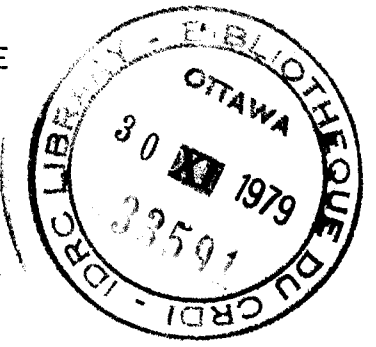

TALK TO THE AUSTRALIAN INSTITUTE OF FOOD SCIENCE AND TECHNOLOGY ANNUAL CONFERENCE, MAY 1978

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THE FOOD SCIENTIST IN INTERNATIONAL DEVELOPMENT

At the outset may I thank the Executive and members of the AIFST for conferring upon me the honor of opening this important conference. I am indebted also to many old and new Australian friends for a warm and splendid welcome that has been extended to me by each of the AIFST branches. Finally, I am deeply grateful that through the generosity of AIFST I received the IFT International Award in 1977.

The AIFST and its members are to be congratulated upon their evident pragmatic attitude to food science and technology. This conference program bears testimony to the fact that AIFST is concerned with the issues of the moment: with energy supply and utilization; with human nutritional needs; with the ecology and the environment as it influences and is influenced by food science and technology; and finally and most important with consumers' needs and concerns. This attitude of social concern was evident among the branches I visited and particularly in Sydney where in the annual reports of the subcommittees communication with consumers and with the significantly changing pattern of food habits was given high prominence. AIFST is clearly an institute which addresses the problems of today and the immediate future and what

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The views expressed are those of the author and do not necessarily represent the views of the International Development Research Centre.

appear as the vital concerns of the Australian food economy. It is obviously not a society in which scientists seek only to amaze other scientists with their ingenuity.

Since I have spent only a little over one week in Australia, it would be impertinent to comment upon or recommend what is best for the AIFST or Australia's food economy. Consequently I shall attempt to deal with food science and technology in a broader international context and specifically with the needs of the less developed countries and with the world community as a whole.

The proposition I propose to argue is that agricultural scientists have made and are making a more significant and relevant contribution to the progress of the less developed countries than are food scientists and technologists. Agricultural scientists have more clearly identified their priorities and objectives, organized the material and scientific resources available with imagination and economy, concentrated their efforts upon comparatively few, but vitally important food crops and agricultural systems, put into effect an integrated international system of research demonstration and practical training, and created a cooperative and inter-linked network of research centres, each dedicated to a sharply focussed and intensive program of research. Most important they have organized a consortium of donor agencies and developing countries to finance and monitor this food program.

The program of systems I refer to is the Consultative Group on International Agricultural Research which began at a meeting held in Washington in 1971. The problem then and now was that populations in less developed countries are increasing faster than the rate of growth

in food production. For the most part previous agricultural research in many LDCs, particularly those which were colonies, concentrated more on cash crops for export than upon basic food crops such as cereals, food legumes and root crops from which the majority of the people in the LDCs particularly the rural poor, derive between 60 and 90 per cent of their food energy and protein supply. The group that met in Washington identified several opportunities for research most important of which were research to increase food crop yields and productivity per hectare and secondly the more productive use of marginal lands. The group of agencies that met in 1971 was impressed by the success of the International Maize and Wheat Improvement Centre in Mexico and the International Rice Research Institute in the Philippines which respectively had developed the high yielding varieties of wheat and rice. These successes resulted from an intensive concentration of research efforts upon only two crops, wheat and maize at CIMMYT and one crop, rice, at IRRI. The group in Washington believed that an equivalent success could be realized if similarly constituted international agricultural research centres were to focus upon other neglected food crops.

The various agencies and organizations that met in 1971 adopted the name the Consultative Group on International Agricultural Research. Initially the CGIAR consisted of the World Bank, FAO and UNDP as sponsors and 15 donor agencies. During 1972 this group committed approximately 12 million dollars to the support of four international agricultural research centres. By 1977 the CGIAR had expanded to 30 members which for 1978 committed close to 90 million dollars to the support of 11 international agricultural research centres and related efforts. Each

international centre was established in a country or region in which the crops and/or farming systems of its responsibility are important. For example, the Institute for Crops Research in the Semi-Arid Tropics (ICRISAT) is located in the important semi-arid region of India with its headquarters at Hyderabad. And the newest of the family, the International Centre for Agricultural Research in the Dry Areas (ICARDA) has been established with stations in three countries, Syria, Lebanon and Iran.

The Australian contribution to the CGIAR has been significant not only because the government of Australia is a member of the CGIAR but because Australia provided the chairman of the CGIAR's Technical Advisory Committee (TAC), Sir John Crawford, the Chancellor of the Australian National University. The TAC is a group of twelve eminent scientists from all parts of the world that advise the CGIAR upon its priorities and review the research programs of the individual centres. Furthermore, several distinguished Australian scientists are to be found among the research staffs and governing boards of the various centres.

The CGIAR members consist of representatives of developing countries, international development banks, UN agencies, governments, and foundations such as the Rockefeller and Ford. Each donor member contributes according to the financial and technical resources at its disposal.

The International Development Research Centre (IDRC)

Perhaps the various kinds of support which the IDRC provides will indicate the potential scope. IDRC gives direct financial support

to specific research programs in various centres; it provides financial and technical support to outreach and cooperative networks in developing countries to enable the results of the international centres to be tested and adopted through national research institutions; where desirable and possible it encourages fundamental research in Canadian institutions in support of specific international centre programs and related projects. In addition, it has supported technical working groups to review and assess the state of knowledge in a particular subject, it has commissioned state of the art reviews, at several centres it has established international information services, and acted as the executing agency for the creation of new centres and related programs.

One of the first international research programs with which IDRC became associated is the multiple cropping program at IRRI. For most small scale rice farmers throughout Asia arable land is a primary constraint. Consequently the farmer who wishes to increase his production and income must do so by increasing the output per unit of land per year. The opportunity to do so was created by IRRI's development of high yielding varieties which not only produce more edible rice grain per hectare per year but many of which mature in 90 to a hundred days thus permitting a farmer to grow two or three crops during each year. Alternatively the farmer may grow one or two crops of rice in association or in rotation with other crops such as food legumes, horticultural or root crops.

It may be useful briefly to review the sequence and pattern of the multiple cropping research since it is one that might be a useful guide for other applied research efforts in developing countries.

Most important is that it starts with a thorough understanding of existing farming practices, and of the technical and economic factors by which the farmer's opportunity to expand his production is constrained. A detailed agroclimatic survey was made of the whole Asian region and then alternative multiple cropping systems were developed for different conditions of soil, topography and rainfall patterns. The University of the Philippines at Los Banos cooperated by screening a wide range of other crops, including sorghum, sweet potatoes, food legumes, and some horticultural crops, for characters that would fit best into the multiple cropping programs proposed. IRRI scientists including both agronomists and agricultural economists, developed and tested the alternative cropping systems under the various agroclimatic conditions for which they were proposed and most important, in farmers' fields under farmer management. There now exists an integrated network of multiple cropping research guided by IRRI and including scientists and farmers in the Philippines, Indonesia, Sri Lanka, Bangladesh, and Thailand. Other Asian countries are gradually joining the network. Children and high school students in the rural communities have played an important part by observing and recording the nature and level of farm inputs, such as labor for planting, weeding, harvesting and other activities, the cost of these inputs, and the value of the harvested crops. This has enabled IRRI to assemble and maintain a comprehensive record of multiple cropping under real life conditions over a very wide geographical area. IRRI has provided regular training in multiple cropping research and development for a large number of scientists, extension workers and rural community leaders throughout Asia, along with provisions for a

regular information service. Most important IRRI convenes a regular meeting of the multiple cropping working group which involves all of the countries participating. The purpose is to review progress, difficulties and to agree upon priorities and methodologies for future research.

Success is measured by increased production and income on the small farms not by papers published in scientific journals. It is most important to note that, as with most reliable applied food and agricultural research, each project starts with the farmer, the person who is to use and benefit from the results of the research. This is done by determining the nature and condition of his farming system, his opportunities and constraints for further improvements. Furthermore the products of the research are ultimately assessed in farmers' fields, not in a scientific journal.

This approach tends to make obsolete the traditional concept of research followed by extension followed by communication to the farmer and finally delivery of the product to the consumer. In the IRRI multiple cropping program, all are integrated into a cooperative continually expanding and diversifying research system. In general this is typical of the way research is conducted among the CGIAR family of international agricultural research centres.

A similar program with which IDRC has been involved is the cassava improvement program which has its main headquarters at the international centres for tropical agriculture, CIAT in Colombia and IITA in Nigeria. This project started in 1971 by convening a working group of all known cassava research workers to determine first, the

state of knowledge- where and how cassava was grown, what were the constraints to its productivity and from this information to define a research program and priorities. The international centre in Colombia (CIAT) was charged with determining the genetic and agronomic factors that influence yield, and as a result of its intensive efforts and the application of improved technology, average yields in farmer's fields in Colombia have been increased from about 15 to 35 tons per hectare. In cooperation with CIAT, IDRC is supporting an international cassava outreach network, including India, Indonesia, Thailand, Nigeria, the Philippines and Malaysia. Each country is testing the results from the international centres and adapting the new technologies to suit their own agricultural economy and environment. Of interest to food technologists will be the research at the Asian Institute of Technology in Thailand and at Khon Kaen University where improved solar drying, chipping and pelleting of cassava for use in animal feeds is being pursued, and in Nigeria where the protein of cassava leaves and waste oil seed meals are used to supplement the essentially pure carbohydrate of the cassava root.

Several Canadian universities are involved in research in support of one or more components of the total cassava research system. At Saskatoon apical meristem tissue culture is being used to propagate disease free planting material from infected cassava. This technique will enable cassava research workers throughout the world to exchange material without fear of introducing unfamiliar and undesirable pathogens. At the University of Guelph a study is being made of the cyanogenic glycoside linamarin present in most cassava roots which on hydrolysis

liberates hydrocyanic acid. The ingestion of linamarin by major consumers of cassava is known to cause thyroid defficiency, goitre and in some cases cretinism. Microbiologists at Guelph are studying tropical microorganisms which in the presence of inorganic or organic nitrogen will both hydrolize and ferment cassava. Preliminary results indicate there are some that can produce up to 30 per cent crude protein on a dry weight basis. Some of these organisms grow well at a very low pH and at about 40^{o}-45^{o}C and effectively dominate other microorganisms, thus obviating the necessity for refrigeration as is necessary if temperate organisms including common yeasts are used. IDRC is financing an international cassava information service and two cassava research liaison officers, one in Latin America and one in Asia, to ensure a rapid flow of new knowledge and relevant technologies among all those who cooperate in the cassava network.

As a means of making more productive use of marginal lands such as areas of high altitude, low night temperature, acid sandy and high aluminum soils, we are supporting an international network of research on triticale. Triticale is the first commercially successful intergeneric cereal hybrid and consists of a cross between wheat and rye. The first wheat X rye cross was reported in Scotland more than a hundred years ago but this proved little more than a scientific curiosity until comparatively recently, because, like the mule the progeny of the cross was infertile and the seed quality poor. Following some important research at the University of Manitoba during the 1960s, the International Maize and Wheat Improvement Centre (CIMMYT)

in Mexico financed by a grant from CIDA and IDRC has developed triticales with inheritable fertility, a seed grain quality almost equivalent to the best wheat, and the important ability to grow well on marginal lands unsuited to wheat and other cereals. Furthermore the triticale hybrid has inherited the higher lysine characteristic present in rye thus providing a protein which is nutritionally superior to most wheat varieties. Some of the more advanced triticale lines at CIMMYT display lysine in excess of 4 per cent of grain protein. Triticale gives higher yields than the best wheats in the Himalayas of India, at an elevation of approximately 6,000 feet, in the highlands of Ethiopia and Kenya, and over wide areas of Mexico and Chile. In Ethiopia triticale has been demonstrated as an acceptable replacement for the traditional but inadequately produced cereal grain teff.

In contrast with the success of the international agricultural research system, the establishment of successful food science and technology programs in developing countries are less spectacular. While there clearly have been a number of food research, food technology and food industry development projects in developing countries that have been productive and beneficial, in general a great many have fallen short of original expectations. In many developing countries, under the stimulus of aid from either multilateral or bilateral agencies, the primary purpose has been to establish a food research institute owned and operated by a national government. In spite of the wide diversity of levels of economic, social, and technical development among less developed countries there has been a tendency to establish food research institutes according to a more or less standard

pattern. This pattern often requires a large initial investment in buildings and equipment; the establishment and equipping of analytical, biochemical, microbiological laboratories and a pilot plant with all manner of processing facilities and of course the inevitable taste panel rooms with their exotic lighting and hedonic scales. Several of these institutes were built and equipped before detailed programs and priorities were adequately defined or an assessment made of the country's scientific capability. Consequently, many food research programs have been dictated more by the equipment and facilities provided than by the urgent priorities of the developing countries food processing and distributing industries. A number of scientists in developing countries are now struggling to overcome the difficulties of the methodology having preceeded the objectives and the means dictating the ends.

The difficulties that some of the food research institutes, particularly those in the least developed countries are experiencing are not of their own making. The responsibility of the unsuitability of many food research programs must be laid at the door of the multilateral or bilateral agency by which they were created. In some instances they were designed by consultants with little in-depth or first-hand knowledge of the local food and agricultural economy and resources, consultants who appear to have taken too little time or made inadequate effort to consult with the local food industries technologists.

In some instances the difficulties have arisen through the constraints of tied aid in which the donor's primary objective is to transfer as much capital equipment from the donor country to the

recipient in as short a time as possible. In common with many human misfortunes, the shortcomings of food research and food industry development projects in developing countries can usually be attributed to inadequate consultation and mutual understanding between the multilateral or bilateral donor and the recipient country.

The greater success of the CGIAR system is that it is international and comparatively independent of governmental bureaucracy and political involvement. Each of the centres established is autonomous and is governed by an international board of directors including several competent scientists from the region in which the centre in established. In general most food research programs have been established on a national basis and one can think of very few successful international or regional cooperative programs and certainly none comparable to the CGIAR family of agricultural research centres. Given the dominance of a national orientation in food research one tends to find research institutes with too many projects and too few scientists; duplication of efforts among different countries; tendencies to political and government control and constraint. Furthermore, it is unfortunate that many of the food research institutes have been established in the larger cities whereas the major problems and opportunities for effective food research, improvements in food preservation and distribution are to be found among the rural communities.

The foregoing is not to deny the importance of strengthening national research capabilities. To do so is one of the primary objectives of the international agricultural centres. But it is more

economical to solve problems common to several countries by a co-operative effort. It is impossible for every country to undertake a national research program equivalent to the sum of the research effort in all the international centres.

There now exist many well-equipped food research institutes in developing countries which, with a measure of political good will could serve the common needs of several developing countries, no one of whom can tackle all of its problems from its own resources.

In spite of the difficulties and constraints described one could cite several food scientists and technologists in less developed countries who have broken through the walls of the externally imposed ivory towers with remarkable results. In one country of Latin America where the food research institute was in the national capital, yet all the processing industries were several hundred miles away, an enterprising young food scientist loaded the necessary equipment into the back of a truck and drove to the areas where fruit, vegetable and fish processing were practiced among many small and technologically inefficient factories. There he demonstrated simple techniques whereby the processors could increase their production and significantly reduce their losses. Benefiting from this young man's success and with assistance from the Canadian food processing industry, we were able to design and provide to a number of developing countries mobile food laboratories. These can be moved to wherever the food processing industry is located and can undertake applied research, quality and process control and demonstrate improved techniques to rural based industries.

It is my personal view that, in some developing and developed countries, a bricks and mortar food research institute built on classical lines can be more of an impediment than an assistance to the development and improvement of food processing industries.

Recognizing the dominantly national, and somewhat isolated orientation of food research in many developing regions, it was gratifying, when in 1971 during a visit to Asia, several Asian food technologists stated their wish to cooperate more effectively with each other. As a result, IDRC provided the means for representatives of 11 Asian food research and food industry institutes to come together to discuss with one another their programs, their difficulties and their common interests. Subsequently this group produced a directory of food research in Asia which has been published and widely distributed. More important they identified the major priorities for food research common to most Asian countries, which in order of priority were:

1. improved post-harvest rice systems
2. more efficient fish processing, and
3. the processing of food legumes.

During subsequent meetings the Asian food science and technology group prescribed the need for a cooperative post-harvest rice research program. One of their members together with other consultants made a detailed study of the post-production rice systems among the Asian countries, and wrote up a set of recommendations. They recommended that no new institutional research facilities were required but that more research should be undertaken among the rural communities; a

means of cooperation among the Asian countries should be established; there should be much more efficient coordination among donor agencies, both bilateral and multilateral, many of whom seemed to be working in competition with one another. As a result of these recommendations, there now exists the Asian Post-harvest Research and Development Program, a regional undertaking designed "to raise the levels of availability of rice and other important grains by improving existing and devising new and improved post-harvest systems best suited to the conditions prevailing in countries of Southeast Asia."

This program is financed by a consortium of donors which came together under the sponsorship of the CGIAR. Each of these donors contributes to the maintenance and technical support of an international research advisory team which has its headquarters at the Southeast Asian Regional Centre for Graduate Study in Research and Agriculture (SEARCA). An important characteristic of this program is that it is controlled by a Policy Advisory Board whose chairman and a majority of its members are senior officials in the participating Asian countries. The research advisory group reports to this Policy Board which in turn decides what cooperative activities are most essential and will receive highest priority. It then establishes a forum for exchange and dissemination of information among all the Asian countries and a means of coordination among the donors.

Australia is not yet a full member of the Asian program but we have every hope that in the not too distant future it will become one. It should be recorded however that the Australian government has financed the construction and distribution of a number of flat

bed rice dryers to be used and evaluated among the cooperating member countries.

We are now working to develop a regional network of fish processing and preservation projects throughout Asia to combat the present immense post-harvest losses. Given the remarkable progress and promise of high productivity from aquaculture research, particularly in the Philippines and in India, we may anticipate over future years a considerable increase in both fresh water and coastal fin and shell fish production throughout the region. This increase in production will be of limited benefit if technically efficient and economically and socially acceptable forms of fish preservation are not introduced. Clearly, for most countries particularly the rural communities, a freezer chain is out of the question. Consequently we must look to improved preservation by osmotic dehydration using sea salt, and solar and wind drying, such as has been applied to grain crops in Africa, and to the use of smoke and wood kiln dryers of improved design.

In other parts of the world, particularly in Africa, cereal grain and food legume processing are immensely important. In a recent study in West Africa it was demonstrated that many of the village women spend ten hours out of every day in grinding sorghum, millet and legumes with a large pestle and mortar, and in carrying water and wood by which to cook them. IDRC has supported research in Northern Nigeria and more recently in Botswana which has resulted in the establishment of rural grain mills that can successfully dehull sorghum, millet, maize and a variety of food legumes, and subsequently pulverize

them into a desirable particle size. These projects began by first making a detailed study of what were the local concepts of grain and flour quality in order that the mills when operating, would provide what was most desired.

This network of African grain and legume milling is given technical support in terms of machine design and construction by the Prairie Regional Laboratory in Saskatoon. Almost all of the applied research is however undertaken in Africa, not in a research institute, but among the rural communities. There are now good indications that regional food technology working groups can be established in the Near East and in Africa which, following the pattern of the Asian food science and technology group, will help to define common priorities and a system of mutual cooperation and exchange of information.

It is our belief in IDRC that the comparative success of East African and Asian projects has resulted from the fact that they began with the rural community and the consumers to be served before proceeding to define and establish a research and development program.

It is our further belief that these results indicate important considerations for those whose business it is to train and educate food scientists and technologists in developing countries. Food research is applied research; applied research is of essence research for human benefit. Consequently it becomes important that food scientists be persuaded that the criterion of success is not simply technical ingenuity but the satisfaction of human need and desire. It requires that food scientists and technologists acquire clear concepts of systems research management in order to understand

where their research projects fit and how they contribute to the total system and above all to human welfare. It is, we believe, quite inadequate in today's complex world to teach only scientific theory and research techniques. Food science is above all a human and a social science. Consequently every food scientist must be possessed of a high degree of professional integrity and competence. Equally important every food scientist must be imbued with a highly refined social conscience and a sensitivity to human need.

As I stated at the outset, the practical and social concern among Australian food scientists has been clearly evident among the branch activities and from the content of this program. I am extremely grateful that I have been permitted to have a small part in it.

/jpt

June 26, 1978