Report of the CIMMYT
External Program Review Panel
April 24-28, 1972

by

Hassan Ali El-Tobgy
A. B. Joshi
Vernon Ruttan
Howard A. Steppler
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**Letter of Transmittal**

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About the Panel Members:

Hassan Ali El-Tobgy, Ph.D., holds a doctorate in genetics from the University of California (Berkeley). A citizen of U.A.R., he has served his Government as Under Secretary of Agriculture, in charge of Agricultural Research, and is presently Regional Agricultural Advisor to the Ford Foundation, Beirut, Lebanon.

A. B. Joshi, Ph.D., obtained his doctorate in genetics from Cambridge University, England, and has served the Government of India as agricultural researcher and administrator for 32 years. Since 1966 he has been Deputy Director General of the Indian Council of Agricultural Research (ICAR). During 1970-71 he was FAO advisor on research to the government of the U.A.R.

Vernon Ruttan, PhD., agricultural economist, is presently Director of the Economic Development Center, University of Minnesota, St. Paul, Minnesota. Dr. Ruttan was formerly agricultural economist on the staff of the International Rice Research Institute, The Philippines, 1962-65.

Howard A. Steppler, Ph.D., is a Canadian geneticist, presently Professor of Agronomy for McDonald College, McGill University, Quebec. He is a consultant on agriculture to the Canadian International Development Agency.
28 April, 1972

Mr. Haldore Hanson
Director General
CIMMYT

Sir:

We respectfully submit the report and recommendations of the External Program Review Panel which has met from 24 - 28 April, 1972. May we tender our warmest thanks to you and the members of your staff for the courtesies and cooperation which have been extended to us.

Hassan A. El-Tobgy
A. B. Joshi
Vernon Ruttan
Howard A. Steppler
Introduction.

1. The CIMMYT External Review Panel was appointed by the Director General of CIMMYT. The Panel was charged with reviewing the research, outreach and related programs. It met in Mexico April 24-28. The first two days were devoted to a review of the wheat program at the Obregon station. The last three days were spent reviewing the maize and related programs at El Batán.

2. CIMMYT was established as an international institute with responsibility for research and training in wheat and maize in 1966. It evolved from an earlier cooperative program between the Rockefeller Foundation and the Government of Mexico. The evolution from a national program to an international center occurred primarily between 1963 and 1966. It was apparent to the panel, however, that the program, as it has evolved between 1966 and 1972 has continued to reflect both the strengths and limitations of its earlier history and commitments. This transition is expected to be essentially complete within the next several years.

3. In examining the program the panel has worked within the general framework of the scope of CIMMYT and its mandate. Thus we recognize that CIMMYT is the only International Institute with wheat as its mandate while three institutes have maize. The success of CIMMYT has placed a very heavy burden on it in terms of its outreach program and not the least in terms of the number of visitors to CIMMYT.

4. There is a continuing problem of maintaining viability in the program, solving the problem associated with the research and yet not growing beyond the terms of its mandate and its competence. No centre can be all things to all people; the most difficult decision which faces the staff is when to say No.
THE WHEAT PROGRAM

5. At present there are three crops featured in this program, namely bread wheat, durum wheat and triticale with a fourth barley under serious consideration. Each of these will be treated separately.

Bread wheats

6. The bread wheat program started in 1944 so that there had been 22 years work i.e. 1944-66 completed when CIMMYT was formed in 1966. The program has been most fortunate in having continuous direction by the same individual, Dr. Borlaug, from inception to date. The program demonstrated its success first in 1956 when Mexico went into a surplus position on wheat production and again in 1962 when the dwarf wheats were released and moved for testing into many developing areas where they achieved notable success. There are probably many factors which have led to this success, the continuity of direction, the clarity of breeding objective, the recognition of the need for an improved technology to accompany the new germplasm, and the training program. The program has been equally successful since 1966, especially in the area of training and outreach.

7. We are much impressed by the success in incorporating disease resistance and the newer dwarfing genes into the bread wheats. This has added greatly to the stability of yield even though it has not led to appreciable increases in yield potential.

8. It is only in the past two years that plant physiology per se has become a part of the program albeit that agronomy and the need for management practices has long been recognized. The statement was made that the average yield of cross No. 8156 has not been significantly exceeded in the past five years. Does this suggest that a yield plateau - in the experimental fields - has been reached? Is this a plateau representing the potential of the species or one imposed by the present selection techniques? Dr. Fischer indicated that the pattern of yield in the Yaqui valley was:

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<th>Description</th>
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<tr>
<td>10 year average prior to 1962</td>
<td>1.5</td>
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<tr>
<td>Average yield now (1971)</td>
<td>4.0</td>
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<tr>
<td>Best agricultural practices (1971)</td>
<td>8.0</td>
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<td>Best research practices 1971</td>
<td>11.0</td>
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9. This would suggest that the plateau is probably imposed by selection technique and that new avenues of attack must be developed in order to move off the present plateau. It is our opinion that these new approaches will be found through the research in crop physiology.

10. There appears to be a wide range of plant types available in the present population - both in relation to plant structure and disease resistance. It is not clear whether this exists for insect resistance. However it is becoming increasingly evident in certain areas in the Middle East that insect damage presents a serious problem.

11. There has been little if any success in improving the quality of wheat, in fact it would appear to be quite stable in this characteristic. In this sense one could say that the wheat program has failed to meet a part of CIMMYT's mandate which as stated is "to improve the quantity and quality of maize and wheat --". While this is no doubt a disappointment, it pales when one recognizes the very great success in "quantity".

12. Considerable stress has been placed on training in the wheat program. It has been strongly oriented to field training to put to use academic learning in a production oriented research program. The success in moving wheat into developing countries through the outreach program has no doubt come from the presence of former trainees in those countries. Dr. Borlaug stressed the need for more trained personnel in the developing countries. In this we completely agree and further feel that this may be the most lasting international benefit of CIMMYT

13. There are increasing demands on CIMMYT to extend its outreach program. While these are funded outside of the core budget they do place an increasing demand on research staff. It is a moot question whether there should be developed a regional aspect with a person serving a group of countries of similar eclogy, and stationed in one of the countries where he has an ongoing program. It is recognized that such a person maintains his credibility only as long as he maintains his active participation in a program.

14. Recommendations on bread wheats:

   (1) We commend CIMMYT on the action already taken to add crop physiology to the wheat program, and recommend that even more emphasis be given in order to develop the new selection criteria and techniques.

   (2) There seems to be a considerable body of information available on wheat physiology but the key personnel have not been brought together. We would strongly urge
that a workshop of wheat physiologists with a few other specialists e.g. a "carbohydrate sink" specialist, be held at an early date.

(3) We recommend that a continued emphasis be placed on the training program.

(4) We recommend that the operations of the outreach program be examined with a view to the possible establishment of "regional" operations.

**Durum wheat**

15. This program is relatively new, having begun in 1968. The field success to-date is most impressive with an obvious spin off to durum from both the materials and techniques used with the bread wheat. We have every reason to believe CIMMYT's projection that within five years very important new advances will be made with the durums in the developing countries.

16. There is an intimate relationship between the durum program and the triticale program in that it produces new parental stocks for triticale.

17. **Recommendation on durum wheat:**

(1) That the durum program continue at its present level and objective. The program should be prepared to utilize any technique arising from the bread wheat physiology when applicable.

**Triticale**

18. CIMMYT started a limited program on triticale in 1964. In 1968 the first major break in triticale came when highly fertile plants were discovered in $F_4$ segregating lines. This fertility has now been transferred to many populations. At the same time, dwarfing has been introduced, disease resistance has been introduced and day length insensitivity has been achieved. Further, many lines with superior biological quality have been identified and the antimetabolic element has been eliminated from many populations.

19. Biological evaluation with voles and chicks have shown remarkable nutritional quality - exceeding conventional grains - in some of the breeding populations.
20. There is still however one characteristic missing from triticale which would make it a fully acceptable "crop". The breeders have not yet overcome the shrivelled grain. While it is obviously desirable to have a grain which has "good" appearance, and this would no doubt make it more acceptable in the market place, there is nevertheless a question whether the lack of plumpness makes it less useful nutritionally and especially as an animal feed. There would therefore seem to be justification to put into production a line or lines of triticale for feed purposes when they have shown nutritional superiority and are equal in yield to wheat or the other grains grown within the area in which they are likely to be used. At the same time a considerable effort should be made to overcome the shrivelled grain problem. The possibility of doing this through the funds available to Canadian research institutions should be explored.

21. The projected staffing and phasing of such staffing for the program seems adequate to meet the needs of the program. We judge that there is no need to change this.

22. Recommendations on triticale:

(1) That a line or lines of triticale be put into production for feed grain production as soon as nutritional superiority has been proved and irrespective of the kernel characteristics. Such material must of course, be yield-competitive in the areas for which it is intended.

(2) That increased emphasis be placed on the search for desirable kernel characteristics and that ways be explored to do this with the funding for Canadian research institutions.

Barley

23. Prior to the establishment of CIMMYT the Rockefeller group conducted a barley improvement program in Mexico from 1952-1962. In 1972 a research program was re-initiated in barley - unfortunately the Panel did not have time to see the material at the CIANO station.

24. The Panel does not question the role that barley plays as a human food nor for the need for improvement. The new "hyproly" gene offers exciting possibilities in improving the nutritional value of barley as a human food.

25. The Panel is however concerned with the effect that such a program will have on the staff growth of CIMMYT or diverting resources from existing programs. In its view such a program will rapidly grow to a major endeavour and certainly well beyond a single man.
26. Recommendation on barley:

(1) The Panel does not support the development of a barley program at CIMMYT at this time.
The MAIZE Program:
Maize Research in Mexico by CIMMYT predecessors

27. For 23 years (1943-66) before CIMMYT was created as an international agency, scientists of the Government of Mexico and staff of the Rockefeller Foundation conducted joint research on maize in Mexico, and CIMMYT received the results of this work.

28. During the 23 years, the central thrust of maize research was on the development of hybrids suitable for Mexico. The work was successful in the research stations, but less successful when measured by farmer adoption. During 1947-66, more than 20 hybrids were released by the Mexican Government. The hybrids offered far higher yield potential (up to 8 metric tons per hectare) on farmer's fields, under adequate moisture and fertility, compared to the traditional, open-pollinated Mexican varieties. By 1966, the use of hybrids in Mexico had reached no more than 10% of the private maize fields, chiefly because of the lack of an effective production and distribution system for hybrid seed, and the unwillingness of many farmers to replace their seed each year, at relatively higher cost.

29. Maize Germ Plasm Bank. Among the most significant factors which have been responsible for the genetic improvement of maize not only in Mexico but also in many developing countries was the building up of extensive collections of maize races and varieties, as also of related wild species and genera, from the primary world centers of origin and diversity of this crop. A major part of this work was accomplished by CIMMYT predecessors. Today, CIMMYT's maize germ plasm bank contains more than 12,000 accessions from 47 countries. Current activities under the germ plasm bank programme include inventory, seed renewal and propagation of new accessions, seed storage on long-term basis under controlled conditions of temperature and humidity, and supply of seed for breeding programmes to more than 30 countries.

30. Objectives of the present maize program. The objectives of CIMMYT's maize improvement program are:

(1) To assist in the development of national and regional maize improvement programmes, and to supply technology for those programmes which will benefit the largest possible number of farmers, especially in developing countries.

(2) To increase the efficiency of maize yields, as measured by yield per land unit, and by reduction of production costs per measure of grain.

(3) To improve the nutritional quality of maize, especially in protein quality and quantity.
31. Improvement of the maize plant: CIMMYT has been seeking, since 1968, to improve the maize plant in open-pollinated varieties, along the following major lines:

(i) Reducing plant height and lowering the placement of ears.
(ii) Incorporating genetic resistance to the major diseases and pests.
(iii) Raising the protein quality by increasing the content of two essential amino acids (lysine and tryptophane).
(iv) Obtaining acceptable kernel type without losing protein quality or yield.

32. Genetic improvement of populations: As a result of basic genetical and plant breeding studies carried out in the U. S. A., India, Mexico and some other countries during the early 1960s, it became clear that it was possible to develop populations of maize, to yield levels comparable to those obtained from the best among the hybrids. In 1966 CIMMYT discontinued work on hybrids and devoted attention wholly to improving populations.

33. Breeding for improved protein quality: The discovery in 1963 that major nutritional differences associated with the genetic mutants, Opaque-2 and Floury-2, exist in maize, resulted in a proliferation of efforts to exploit them for developing populations with high nutritive value of the grain. However, the original hopes of an immediate breakthrough in this direction could not be readily achieved due to several defects -- unattractive kernel appearance, loss in kernel weight and hence lower yields, and susceptibility to ear rots -- associated with either mutant. During the past two years, genetic modifying factors have been discovered by CIMMYT and by maize breeders in some of the developing countries. This has enabled the CIMMYT breeders to develop five high-nutrition populations with a yield potential of about 5 1/2 metric tons per hectare without much loss in kernel weight. Feeding trials on animals are currently in progress, using the meadow vole, for evaluating the protein efficiency ratio in them. CIMMYT has developed, during the last three years, very good laboratory facilities for this type of work.

34. Cooperative studies of maize phylogeny: CIMMYT is participating in a cooperative study on the evolutionary origin of cultivated maize, largely from cytogenetic data. This is an interesting line of basic research.

35. Agronomy - Physiology research: The objective is to provide the plant breeders with quantitative information on physiological factors influencing grain yield and to indicate the most probable ways in which factors currently limiting yields can be overcome.

36. Plant Protection research: The maize entomology and pathology activities of CIMMYT have been integrated, since 1970, into the unified maize program. The activity is closely linked to the maize breeding
endeavour in order to incorporate resistance to the most wide-spread, economically-important insect pests and diseases affecting maize, into widely-adaptable populations. Facilities have been developed to produce, on mass-scale, populations of insect pests, and for creating artificial epidemics of diseases for this purpose.

Resources for CIMMYT maize programme

37. **Staff:** The staff assigned to CIMMYT's resident maize programme in 1972 includes 14.0 man-years of professional staff (Grades I-IV) and 608 man-years of other supporting staff. These include 1.5 man-years of professional staff and 22.3 man-years of supporting staff for Plan Puebla and a total of 2 man-years for professional staff and 5 man-years for supporting staff for training and Director's office. Future staff expansion envisaged includes a Deputy-Director of Maize Program and an Assistant Training Officer.

38. **Funds:** The total provision budgeted for the maize programme in 1972 stands at US $ 1,248,700. This includes the special Rockefeller Foundation grant (US $ 128,000) restricted to Plan Puebla and UNDP special quality protein maize. The provision seems adequate.

39. **Experiment Stations and Land:** The research programme operates at the headquarters (El Batán) and at 5 outstations representing altitude ranging from 30 m. to 2640 m. The land available for experimentation ranges from 5 to 45 hectares per station.

Some Constraints:

40. Intensive operation of materials in the field and laboratory at 6 stations, two crops per year, and also the need for extensive local and international travel puts a great pressure on the physical capabilities of the professional research staff and supporting staff.

41. There is a growing, and justifiable, feeling that tropical maize researchers of the 1950s and 1960s were unable to produce a dramatic breakthrough in maize yields comparable to those achieved in wheat and rice during the same period of time. This seems to have been due to:

(a) Frequent leadership changes in the CIMMYT maize staff,
(b) At its inception in 1966, CIMMYT had to start developing new facilities because the land and facilities of the pre-CIMMYT period were transferred to the national Mexican maize program.
(c) Paucity of field research and demonstration work by CIMMYT in Mexico to demonstrate to the farmers the yield potential of maize hybrids and varieties under rainfed conditions (in contrast, the new varieties of
wheat and rice attained high production levels because they were raised under irrigation).

d) Hybrids are more difficult to exploit in the field, especially in developing countries, than open-pollinated varieties, and they require the application of specialized seed production techniques.

42. Recommendations on maize:

(1) The newer approach in maize breeding, adopted by CIMMYT since 1966, namely the development of superior, short-plant-type population (as opposed to production of maize hybrids), is a step in the right direction, which is fully endorsed by the Panel.

(2) The outreach cooperative effort in research should be further intensified.

(3) Work on the development of high-quality protein varieties of Maize is progressing very well at the CIMMYT headquarters in Mexico. We recommend a more active support to this program in the cooperating countries.

(4) General dissemination of high-quality protein varieties to the farmers should await until the new varieties are developed and fully tested out on farmers'fields. Meanwhile, the material already developed needs to be tested on a modest scale to observe its effect on the nutrition of animals (swine, poultry, humans) in cooperation with private farmers and animal producers.

(5) The present staffing appears to be optimum. The few staff additions proposed are justifiable.

(6) For providing the high yield potential of the new "composite" varieties of maize, on the farmers' fields, under varying conditions of rainfall, field trials in selected farmers' fields should be carried out in Mexico in cooperation with the Mexican extension agency. These field demonstration-cum-research trials should lay special emphasis on fertilizer and other crop management practices for optimising maize yields under rainfed conditions. Lack of progress, so far, in this direction appears to have slowed down the field application of the new maize production technology.

(7) Far greater emphasis than before should be placed on training in maize improvement especially in view of the new CIMMYT approach to maize breeding, which seeks the development of populations combining superior yielding ability with tolerance to pests and diseases and nutritive value of the grain.

(8) CIMMYT's small sorghum testing program, which has been carried on for more than 15 years, seeking to develop sorghum varieties and populations suited to altitudes above 6000 feet.
should be maintained by CIMMYT for two more years, in order to preserve the germ plasm until the new sorghum institute now being organized in India, ICRISAT, has opportunity to establish its program, and decide what the future should be for high altitude sorghum work. The Panel understands that CIMMYT will ask a separate line item in its core budget for sorghum work during 1973-74, in order not to divert funds from maize research. The Panel endorses this action.
OUTREACH AND OTHER SPECIAL ACTIVITIES

43. International activities

CIMMYT's outreach program covers the international services it renders to wheat and maize growing countries. It includes the following approaches: 1) Consultations between CIMMYT's staff and individual governments, 2) International nursery trials, 3) Developing national staff capability, 4) Developing national cereal improvement campaigns as well as regional networks, 5) International workshops.

44. The outreach program has grown tremendously in size during the last few years. In 1972, CIMMYT has 23 resident staff members assigned to ten countries (other than Mexico) to help develop national cereal improvement programs. Several other countries use CIMMYT headquarters staff as consultants. It is estimated that CIMMYT staff in Mexico collectively spend approximately 24 man-months each year in consultations around the world. The international nursery trials in wheat and maize included 596 separate trials in 78 different countries in 1971. CIMMYT also assists in five 'regional networks' in maize improvement and one 'regional network' in wheat. This last one serves over 20 countries cooperating in the Near East Regional Wheat & Barley Improvement Program, in which FAO takes leadership. Each of these regional groupings has been holding international workshops to exchange information and plan future work in their own national programs. Two world-wide workshops are planned for the next two years, for wheat and maize improvement in the 1970's.

45. It has been the policy of CIMMYT, as established by its Trustees, that outreach activities conducted for the benefit of other countries be financed by individual special grants earmarked for that purpose and not be charged to core budget. This principle has led to a complicated pattern of financing and some international activities were routinely charged to the core budget. CIMMYT has never presented an overall budget of its outreach activities, but if such a picture were presented for 1972, it would have shown $2,151,578.00 in funds available for international activities, of which $1,623,414 are in special grants and $528,164 from the core budget (or roughly one fourth of the total outreach expenditures).

46. It must be pointed out that CIMMYT outreach program has made a tremendous impact in the countries in which it has been operating, not only by supplying them with new sources of germplasm and segregating material for their breeding programs and with new improved high yielding varieties for testing under their own environmental conditions and in training their manpower and building up their technical advice on starting wheat or maize production programs.
47. It must also be stressed that the picture of CIMMYT to the world at large, and to the wheat and maize growing countries in the developing areas in particular, is through its outreach activities and its success or failure in raising their productivity of these two major cereal crops. Otherwise CIMMYT would become a national institute for the region in which it was established, especially in view of the historical background which preceded the establishment of CIMMYT as an international center in 1966.

48. The Panel believes that the core and outreach programs of an international center are inseparable as one of them does not exist without the other. Hence, they should have the same source of funding. For the outreach program to be financed entirely by special grants, and should these for one reason or another be wanting, then the existence of the center itself becomes meaningless. The core program of the center would cease to be international and would become strictly national. Granted this is a hypothetical and highly improbable case, it helps to illuminate the issue. Ideally the core and outreach programs of any international center should be funded from the same source or sources.

49. In view of the changing status of CIMMYT and of its recognized leadership in the improvement of wheat and maize production in all developing nations of the world through its outreach program, it is advisable that a thorough study be made of the current policy of CIMMYT of financing the outreach program through individual special grants and not through the core budget. However, should the present policy continue, sufficient provision should be made in the core budget to fully take care of the special needs and requirements of other countries growing wheat and maize under environments different from those in Mexico. To cite some examples: breeding for resistance to several wheat diseases in North Africa, breeding durum wheats for the same area, and breeding hardy spring wheats or winter wheats for Turkey, Iran and Afghanistan. These three cases represent tremendous additions to the original CIMMYT wheat breeding program, as carried out at its headquarters, and they should therefore be adequately financed in the core budget.

50. Recommendations on international activities:

(1) That a thorough study be made of the current policy of CIMMYT for financing its outreach program primarily through individual special grants and not through the core budget.

(2) That all international centers should follow a uniform policy in financing their outreach activities. The question may be brought to the attention of the Consultative Group on International Agricultural Research.
51. The Plan Puebla (PP) which started in 1967, is a pilot project which aims to demonstrate a method for doubling maize production and yields within 5 years among small holders in the rainfed area of Puebla, Mexico, and to train young leaders for service in similar projects in Mexico and elsewhere.

52. CIMMYT is the responsible agency. The project is now expected to end as an experiment in December 1973, and hopefully to continue as a regular activity of the Mexican government. The total cost of the project for the seven years of the experiment is now estimated at $1.1 million furnished by the Rockefeller Foundation, the UNDP and CIMMYT's core budget. It is estimated that total direct and indirect costs to CIMMYT's core budget amount to some $355,000 during the period 1967-71.

53. Some of the benefits of PP can be estimated while others cannot. By 1971, the number of participating farmers reached 5,259 (out of 47,000 in the project area) and the area of participants involved 14,438 hectares (out of some 120,000 ha. of cropland in the project area). In the two first years, 1968 and 1969, there was an increase of 1.2 - 1.4 tons/hectare in the yield of maize of participants over that of others, but in the two successive years, 1970 and 1971, the increase dropped to 0.8 - 0.9 tons/hectare. This amounts to an increase of about 50% in the yield of the participants and falls short of the expected doubling of productivity within five years of the initiation of the project. It is also estimated that the increase in maize production for the whole project area has reached at least 9% by 1970, which is again far short of the expected doubled production.

54. However, irrespective of the achievements of the project and even if the expected goals are fully reached, it is the considered opinion of the Panel that the management of development projects of this nature falls outside the responsibility of an international research and training institute such as CIMMYT, except in a consultative manner. CIMMYT should be able to advise on the required improved technologies needed to upgrade maize production in the area selected for the project. It may also be called upon to make some evaluation studies of the project. But to be the agency responsible for the project is something else. This is the domain of the national program, with or without outside assistance from international or regional development agencies. Projects of this nature depend to a large extent on national policies with respect to availability and terms of credit and inputs to small holders as well as on the agricultural price policies of the government. To get international center, whose function is mainly research and training
on a world wide basis, involved into an activity of this nature is far bey-
ond its call of duty. CIMMYT now is crowded with responsibilities
towards fulfilling the needs of research and training of the other wheat
and maize growing countries. Yet it has furnished from its core budget
approximately one third of the total cost of the PP.

55. **Recommendations on Plan Puebla**:

That, except in an advisory capacity, CIMMYT should not get
involved in executing or managing any more developmental projects of
this nature anywhere, and that it should terminate its responsibility
for the Plan Puebla by the end of 1973 as intended.

**HIGH LYSINE MAIZE (UNDP special contract)**

56. On March 12, 1970 CIMMYT signed a contract with the UNDP
on the research, development and utilization of high lysine maize. The
UNDP grant to CIMMYT provides $1,543,000 over a period of 3 years
and the project is limited to Central and South America. The project
is divided into 3 distinct areas of activity, namely:

- **a)** genetic research and breeding to provide a range of maize
  populations high in lysine and nutritive value but also with improved
  yield and agronomic characteristics,

- **b)** chemical research and analytical service to provide analy-
  tical techniques for identifying single maize grains with high lysine
  and tryptophane content, and as an analytical service for breeders to help
  them in making their selections, and

- **c)** training and assistance in the initiation and operation of Nu-
  tritive Maize Production Programs (NMPP's).

57. The genetic and breeding program has so far demonstrated that
high yielding, vitrous quality grain maize with the Opaque-2 gene can be
produced for use in a wide range of environments and rapid progress is
being made for release of populations for testing and selection.

58. Techniques for the routine evaluation of populations (by ana-
lyzing small bulk samples) and segregating material (by the non-des-
tuctive analysis of the endosperm of single kernels) have been developed
and are already in use.

59. Five nutritive maize production projects have been initiated in
Mexico, Colombia, Peru and Honduras. Several other governments
have expressed their interest in similar projects.
60. Recommendations on High Lysine Maize:

(1) That the role of CIMMYT in the first two fields of activity under the UNDP project is clear-cut and we recommend that CIMMYT continue to work on these areas of this project, namely, a) genetic research and breeding and b) chemical research and analytical services.

(2) CIMMYT should seek renewal of funds for continuing the research, international testing, consulting, workshops, and training program but the production effort should confine itself to the recommendations under maize of this document (see paragraph 42, items 4 and 6). CIMMYT should not involve itself in NMPP's that are pilot type projects.

RESEARCH ON DELIVERY SYSTEMS

61. During the course of these discussions with staff and based on the experience of the Panel it has become clear to us that there is a great need to improve the "delivery systems" for new agricultural technology. This must be done in order that the farmers in the developing country will benefit. We also fully realize that in large measure this is a problem which is unique to each country. We also are of the opinion that this problem will arise in the other institutes, particularly IITA and CIAT. It is not fully clear to us what the role of international research would be in the development of such "delivery systems" although we are of the opinion that there could be identified an international research component. At the same time we are strongly of the opinion that CIMMYT should avoid involvement in the management of delivery systems since we believe that it would rapidly lead beyond the mandate of CIMMYT and result in a considerable increase in staff. We do, however, feel that it is entirely appropriate for CIMMYT to conduct research on the effectiveness of alternative delivery systems and to consult with national organizations on the improvement of systems for the delivery of the new technology to farmers.

62. Recommendations on Delivery Systems:

(1) That the Trustees of CIMMYT and the Director General urge the Consultative Group to undertake studies on how this problem may be attacked.

(2) That CIMMYT should be prepared to cooperate fully with such a research undertaking.
63. In many respects the wheat and maize programs operate as two commodity institutes linked by a set of supporting professional services and administrative services. The supporting professional services or program areas, include economics, biometrics, laboratories, library and communications.

Economics

64. The economics program was initiated only within the last year. It is anticipated that a second economist will be added to the staff within the next year. Three lines of activity have been initiated. The first has emphasized the interface between economics and agricultural technology, the economics of wheat and maize production, of farm organization and commodity marketing. This line of work has been carried out primarily with data generated by the Plan Puebla and in association with graduate students from the National University at Chapingo. A second area of agricultural research is focusing more broadly on the economic dimensions of the CIMMYT outreach program. A third area of activity has involved the addition of an economics component to the wheat and maize training programs.

65. It is clear that the limited resources available for an economics (or social science) program at CIMMYT imposes severe constraints on the choice of activities in the program. It seems clear that a major objective of the economics program must be to enable the leaders of the wheat and maize programs and the CIMMYT administration to correctly assess the economic significance of the technical and institutional constraints on the growth of wheat, maize and related commodities in the developing countries and regions. The program that has been initiated is clearly consistent with this objective. It is possible that somewhat higher priority might be given to a collaborative effort, with economists in other countries, to assess the policy implications of institutional constraints on the progress of wheat and maize production programs.

66. The panel commends the CIMMYT administration for taking the steps necessary to add economic competence to the staff. The step had been taken earlier at IRRI, IITA, and CIAT.

Biometrics and Computer Services

67. CIMMYT has not, at this time, developed a central capacity for statistical analyses and computational services. Individual staff members in both the wheat and maize program possess substantial competence in applied statistics. Steps are being taken to review the computer service requirements for managerial services and for analyzing the international Nurseries data.
Recommendations on Biometrics:

1. The review of computer service requirements at CIMMYT should not be delayed.

2. CIMMYT should proceed to assess the contribution which additional capacity in biometrics might make to other program areas, including its training program. The breeding methodology introduced first in the wheat program and later in the maize program suggests that dramatic increases in the efficiency of experimental design and method have been achieved, when evaluated against the overall objective of rapid identification of superior varieties. It is possible that a careful biometric interpretation of these innovations could contribute to their systematic development, to their interpretation in the training program, and to their diffusion to other breeding programs.

Laboratory Services

69. CIMMYT has developed a highly efficient central laboratory program that serves both the wheat and maize programs. It clearly has strong leadership. The panel has no specific suggestions in this area.

Library Services

70. As a result of the establishment of CIMMYT as an international institution and relocation at El Batán, CIMMYT lost convenient access to the library that had been built up in the old Office of Special Studies. "Office of Special Studies" was the name given by the Mexican Ministry of Agriculture to the cooperative program between the Ministry and the RF during 1943-60. The gap has been partially remedied by access to the National Agricultural Library at Chapingo. However the procedures remain time consuming and cumbersome.

71. Within the near future CIMMYT must decide:
(a) whether it will maintain at El Batán a small working library, or,
(b) whether it will attempt to become a documentation center for wheat and maize.

72. Recommendations on Library Services:

1. That CIMMYT engage the necessary staff and external consultation to arrive at a rational decision on this issue within the next year.

2. CIMMYT should also engage the necessary technical competence in the library field to work out a system to achieve efficient service from the National Agricultural Library at Chapingo.

Communications

73. The CIMMYT communications program is relatively well developed. Much of its activity has been devoted to the dissemination of technical information and to "image building" activities. The Panel suggests
that there be some reallocation of effort.

74. Recommendations on Communications:

(1) Part of the staff effort of the Communications unit should be devoted to relieving the visitor burden on senior staff and administration, while continuing the important educational effort involved in effectively servicing the interest of the numerous visitor categories.

(2) The panel supports the proposal for a CIMMYT newsletter devoted to the technical and scientific aspects of the program (an IRRI type newsletter).

(3) The Panel suggests that consideration be given to making the annual report a document of greater technical and scientific substance.

Training

75. The training program has expanded rapidly since 1966. Both the wheat and the corn programs appear to have evolved a highly efficient system of in-service training that avoids the limitations of departamental fragmentation and lack of relevance that characterizes many academic training programs. We referred to the training program in the sections on wheat and maize. Here we have several additional comments.

76. The panel commends the CIMMYT staff for the association that it has developed with the Post Graduate school at Chapingo and with institutions in other countries. A number of examples were presented which indicated the significant contribution to the CIMMYT program resulting from collaborative theses research. The panel believes that a training function represents a necessary condition for the continued professional viability of the CIMMYT research, training and outreach functions.

77. The Panel is deeply concerned with the approaching terminal date of present support for trainees in maize and wheat in Latin America by the Inter-American Development Bank and by the Rockefeller Foundation with respect to the wheat trainee program in the Mediterranean and Near East. We consider the training program to be a vital part of the international mandate for CIMMYT. This projected completion of present grants is serious for both maize and wheat since it is our opinion that both regional programs are probably near the point of take-off.

78. Recommendations on Training:

(1) The Panel recommends that the CIMMYT training officers
and program leaders give careful consideration to whether the objectives of the training program are not sacrificed, to some degree, to meeting the logistical needs of the CIMMYT breeding programs. The Panel also believes that the trainees should be exposed to more efficient data handling, storage and retrieval techniques even though such techniques may be beyond the capacity of many countries at the present time.

(2) The Panel recommends that the further strengthening of effective working relationship with institutions of higher education in Mexico, in other developing countries, and in the developed countries, should continue to be given high priority by CIMMYT staff and administration.

(3) That CIMMYT seek funding either by renewal or a new source to enable the programs described in paragraph 77 above to be carried for at least four additional years (i.e. wheat, maize training in Latin America, funded by EID; and wheat training in the Mediterranean and Near East Region, funded by Rockefeller Foundation).

COMMENT ON CIMMYT RESOURCES AND MANAGEMENT

79. There are several issues related to the development and management of CIMMYT resources on which the panel would like to express its concern.

Location of Staff and Facilities

80. The CIMMYT program is conducted at six locations in Mexico and in 78 different countries. None of the Mexican locations are convenient to the housing of a substantial number of the CIMMYT senior staff. It appears to the panel that the travel and related logistical problems resulting from the geographic dispersion of scientific effort imposes a heavy cost in terms of professional time to the Institute and a heavy personal burden on the families of CIMMYT staff.

81. The panel is not in a position to make specific recommendations with respect to the problems of a less diffuse geographic distribution of scientific effort. It does recommend that the staff and the administration carefully evaluate the cost-effectiveness of the present locations of activity in Mexico and in the testing and outreach activities. Particular care must be taken to evaluate the personal and professional costs involved before accepting additional commitments involving substantial
local or international travel.

Staff and Program Size

82. The Panel notes that both the CIMMYT administration and staff appear to share a perspective that the present budgeted core staff size is somewhere near its optimum size. There are presently 23 CIMMYT staff members working in national cereal production programs outside of Mexico. It appears to be the judgment of CIMMYT administration that the core staff, as presently budgeted, would be consistent with an outreach program approximately 50 percent larger than the present size by 1977.

83. The Panel notes, however, that the present staff size is well beyond the levels that might have been projected even a few years ago. It can also visualize continued pressure for expansion of both core and outreach staff beyond the levels presently contemplated. The Panel anticipates that the CIMMYT staff and administration will have to arrive at a more carefully considered consensus regarding the principles involved in research, training and outreach resource allocation if CIMMYT activities are to continue to result in the high pay-off or benefit-cost ratios that have characterized past activities.

Funding

84. The rapid growth of staff and program since 1966 has also been associated with a diversification of funding sources. Some of this funding has been of a relatively short term nature. Yet the productivity of a biological research program depends on substantial continuity of both personnel and program.

85. The Panel is concerned that some of the short term funding has been expensive in terms of administration resources devoted to the process of negotiating and of staff resources devoted to consultation and review. The Panel urges the CIMMYT administration to clarify with donors the implications of short term funding on program productivity, and to work toward a pattern of funding based on grants and contracts that are consistent with at least a 5-year planning horizon. The recommendation applies with the somewhat greater force to the core program than to the outreach activities.

Review Panels

86. This review panel is of the opinion that periodic review of the program and operation of a centre can be most useful. We would suggest that there are three such reviews which could operate.