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THE EVOLVING ROLE OF CIMMYT: SOME ISSUES FOR WORLD FOOD AND AGRICULTURE

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The CGIAR System and History

The Consultive Group on International Agricultural Research (CGIAR) emerged in the early seventies as a consequence of apprehension about food production capacity in developing countries. There was a conviction at that time that the food shortages that were being encountered could be ameliorated through a concerted international effort. The model for that international effort was Centro Internacional De Mejoramiento de Maize y Trigo (CIMMYT's) earlier work in Mexico and International Rice Research Institute (IRRI's) with rice in the Philippines. CIMMYT's started under the auspices of the Rockefeller Foundation in the midforties. It was the success of those efforts through the fifties and sixties, (from Mexico to North Africa, India, and Pakistan) that gave the organizers of the system the faith that this model might be a useful way to organize agricultural research focused on other problems. The system was thus born.

It was recently reaffirmed that the major focus of the system is to help increase developing countries' (LDC) production of staple foods. There is a center that focuses on agricultural policy issues, International Food Policy Research Institute (IFPRI), and another that focuses on management issues in agricultural research. The budget currently is around \$180-\$185 million a year. The system has not grown in real terms over the past 6 years. We are becoming even more conscious of our need to be efficient, and because of this, we are achieving some efficiencies in the organization of our activities. There are approximately 40-45 donor countries. The number varies from year to year, depending on each countries capacity to give. None of our current donors are foundations.

The system has been able to make fairly significant contributions to agriculture around the world without any sort of a formal structure. We deal directly with national governments and develop working relationships. The system is abstract, fragile, and loose knit. That is not to say that the CGIAR system, per se, has no international status. It really is an idea that works largely because of the commitment of the people who are associated with it and because it turns out to be a very efficient and effective way to pursue improved technologies for developing countries.

CIMMYT's Structure

CIMMYT's staff is divided into two parts: a core staff that is directly funded through the operations of the CGIAR, and a staff that is associated with special projects. There are slightly more than 100 senior staff members, of which 85 are funded under the auspices of the CGIAR. We deal with CGIAR for those positions through the Technical Advisory Committee (TAC). Our regular budget was approximately \$20 million for 1986. In addition, \$5 million came from special project funding. The staff of 85 is distributed with 34 in the maize program, 29 in the wheat program, 7 in the economics program, and the remaining 15 in experiment station management, communications, computers, laboratories, accountant, and financial advisors.

¹Director General of CIMMYT. Parts of this paper are drawn from "CIMMYT Research: Extending the Gains", presented at the Ceremony Celebrating the 20th Anniversary of CIMMYT.

The Hallmarks of the CIMMYT

The essential elements are on field work, on the importance of direct researcher involvement, and on a pragmatic basis, with the needs of farmer-clients and the benefits and obligations of an open association with the worldwide network of practitioners sharing the same principles. Throughout our history, we have played our role in concert with national research programs. These programs are CIMMYT's clients. We see ourselves as agents for complementing their work, thereby facilitating their efforts to serve their own clients--the farmers. The center is recognized and treated as being above politics. This turns out to be enormously important. Over the years, it has always responded to the needs of national programs without limitations imposed by its individual donors. National programs have long recognized that status and have no reservations about sharing through CIMMYT nor about CIMMYT's willingness to share with them. This even handedness is a continuing CIMMYT hallmark, and the resulting trust is one of our most valued assets. Like others in the CGIAR system, we see clear advantages in long horizons and sharp focus. The two combined bring patience and care in the pursuit of well defined research themes. That blend contributes notably to CIMMYT's success as it did to the success of our predecessor organization. Our evolution continues to be conditioned by a commitment to multidisciplinary research. We see advantage in combining disciplines, practice this ourselves, and advocate it for national programs.

CIMMYT's Products

We produce intermediate goods that are made available to national programs. National programs fashion finished technologies for farmers. We produce germplasm (our primary product), research procedures, training, counseling, and information.

CIMMYT's Future

We recognize the importance of our work given the current emphasis on productivity. Previously when you read statements related to the CGIAR system, it was production that was emphasized. We also recognize that growing international trade in agricultural commodities has important implications for national program research. We also see the importance and the difficulty in identifying comparative advantage in today's open economies. Because financial flows influence exchange rates, it is difficult to identify comparative advantage. This reflects in the national programs ability to identify where their interest lie and thus to determine what it is that they most want from us. We see growing strength in some national programs and recognize that this presents the CGIAR system with new opportunities. CIMMYT and IIRI have discussed ways in which tasks that are currently undertaken by the institutes might feasibly evolve into mature national programs. We believe new science will bring new opportunities to complement conventional approaches. We can hope that national policies will favor increasing investment and well directed research through judgment based more on biology and resource endowments than on caprice or misapprehension.

Finally, we understand that if desired rates of economic development occur, even higher proportions of our products will be use for livestock feed. This has strong implications for the relative demands for maize and wheat.

The Productivity Issue

We are among those who argue that improved technology lowers costs of production. Generally, although not always, these efficiencies increase incomes to those who farm or who hold the agricultural assets. This increased agricultural income generates rounds of spending, which can become an engine for economic development. We are impressed with the need to

quantify the flow on effects of agricultural development. This general economic benefit to people and countries is one of the beliefs that motivate our efforts. Hence, when we talk about our own priorities, we talk about them in terms of the productivity of resources held in agriculture rather than about production of agricultural commodities.

One of the things that I see us doing in the future is expanding our emphasis on networking. This is now in the planning stage. Scientists from several countries are involved, and their efforts are focused on a particular problem. One application that we are currently contemplating could focus on problems such as weeds, fertility, soil structure, tilling and salinity, inherent in sustaining yield increases in the ever more intensively used lands under the rice-wheat rotations from Pakistan to Bangladesh. In this application, the focus is beyond agronomy and technology generation; it will look to science as the underlying relationships on which sustainable yields must be based. Such networks might plan joint research, partition problems according to competencies, share data and analysis, and ensure the professional and technical quality of the research itself.

This issue of sustaining yields is one that is getting our increased attention. Derek Byerlee reports that on the basis of some of his research in Pakistan yields are staying constant, while inputs are increasing and management skills among farmers are improving. So we have in effect lowered productivity of resources that are committed to rice-wheat rotation. We are considering organizing a network of scientists, soil chemists, soil physicists, and microbiologists to focus on that set of problems.

New Science

We are all aware of the startling developments in science as molecular biologists, biochemists, and others have brought their discoveries to bear on issues in plant improvement. CIMMYT has moved in deliberate ways to take advantage of these developments and has established consulting and professional relationships with leaders in these and related fields.

We have done so because, as others, we are impressed with the advantages latent in the new techniques and feel it is only prudent to take steps to assure access to unfolding developments. One such step is to add a molecular biologist to our staff and to bring into play the physical and organizational infrastructure necessary to support these activities.

Our thinking about the extent to which CIMMYT should invest in new science is shaped by three considerations: First, we see ourselves applying the techniques others develop--we are more tool users than toolmakers; second, we must ensure that CIMMYT is able to employ new findings in the practice of plant breeding as they become applicable; third, we recognize that beyond CIMMYT's own requirements, national programs look to us to help them stay abreast of new developments.

Our current collaborative work using the new tools of plant breeding focuses on tissue culture concentrating on finding new ways to maintain and multiply the hybrids emerging from wide cross programs; on callus work to induce chromosomal breakages; and electrophoresis to identify the extent of gene transfer occurring through intergenetic and interspecific crosses. The work currently underway is aimed at bringing traits out of wild relatives into maize and wheat. Our special concerns are selected disease and stress conditions.

Another major new technology that appears to be applicable to CIMMYT's work is the use of gene probes. These could be used to screen large amounts of materials in the laboratory, reducing the need for large field experiments. They could also be used for diagnosis, such as ascertaining the presence of a virus and to assess the success of efforts to transfer alien genetic material. And perhaps, just perhaps, we could become the repository for such probes or clones as they are developed, both by ourselves and by others around the world.

While much has been promised by those who pursue the applications of new science to plant breeding, there are grounds for caution. For example, while genes can now be transferred and spliced, those in maize and wheat have not yet been mapped for function. Moreover, regeneration is still more an artform than a science. Until these challenges are met, the techniques related to splicing have limited applications for CIMMYT.

There is much to suggest that we make haste slowly. Even so, I am impressed by the commitment that major private plant breeding companies are making in this field with some reporting as much as 10-15 percent of their research resources devoted to biotechnology. We are mindful of Thomas Huxley's observation that "a customary fate of new truth is to begin as heresy and end as superstition."

Biotechnology is a fast-breaking field. We must organize so as to ensure that we know what developments are relevant to our needs and can move quickly to incorporate them. This will not only require expertise in the field of biotechnology and a recognition of the practicalities of conventional plant breeding but will require sufficient sympathy and familiarity that an augmented supply of science finds a responsive demand. The steps that we are taking are designed to serve those ends. We see a continuing central role for conventional breeding, and, to the extent desirable, we want to augment its efficiency through relevant new tools.

Germplasm

As in the past, germplasm will remain CIMMYT's major product. Our work in germplasm development has tended to favor the better environments of developing countries. This is true for wheat, where much of the attention of the past has been on well-watered areas. That emphasis was quite appropriate given that some two-thirds of the developing world's Spring wheat is grown in such environments. Most tropical maize, on the other hand, is grown in the presence of significant environmental threats, with the well-watered areas suffering the menace of disease and insects while the drier areas encounter the dramatic effects of drought. Overall progress in bread wheats, Durum wheat, maize, and triticales has ranged from remarkable to extraordinary. And what about the future?

In deciding the emphasis of the future, we must recognize the importance of the favored environments and at the same time stay consistent with the 1986 TAC priorities paper, which cater more to the needs of the more difficult environments. In deciding on the relative importance of each, we must integrate the differing effects on economic development of new technologies, enhanced productivity, and increased income inflows, along with the probability of achieving results.

As we view research on wheat for well-watered areas, emphasis will be placed on maintaining the gains achieved. Greater attention, however, will be given to materials for more difficult environments. Even if the probable gains were less in the poorer environments, a concern for the poorest coupled with the perception that they tend to occupy the most difficult environments would still be cause to focus on these areas. We cannot say much about the final effects until added rounds of spending of given productivity changes in the two environments. The relative size of such parameters must rate a high priority for economists.

Major efforts are now underway on materials that can accommodate drought stress. The maize program was initiated several years ago, then set aside, and it is now being revived. This research tends to show that maize selected under both drought-stress and well-watered conditions tends to perform much better under drought-stress and somewhat better in well-watered circumstances than does maize selected only under well-watered conditions. Work on Spring bread wheat, on Durum wheat, and on triticales is also well along, and we expect good results given the resources being committed.

Work is underway on wheat for more tropical environments and surprising progress has been made. One aspect of that work involves resistance to disease that, while common to such environments, are less commonly encountered in traditional wheat-producing areas. For selected areas already producing wheats, work is underway that will result in more late heat tolerance for wheats.

For both maize and wheat, there is an expanded effort on earliness. This characteristic offers two advantages. The first is to permit escape from diseases of heat or drought. The second and the one becoming more widely recognized is that earliness enables more intensive cropping, implying more options for farmers.

In reaching for these goals (earliness, tolerance for heat and drought, accommodation to problem soils, and new classes of disease resistance), CIMMYT breeders frequently work directly with concerned national programs. Those relationships will be enlarged and fortified as this class of work expands.

In assessing these lines of work from the perspective of potential benefits at the farm level, we are convinced that we need to know more about these important issues for priority setting and policymaking and are investing in acquiring the needed understanding. Combining these insights with those from a more global perspective should help us and our national programs colleagues to have a clearer sense of priorities.

We have greatly augmented our capacities to serve as curators of selected portions of the world's germplasm of maize, Durum and Spring bread wheats, and triticales. Fulfilling our responsibilities in this area will involve collaboration with several national programs, especially in Latin America for maize germplasm. A substantial portion of the desired materials is in storage, and we are developing the associated data. It is satisfying to report that machinery will soon be in place to satisfy a well-defined portion of the world community's needs.

Professional Training

CIMMYT and its predecessor agencies have invested heavily in supporting the efforts of National Agricultural Research Systems (NARS), with a primary part of this effort expended in augmenting human capital through various kinds of training and consulting. The wheat program staff suggests that as much as 45 percent of their total effort can be ascribed to these activities. We will continue that emphasis in the future but will redirect some of the energies.

We must find ways to multiply the energies we are investing in training on agronomy and crop technology generation. The demand for these skills in developing countries is enormous compared with the training capacities of the International Agricultural Research Centers (IARC's). We have moved in this direction through an expansion in our in-country training efforts. In time, we hope to see more of this training being done by national programs or being offered on a regional basis under the auspices of the more mature national programs. If this occurs, CIMMYT would supply course structures, training materials, counseling on conducting the training, and, at times, staff to participate in such programs.

As in the past, efforts in training will rely heavily on learning by doing. Given new developments in instructional materials and a clearer understanding of their potential role, we are moving to develop more such material. In this case, we are learning by doing as we discover the applications of supporting materials to reinforce the lessons of the crossing-block, the breeder's plots, and the fixing of priorities for production trials.

We have long had a program for visiting scientists from NARS in which they work alongside our staff in pursuit of particular research themes or to familiarize themselves with specific

methods of materials. This too will continue. We are also adding the opportunity for participants to refurbish research skills. Our plans are that participants will remain here for 4-6 months; most of them with data from projects undertaken at home. We will provide them with the opportunity to analyze, to pursue related research through the library, and to write research reports. This will meet a need forcefully expressed by many of our colleagues: that results are not available to peers because researchers do not have the time to analyze and write and that certain research skills atrophy because of that same constraint. Interest in this program is widespread, and we have had extraordinary financial support from donors and from the private sector. Our new training facility will play a crucial role in this undertaking.

Finally, we see a growing need for new specialized courses focusing on a single theme or on closely related themes such as that offered in pathology and funded by the Dutch. These themes would be designed and developed in Mexico, based on the experience of network colleagues and our own staff, and made portable so that they could be offered on a regional or national basis.

Our work in training has done much for human capital formation in agricultural research. What is too little appreciated is what this can do for CIMMYT. First, we have the opportunity to learn from the accumulated field experiences of participants in the programs. Beyond that, and largely unrecognized by the training staff with their own periodic involvements in research and continuing close connection to the research of others, are a vehicle through which CIMMYT's experience is synthesized, impressions formed, and procedures are formulated and improved. These procedures are basic to the development of training programs. It is in training then that CIMMYT's wide experience can be gathered, integrated, and then framed in concrete terms.

Work for Africa

Projects on Africa sharply increased through collaboration with U.S. Agency for International Development (USAID) and Canadian Institute for Development Assistance (CIDA). An increasing proportion of our energies over the next decade will be focusing on activities related to Sub-Sahara Africa. Our commitments there will surely be larger than that implied by the areas of maize and wheat--18 percent and 6 percent of developing country maize and wheat--or by the proportion of the populations dependent on the two crops. Commitments will be small, however, when measured in terms of the need for support and of the potential impact.

This work will be representative of the full range of products that CIMMYT delivers to national programs. A considerable portion of the effort will be in germplasm development. Given the urgency of the food and income problem, we have moved our work on intermediate altitude maize to Africa, are now planning to strengthen our forces by working on germplasm for the humid and subhumid tropics, and are contemplating a shift to bolster efforts related to maize's capacity to accommodate drought. In doing this, we expect substantial cooperation with the International Institute for Tropical Africa (IITA), France's agricultural research centers (CIRAD, SPAAR), and other teams being assigned to the region by donors to the CGIAR.

We have every faith that African farmers will use new technologies. Recent evidence from Ghana where CIMMYT staff has worked with the national program through a bilateral project funded by CIDA supports that faith. In a survey of maize farmers, high rates of adoption of improved varieties introduced from the international maize network of nitrogen fertilizer and of new seeding patterns were evident in selected areas. There will be more evaluation of the Ghana experience in the near future and of other such activities.

Training efforts in Africa will also be fortified. It is our hope that a significant portion of the training required, most notably that related to production agronomy, will be undertaken within African programs.

In our view, there is considerable scope for working with national programs in planning and assessing the directions of their work on maize and wheat. This type of counseling could contribute much to the efficiency with which notably scarce national resources are used. In reflecting on priority setting within national research programs, there are many cases in which it is relevant to ask if too many or too few resources are devoted to maize or wheat research. Such decisions, of course, are properly in the hands of national program leadership; even so, we can provide pertinent information. Furthermore, in collaboration with such newly emerging entities as SPAAR, CIMMYT staff will be a good source for information about high-priority investments for potential donors in the activities of national programs.

Finally, we see ourselves as more actively engaged in direct collaboration with other IARC's whose mandates include work for Africa. One potential form of such collaboration is in research on technology generation involving several IARC's and relevant national programs. While we believe that others could do this job, there are two good reasons for us to actively participate. The first is the overwhelming urgency of the need for improved technologies appropriate to the circumstances of African farmers. The second is that African support for research in Africa would be substantially fortified by examples of successfully applied or adaptive research.

Sustaining Momentum

By any standard of measurement, the CGIAR system must be regarded as a marvelously successful venture. The recently concluded CGIAR impact study gives ample evidence of this. One welcome result of the study is that it should quiet apprehensions about the distribution of the benefits from IARC research. The evidence shows widespread benefits, especially to poor consumers. This should be a comfort to those who were concerned about benefit flows. This is not, of course, to suggest that all is well on the income distribution front, but rather that the earlier, more strident critics seem to have been well off the mark.

How can CIMMYT and the CGIAR best maintain the momentums that have contributed so substantially to agriculture in developing countries? The earlier discussion makes the case that the spirit of innovation must hold sway, not just in research itself, but also in contributing to new forms and structures in collaboration, in product, in training, and in procedures.

Sustaining momentum relates not only to support for the IARC's but also to bolstering support for the agricultural research programs of developing countries. During CIMMYT's short 20 years, we have seen that support oscillate first for one institution and then another. We know that constancy strongly influences the utility of research and that on-again, off-again support seldom leads to acceptable payoffs. We also know that sustained support will probably only come after national decisionmakers are convinced that they cannot do without agricultural research and that their constituents will challenge their judgment if support is inadequate. And we know that those convictions can only come if research programs give clear evidence that an investment in their research is an investment with high payoffs.

CIMMYT must also maintain its energies and does so in the face of more subtlety in our understanding of the potential payoff to research. The convictions of an earlier day were maintained by rallying cries that gripped the imagination--"Food for hungry bellies." Today's shibboleths sound faint and pedantic by comparison. We must also, even with the increasing emphasis on new science, maintain the luster of more conventional forms of research, forms that will surely provide the gains of the next decade and more. Finally, in the face of

apparent abundance, we must gather the energies to add choice to the lives of the desperately poor.

Surely these are formidable challenges, but these do not suggest that this is the end. To paraphrase Winston Churchill, "it is not even the beginning of the end, but it may well be the end of the beginning." The circumstances of the next two decades will differ markedly from those of the last two. With the experience, the energy, the wit, and the innovative spirit of our staff, we will reach new highs, with an expanding array of viable options to national agricultural research programs and, through them, to farmers.