in middle-income countries, but with projects specifically designed to benefit neighbouring poorer countries, or to carry on research there on their behalf.

e) Considering the progress made in Asia and the generally higher standard of development in Latin America, further increase support to the African continent, by increasing its share from the present 39% to say 55% over the next five years, irrespective of the problems and difficulties this may present.

f) Considering the very uneven distribution of research capability among low- and medium-income developing countries, the great lack of user-oriented research, the imperfect relations between IARCs and NARCs and the highly opportunistic nature of research, AFNS should concentrate on a global approach to research support. This approach should focus on those factors that will increase

food availabilty, improve living standards of the rural poor, and maintain or improve the future productive capacity of land and water resources of developing regions.

2. Responsiveness vs Initiative

AFNS is largely considered "responsive", as it funds requests made by scientists of developing countries. Since projects are proposed by recipients, they are presumed to satisfy the policies of that country. In terms of administrative policies, the policies of the host are accepted as long as this satisfies the basic requirements of financial responsibility. The final decision about the implementation of a project always lies with the recipient. Where a project submission may be in conflict with IDRC policy, AFNS is open to discussion, to attempt to reconcile the two policies. This responsiveness however is not complete, as in practice the program officers have a considerable influence on what type of project is submitted from which country. As there is a much larger number of project requests than the AFNS budget can support, this provides for a degree of selection of projects according to the mandate and priorities of the division. Here AFNS would like to be able to encourage change in national programs where this is appropriate.

The submission of a project by a researcher in a host country is interpreted as an expression of a specific need as perceived by him. As such it is an indication of the food and agricultural production conditions in that country and the understanding of the scientists about the relative importance of various intervention alternatives. AFNS, however, is aware that few scientists, disciplinary, or sector subgroups of developing countries have an overall understanding of the interactions between the different components of the overall food production system. For this reason, it is also an AFNS policy to help national program scientists to strengthen their capability to

set appropriate priorities for research. This is done through consultation with individuals and in workshops, while AFNS itself participates in a number of multidonor audiences which address the same issues. Difficult choices have to be made to do justice to the priorities and relative emphasis. Often diverse practical considerations shift this emphasis away from the desirable to the possible, even if it is less in line with the overall policy. Relative emphasis needs to be constantly evaluated and justified between national programs and projects at nonnational institutions, between the different countries and regions, and between the types of projects submitted.

For AFNS, being responsive to outside initiatives rather than controlling its own direction, is a factor that affects many management aspects. A major new input here is the increasing placement of program officers with specific skills in regions where that subject matter is considered a priority. Through such strategic placement of staff, AFNS is becoming more able to influence the type and number of new requests from a given region. Aside from the placement of officers, there are however few AFNS guidelines, rules, or policies that would allow the division to take the initiative which would give it control over the type of program that is considered desirable. This means that policy decisions can only be carried out to a certain degree. Future policy might want to strengthen fisheries or nutrition, but if project submissions are not forthcoming due to factors outside AFNS control, such a policy cannot be followed. Budgeting is another area where responsivenss causes uncertainty. Budget allocations are given to a program or a region based on an estimate of how many new projects might be forthcoming in the next financial year. The past flexibility has allowed the system to work well, but in many instances the division could operate better if it had more control over the number, type, and origin of project proposals it receives. There are several options that merit consideration.

a) That AFNS has done well with its approach to respond to requests as they are produced and should continue in this fashion, even if policy decisions cannot be as accurately followed, and the system causes a degree of uncertainty.

b) The capability for setting research priorities and choosing appropriate research approaches is weak in many low-income countries. That AFNS through its program officers and through support of strategic research should increase its support toward the better identification of research needs, and that it should increasingly act as a catalyst, encouraging the submission of projects in those fields considered to be a priority.

c) That AFNS places specific program officers with well-defined skills in the region where that type of project is a priority and have the officer actively promote the type of project that AFNS is looking for to give priority support.

d) The lack of direct control is a hindrance to making the best possible use of the resources available. Priorities of region, program, and emphasis need to be set out clearly by AFNS to be able to manage the division well, control the budget, and allocate the resources where they are most needed.

3. Concentration of Support

During the past five years, AFNS has funded projects in 64 developing countries. A concentration of projects has been evident in several Southeast Asian countries, where in many cases some of the projects were interconnected, such as CAPS cereal projects and PPS crop-drying projects. Such a concentration of support has given tangible benefits to these countries, and has given AFNS enough presence to also be able to influence future research directions and policy decisions in government and research institutions. Thailand, Malaysia,

Indonesia, and the Philippines hosted a total of 60 projects and received a financial input of $10.2 million. Because of the parallel strong emphasis on networking among these countries and their similar physical and social environment, the results of one project could often be used by other countries.

Elsewhere in the world, similar conditions are not often found, as countries are small, scattered, and have less in common. As a result, of the 64 countries that had AFNS projects over the last five years, 24 had only one project with an average input of $21,000 per country. A further 12 countries had two projects each and received $420,000. Such a thin spread of AFNS projects drastically increases the workload of program officers, who need to monitor projects over a large region with extra traveling time and cost, and less contact and interaction with projects. Projects are too isolated to be of benefit to similar projects elsewhere, and where attemps are made to bring them together, high traveling costs impose limits. With only one project in a country, the presence of AFNS is insignificant, and opportunities to help direct research and policy limited. Therefore, because over one-third of the projects are the only one in a country and half the countries have two or less projects, limited AFNS resources are not used well. However, a move away from the present mode of operation would imply a reduction in open access and a more restrictive or directive policy. To reduce the spread, certain types of countries would have to be excluded. One example that comes to mind is the Caribbean with its numerous small countries. At the same time, it might call for the identification of a group of countries with preferential status, similar to the past concentrated support in Southeast Asia. Such special preference areas could be the southern Sahel fringe, the Andean countries, or the member countries of the SADCC. Such a concentration of support to one area, however, inevitably would lead to the exclusion of other countries.

The projects that AFNS supports are to a large degree influenced by the developing countries, political and administrative support. But especially in poorer countries policies toward research are not formulated or not followed. The limited research that is carried out lacks direction, is disjointed, and is sometimes irrelevant. In a few countries, where AFNS has a larger presence, it has been able to assist governments and institutions to set clear priorities, coordinate their work, and follow the set policies. This progress within a country's leadership is seen as a major step in the preparation for future research work to be supported by AFNS that will be relevant and have an impact. This type of influence on host-country policy, however, is only possible where AFNS has a substantial presence and, in the future, the division could make a larger and longer-term commitment to specific countries, if this can be linked to the setting up of research policy and a long-term commitment by that country. The options on the relative concentration of support need to be evaluated to give direction on this topic.

a) **The AFNS division has few restrictions on the type and origin of project proposals it receives. That has allowed it to contribute to institution building and scientific research in over 60 countries in the past five years. This mode of operation allows scientists open access and has provided benefits to numerous developing countries. This approach should therefore continue.**

b) **Many countries have received very minimal support, and the impact of a single project on the development of these countries is negligible. At the same time, the monitoring and support necessary for widely scattered projects is a heavy burden on staff and their workload does not allow for the degree of support that the project needs. To make better use of staff and resources, a country should have at least three to six active projects, hopefully linked among themselves and with similar ones in neighbouring countries. The associate directors and their**

staff are to decide in which areas and countries this is best possible.

c) That recipient countries are specifically defined according to need, and bunched into especially deserving groups. A large amount of AFNS support should go to such groups, and if the experience of Southeast Asia is taken, this will lead to a considerable impact. On that level, some five to eight clusters could be supported if all other countries were excluded.

d) Because government commitment to research is of increasing importance to AFNS to assure project success, the division should choose some specific recipient countries, that have both the will and the potential to concentrate efforts on scientific investigation. Here, AFNS would make a long-term commitment to a level of research support, but link this to an equal long-term commitment by the host country to support such research, continue it after the project is finished, and provide the extension system for its dissemination. Such an agreement would need to include a role for AFNS to advise on the formulation of research policy and the restructuring of the research system to make it more effective.

4. Application of Research Results

The industrial countries' approach to scientific investigation has to some extent been a division of labour between universities and industry, where the former tended toward pure science, while industry made use of this by applying the new knowledge. The system has been successful because of the ample resources generally available, the excellent communication system, and the presence of a consumer base to make new technology profitable. This model has been transferred to developing countries through the establishment of universities during pre-independence and the training of most Third World scientists in the West. However, due to the very characteristics of

underdevelopment, this system has not served these countries well. Research is often of limited use, misapplied, or economically nonviable.

AFNS from its early experiences had put major emphasis on applied research, on close links to the farmer, and on an integrated approach. It has been able to help reorient several IARCs and national research systems toward giving this approach more prominence. The main rationale has been to be cost-effective by carrying out the type of research that is of immediate application to the end user, and will improve an aspect of his productive system to benefit himself and his family. The research system present in developing countries, however, has been found to be quite entrenched in the traditional approach, and this has made change very slow and difficult. Such an approach is much more complex than carrying out pure research, because the scientist also needs to be familiar with the end users and their social and economic environment. While AFNS is convinced that its approach is both right and necessary, it has not always been able to carry it as far as it might have liked. The division has experience with some projects where technically sound innovations could not be widely applied, or the new technology proved too costly for widespread adaptation. These examples are an unsatisfactory return on the investment of AFNS resources, and the division is now paying increasing attention to dissemination of the technology created. One major step was the creation of an AE program, which has as one of its aims a supportive role to the projects of the other programs, to provide an economic component. Dissemination remains a concern. Basically, each developing country has an established extension system that is charged with the responsibility of disseminating knowledge by direct contact with farmers. The effectiveness of this system is often poor, and the gap between scientist and extension officer is often big, intellectually and because of the institutional structure. The question of how to make sure that the newly created technology is useful and how to

disseminate it to the farmer, fisherman, or village person is thus increasingly occupying AFNS staff, and several options need to be considered.

a) **That AFNS extend its support to the pilot implementation phase of research results. This should, where possible, be funded by CIDA or other donors, but AFNS should continue direct project involvement through administration and monitoring.**

b) **That AFNS increase its insistence on participation by the end user and consideration of social and economic constraints supports. This should include the support for experimental approaches to farmer participation, and increased farmers' leadership in the research process.**

c) **That AFNS expand its support of research on the extension process, where it deals with experimental approaches or action-oriented research.**

d) **That AFNS insist increasingly on the participation of extension staff of government or NGOs in the research process.**

e) **That AFNS refrain from supporting activities beyond the research phase, but that it insist that national program or NGO extension staff be included in the research team.**

5. AFNS Managing Projects for Other Donors

Two of the earliest agricultural projects carried out by AFNS in Latin America were in cooperation with CIDA. Since then the two organizations have on many occasions had an opportunity to share useful information. More recently, CIDA has become increasingly interested in AFNS taking on the a role of executing agency for large research projects, which would be funded by CIDA. Given the

opportunity to widen the scope with extrabudgetary financial support has thus become an interesting new opportunity. A similar development has also occurred in a different area. AFNS has for some time stressed linkages and has been very active in promoting and supporting a number of informal networks. Once their contribution was more widely established, some more formal organizations have now been set up, often again with active involvement of AFNS. It is thus not surprising that in several instances AFNS was asked to play a leading role in the establishment of such organizations as ICRAF and INIBAP.

In the past, once the value of the research undertaken was demonstrated, national governments or larger donors have taken over several of the earlier AFNS-supported projects. More recently, however, on several occasions larger donors, impressed with the results, have asked AFNS to expand such project work, and were willing to financially support it. Several nonnational donor organizations as well as some governments of developing countries have thus recently asked AFNS to take over a specific project at a much larger scale, and have offered their financial support.

These developments show that the modest work of AFNS is being appreciated in wider circles, to the extent that now several offers of financial support for specific tasks are forthcoming. The division can be very pleased with this expression of confidence and appreciation. It is at the same time put into a difficult situation in having to respond to these requests, up to now largely in the negative. The main reason for this reaction has been that the complexity and size of some of these tasks, while offering considerable potential, are beyond the administrative capability of AFNS. As pleasing as such offers of support are, they demand inputs by the division, in terms of staff, space, and support. Without these prerequisites being assured, such additional tasks cannot be considered. This has meant passing up several opportunities and has led to the need to formulate a clear policy for the division on this topic.

a) The administrative burden that the management of such large projects will bring is far too heavy for a relatively modest organization such as AFNS. The division should thus support these activities as in the past, but should refrain from taking on more responsibility.

b) Due to the common interest and area of operation of IDRC and CIDA, closer cooperation between the two agencies would be very beneficial. AFNS should therefore play a bigger part in providing the research component to large CIDA projects, or act as executing agent to specific CIDA-funded projects. This new involvement, however, would stretch the division's resources and make it inadvisable to take on similar tasks for nonnational organizations or governments of developing countries.

c) The appreciation of the past work of AFNS indicates that its experience and orientation can be put to valuable use in a much wider area. If substantial outside funds could be sollicited to support research, then IDRC should make a contribution toward this expanded scope of AFNS. While the outside funds would be directed to the research tasks, AFNS would provide the administrative segment, and the division would have to receive additional financial support to make this possible.

d) The limitations on expanding the financial support to AFNS make these offers of outside funding too good to pass up. The division should thus accept these offers from wherever they come, and use its know how and experience as widely as possible. The budgetary limitation of the division, however, would make it essential that all additional costs would be covered by the outside donors.

CONCLUSION

This rather extensive document has taken a path from the general to the specific and from the past into the future. AFNS is subject to a multitude of influences that cause the constant changing of the development situation, and has to take these into account in its formulation of policy. Since its modest beginnings, the Division has grown rapidly, but compared to other donors remains of modest size. This, however, has not hindered AFNS from being a major influence in many research-oriented development areas. Its emphasis on the rural poor has led to much research on neglected crops. Some are minor crops on a world scale, and have thus received little research attention, but they are the staple foods of large populations, especially in the poorest and most backward areas of the Third World. AFNS leadership has also been influential in such diverse areas as aquaculture, agroforestry, and grain milling. Aside from specific project support, the efforts of AFNS in emphasizing farm-oriented, applied research have influenced governments, universities, and IARCs to give more attention to this type of work. The Division's early emphasis on the linkage between projects and scientists has led to a considerable number of networks, many of them now independent of AFNS support. As the amount of research expands in developing countries, AFNS can also look back to the substantial number of staff, from team leaders to technicians, that through experience and formal education have learned enough to be able to carry on difficult and complex research work successfully.

In such areas, AFNS can proudly look back to achievements, but it also is quite aware of the shortcomings that have occurred. The work has been far from perfect and there is much room for improvement. This document, however, has highlighted a strength of the Division that may be more important than a few well-done projects. The ability to analyze critically both the projects and the general development environment. Out of this has grown a corporate awareness of a need to learn, to adjust, to open up new areas, and to profit from new opportunities. The previous chapters make it clear that AFNS is on the move. Staff at every level are looking for needs, evaluating opportunities, and learning from mistakes. In an area such as development, this

flexibility and mobility are assets that cannot be overvalued. This positive attitude is largely the result of the capability and flexibility of the staff. The importance given to learning has recently meant that the quality of proposals for project funding is increasing, and the proximity of the officers will have a lasting beneficial effect on the success of the projects.

This document has taken a close look at what has been done and what is presently being done. The fact that results of scientific investigation take 10 to 15 years to become tangible will also mean that an increasing number of projects will, in the next years, reach the point of wide dissemination of the technology. The final emphasis of the document, however, is on the future. There, many topics have been addressed, and some decisions on emphasis and direction have been made. But for some of the largest topics, the Division looks to the Board of Governors for guidance and support. Support foremost in terms of funding, at least at the share of previous periods, without which much of the work will suffer. Guidance will also be needed on the relative allocation of resources to programs and regions, as well as on mode of operation and the dissemination of the results generated.

The overall mandate will remain, but within it a different emphasis and many new opportunities will demand the full effort of every staff member. In turn, the Division also looks to the Board for policy directives it needs to carry on its important tasks. With the guidance as to its direction, the AFNS Division will maintain the good reputation it has acquired in numerous countries of the developing world.

APPENDIX I

TABLES

APPENDIX II

Acronyms

ACSN - Asian Cropping Systems Network
AE - - Agricultural Economics (AFNS)
AFNS - Agriculture, Food and Nutrition Sciences
APSR - Animal Production Systems Research (AFNS)
ARNAB - African Research Network for Agricultural By-products
ASRO - Regional Office for Southeast and East Asia (IDRC)

CAPS - Crop and Animal Production Systems (AFNS)
CATIE - Centro Agronomico Tropical de Investigacion y Ensenanza
CGIAR - Consultative Group on International Agricultural Research
CIAT - Centro Internacional de Agricultura Tropical
CIDA - - Canadian International Development Agency
CIMMYT - Centro Internacional de Mejoramiento de Maiz y Trigo
CSR - Cropping Systems Research (AFNS)

DAPs - Division Activity Projects (IDRC)
DRSPR - Division de recherches sur les systèmes de production rurale

EARO - Regional Office for Eastern and Southern Africa (IDRC)
EEZ - Extended Economic Zones

FAD - Fellowship and Awards Division (IDRC)
FAO - Food and Agriculture Organization of the United Nations
FSR - Farming Systems Research (AFNS)
FPU - Forest Products Utilization

GNP - Gross National Product

HS - Health Sciences (IDRC)

IARC - International Agricultural Research Centre
IBPGR - International Board for Plant Genetic Resources
IBSRAM - International Board for Soil Research and Management
ICARDA - International Centre for Agricultural Research in Dry Areas
ICRAF - International Council for Research in Agroforestry
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics
IDRC - International Development Research Centre
IFPRI - International Food Policy Research Institute
IITA - International Institute for Tropical Agriculture
INIBAP - International Network for the Improvement of Banana and Plantain
IRRI - International Rice Research Institute
IS - Information Sciences (IDRC)
IUFRO - International Union of Forest Research Organizations

LARO - Regional Office for Latin American and the Caribbean (IDRC)

MERO - Regional Office for the Middle East and North Africa (IDRC)

NGO - Non-Governmental Organizations

OECD - Organization for Economic Co-operation and Development
OPE - Office of Planning and Evaluation (IDRC)
OPEC - Organization for Petroleum Exporting Countries

PPS - Post-Production Systems (AFNS)

SARO - Regional Office for South Asia (IDRC)
SS - Social Sciences (IDRC)

UNESCO - United Nations Educational Scientific and Cultural Organization
UPLB - University of the Philippines at Los Banos

WARO - Regional Office for West and Central Africa (IDRC)

APPENDIX III

AFNS Publications 1980-1985

1980

IDRC-115eM
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