

BOOK No. 5

*Agencia Item 3b:*

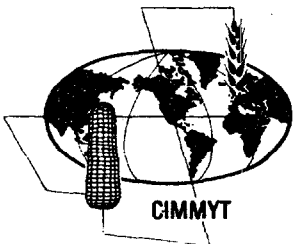
CIMMYT

A PROPOSED FIVE YEAR PLAN

1971 - 1975

PREPARED FOR BOARD MEETING HELD

SEPTEMBER 9-10, 1970



**CENTRO INTERNACIONAL DE MEJORAMIENTO DE MAIZ Y TRIGO**

**INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER**

**Mexico**

CIMMYT 1971-1975A PROPOSED FIVE-YEAR PLANI INTRODUCTION

Agricultural assistance to developing nations has been undergoing an evolutionary change since the initiation of the Rockefeller Program in Mexico in 1943. The rate of change, however, has increased dramatically during the past year or two and many interacting forces are now operating which will have a considerable influence on the future of the International Maize and Wheat Improvement Center (CIMMYT) and the other International Centers.

CIMMYT evolved from many years of cooperative effort between the Rockefeller Foundation and Governments of Mexico, Central America, Colombia, Ecuador, Chile - and more recently several other countries in the Near and Middle East - in the improvement of the quantity and quality of maize and wheat. CIMMYT was established in its present form on April 12, 1966, in accordance with Mexican laws, as an autonomous, non-profit, scientific and educational institution by Mexico's Ministry of Agriculture and the Rockefeller Foundation to be governed by an international Board of Directors. It was provided with the freedom necessary for operation of its worldwide programs, allowing receipt of funds from all agencies interested in advancing its goals.

Initial financing was provided by the Rockefeller and Ford Foundations, but more recently funds have been added by USAID, UNDP Special Fund, and the Inter-American Development Bank. Since 1966, there has been a steady increase in the responsibilities of CIMMYT and an expansion of its influence into new areas of the developing world. Further financial support will be needed if CIMMYT is to adequately fulfill its present international commitments.

II NEW FACTORS INFLUENCING CIMMYT

A number of factors are currently interacting to provide an exciting opportunity for CIMMYT to move forward in its task to increase the production of maize and wheat throughout the developing world.

Several of the factors influencing CIMMYT have stemmed from the tremendous success of its wheat program in the Near, Middle East and Asian areas, following its success in Mexico. West Pakistan has reached self-sufficiency, India is very close to being so, and a number of other countries in the Near and Middle East are approaching self-sufficiency. These dramatic examples from the CIMMYT wheat program led by Dr. N.E. Borlaug, along with similar successes in the IRRI rice program, have encouraged funding

organizations to review their contributions to improving world food production.

#### A. Changes in Pattern of Financing

Impressed with the tremendous benefit-cost ratio of the CIMMYT and IRRI programs, representatives of such organizations as the World Bank, the Area Aid Banks, UNDP, Rockefeller and Ford Foundations, USAID and a number of other country aid groups, met in Bellagio, Italy. The purpose of the meeting was to plan the funding and inputs to agricultural aid programs and to look specifically at the International Centers as organizations capable of stimulating greater and more efficient food production in the food deficit areas of the world.

The decisions reached by this group are fundamental to the future of the International Centers. They have agreed to search for ways to adequately finance the Centers. They are exploring methods which will enable other funding agencies to contribute to the cost of operation of the Centers and they are encouraging collaboration with the Centers as a means of coordinating and increasing the efficiency of international agricultural aid.

The level of financial support which eventually may be available through this group opens up possibilities for program development which previously would not have been possible. The Bellagio group will depend upon centers such as CIMMYT to help provide the leadership and necessary action to increase world food production.

#### B. Program Dynamics

Although the availability of funds is obviously an important factor concerning CIMMYT's future effectiveness, there are several other factors which currently are affecting the aims and method of operation of its programs.

##### 1. Expansion of Influence

Several changes affecting the scope of CIMMYT's programs have stemmed directly from the Bellagio meetings. In June, 1969, UNDP Special Fund directors were granted authority by their governing council to undertake joint research projects of a global nature with existing research organizations. Under this new charter, it initiated its first global research program. "Research and Training in the Development of High Lysine Maize" through a direct contract with CIMMYT, with advisory assistance from FAO. Previously, UNDP was able to provide funds only at the request of a member government, and the program could be implemented only through a U.N.

Agency such as FAO or UNESCO.

The contract calls for CIMMYT to carry out research into the genetics, breeding and chemistry of more nutritive maize varieties, and to initiate nutritive maize production programs in Latin American countries with the aim of raising the production of subsistence farmers. The training of teams of scientists from cooperating countries forms a significant part of the project. This project should greatly stimulate the more rapid development and utilization of high lysine maize in the Latin American region. Although the project is focused initially on Latin America, it will be extended to other areas of the world as soon as feasible.

In August 1970, the Inter-American Development Bank agreed to provide funds for CIMMYT to train 60 Latin American scientists as Production Agronomists. This contract further strengthens CIMMYT's wheat and maize programs in the Latin American region. It also provides extremely important opportunities for mutual cooperation. The efficiency of improving production in cooperating countries is greatly enhanced by CIMMYT providing the technical assistance and training of local scientists. The Bank, by providing funds for training and low cost loans to the country to implement the production programs, will help to ensure that funds and facilities are available for the trained scientists to carry out their roles effectively.

## 2. Changes to Existing Programs

Much of CIMMYT's international program in various areas of the world has been carried on as a collaborative effort with other agency programs. For example in India's wheat program financed by the Rockefeller Foundation, CIMMYT has provided technical guidance, breeding materials, information about production practices and training for Indian scientists. Similar cooperation has been supplied to the Accelerated Wheat Production Programs in Pakistan, financed by Ford Foundation, etc.

Arrangements currently are being made for CIMMYT to take over the direct responsibility for the technical direction of wheat and maize programs in some of these regional agricultural assistance programs. Negotiations are now under way for the staff of these cooperative programs to be directly assigned to CIMMYT, and for the funding of these programs to be channeled through CIMMYT for its administration at the international level.

Administration within the region will continue to be handled through the local office of the funding agencies. By this arrangement CIMMYT avoids the need to set up an expensive international network of administrative offices.

Several programs are already operating under this arrangement in the Near and Middle East, West Pakistan, Central America and the Caribbean and Argentina. Negotiations are proceeding for programs in South East Asia, India and Turkey.

The arrangements provide CIMMYT with a much better controlled and well integrated international organization with regard to technical program.

### 3. Inter-Center Cooperation

The development of the International Institute of Tropical Agriculture (IITA) in Nigeria, and the Centro Internacional de Agricultura Tropical (CIAT) in Colombia, have provided an excellent opportunity for collaboration, particularly to increase the production of maize in the areas serviced by these institutions.

Both of the new Centers have appointed a maize scientist and cooperative planning with CIMMYT maize personnel is under way.

### 4. New Program Emphasis

In order to make a quick and significant contribution to world food supplies, CIMMYT concentrated its initial programs mainly in regions adequately supplied with rainfall or irrigation water. In these areas, dramatic increases in food production have been obtained with inputs of new high yielding, widely adapted, disease resistant, fertilizer responsive, varieties and the application of new farming technology, including the efficient use of fertilizer and water.

In general, it has been the larger farmer with some capital to invest who has been able to benefit most from this new farming technology. In many areas, the small farmer also has benefitted, but many of the small farmers, particularly those on natural rainfall areas where moisture conditions are often highly variable, have not benefitted so directly by the so-called Green Revolution.

As part of its dynamic program policy, CIMMYT is placing more emphasis on the problems of the small farmer. The Puebla Project was a direct result of this decision. Within the project financed by UNDP for the research and training in the development of high lysine maize, the specific aim is to help the small peasant farmer in Latin America, who until now has benefitted little, if any, from the discoveries of new agricultural technology and who does not enter into the general economy of his country.

In CIMMYT's wheat program during the past two years, greater emphasis has been placed on raising levels of production in dry-land farming areas, particularly in North Africa. Here, also, the emphasis is shifting towards help for the small farmers, so they may benefit from new improved v

and technology. The research, administration and logistic support for this difficult task is being built into the forward planning of CIMMYT operations, in cooperation with local governments, the Ford Foundation, and USAID.

### 5. Fundamental Research and Advanced Training

The CIMMYT Directors have agreed that the research and training activities of the Center will continue to be production-oriented, and that the more fundamental aspects of research and higher level training will be carried out in collaboration with other organizations. Funding agencies, in line with the policy outlined at the Bellagio meetings, also are attempting to orient requests for research and training funds from universities and other organizations towards a cooperative effort with International Centers such as CIMMYT. The total effect of these policies is to provide a flexible, but realistic pattern of operation for CIMMYT concerning its research and training of agricultural leaders in collaborating countries.

Several agreements have been signed. For example, the Oregon State University has been granted funds by the Rockefeller Foundation to collaborate with CIMMYT and the Turkish government. The University will provide technical support to the Turkey Wheat Improvement Program and post-graduate training opportunities for young Turkish scientists.

Purdue University has received funds from USAID to carry out a maize breeding, physiology and biochemistry research program and to collaborate with CIMMYT in training personnel from developing countries in these research areas. An important feature of contracts such as these, is that training is a major feature. The need for scientists with a much higher level of academic training combined with practical training is becoming critical in many country programs as they begin to function successfully on their own.

This concept of cooperation with other organizations is providing an exciting opportunity for individuals, departments and organizations to become a meaningful part of an international program. By assisting other organizations to obtain funds to support collaborative programs, CIMMYT is performing a vital function from an international viewpoint. At the same time, it is providing essential "back-up" research and training capacity for its own program of operations. Universities cooperating with CIMMYT and working on problems and materials of international significance, are providing more comprehensive background for training of young overseas scientists and students. Projects are specifically oriented towards the problems these scientists will face when they return to their home country. Some of the graduate students undertake their thesis project in Mexico under the supervision of CIMMYT staff as another means of ensuring that their training will be properly oriented.

## GENERAL PLANS FOR 1971-1975

For present purposes, CIMMYT's programs and funding arrangements are subdivided into: A) The Resident Program, and B) The International Program. Although it is useful to subdivide the overall operation in this way, it should be understood that these two parts are completely interdependent in actual function as will be seen below.

### A. CIMMYT's RESIDENT PROGRAM

CIMMYT's Resident Program, as the name implies, is situated in the headquarters country of Mexico. It fulfills a number of central functions for the International Program.

1.- It produces the basic genetic materials which have the high yield potential, wide adaptability, fertilizer responsiveness, disease and insect resistance and nutritive quality capable of raising the productivity and quality of maize and wheat around the world.

2.- It investigates factors important in developing the package of production practices necessary to exploit the yield potential of the improved varieties. Much of this research is specific to the regions where the varieties will be grown and is most efficiently done in those regions.

3.- It provides in-service, research assistant, and post-doctoral training programs in a range of disciplines to improve the competence, drive and imagination of young scientists. Visiting politicians and government officials also are briefed on essential features of raising productivity levels.

4.- Finally, it provides the administrative headquarters for the total CIMMYT operations and the detailed administration for the Resident Program.

To more readily understand the functions, problems and future plans for the Resident Program, it can be divided further into four interacting units:

BOARD OF TRUSTEES

DIRECTOR GENERAL

GENERAL AND RESEARCH ADMINISTRATION

MAIZE  
PROGRAMS

SERVICE  
PROGRAMS

WHEAT  
PROGRAMS

Genetics  
Breeding  
Agronomy  
Physiology  
Entomology  
Pathology

Field Stations  
Quality Labs  
Soil and Plant Labs  
Nursery Program  
Communications  
Information

Genetics  
Breeding  
Agronomy  
Physiology  
Entomology  
Pathology

RESEARCH  
AND  
TRAINING

RESIDENT  
PROGRAMS

Personnel (Scientists, Trainees etc.)

Genetic Materials  
Information

PROGRAM AREAS

- a. LATIN AMERICAN
  - i) Central America & Caribbean
  - ii) Andean Zone (CIAT)
  - iii) South America
- b. AFRICAN
  - i) West Africa (IITA)
  - ii) East Africa
- c. NEAR & MIDDLE EAST
- d. INTER-ASIAN

INTERNATIONAL  
PROGRAMS

PROGRAM AREAS

- a. LATIN AMERICAN
  - i) Central America
  - ii) South America
- b. NEAR, MIDDLE EAST & ASIA
  - i) South Asia
  - ii) N. Africa & E. Med.
  - iii) Turkey & N.E. Med.
- c. EAST & SOUTH AFRICA



1. The Resident Maize Program
2. The Resident Wheat Program
3. The Resident Service Program
4. Administration

1. The Resident Maize Program

Maize originated in the tropics and subtropics of the Americas. For this reason, various agencies over the past 25 years have devoted a great deal of effort toward collecting, studying, improving and distributing maize from this region to all maize growing areas of the world. This program has had a very significant influence on world maize production.

Since its creation, CIMMYT, has strongly emphasized the further expansion of these activities and is fast becoming the center of a worldwide effort to raise maize production in food deficient areas.

A reappraisal of the maize program has been stimulated by some of the factors now influencing CIMMYT as mentioned above. Several basic improvements in the organization are now under way.

A fully integrated maize program has been created in which geneticists, breeders, pathologists, entomologists, agronomists, etc., work together toward well defined objectives. Similarly they cooperate with, and provide back up services for, the country and area projects of the international program.

The most important objectives are:

a) Maize populations with wider adaptability: Traditionally, maize has been considered a crop in which the varieties or populations have a relatively narrow range of adaptation to environmental conditions. This poses no great problems for breeders in a relatively uniform environmental area, but places real restrictions on the effective development of genetic material by an organization such as CIMMYT that has to consider a global range of environments.

If CIMMYT is to have a greater international influence on maize production, it must breed varieties which have high yield potential, fertilizer responsiveness, disease and insect resistance and high nutritive quality, as well as an ability to express these characteristics over a wide range of geographic and climatic conditions.

A number of composite populations have been developed which contain a wide array of available genetic variability. These populations serve as the basis for a selection program to be carried out at several test sites which have widely different environments, latitudes, altitudes and disease and insect problems.

An international maize adaptation nursery also has been initiated, which consists of 50 populations and hybrids from many different countries. This uniform nursery is currently being grown at 40 sites throughout the world. These experiments should: (1) provide valuable information about the range of adaptation of existing germ plasm, (2) provide a basis for measuring progress of the CIMMYT adaptation breeding project, and (3) highlight the factors which are important in breeding for wide adaptability.

b) Increasing yield potential: Research has been initiated to identify factors which may be limiting maize yields in wide range of environments. In this project, the breeders and production specialists are working closely with a physiologist and research agronomist to define the morphological and physiological factors which are interacting with the environmental and edaphic features under field conditions to produce high yields. This project is being supplemented by cooperative research in U.S. and Canadian Universities. High priority is being given to this research, as it is basic to further understanding and increasing yield potential.

c) Nutritional quality of maize: In 1963, scientists of Purdue University discovered that Opaque-2 mutant gene maize greatly enhanced the nutritional quality of the endosperm, due to increased amounts of the amino acids lysine and tryptophan in the proteins. Since that time, a great deal of research into the chemistry, genetics, breeding and nutrition of maize containing the Opaque-2 gene has been conducted in many countries.

In its resident research program, CIMMYT is giving very high priority to the incorporation of this gene into a wide range of maize populations. A collection of genetic materials containing the Opaque-2 gene have been obtained from other research programs for assessment of their performance in Mexico and at 17 sites in other countries. The best of these populations will be incorporated into the basic breeding populations of the CIMMYT maize program.

One of the major problems with the Opaque-2 gene is that it tends to produce floury, less dense kernels. In many areas there is a strong objection to the floury type maize. Considerable advances have been made, however, towards producing normal, hard-grain, types with improved lysine and tryptophan content. But further testing with animal feeding trials will be necessary to determine if these types are as nutritious biologically, as the floury types.

An expanded program of quality assessment of total protein and amino acid content of breeder's selections of maize is being handled in the CIMMYT quality laboratory.

The nutritive maize program is being financed largely with funds from UNDP.

d) Disease and insect resistance: Much of the selection for disease and insect resistance is carried out in the resident maize program. Special disease laboratories and greenhouses will be available at the new CIMMYT headquarters, but facilities for the rearing of large populations of insects pests must be developed to enable efficient field and laboratory testing for insect resistance to be undertaken.

Several important diseases and insect pests of maize do not occur in Mexico. Populations resistant to these will be selected in areas which are serviced by the international program where these diseases and pests are a problem. The continual interchange of germplasm between cooperators during the selection process will help to increase the width of adaptability of the populations and allow strong selection pressure to be applied for other yield limiting factors.

e) Increasing productivity on small farms: In 1967 in collaboration with the Graduate College, Chapingo, and with the help of a special grant from the Rockefeller Foundation, CIMMYT initiated the Puebla Project as an experiment to see if it was possible to bring together all the factors necessary to raise the productivity of smallland holdings. Many lessons have been learned and, in general, the experiment is proving very successful in the Puebla region.

As an additional function, the project now is being used as a training area for teams of scientists who learn the concepts and technology necessary to initiate similar or modified versions of the project in their own countries. Teams of scientists from Mexico and other countries have begun training at the Graduate School in Chapingo and within the Puebla Project, in a program financed by UNDP.

f) Training young maize scientists: Training of young scientists is one of the most important aspects of CIMMYT's maize program. It is recognized that without a strong scientific base from which to operate, food deficient countries will not be able to provide the scientific leadership and expertise to raise their level of production by the use of the necessary modern technology.

The highest possible priority will be granted to all categories of training. in-service research assistants, post-doctoral researchers, as post-graduate students working towards a degree either at a Mexican University or a University in some other country, will be provided with training in any aspect of the maize research program. The trainees will work closely in association with the staff to gain the maximum benefit from their period in Mexico.

Many more fellowships are required in all categories of training if the scientific services of food deficient nations are to be improved.

## 2. The Resident Wheat Program

This program consists of five main sections:

- a) The spring bread wheats
- b) The winter-hardy spring bread wheats
- c) The durum wheats
- d) The Triticales
- e) The training of young scientists

During the next five years, different emphasis will be given to each of these five sections of the wheat program.

### a) The Mexican Spring Bread Wheats

These wheats have been very successful in almost all parts of the world where they have been grown. They have shown an exceptionally wide range of adaptation at levels of yield previously not thought possible. They have revolutionized wheat production in many countries; there are few, if any, spring wheat growing areas of the world which have not been influenced by the genetic materials produced in the CIMMYT breeding program. To further exploit the potential of these materials, the following areas of research will be emphasized during the next five years.

Improving yield potential: The present initiation of an agronomic physiology oriented wheat production research program, is an attempt to raise the yield potential of wheat to still higher levels. In order to do this, a much better understanding is needed of the factors limiting yield in the present genotypes and environments. This work will be carried on in collaboration with outside universities and will need further personnel and equipment development. The use of post-doctoral and graduate student assistance will enable the project to be used for training purposes and to supply some of the needed research assistance.

Breeding wheat for rainfed conditions : Almost all of the work in Mexico on spring wheats has been carried out under irrigated, high fertility conditions. Although the varieties bred in this way have performed very well in other environments, even in rainfed conditions, a greater emphasis will be placed on the selection of varieties specifically for such environments. While most of the selection will be done in the international program areas where wheats are grown under natural rainfall conditions, the bulk of the crossing to produce the variable germ plasm necessary for selection, will still be conducted in Mexico where the expertise and broad range of genetic material is readily available. The worldwide distribution of genetic materials at various stages of development, ranging from bulk F<sub>2</sub>'s, F<sub>3</sub>-F<sub>7</sub> segregating selections, up to varietal selections and recommended commercially available varieties, will remain one of the main functions of the resident breeding program.

Greater emphasis on disease resistance: Mexican spring bread wheats have been known for their disease resistance in those areas where they were developed. However, as they have been grown in an increasing range of environments and locations around the world, their susceptibility to a variety of disease has caused concern in certain regions.

The identification of problem diseases and sources of resistance is carried out through the continuous interchange and testing of varieties and breeding material in more than 50 countries around the world. A range of resistance genes is being identified and incorporated into the germ plasm complex of the resident breeding program. This work will form a major part of the continuing spring wheat program and must be supplemented by a better source of identification and background knowledge of the distribution and epidemiology of the various diseases concerned. Projects within CIMMYT's International Program designed for this purpose will receive a high priority during the next five years.

Quality research: Increasing the yield and overall production of wheat was the first objective of CIMMYT's wheat program. In this initial phase nutritional or manufacturing quality of the grain received little or no attention. Now that yields have been greatly increased, more emphasis is being placed on the search for varieties with better nutritional and manufacturing quality. This will continue to be a research area of vital interest. The range of environments in which the wheat is grown and the social demands for different qualities of wheat require that the resident program maintain a strong quality breeding program in conjunction with the CIMMYT quality laboratory. Regional quality laboratories also are being set up in the major collaborating countries to supplement the work in Mexico and assist local scientists to select higher quality varieties in their own breeding programs.

Insect resistance: Until now, insect pests of spring wheat have not been a major problem within the CIMMYT program. However, now that the wheats are being grown in a much wide range of environments, a number of instances of very severe insect infestation have been noted. The problem of insect pests and the search for resistant varieties will be carried out initially with the help of entomologists from the maize program and in cooperation with other institutions. Should this problem continue to increase, a full-time entomologist may need to be added to the wheat program.

Discontinuing hybrid wheat research: For several years a hybrid wheat research project has been functioning within the wheat program. Good cytoplasmic, male-sterile, and fertility-restorer lines have been developed and sent to wheat scientists throughout the world. Even though this project has been progressing satisfactorily, it is now receiving lower priority and will be discontinued gradually.

This decision was made because the private seed industry is giving high priority to the research and development of hybrid wheat. More importantly, however, the complexity of seed production would preclude its use in the developing countries where seed production programs are usually very poor or non-existent.

#### b) The Winter-Hardy Spring Bread Wheats

There are a number of wheat deficient regions of the world where winter-hardy varieties are required to withstand the rigors of the local environment; for example, the Anatolian Plateau of Turkey; the higher areas of Iran and Afghanistan and South Central Chile, etc.

As this type of wheat cannot be selected easily in the Mexican program, a substation arrangement has been set up with the collaboration of the University of California at their Davis campus. Here Dr. J.A. Rupert, a CIMMYT wheat breeder, is producing a germ plasm complex by combining the desirable characteristics of winter and spring wheats. Winter-hardy selections are made at a number of test sites which have been chosen for their particular environmental conditions.

Although this program is conducted outside of Mexico and is funded by a special grant from the Rockefeller Foundation, it has been included logically in the Resident Wheat Program because of its role in developing germ plasm for use in wheat deficient areas.

Interchange of genetic material and information is proceeding continuously between this winter-hardy spring wheat program and other parts of the resident program in Mexico, and also with cooperating institutions and CIMMYT regional testing sites. The transfer of desirable features of winter wheats into the CIMMYT spring wheat germ plasm complex to further expand the range of genetic variability is essential, if varieties are to be

produced, adapted to a wider array of environments, and having still higher yields and quality. For these reasons, the winter-hardy spring wheat program will be given increasing emphasis during the next five years.

c) The CIMMYT durum wheat program is still in a relatively early stage of development, but already varieties which have outyielded the spring wheats in Mexico have been selected and they appear to have considerable potential for further development. The durum program is just beginning to expand in terms of international testing and the development of widely adapted lines. Diseases pose a problem in many areas and are likely to do so for some time. Quality, as yet, has not been adequately assessed in the new breeding lines.

The durum wheats which are so important to some parts of Africa, South America and other regions, require a considerable input of assistance from pathologists, agronomists and quality chemists to take their rightful place in world agriculture. The durum wheat breeding project will receive a high priority during the planned period.

d) The CIMMYT Triticale Program was initiated in collaboration with scientists from the Plant Science Department of the University of Manitoba. Although at a more primitive stage of development than the durums, the Triticales have an exciting potential. The initial problems of creating a man-made crop have been largely overcome. A great deal of breeding material with fully fertile heads, plump grains, disease resistance, short straw, lodging-resistance and other desirable characteristics now is available within the breeding program. At present, the problems are largely concerned with an orthodox breeding program to combine the various components required for a high yielding, high quality crop. However, a great deal more genetic variability also needs to be generated to ensure continued progress in the development of this exciting new crop plant.

The nutritive quality of many of the Triticale lines is very high, and could lead to the use of this crop as an animal and human food source of unusually high quality protein.

The Triticale program now is ready for large scale development. CIMMYT as an action Center whose responsibility also involves the imaginative catalyzing of new ideas into actual production practices, has the continued responsibility for developing new approaches to the question of food production. For this reason, funds will be sought to continue and expand the work already initiated on Triticales and Agropyron-Triticum crosses, and to develop new

wide cross species with potential for yield and quality. This area of the wheat program holds exciting prospects. Work done previously by CIMMYT leaves no doubt that considerable benefits may accrue from this type of production oriented research. Continued cooperation with fundamental research organizations in other parts of the world will be a feature of this expanded program.

e) The training of young scientists

Resident training programs: The training programs within the wheat section have continued to expand and improve. CIMMYT considers the training of young men for duty in agriculture within their own country as one of its top-priorities, recognizing that it is only through dedicated and imaginative people that any of the countries will achieve self-sufficiency in food production and self-respect in research potential.

The increased number of trainees being attached to the research personnel of the wheat program is placing a tremendous load on the staff. There is a real need for an expansion in training personnel who can absorb some of the load, but who will ensure that continuous contact with the research programs and personnel continues. Training, particularly in breeding, pathology, production agronomy, cereal chemistry and extension must continue in the future.

Regional training programs: The training of wheat specialists in all aspects from breeding through to final production at the farmer level, needs to be expanded within the International Program to supplement the work within Mexico. Particularly, there is a need for a training program under dryland rainfed conditions, as the irrigated research and production practices of Mexico do not provide an ideal environment for this type of training.

It is envisaged that the training program within Mexico may gradually become more strongly oriented towards "training the trainers" and that regional training programs, where language barriers are not present and where similarity of environments exist, should provide the basic training for production oriented programs for that region. It is essential however, that any training program should be encompassed within an active, successful and on-going research program, so that all phases of development in training can be accomplished.



### 3. Resident Service Programs

There are a number of areas of endeavour within the CIMMYT resident program which provide a service to both the maize and wheat resident and international programs. These include:

a) CIMMYT Field Stations. The expansion of CIMMYT's operations to a wide range of different environments throughout the world, has made it necessary to develop some new field stations in Mexico. Five main field stations have been strategically selected to provide the necessary environmental conditions for the breeding of maize and wheat for world-wide use, and for the research necessary to develop the production practices to exploit the high yield potential of the new varieties.

The Northwest Agricultural Research Center at Ciudad Obregon, in the State of Sonora which has provided excellent cooperation for many years was selected for continued collaborative research. The other four stations have been recently purchased by the Mexican Government for CIMMYT, or by CIMMYT itself. These stations, together with certain other facilities offered by the National Research Institute, provide CIMMYT with its basic operational facilities in Mexico for research and training.

Because the new field stations are only now beginning to function, and because they are so fundamental to CIMMYT's role in raising world maize and wheat production, their continued development will receive urgent priority until they are fully operational.

b) Research and Service Laboratories - are an essential feature of CIMMYT's programs in both maize and wheat.

The protein quality laboratory - will play an increasingly important research and service role as the maize and wheat programs place greater emphasis on the quality of the varieties produced. Training of laboratory technicians to staff regional quality laboratories and the development of simple, but effective analytical technology for their use, will also be an increasingly important function of the staff of the CIMMYT laboratory, as the International Programs expand and reach a stage of development requiring their own service laboratories.

The plant and soil analytical laboratory - has tended to be fairly specialized up until the present time, but with the initiation of research projects on production agronomy and physiology within both the maize and wheat programs, its role will broaden to increase the range of research and services provided. During the next year or two, training will also be provided by the staff of this laboratory.

Two new laboratories are planned to service the CIMMYT Maize and Wheat Programs.

Small animal nutrition laboratory: As already mentioned, increasing importance is being given by CIMMYT to the nutritional qualities of maize, wheat and Triticale. Cooperative research is proceeding with Mexican and U.S. institutions to obtain a better understanding of the nutritive quality of some of the CIMMYT breeding lines and varieties. Research results indicate that seed with a good amino acid balance within the protein, is not necessarily reflected by superior animal growth.

There is a very real need for a service laboratory within the CIMMYT resident program, which would assess nutritive quality by the routine testing of large numbers of samples of genetic materials by feeding trials with small animals. This service will be carried out in close association with, and under the direction of the staff of CIMMYT's protein quality laboratory.

Space has been planned for this laboratory in the new headquarters buildings, but the staff, equipment and operating expenses will be required soon.

Embryo culture laboratory: As part of the expansion of the Triticale and the Triticum-Agropyron gene pools and the initiation of other wide cross cereal programs, it is now opportune to exploit the fundamental research that has been developed in many laboratories around the world.

To handle adequately an enlarged Triticale program, CIMMYT requires a specialized small laboratory in which embryo culture, tissue culture, etc. can be carried out on a large scale to assist the breeders with their crosses and selections. Space is available for this laboratory but staff, equipment and operating expenses will be required.

c) The International Nursery Program: This service continues to handle the international interchange of increasing numbers of genetic samples in the form of uniform testing nurseries, segregating populations, or as selected breeders' lines. The interchange of data concerning the characteristics and performance of maize and wheat is increasing rapidly.

The present staff and organization is adequate for the present, but towards the end of the 5-year period, additional staff may be required if the program continues to expand. It is planned to use this program as part of the maize and wheat international activities for training post-doctoral scientists. Excellent experience for potential 'international staff' will be provided for post-doctoral scientists as they assist with the breeding of maize and wheat for world use. They then can supervise and study the performance of the new genetic materials in different countries.

d) Communications. CIMMYT's communications service handles written reports, research bulletins, news items, and has an audio visual section for the production of educational material. In cooperation with the Graduate College of Chapingo, training is provided in communication techniques. The CIMMYT library is administered within this service.

Expanding research, production and training program are requiring more supporting services in terms of publications, particularly in the training programs where special training publications have been little used.

Planning is underway to meet these expanded requirements to keep these needs in balance with the research and production programs.

e) Economics Office. CIMMYT's Directors have decided to set up an Economics Office as soon as funds can be obtained. The purpose of this program will be to determine the cost-benefit relationships of the various genetic materials and agronomic practices evolved by CIMMYT Scientists.

Studies will be made of these factors in different cooperating countries to assist the scientists and collaborators to better understand the likely impact of modifying traditional agricultural practices.

#### 4. Servicing the CIMMYT International Program

The resident program has another extremely important function to perform. Specialized staff within the resident research programs are required to provide a scientific service to the various international programs around the world.

Each of the country programs forming part of CIMMYT's international program will not require a full team of research and extension personnel to be supplied by CIMMYT. In many instances the services of a specialist such as a pathologist, entomologist, quality chemist, etc. will not be required on a full-time basis. These personnel should be available from CIMMYT headquarters, or from regional programs associated with CIMMYT, to travel and provide the expert services necessary.

Directors of programs and their associates also will be needed for consultation and direction of country projects, and to ensure that they are adequately integrated into the overall CIMMYT program. Further, they will be needed to advise and assist governments and government officials in the planning and operation of their country program to ensure satisfactory progress towards the planned production increases.

This is an area in which CIMMYT must be strengthened. The resident staff is barely adequate to handle the resident program.

CIMMYT plans to build up post-doctoral positions soon to provide greatly expanded training opportunities and also increase the research capacity of the resident program. This will allow the staff a greater flexibility and opportunity to provide consultation and assistance to the international program when required. Occasional contact with the area programs is necessary for all resident technical staff if they are to maintain a balanced perspective in their research.

## 5. Administration

The evolution of larger and more complex resident and international programs for both maize and wheat, has been accompanied by a greater complexity of funding. In turn this has generated a need for a system of general and research administration which will provide a simple, efficient and low cost framework for CIMMYT's worldwide operations.

### a) Resident Administration

The administrative headquarters are situated in Mexico and soon will be housed in a new building complex at El Batan, just outside Mexico City. Construction is due to be completed during the first half of 1971.

The overall responsibility for CIMMYT's operations rests with the Director General who reports to a Board of Trustees consisting of distinguished men of international reputation. A senior staff of administrative and research personnel directly supervise the efficient operation and maintenance of all financial, physical and human resources, together

with technical programs within the direct control of CIMMYT.

The association between CIMMYT and its financing and cooperating agencies is maintained through meetings of the Board of Trustees and Directors and by direct contact.

The goal of the general and research administration is to help the scientist in the field carry out his assigned task with maximum efficiency. The ability of the field scientist, to maintain flexibility and adapt to the changing conditions is basic to the whole concept of CIMMYT's mode of operation.

b) International Administration

To avoid setting up expensive regional administrative offices in all the countries serviced in the international program, arrangements are being made with donor organizations for the continued provision of administrative services through their country or regional offices.

B. CIMMYT INTERNATIONAL PROGRAMS

CIMMYT's international involvement in maize and wheat is already very extensive. There is a world-wide interchange of genetic materials, information and special assistance through collaborative programs, as well as through those operated directly by CIMMYT staff.

In planning a logical organization for the international program, the following concepts will continue as guiding principles:

The basic concept initially used by the Rockefeller Foundation "that we should help the cooperating countries help themselves".

"Every effort should be made to encourage countries to help each other and thus develop international cooperation and goodwill".

With these principles in mind, and appreciating the worldwide distribution of CIMMYT's involvement, it seems logical to plan that the international program should be loosely divided into coordinated areas according to geographical, ecological and ethnological criteria.

1. The Maize International Areas

a) Central and South American Areas

Because of the size of the area, the number of countries involved and the tremendous range in environments, this area is further subdivided into the following more manageable sub-areas:

Central America and the Caribbean; which at present is coordinated from CIMMYT headquarters, but which may require a coordinator to be stationed in the region in the near future.

Andean Zone of South America. This area will be coordinated by CIAT in Colombia in collaboration with CIMMYT.

South America (Southern cone). A large and ill-defined area at this stage, although recent funding from UNDP and IADB for CIMMYT to stimulate increased cereal production, primarily through training local scientists, is leading towards more formal program development.

#### b) African Area

West Africa. Mr. M.H. Harrison, the former CIMMYT maize coordinator for East Africa has been appointed to the staff of IITA and will now coordinate the maize programs of West Africa in collaboration with CIMMYT, International, British and French agencies.

East Africa. At present CIMMYT does not have any scientists stationed in this area, although genetic materials are still being supplied to continuing programs. Preliminary discussion with funding agencies are taking place to negotiate further direct CIMMYT participation in raising the production of this area.

#### c) Near and Middle East

Although it is not clearly defined at the moment, it is planned that countries in North Africa, Eastern Mediterranean, and Turkey might form a cooperative grouping, with a secondary sub-area of Afghanistan, Nepal and West Pakistan. All will eventually be covered by a coordinator stationed in a country where CIMMYT has scientific staff.

#### d) Inter-Asian Area

CIMMYT and the Rockefeller Foundation are negotiating so that the Inter-Asian Maize Program might come under CIMMYT's direct technical administration as part of the international maize program. This program would reach from Pakistan through Thailand, where the coordinator and associated CIMMYT scientists are stationed, through the Philippines to Indonesia.

## 2. The Wheat International Areas

CIMMYT is concentrating its main efforts in raising wheat production efficiency in three large regions of the world.

#### a) Latin American Area

Central America, including Mexico. Cooperative work will continue with the Mexican scientists to ensure continued improvement in wheat production.

South America. This has tremendous unexploited potential for wheat production. Several countries cooperate in different ways with CIMMYT, including Brazil, Argentina, Chile, Ecuador and Colombia. This area will be given a much higher priority for assistance in the next few years.

b) Near East, Middle East and Southern Asian Area

This very extensive area stretches from India in the East to Morocco in the West below the Mediterranean, and Turkey above the Mediterranean. Although there are sub-areas within the region, it has been, and will continue to be, coordinated as a large complex cooperative region.

The sub-areas planned are:

India, Pakistan and Afghanistan  
 North Africa and Eastern Mediterranean  
 Turkey and Northeastern Mediterranean

c) East and South Africa

Considerable amounts of genetic materials are being supplied to programs in countries such as Ethiopia, Sudan, Kenya, Rhodesia, South Africa, etc. Excellent cooperation with research scientists in these countries has contributed significantly to the selection and improvement of some of the CIMMYT wheats, and at the same time helped to raise productivity in the countries concerned.

Continuing collaboration is planned with scientists in this region.

3. Area Coordination

It is recognized that each country within an area is an individual unit with its own particular problems of agriculture production. Each, therefore, requires different types and levels of assistance. For this reason, CIMMYT plans to develop two categories of country programs within each major area of its international program.

a) Key Country Programs

These are country programs in which CIMMYT has, or plans to have, a group of one or more scientists resident in the country who work directly with counterparts in the local agricultural organization to provide technical assistance. CIMMYT also assists with the input of genetic materials and technical knowhow on developing production practices to exploit the yield potential of the new varieties; the identification of potential young scientists for training at different academic levels; and the provision of technical advice and assistance to other country programs in the area.

b) Associated Country Program

For these programs, CIMMYT provides technical assistance by shorter term appointment and/or visiting CIMMYT specialist; the input of necessary genetic materials; assistance with personnel training and general advice and guidance for increasing crop production.

c) Area Collaboration

The key country programs will provide the basis for an overall collaborative program for the area, as well as coordination between the area and the main CIMMYT program in Mexico and other areas.

For example, it is planned that Turkey will become a key country program. The main emphasis of this country program will be to assist the Turkish scientists in boosting the production of wheat in Turkey. However, because of the rather special range of environments existing in much of the wheat region of Turkey, CIMMYT plans to concentrate most of breeding and production of winter-hardy spring wheats in this program. This will tie directly with the CIMMYT program in Davis, California, and the collaborative program with Oregon State University. Together with the resident wheat program in Mexico, they will provide most of the basic genetic variability for testing and breeding purposes. The winter-hardy spring wheats that are selected will also be available for use in Iran, Afghanistan, Iraq, etc. and other associated country programs.

Although the local Turkish program would emphasize the winter-hardy spring wheats, also it will need to select durum wheat and spring bread wheats for local conditions. These may best be obtained by cooperative interchange with other key country programs in the area and with the central breeding program in Mexico.

The Middle East-North African area presently involves Lebanon, Tunisia, Morocco and may soon include Algeria also. Lebanon and Tunisia are concentrating their efforts on the production of dryland wheats of both the Aestivum and Durum types for the Mediterranean-type environment. The varieties and production practices evolved in these regions by CIMMYT scientists in collaboration with local scientists, also will be transferrable to other country programs in the region.

In the east, India and Pakistan are providing the main leadership for the production of the high yielding irrigated wheats in collaboration with the resident program in Mexico. Some of these wheats are now being used in other countries within the area.



An area coordinator will coordinate the country programs of the area, supervising the interchange of materials and the technical knowhow. He will interact with CIMMYT's scientists within the region and specialists from Mexico and other areas. Also he will encourage cooperation with other agencies within the area and provide assistance to them if this is to the benefit of the program as a whole.

An area coordinated program of this type with a small input of CIMMYT manpower, expertise and materials, not only helps countries to help themselves, but provides the means whereby they will help each other very significantly. Similarly, but on a wider scale, the individual area programs and their inter-linkage through CIMMYT headquarters, by the program directors, scientific specialists, breeding gene pool and the international nursery program become a network of collaboration. Each individual country will not only be increasing production, but will be interacting with all other collaborating nations and contribute to a truly collaborative international production program.

It should be stressed that much of this network of collaboration between the countries is already in operation and is one of the really outstanding accomplishments of the CIMMYT international program.

#### 4. CIMMYT Staff Mobility

The area program provides an opportunity for CIMMYT to have key personnel under its control within the area. This will have its main benefit in providing the mobility of staff who will be able to provide improved servicing for the associated country programs. CIMMYT headquarters in Mexico also will provide servicing by personnel in specialized fields such as production agronomy, pathology, entomology, cereal chemistry, etc.

#### 5. Pest Recording Network

A further advantage of the area programs is that they will provide a technical framework within which a network of disease and insect recording plots can be organized. These will be used to monitor the spread of diseases and insects and the changes in disease races. This information is essential if the breeders are to ensure rapid modification of varieties to combat the changing structure of the pest populations. Such a program has already been operating successfully in India by Dr. Eugene Saari of the Ford Foundation working in collaboration with the Rockefeller Foundation and CIMMYT. He has shown that this is practical and of extreme value to the country. To accelerate the inauguration of an area pest detection service in the Near and Middle East area, this program will be used to train pathologists from other countries of the area.

## 6. Germ Plasm Collection and Maintenance

Perhaps more than any other organization, CIMMYT has done more to displace local varieties and primitive cultivars of maize and wheat in their centers of genetic diversity. The spread of CIMMYT varieties, particularly wheat varieties, in the Near and Middle East has been dramatic and is progressing at an increasing rate.

The expanding CIMMYT maize and wheat programs require greater genetic diversity if they are to continue to produce varieties with higher yields, better quality, wider adaptability and improved resistance to pests and diseases. Much of the genetic variability for this purpose will be found in the wild cultivars, at present threatened with extinction by the culture of introduced CIMMYT varieties.

Appreciating the urgency of this problem, CIMMYT plans to take an increasingly active role to conserve valuable germ plasm. It is already working with FAO, IBP and the Rockefeller Foundation toward this goal.

## 7. International Meetings

The completion of the new headquarters buildings, near Mexico City will provide CIMMYT with a number of urgently needed facilities to enable it to function efficiently. For the first time since its inception, the CIMMYT resident technical staff will be housed as an integrated unit, including laboratory staff.

With adequate meeting and conference accommodation, CIMMYT plans to embark on a program of technical seminars of international importance for world food production. Staff appointments to organize and run these seminars and assist with publication of proceedings will be given priority.

It is planned to bring together the scientists employed by, or assigned to CIMMYT for annual area staff meetings and occasional international staff meetings. These meetings, which will also often include key cooperators, will be held at CIMMYT headquarters or in program areas of particular current interest.

## IV FINANCIAL REQUIREMENTS 1971-1975

CIMMYT receives two types of financial support: A. Core Support, and B. Restricted Grants and/or Contracts.

A. CORE SUPPORT

When CIMMYT was established in its present form in 1966, it received contributions of funds towards the general operating expenses of the Resident Program from the Ford and Rockefeller Foundations.

At the beginning of 1968, the two Foundations agreed that they would contribute equal amounts of funds and put a ceiling on the level of their general support, (at present \$750,000 each). They also decided to encourage other funding agencies to join them as partners in the financial support of CIMMYT's resident administrative and research programs.

The detailed 1971 budget B provided in this document, indicates that there is no potential for any expansion of the Resident Program in 1971. The research and administrative expenditures, allowing for minimal inflation and merit salary increases, will absorb all of the 'funds in sight' assuming a ceiling contribution of \$750,000 from each of the three general supporting agencies, the Ford and Rockefeller Foundations and USAID, plus the restricted grants from UNDP and IADB.

If CIMMYT is to carry out its planned program to support its present level of international activity, it should attract sufficient extra funds to finance detailed 1971 budget A as soon as possible, but preferably not later than January 1972.

Financial support from two more general supporting agencies would provide an opportunity for CIMMYT to move ahead as planned, and would also ensure sufficient funds until 1974, assuming the present ceiling of \$750,000 was maintained, (see figure on page 45 ).

B. RESTRICTED GRANTS AND/OR CONTRACTS

Grants and Contracts under this category of financing are provided for support of specific projects or parts of projects of either the Resident Programs or the International Programs.

The funds for each of CIMMYT's country or area programs are provided in this manner by a funding agency. Several specific projects within the Resident Program are also financed in this way. For example, the UNDP contract for "Research and Training in the Development of High Lysine Maize" and the Rockefeller Foundation special grant for the "Puebla Pilot Program", etc.

Although restricted grants and contracts lack the flexibility of the general support funds, some funding agencies are able to finance only specific types of projects. This category of financing provides them with an opportunity to participate in CIMMYT's operations.

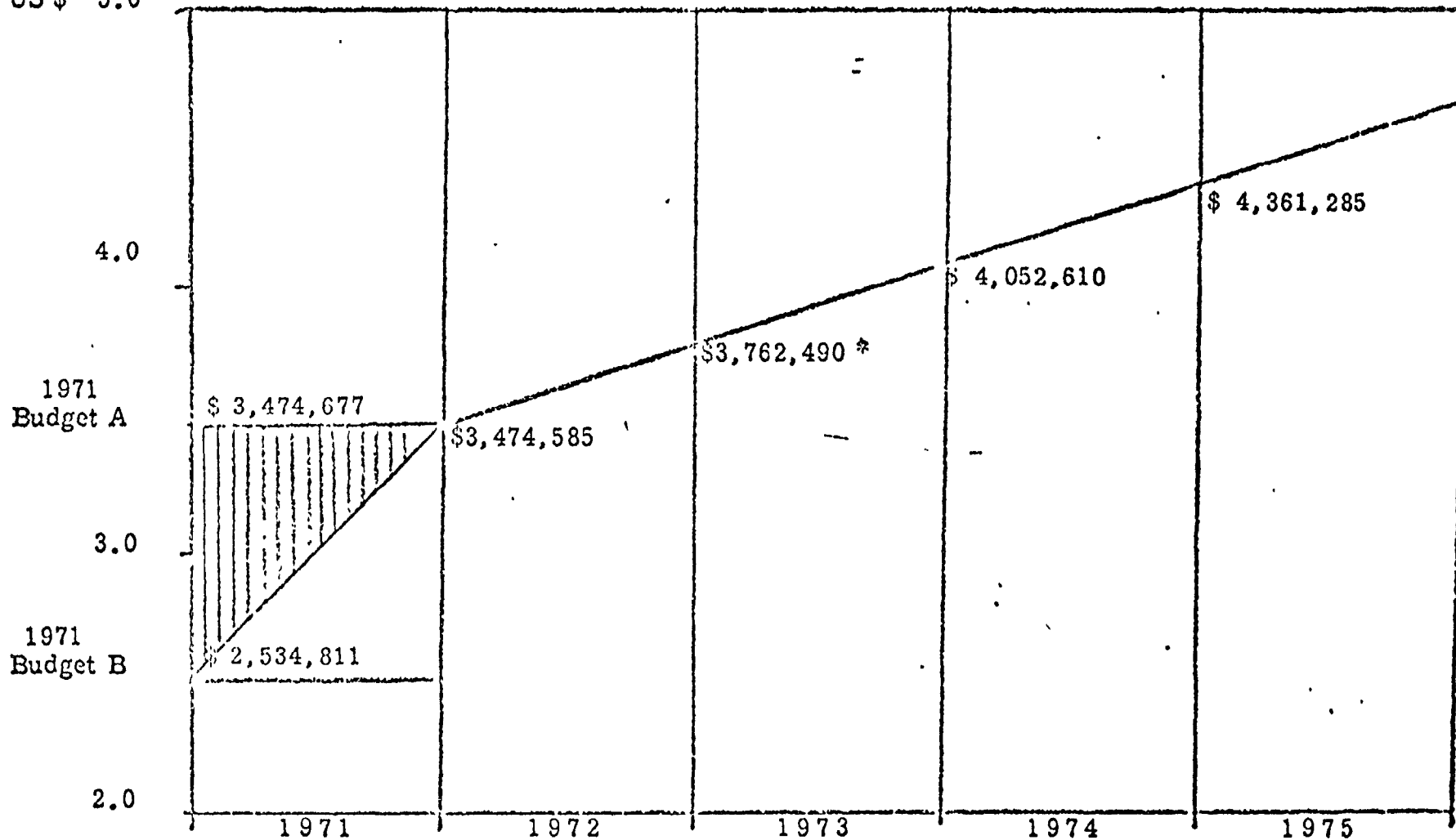
The present financial arrangements for the various country and area programs are satisfactory. Each is negotiated specifically to fulfill the needs of the program and renegotiations are usually possible after periodic review of progress. Any expansion of CIMMYT's International Programs will be considered in relation to the availability of adequate technical support from its Resident Program. All future international program contracts will include sufficient overhead charges to ensure that they do not become a financial burden on the Resident Program.

Given the funds to enable it to move ahead as planned, the staff of CIMMYT are confident that they can continue to make significant contributions to world food supplies and the goodwill of mankind.

CIMMYT 1971 - 1975

ESTIMATED CORE FINANCIAL REQUIREMENT

Millions  
US\$ 5.0



\* 1972 - 1975 Estimates include 7% increase plus one additional scientist per annum.