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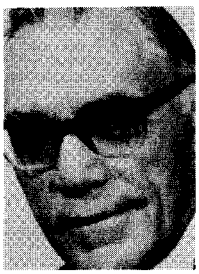
Operations Research Is Needed at Home and Abroad in Development



Omond Solandt, ICARDA

I am violating my own rules: speaking to an audience that knows more about the subject than I do. I am a newcomer to the field of using science and technology to aid development. My interest is there, however, and in 1975 I was recruited by Joe Hulse, Director of the Agriculture, Food and Nutrition Sciences Division of IDRC to help establish ICARDA — the International Centre for Agricultural Research in Dry Areas. This simple beginning has led me to an extensive involvement in development. I am now on the Board of Trustees of CIMMYT — the International Institute for Wheat and Maize Improvement in Mexico — the International Centre for Insect Physiology and Ecology in Nairobi, and the International Centre for Research in Diarrheal Diseases in Bangladesh.

I have also had some relevant experience in Science and Technology in another developing country — the Science Council of Canada, formed in 1966. At that time Canadian research was funded at 1% of GNP and by 1968 the government was asking how to raise this to 2% in 4 years. The Science Council gave guidance — including the assumption of a 2% per year "escalation in the implicit price index," which was a polite way of saying inflation. More than 10 years later, we are still at 1% but the target is 1.5%, and the inflation rate is 8–10%. It may be that help for developing countries should begin at home.

First, a word of praise for IDRC. My earliest contact was in 1968 when Stu Peters was trying to get the Centre established. Mitchell Sharp, then Secretary of State for External Affairs, asked me to shepherd the bill through the cabinet committee. I outlined a plan for IDRC — my own. But there is no record of this, and the plan has disappeared.

In spite of this strange beginning, IDRC has prospered. Rex Nettleford has told you about it, and I support every word of praise he has given to it. IDRC is an international foundation that ranks at least with Ford and Rockefeller in influence and esteem.

Unfortunately, I do not share Nettleford's confidence that IDRC is certain to survive in the bureaucratic jungle of Ottawa. The power-hungry bureaucrats are like my wife's dogs — she breeds them — when one of them becomes old or ill, the rest turn and kill and eat him. I watched it happen to Defence Research Board after 25 years of extremely successful operation.

To continue to exist, IDRC must remain strong. Canadians must know about it and friends must speak up.

I must emphasize that my viewpoint is that of a person with long experience in helping to apply science and technology to national problems in Canada, the United States, and the United Kingdom. I am a newcomer to problems of developing countries. My conclusions, therefore, may be of profound significance, startling glimpses of the obvious, or just plain wrong.

I believe that we should distinguish two levels of aid, or two parts of the spectrum of aid, because they merge but are distinct.

The first is helping the subsistence farmers grow enough to ensure an adequate and dependable supply of food, clothing, and shelter. Much can usually be done to help them by developing seeds that are higher yield and disease- and drought-resistant and improving their farming system. At ICARDA in Aleppo, Syria, for example, plant breeders collected strains of chick-peas from many parts of the world. From these, they were able to select seeds that were suitable for winter planting, gave a high yield, and were resistant both to the ascochyta blight and the cold weather in the region. Thus they gave the local farmers a greatly improved crop of one of their favourite foods.

The second level of aid is directed at people above the subsistence level. (We shall be talking mainly about rural conditions because in the poorest countries the people are still mainly rural.) Now the problems become more complex. A first consideration is markets. No farmers will grow more if they cannot be sure of selling it at a fair price. This phenomenon is not limited to primitive agriculture. It is pretty certain that even in Canada the farmers grow only what they can sell. If they could sell more at a good price, then they would grow more. This requires transportation for produce going out and for goods and fertilizer and tractors coming in, as well as credit for inputs. Even at the simplest farm level, there is a fairly complex system involving seed, soil, climate, farming methods, local customs, food preference, and so on.

When we begin at the second level to consider how science and technology can help in the development of an entire country or region we begin to deal with a complex system and at the heart of this system are social and cultural — including religious — backgrounds to be considered. Goals for development differ widely: they must be understood, not imposed. Whatever the development goals and the existing state of development, the problem is one of improving the performance of an existing system, not arbitrarily imposing a new system.

The need is for old-fashioned World War II Operational or Operations Research (OR).

Operational research is action-oriented. It used to be defined as an attempt to apply the general principles and methods of science to the solution of problems often not obviously scientific that arose during the operation of a complex system involving men and machines.

During the war, many of the best practitioners were biologists, partly because the physicists and engineers were working on radar and partly because biologists are less appalled by the untidiness of complex systems that include people than are physicists and engineers. We had social scientists even then — mainly psychologists.

Now we need all kinds, including the new generation of systems analysts and engineers. Economists will certainly play an important role but economics is not known as an experimental science so leadership could come from other disciplines.

The social sciences, other than economics, must be well represented. Cultural problems of race, language, and religion are all part of the system and cannot be ignored.

But probably most important of all is the need to involve the people of the developing countries as directly and completely as possible. The nature of this involvement will vary greatly with the educational level of the nation or region where help is being given but the need to have as much as possible not only done but also fully understood by local people must always be uppermost in everyone's minds.

Here language is often a serious problem. There is a tremendous advantage in speaking the local language. IDRC itself provides a good example. It supports local research programs with money and some expert guidance, but credit goes to the national agencies. The international agricultural research centres, such as CIMMYT, never release new varieties of grains to farmers. This is always done through national programs. And this even includes China.

And now, back to the early ideas of operational research. The key words were: observe, measure, and experiment. Watch the system in operation, try to understand it, measure everything that can be measured, and devise new ways of quantifying things; when you have data, begin to evolve a computer simulation. (I said old-fashioned because some of the young computer-minded OR types make their simulation or, even worse, a mathematical model first and then try to fit reality into it.) This will show you the bottlenecks in the system. Then, try experiments to remove the bottlenecks. If you succeed, you will create new ones and so on. A computer can be very helpful to identify problems but is only an aid in the search.

The concept of development as a system problem is not new, but it has tended to result in a top-down approach when a strictly bottom-up one is needed.

The closest approximation to the approach that I advocate is being made by agricultural economists but no doubt there are many others. Two that I have watched close-up are Don Winkelman at CIMMYT and David Gibbon at ICARDA. Both put the social organization aspect of the system in the forefront. Don tends to emphasize the more central parts of the system. David looks first at the farm and the village. Both are coming to be first class practitioners of OR.

The importance of the systems approach is nowhere better illustrated than in the changing emphasis of the wheat program at CIMMYT. Norman Borlaug, Glenn Anderson, and many others developed the high-yielding wheats that were expected to solve the world food problem at least for a time. The new wheats did help a lot but rarely realized their potential for a host of practical reasons — politics, shortages of inputs, poor transportation, wrong policy decisions, etc. Now the CIMMYT wheat program is setting up regional offices, partly to ensure that new genetic material from Mexico is sensibly adapted and selected locally and that results are fed back to Mexico but mainly to try to get national authorities to see the whole system and try to improve it. Don Winkelman's agricultural economists are a key part of each regional team.

CIMMYT is also initiating a series of courses using the case method to try to get national decision-makers to see their agricultural system as a whole and thus make better decisions. The next stage is to get national decision-makers to see the interaction between urban and rural problems — industry and agriculture, economic growth, social welfare, etc. This is beyond the mandate of the international agriculture research centres but not of many of you here.

And Norman Borlaug from CIMMYT — like Mike Pearson, a Nobel Peace Prize winner — forester-turned-plant-breeder-turned-world-diplomat — now goes from nation to nation working to improve many elements of the system from plant breeding to birth control, from organizing seed and fertilizer supplies to formulating national economic policies.

You might well say that all this is old stuff for both politicians and economists. They both purport to understand and deal effectively with social and economic systems. But experience has repeatedly shown that the complexities of even relatively simple socioeconomic–political systems are beyond the present understanding of even the collective wisdom of the human race. And they are much too important to be left to the economists and politicians. Every kind of natural and social scientist must jump in to help. We must try to recreate the spirit of the wartime operational research groups where multidisciplinary teams of scientists, who did not command but observed operations, were remarkably successful in helping at all levels from the design of weapons to the training of people and from making major strategic decisions to conducting battles.

There is a strong tendency for the physicist or scientist or engineer who improves farm machinery or irrigation or fertilizer production or designs and builds roads, railways, ports, factories, or power plants and for the biological scientist who improves crop yields, fights pests and disease in humans, plants, and domestic animals to leave the systems problems that almost always limit the success of their work to others to analyze and understand.

This must stop. Science can be defined as the human race's accumulated and organized knowledge about itself and its environment. If this is accepted, then it is clear that all of the knowledge must be brought to bear on the global problems of poverty and inadequate opportunity. This can only be done effectively when we agree that "everything is related to everything else" and organize ourselves to bring diverse and powerful teams of scientists together to help to understand the problems that beset the world. Most of these problems can never be solved but we can learn to keep them under such good control that we can live with them comfortably.

But how can we as social and physical scientists or lawyers, whether in government, university or industry, convert this understanding into effective action?

We must recruit systems thinkers everywhere, get them into programs in developing countries, look always at each project as an element in a system. We must not isolate the systems approach from the existing work, nor seek new funds for it; we must use it to increase the effectiveness of everything that is done.

We cannot collectively solve the problems of the world, but we can make them easier to live with. We must do this soon, especially for the poor who are continually becoming more numerous. They too are people, often fine people, and they are a part of our complex system. We must improve it to make their lives less arduous. Let us stop talking and start doing.

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