consultative group on international agricultural research
technical advisory committee





# report of the second external program review of the centro internacional de agricultura tropical (CIAT)



tac secretariat
OOD AND AGRICULTURE ORGANIZATION OF THE UNIITED NATIONS

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

# REPORT OF THE

# SECOND EXTERNAL PROGRAM REVIEW OF THE

# CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL

# (CIAT)



TAC SECRETARIAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

January 1985

This report comprises:

(a) Extract from "Main Conclusions Reached and Decisions Taken" CGIAR Meeting, 5 - 9 November 1984

(b) Transmittal Letter from TAC Chairman to CGIAR Chairman

(c) CIAT Response to the Report of the Second External Program Review

(d) TAC Commentary on the Second External Program Review of CIAT

(e) Transmittal Letter from Panel Chairman to TAC Chairman

(f) Report of the Second External Program Review of the Centro Internacional de Agricultura Tropical (CIAT)

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

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From: The Secretariat January 8, 1985

Consultative Group Meeting
November 5 - 9, 1984
Washington, D.C.

CIAT External Program and Management Reviews - Agenda Item 19 [1/]

The External Program Review

Dr. Fred Hutchinson, Chairman of the EPR Panel noted that all the recommendations of the 1977 Quinquennial Review had been implemented some time ago, save that for improvements in the distribution of responsibilities for cassava research between CIAT and IITA. However, the very recent CIAT/IITA cassava agreement was welcomed by the Panel. The impact of CIAT's rice research has been widespread and impressive, accounting for more than US$ 850 million increased annual production in Latin America. Forty varieties of beans have been released and new cassava varieties have been distributed to ten countries, but it is too early to assess their production impact. New pasture cultivars have been released and are beginning to be planted. The Seed Unit is unique and useful, and CIAT should explore the possibility of it becoming semi-autonomous to enable it to attract industrial funds and to prevent its non-research activities from interfering with CIAT's research programs. The training program receives high marks from the national programs and is much appreciated. CIAT's long term plan was characterized as a good one and well understood by the center. CIAT has made hard choices over the years, having closed down programs in swine and beef production, and small farm cropping systems and having moved from irrigated to upland rice. The Panel pointed out that the outreach program, a recent development, is heavily dependent on extra-core funding.

The cassava program is in a period of uncertainty because of questions about the long-term demand for cassava as a human food; cassava's long-term demand prospects as an animal feed need to be assessed before CIAT's future plans in cassava research can be finalized. Two major forces affect the market potential for cassava: (i) new production technology that may affect both costs and returns or production, and (ii) increasing external debt of some countries which may create new demand for indigenous products like cassava. CIAT will undertake a market study for cassava based on country-by-country studies using some outside help. CIAT will also collaborate with IFPRI

1/ Extract from "Main Conclusions Reached and Decisions Taken", Consultative Group Meeting, November 5 - 9, 1984, Washington, D.C.

in its studies of cassava and will continue to develop improved technology for cassava. The bean program was praised by the EPR Panel for attempting to develop low-input technology for resource-poor farmers, but the Panel cautioned that CIAT should place more emphasis in the future on increasing the yield potential of beans. CIAT envisages increased activities in Asia and Africa. Dr. Hutchinson closed by stating that it had been seven years since the last quinquennial review; he saw no evidence that the period was too long and suggested that review periods of perhaps 8 to 10 years might be suitable. As a result of the EPR, CIAT will now revise its long-term plan, which will be presented to the full Board in May, 1985.

Dr. Camus noted that TAC considered CIAT to be a very successful and productive Center that has made a strong effort to sharpen its program focus. CIAT's major quantifiable impact has been in irrigated rice but that of beans and tropical pastures is increasing. Impact in cassava has been less spectacular and difficult to quantify, for that reason TAC endorsed the Panel's recommendation that a study of the demand for cassava be undertaken to help guide CIAT in its future planning.

The discussion centered on several points: (i) the pending decentralization of CIAT in order to expand its outreach program was supported, although some speakers expressed concern about any efforts to move activities out of Latin America; (ii) the impact of the rice program was acknowledged and is clearly appreciated; (iii) some doubt was expressed by a few speakers concerning the recommendation to make the Seed Unit a semi-autonomous organization, one speaker called for a longer term look at the future role of the Seed Unit, including its role in research, training, and technical assistance; (iv) in general, the expanded bean program in Africa was supported. CIAT responded that decentralization does not include just the outposting of staff, but also includes using a breeding strategy that takes advantage of other locations where researchers can both contribute and benefit from shared responsibilities. CIAT is still learning how to handle decentralization, which complicates management. The Center is attempting to respond to these difficulties by: (i) stationing CIAT staff in strong national programs, (ii) making sure each outposted scientist is part of a scientific team at headquarters, and (iii) sharing administrative costs with other institutions, including other CG centers where possible. The Chairman of the Board of Trustees stated that EPRs and EMRs are held too frequently, and called for greater responsibility to be given to the Boards of Trustees in handling internal reviews.

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

**TECHNICAL ADVISORY COMMITTEE**

**The Chairman**

8 August 1984

Dear Mr. Husain,

I take pleasure in transmitting to you the report of the second External Program Review of CIAT which was conducted during February and March 1984.

The Review Panel was chaired by Dr. F.E.Hutchinson, who presented the report to TAC at its 34th meeting in June 1984 at Addis Ababa, in the presence of Dr. R. Hertford, Chairman of the Board of Trustees, and Dr. J.L. Nickel, Director-General of CIAT.

TAC discussed the report in conjunction with the report of the External Management Review of CIAT. The Committee noted that the CIAT Board generally agreed with most of the recommendations of both Review Panels and planned to take early action on their implementation.

On the basis of its discussions, TAC prepared a commentary which summarizes its conclusions, comments and recommendations. This commentary together with CIAT's response to the review is attached to the report.

I would like to underline here that CIAT emerges from the Review process as a well balanced and very successful Center. This is largely due to the fact that CIAT, originally conceived as a tropical lowland Regional Center with a strong animal production component, stands out in the effort it has made over the last decade, and continues to make, in sharpening the focus and operational definition of its mandate. The Center has indeed established an effective process for a continuing review of its strategies and priorities.

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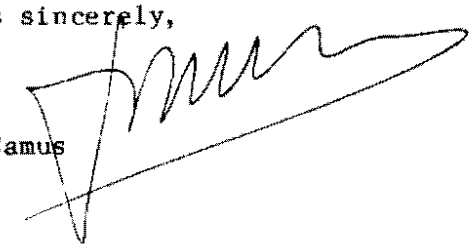
I would also wish to underline the Review Panel's conclusion concerning the impact of the improved technologies developed by CIAT. The technology with the greatest quantifiable impact is irrigated rice, and that of beans and pastures is steadily increasing.

Despite spectacular advances made by the Cassava Program, the impact of the improved cassava technologies has been more difficult to quantify because this crop is grown primarily by subsistence farmers and has not benefitted so far from strong support of many governments in Latin America. The situation is however quite different in Asia and Africa. The Panel has suggested and TAC and CIAT have agreed that a demand study for cassava be made worldwide to guide CIAT's research activities and resource allocations. It should also be noted that TAC is pleased with the prompt and effective manner in which CIAT and IITA have improved their collaborative agreement on cassava research.

These and other aspects which TAC wishes to draw to the attention of the Group are elaborated in TAC's Commentary.

Yours sincerely,



Guy Camus

# CIAT RESPONSE TO THE REPORT OF SECOND EXTERNAL PROGRAM REVIEW

CIAT welcomes the constructive and useful advice and recommendations it received from the External Program Review Panel. The clearly stated recommendations and suggestions by the Panel reflect perceptiveness of the problem context and constitute clear guiding points for the research and international cooperation strategy of the Center. CIAT is pleased that the Panel, after an exhaustive review, was in a position to fully endorse the basic objectives, strategies, and approaches of the commodity research programs, and to eloquently attest to the solid achievements in research and international cooperation which have been realized since the first External Review. CIAT generally agrees with the recommendations and suggestions made by the Panel. To a large measure, the recommendations coincide with CIAT's own appraisal of adjustments that are necessary at the present stage of development, and thus sees in the recommendations by the Panel a confirmation and endorsement of CIAT's evolving strategies. The Panel also reviewed the CIAT Long-Range Plan of 1981 and an updated version of projections which was made available during the Review. The Panel strongly endorsed the Plan and concurred with the overall strategies and projections of resource requirements to the end of the decade. The Panel was complimentary of the realistic projections which the Center has made in the light of expected reduced growth in resource availability.

A detailed point-by-point response to the suggestions and recommendations made by the Review Panel was presented to the TAC. A summary of the response to the most important points follows.

## BEAN PROGRAM

### General Assessment

The EPR has given strong support to the on-going research and international cooperation activities of the Bean Program and approves of the planned expansion into Africa. With respect to the overall progress of the program the EPR notes steady scientific progress and an increasing impact at the national level in terms of cultivar releases by network collaborators.

### Program Emphasis

The Panel endorses the Program objective of placing more emphasis on raising the yield potential of improved varieties and specifically recommends that a larger effort should be given to breeding for higher yield potential under higher inputs.

The strategy of the Bean Program which was defined and focused in 1974-75 has proved to be very effective. The initial focus of the Program on disease and insect resistance breeding was based on a realistic assessment of the biological constraints to increased productivity

in this crop, and the environmental conditions under which beans are mainly produced around the globe. Progress since Program aims were clarified has been significant. An effective network of bean scientists has been created in the Western Hemisphere and network development is underway in Africa. Cultivar release and farmer adoption is accelerating and national increases in productivity and production appear to be in evidence in some countries. Studies on adoption are underway in selected countries.

Progress made to date would suggest that the original strategy adopted was indeed correct. One of the spin-offs of increased resistance to biological constraints is a reduction of the riskiness of the crop which provides the basis for an increased readiness by some farmers to apply higher levels of purchased inputs, principally fertilizers and possibly insecticides, once disease incidence has been reduced.

CIAT considers that a significant shift of Program resources away from the present focus towards more stressful environments may not be of immediate benefit to the majority of small farmers, especially as the Program becomes more involved in Africa where bean production is almost totally concentrated within the small-farm sector and usually on impoverished soils prone to periodic water stress. Indications from work in the Bean Program suggest that germplasm selected under low inputs is also reasonably well adapted at higher levels of input and/or in stressful environments. On the other hand materials selected at high levels of inputs often perform quite poorly at low levels of inputs.

CIAT, in responding to this EPR recommendation, suggests that a move in this direction is justified for cultivars with particular seed type/growth habit combinations which are presently grown in more favored ecologies. Physiological research will continue to focus on the factors related to increasing yield potential through breeding in this species under favored production conditions. This research will concentrate on those plant types which could be expected to enter cropping systems where the level of constraints is lower and where chances of exploiting higher yield potential are greater.

On-Farm Research

The Panel expressed the view that greater clarity in the definition of the objectives of bean on-farm research would be welcome.

The principal objective of the on-farm research is to increase the efficiency of CIAT and national research efforts by feeding back information into the technology generation process about on-farm problems and the on-farm performance of network-developed germplasm. Due to the great diversity in the areas where beans are grown, CIAT alone cannot achieve this goal and neither should it try to do so. National programs necessarily have the primary responsibility to conduct on-farm research. Consequently, in order to obtain the needed feedback, CIAT must also be concerned about strengthening national capacity to implement effective on-farm research. To achieve this end, not only is CIAT involved in the adaptation of existing on-farm research methodologies for use by national programs, but also an exploratory

program has been developed for the training of national program personnel in on-farm research techniques, and for their preparation to participate in informal networks of on-farm researchers. The recommendation of a recent meeting at CIAT of a group of invited specialists in this field focused on the need for CIAT to be involved in on-farm research with a farming systems perspective mainly with the objective of developing national capacity in germplasm evaluation activities at farm-level. An implicit realization behind this recommendation was that farming systems research at the national level cannot be commodity-specific, and thus the need for a farming system perspective in CIAT activities. On-farm research in all CIAT programs is monitored by an internal committee of relevant biological and social scientists who advise the Director General on the appropriate role for CIAT within this general area of research.

Quarantine Issues

The Panel recommended that a solution be found as rapidly as possible to allow any necessary movement of seeds from high-risk to low-risk areas and from Africa in order to implement fully the Eastern African bean project.

Partial solutions to the problem of intercontinental quarantine between Africa and the Americas have been explored with respect to Phaseolus, and a modest program of germplasm collection transfer through third-country quarantine is being informally instituted with the United States Department of Agriculture (USDA) at Pullman, Washington. In addition smaller numbers of breeding lines will enter Colombia from Africa after prior quarantine in Prosser (Washington) in collaboration with Bean Cowpea/CRSP scientists. With respect to shipments from the Americas to Africa (i.e., under CIAT auspices), CIAT has developed a Seed Health Laboratory which will be monitoring all seed shipments of Phaseolus to ensure that, according to the best available knowledge, seed material is free of economically important diseases and pests. Highest priority will be given to those constraints which are present in the Americas but which are not of critical importance in Africa or in which there are doubts with respect to relative occurrence. In the meantime collaborative research projects with institutions in Europe are being developed to study halo blight race structure in the Americas and in Africa and to better define the interrelationships of the viral complexes between the two continents.

Continued efforts will be made to find a means of developing effective third-country quarantine arrangements in a European country to complement the initiatives in the USA. To date, due to limitations of funds for physical facilities at such institutions, no success has been achieved in this area and the issue probably deserves system-wide attention since other centers are faced with similar problems. The longer-term solution to the issue of quarantine in Colombia is related to the immediate need for bilateral assistance to the Colombian Government in order that the national quarantine services can be strengthened to handle the extra load imposed by the presence of CIAT in that country.

Filling of Vacant Positions

The Panel recommended that the physiology and microbiology positions be filled as soon as possible. The Center agrees with this recommendation; indeed, prior to the visit by the Panel CIAT had already begun very active recruitment which had been suspended for the past several years due to financial constraints. It should be pointed out, however, that these sections are not, at the present time, leaderless. The physiology position is currently filled by a visiting scientist; the microbiology position by a postdoctoral fellow.

## CASSAVA PROGRAM

General Assessment

The EPR has highlighted the excellent scientific progress which the Cassava Program has made against a background of almost complete neglect of this crop by the world scientific community prior to the creation of the programs at CIAT and IITA. It also suggested that additional, systematic information on the potential demand situation of cassava be compiled and that this information be used to define the nature and scope of the Cassava Program.

Cooperation with IITA

The Panel notes that progress towards improved CIAT-IITA collaboration has not been satisfactory and recommends that CIAT and IITA meet at an early date to redefine firm guidelines which reduce the risk of spreading diseases to an acceptable minimum.

The need for more effective IITA-CIAT collaboration in cassava has been recognized by CIAT and repeated and sincere attempts have been made to improve the level of inter-program ties. The issue of more adequate germplasm exchange between the two continents has been complicated, however, by the changing knowledge base, particularly with respect to virus-like diseases of cassava. One area in which CIAT has effectively collaborated with IITA is in the latter's present focus on biological control of insect pests in Africa. There are, however, a number of other areas in which effective collaboration has not been achieved. Both centers are now embarking on a dialog which should lead to a resolution of outstanding difficulties, particularly with respect to cassava germplasm under development at CIAT, which could have important implications for the highland areas of Eastern and Southern Africa. The dialog will also focus on other areas of collaboration, e.g., cassava documentation service at CIAT, and the contribution of information from Africa to particular cassava network publications which have an international focus. The aim of this dialog will be to develop a clearer set of guidelines on means by which CIAT can complement the lead role of IITA in Africa.

Potential Demand Studies

The Panel felt that future developments of the Cassava Program should be guided by information concerning the potential for the crop as a source of human food and animal feed, and recommended that arrangements be made with an appropriate independent institution to conduct, in collaboration with CIAT, the necessary studies as a basis for CIAT to decide the future scope of the Cassava Program. The concern of the Panel in making this recommendation appears to be not so much directed at the appropriateness of the CIAT research and outreach strategy in Latin America and Asia, but rather at the potential return that would accrue from CIAT investment in cassava research, particularly in terms of the resources being directed at Latin America.

Analyses of studies up to the present indicate that there are excellent possibilities for an increase in potential demand for cassava in particular countries in Asia and that circumstances have produced the appropriate climate to expand cassava production and diversify its utilization for national consumption. CIAT will continue its efforts in Asia with the limited resources available. In Latin America the issue is a strategic one of determining effective country plans for exploiting demand potential. Due to the diversity of possible end-uses and the different competing products in each country, separate studies are required on a country-by-country basis. CIAT has presented to TAC a summary of information on the demand situation of cassava in Asia and Latin America already compiled by CIAT economists and external agencies. In addition, CIAT has presented to TAC a plan of action by which the on-going demand research will be significantly accelerated. In the proposed studies the first step is to determine the demand potential for cassava or cassava-based products in each country. In countries with a proven demand potential a careful analysis of the competitiveness of cassava must be made. This will involve the estimation of the price at which cassava or cassava products can effectively compete, the agronomic potential of cassava by subregions and an estimation of production costs using available improved technology and its related costs. CIAT proposes to coordinate such studies utilizing its own unique expertise on cassava but relying on national programs and outside institutions to reinforce its efforts and to independently evaluate the results. Thus IFPRI will be consulted on the possibility of that institution to pay special attention to world markets, the demand for animal feed products in general and, if appropriate, the present and potential cassava situation in Africa. In addition, the Stanford Food Research Institute will be consulted on the possibility of their carrying out a portion of the work and to critically evaluate the results of all the studies.

CIAT proposes to continue present collaborative efforts with national programs to develop strategies on integrated production, processing and marketing in those Latin American and Caribbean countries where studies have clearly identified the future potential of cassava. CIAT regards these limited efforts as an integral part of the studies to precisely define the future potential of cassava and how it can be realized. Consequently it plans to reallocate existing resources within the program so that these studies can be effectively carried out.

In response to the EPR recommendation not to add to core-funded positions while the studies are under way, CIAT has deleted the additional cassava position for a utilization specialist which was previously in the 1985 Forward List. With regard to the projected Liaison Scientist in Asia to be stationed in Thailand, CIAT-- based on the economic studies already completed which show significant potential pay-off for an enhanced CIAT involvement in Asia--proposes to maintain this position in the Forward List so as to assist in the realization of this cassava potential in Asia.

## RICE PROGRAM

### General Assessment

The EPR Report is highly complimentary with respect to the regional progress which has been achieved by the Rice Program at CIAT in collaboration with national programs and IRRI, as evidenced by the significant impact of the new technology on national production of most rice growing countries in Latin America.

### Staffing Priorities

The Panel recommends that a higher priority be given to the establishment of a third core-funded breeding position. The activities of the position would focus on the well-watered, acid-savanna ecosystems--which are presently underutilized in the Western Hemisphere--for rice production. These areas constitute an important potential area for development in order that production can keep pace with the expected growth in demand in the tropical countries of the region.

CIAT had not projected this position in the 1981 version of the Long-Range Plan but it was included as a projected position in the 'optimum' category in the revision of the Long-Range Plan which was presented to the EPR Panel. The EPR recommendation, in effect, places higher priority on this third breeding position than on the projected Economics position in the Program.

In response to another EPR recommendation, CIAT considers it advisable to create a new position of full-time program coordinator for the Rice Program as soon as possible. The present incumbent of the part-time coordinator position is a breeder. The creation of a new full-time position for the coordinator would liberate the breeder position, thus allowing for the recruitment of another full-time breeder for the program. CIAT considers that two full-time breeders would be sufficient to cover the mandate of the program in the Western Hemisphere, at least in the short- to medium-term. In consideration of a longer-term need for a third breeder in the program CIAT intends to maintain the present projections for this position in the 'optimum' category and to project a position for an agricultural economist as a higher priority. This position is considered to be of critical importance in defining future program research strategies on a country and ecosystem basis.

## CIAT-IRRI-EMBRAPA Liaison

The Panel recommends that the requested extra-core CIAT-IRRI-EMBRAPA liaison scientist position be established as soon as possible so as to strengthen the collaboration between CIAT and IRRI on both upland and irrigated rice in Brazil, Latin America's largest rice growing nation.

CIAT endorses the recommendation of the Panel, and fully supports the view of the Panel that the specific focus of the work of the scientist should be related to the "varzeas" areas of Brazil. Obviously this latter recommendation will need to be considered in the light of the priorities of the Brazilian government and EMBRAPA.

## Southern Cone of South America

Regarding the requested outposted core breeding position for the Southern Cone subtropics, the Panel recommends that instead CIAT, through consultations and visits, provide technical assistance on agronomic practices, and, in conjunction with IRTP, accelerate efforts to integrate cold-tolerant, North American germplasm into breeding efforts in the Southern Cone.

CIAT endorses the intention of the recommendation of the EPR in relation to the rice ecologies in the Southern Cone. Representatives of the rice research groups from these countries with more temperate ecologies have requested direct subregional involvement by CIAT in order to accelerate progress towards resolution of particular constraints in this subregion. The recommendation of the EPR provides at least a partial response to the needs of these countries.

# TROPICAL PASTURES PROGRAM

## General Assessmet

The Panel commented favorably on the strategy and organization of the Program in the light of the considerable restructuring of this program which has been instituted commencing in 1976. The Panel noted excellent scientific progress which has been achieved through a close and successful integration of a wide range of disciplines.

CIAT agrees with the recommendations and suggestions made by the EPR regarding the Program, and finds them well-founded and useful. CIAT wishes to make the following specific comments.

## Mandate

The Panel describes the mandate of the Tropical Pastures Program (as having principal responsibility for lowlands in humid and subhumid tropics with acid and infertile soils, but having specific responsibility for the American tropics) and suggests that, with relation to Africa, the mandate needs to be clarified with ILCA.

CIAT's interpretation of its mandate in Tropical Pastures is as described by the Panel and agrees with the Panel's recommendation that, with regard to Africa, this interpretation be discussed and clarified with ILCA. The present ILCA-CIAT agreement de facto recognizes ILCA's leading role in Africa, with CIAT playing a backstopping role, particularly in the provision to ILCA of germplasm adapted to acid and infertile soils in humid and subhumid lowland tropics. As ILCA further refines its priorities and strategies between and within ecological regions, the need might arise to further clarify and define the nature of the collaboration between the two institutions in Africa.

Germplasm Evaluation

The Panel recommends that germplasm collection and characterization continue at approximately present levels, but decrease the evaluation and development studies in the Llanos, and that ICA be approached to join in the later stages of evaluation. The Panel recognizes that if both pasture agronomy and pasture development activities in the Llanos were eventually to be phased out, Carimagua would still be the major site for the Program. Also, the Panel recognizes that due to the differences in the Cerrado ecosystem, the Cerrado CPAC site should continue to be used for some initial evaluation studies, but expects that CIAT's role in later stages of evaluation at CPAC will gradually decrease.

CIAT agrees with this recommendation. It should be pointed out that while more national program involvement (ICA and EMBRAPA) in advanced evaluation at both sites is desirable, CIAT cannot expect national programs to carry out research which is of limited national interest but which is of high international importance. Thus CIAT envisages the need for a continued involvement in the more advanced stages of evaluation.

While the above relates to germplasm evaluation for the savanna ecosystems, CIAT notes that the Panel recommends that both the planned expansion into moderately acid and humid tropic environments go ahead, with one and two core-funded scientists, respectively. CIAT considers as highest priority the evaluation of material for the humid tropics to provide better adapted materials for this region, thereby helping to reverse the severe degradation of pastures in this ecosystem. These plans were already approved by the Board and TAC several years ago but were delayed because of budgetary constraints. CIAT has projected that this position in the humid tropics be filled in 1985, with the other two positions to be filled as soon as resources permit.

## SEED UNIT

General Assessment

The EPR Panel has given strong support to the concept of a Seed Unit at CIAT and to the activities in which the Unit has been engaged since its inception in 1979.

Outposted Staff

In response to the suggestion by the Panel regarding the need for outposted positions by the Seed Unit, CIAT considers that a careful evaluation will need to be made with respect to the role of such outposted positions. Should such an evaluation suggest that outposted positions are required, then a proposal will be presented to appropriate donors for special project funding. At this time it is not clear that such positions are appropriate to the present nature of the Unit.

Future Status of Seed Unit

The Panel recommends that a study be done to determine whether the Seed Unit would best fulfill its functions as part of the CIAT core budget or by becoming a semi-autonomous unit (or by a combination of these).

The Panel recommendation derives from the center-wide issue--which is raised in the case of the Seed Unit--of the inter-relationship of development-oriented activities to the more traditional role of the IARC's in research. CIAT has been concerned with this issue and welcomes the recommendation of the Panel to explore the possibility of a semi-autonomous status (as one alternative) for the Unit under overall CIAT patronage. CIAT will engage a consultant with knowledge of global seed-related activities in developing countries and an intimate knowledge of the CGIAR system. This consultant will evaluate the various alternative modes under which the Seed Unit could be continued at CIAT following the termination of the present SDC-funded project. This evaluation will necessarily need to take account of the implications for funding of such a Unit if it is to have some type of semi-autonomous status within the Center.

The various options derived from this study will then be presented to a small consultative meeting of appropriate donors, selected national programs, representatives from the CGIAR Secretariat, and at least one other IARC. This group will review the consultant's recommendations and prepare an appropriate response for consideration by CIAT Management and Board of Trustees. The Board of Trustees would then approve appropriate action for eventual consideration by TAC and the CGIAR.

## GENETIC RESOURCES

Head, Genetic Resources Unit

The Panel recommended that the position of Head of the Germplasm Resources Unit--which has been vacant for an extended period of time--be filled as soon as possible.

This position was previously filled by a germplasm specialist. When CIAT began recruiting after the position became vacant in May 1981 the Center came under severe budgetary constraints and the position was

cut and recruiting terminated. CIAT endorses the Panel recommendation to re-establish the position and will proceed to do so as soon as possible.

Seed Pathology

The recommendation of the EPR with respect to the establishment of a new position of seed pathologist will have to be seen against Center-wide priorities and the likelihood of further growth in resources allocated to the Center. Establishment of a Seed Health Laboratory within the Genetic Resources Unit was achieved in 1983 and the operation of this laboratory is now monitored by a committee of program pathologists who are, in turn, providing appropriate methodologies for use in routine screening of both seed and vegetative propagation material. A set of techniques is already in use and several additional ones are about to be implemented. In view of the restrictions on growth in Center activities CIAT considers that the above arrangements should suffice, at least in the short- to medium-term. Hence, no specific position of seed pathologist will be projected in the foreseeable future.

## RESEARCH MANAGEMENT

Organization

The Panel indicated that the division of responsibilities between the Director of Crops Research and of Resources Research and International Cooperation is not clearly delineated, and it recommended that CIAT Management reconsider the division of responsibilities assigned to these two positions.

Management has proposed, and the Board has approved, a redistribution of responsibilities between the two program directorates. One will have responsibilities for operational oversight and supervision of all activities of the Bean and Cassava Programs, along with center-wide responsibility for international relations with countries in Africa and Asia; the other will have responsibilities for operational oversight and supervision of all activities of the Rice and Tropical Pastures Programs, and center-wide international relations responsibilities for countries in Latin America and the Caribbean.

Publications

The EPR states that "considering the large amount of productive research being conducted at CIAT, the Panel finds the number of scientific publications to be disappointing," and encourages the staff to bring this part of their scientific activities into balance with the rest, and the administration to encourage staff more strongly in that regard.

CIAT recognizes the need for some increase in the output of research papers in refereed journals, in addition to the considerable attention presently being given to a wide range of CIAT-produced network and methodology publications which are considered to be of critical

importance as a means of scientific communication with fellow scientists in the commodity networks. Among the measures that have been taken or will be implemented to encourage more publication in refereed journals are the following: (a) the annual evaluation of senior staff now includes a reference to the volume and the appropriateness of the publication record of each scientist with respect to the Center's objectives, and (b) with the expected increase in sabbatic leaves it can be anticipated that staff may use this time to catch up on publications.

Central Scientific Unit

The Panel made a specific recommendation on the creation of a new unit to be comprised of germplasm resources management, tissue culture, virology, and applied microbiology.

CIAT considers that--at least for the time being--there are no compelling reasons and arguments for instituting a relatively large cross-commodity research unit composed of a set of rather diverse disciplines. Nevertheless, CIAT agrees that there is indeed merit in the concept of a small cross-commodity effort in the form of a research unit devoted to the emerging field of genetic engineering/biotechnology. Thus, CIAT proposes to follow the spirit of the EPR recommendation by creating a Biotechnology Research Unit along the following lines.

The Biotechnology Research Unit initially will consist of one senior researcher and support staff. The Unit will be charged with center-wide responsibility for all research in the general area of biotechnology. The Unit will act as an interface between CIAT scientists, particularly breeders, and advanced research institutions where new methodologies are becoming available which can be useful in the germplasm development process. The Unit will thus focus on all aspects of applied biotechnology which could be potentially valuable to CIAT and will not place emphasis on basic research. The creation of such a Unit will focus attention on the role of CIAT in this area of work and will allow CIAT to generate special projects and host graduate research students to augment the overall effort. The existing position of cell physiologist in the Genetic Resources Unit will be transferred to the Biotechnology Research Unit to head up that unit.

## TRAINING

The EPR found Training and Conferences at CIAT to be dynamic, well oriented and well executed. In the course of its review it found numerous instances of CIAT-trained personnel in national programs actively and successfully participating in the generation and diffusion of improved technologies for the production of the commodities in CIAT's mandate.

The Panel suggests that the demand for training of key extension and development specialists be met with short courses specifically planned for extension and development specialists. These courses should involve only minor participation of CIAT's senior staff, and a major participation

of the best national Latin American professionals in extension and development within CIAT's commodities.

CIAT shares the EPR concern for adequate training of extension and development personnel. However, it feels that rather than oganizing a separate course for such personnel at CIAT it is best to expand the two-fold approach which has already proved its effectiveness: 1) to assist national research institutions in the conduct of regional and in-country courses for extensionists and to make increased use of non-CIAT instructors selected from the pool of available professionals at the regional and local level; and 2) to include participation in research and production courses at the Center (mainly for researchers) a few selected extension leaders in order to help bridge research and extension by providing for interaction between these professionals. Such a mix of disciplines and professional backgrounds has proven to be highly effective in CIAT courses over the past seven years.

## COMMUNICATION/INFORMATION

The EPR is highly complimentary of the quantity, quality, and relevance of the CIAT-produced menage packages in support of the Center's technology generation and transfer activities, and in support of the commodity networks in which CIAT participates.

Among its specific observations, the Panel states that ideally, a permanent staff member should manage the audiotutorial effort.

CIAT agrees that educational materials are sufficiently important to merit a full-time, core-funded senior staff position. Under the current budget restrictions, however, a full-time visiting scientist with specialization in educational communication is preferable to part-time attention from a non-specialist staff member. Before a core-funded position can be added, its relative merits vis-a-vis other currently needed positions will have to be weighed.

The Panel also notes that the Communication and Information Support Unit (CISU) does not have an English or French editor, and suggests that CIAT study the possibility of immediately contracting an English editor.

The need for an English editor is accepted. CISU currently plans to meet that need by appointing an English editorial assistant and by seeking visiting editors to come from English-speaking countries on one- to two-year contracts. This plan has the advantage of leaving the much needed senior staff positions for more conceptual communication tasks that cross programs and publication types.

# INTERNATIONAL COOPERATION

## Relations with National Programs

Because CIAT has given, and continues to give, highest priority to developing and maintaining productive collegial relationships with the national programs it serves, the Center is particularly appreciative of the statement by the Panel that the relationships of CIAT with national programs in Latin America is uniformly excellent and that administrators and research scientists in the many countries visited by the Panel consistently expressed strong support for the value of their collaboration with the Center.

## Regional Activities

The Panel notes that because of budget reductions most of the outposting of staff has been accomplished with extra core funding. While the Panel accepts this as a short-term reality, it encourages CIAT to attempt to achieve a more proper balance between special project and core funding and activities in each region be, when possible, coordinated by outposted experienced core staff.

CIAT agrees that a proper balance between special project and core funding must be strived towards in relation to outposted staff. In fact, the Center has publicly enunciated what it considers to be a "proper" balance (see, for example, "CIAT's International Cooperation Strategy", dated 30 January 1984). Outposted Research Staff are placed outside of Colombia in those cases in which important, commodity-specific ecosystems are not adequately represented in Colombia. All such outposted research staff should, in principle, be core-funded. In regional cooperation projects, CIAT seeks to place one (or maximum two) core-funded permanent scientist(s) who is (are) to provide on-going liaison between CIAT and the respective commodity efforts in the region. These liaison scientists may need to be backed up by temporary regional research teams which are to provide necessary research input until the regionally available resources are fully organized to take over this responsibility. Such temporary regional teams should, in all cases, be special project funded. In bilateral projects, which are mounted at the request of individual countries or subregional research programs, all staff should be special project funded.

Due to budget funding shortfalls in recent years, several of the regional liaison scientist positions needed to be filled with special project funds. In its forward projections, and in accordance with the Panel's recommendations, CIAT is planning to move these positions into core, thereby implementing its long-standing policy on the financing of outposted staff.

18 May 1984
EPR-B

## TAC COMMENTARY ON THE SECOND EXTERNAL PROGRAM REVIEW OF CIAT

1. In transmitting the report of this Review to the CGIAR, TAC commends and thanks Drs. F.E. Hutchinson and O.M. Solandt and their colleagues on both the Program and Management Review Panels for their very thorough analysis and their excellent, clear and perceptive reports. At its 34th meeting TAC dicussed both Reviews with the Panel Chairmen, in the presence of Dr. R. Hertford, Chairman of CIAT's Board of Trustees, and Dr. J.L. Nickel, the Center Director, who both indicated their agreement in principle with most of the Program Review Panel's recommendations.

2. In dealing with these Review reports TAC appreciates the positive response of the Center to the recommendations of the 1977 Quinquennial Review.

### Evolution and Impact of CIAT's Program

3. TAC agrees with the Review Panel that CIAT is an efficient and well managed Center, the overall research program of which is effectively organized into four interdisciplinary commodity programs. The Center has achieved a satisfactory balance both within and among its commodity progams which also include farming systems components.

4. TAC notes the substantial impact of CIAT's research and training activities. This impact is particualrly significant in the area of rice, but also the other commodity programs are now at a stage where impact is becoming increasingly evident. The Committee strongly commends CIAT for these achievements.

### CIAT's Mandate

5. TAC commends CIAT for the effort it has made and continues to make in sharpening the focus and the operational definition of its mandate. The Committee agrees with the Panel in endorsing CIAT's mandate, which over the years has evolved from many to the present four commodities, i.e. beans, cassava, rice and tropical pastures.

6. The Committee supports the evolution which took place within the commodity programs and their research strategies, striking a balance between strategic and adaptive research.

### Bean Program

7. TAC welcomes CIAT's initiative to implement its global mandate by expanding its bean research into Africa.

8. Concerning CIAT's breeding strategy, the Committee endorses the Panel's recommendation, accepted by the Center, that a balanced approach be adopted with due emphasis to both yield potential and performance under low input conditions. TAC commends CIAT on the significant achievement in transferring resistance against major pests in this crop.

Cassava Program

9. TAC recognizes the scientific quality and achievements of the Program which for various reasons has been concentrated on the Latin American continent. Only recently has CIAT been able to respond to the demands from Asia and thus started to take up effectively its global mandate for this crop. This is a crop which has all the characteristics of a CGIAR-mandate crop, as it is particularly suited to the marginal lands, extensively grown by small farmers, and has until recently received limited research attention.

10. The Committee urges CIAT to continue its assessment of research needs for cassava globally and to carefully consider the Center's priorities in responding to these needs in the regions. Whatever CIAT does in Africa should be done in close cooperation with IITA. 1/

Rice Program

11. TAC supports CIAT's shift in emphasis on research from irrigated to upland rice, but the Committee wishes CIAT to continually examine the needs of both categories in order to ensure an appropriate balance between them.

12. TAC is particularly pleased to note the good collaborative arrangements which have been in operation between IRRI, CIAT and national programs on this important crop.

Tropical Pastures Program

13. TAC encourages CIAT to assume a global germplasm role with respect to tropical pasture species for the acid, infertile soils in the humid and subhumid tropics, and to collaborate with ILCA and other institutions on research in ecological systems associated with CIAT's mandate. However, the Center should not attempt to become the world germplasm center for all tropical pastures species. The Committee agrees with the Panel's recommendations that the outposting of liaison staff at ILCA should be considered in the light of its merits vis-a-vis the implementation of the forage agronomy program at ILCA.

14. The Commitee supports the Panel's recommendation regarding the pasture improvement projects in both the moderate acid soils and the humid tropics with the proviso that in the humid tropics CIAT must focus on already cleared areas with degraded pastures, and not on clearing of new lands.

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1/ Memorandum of Understanding for Collaboration in Cassava Germplasm Exchange, Research and Training Between CIAT and IITA.

BOARD FOR INTERNATIONAL FOOD AND AGRICULTURAL DEVELOPMENT
INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

Agency for International Development
Washington, D.C. 20523

23 March 1984

Dear Professor Camus,

On behalf of the Review Panel, I forward herewith the report of the TAC External Program Review of the International Center of Tropical Agriculture (CIAT). The Review was guided by the terms of reference, guidelines, and additional questions forwarded to the Panel by TAC.

The Panel was fortunate to have the opportunity to participate in the week-long Internal Program Review of the Center prior to conducting the External Review. Also, members of the Panel had an opportunity to meet with research administrators and scientists of national programs in six countries in Latin America and three countries in Asia and Africa. The Chairman met with the CIAT Board of Trustees in October and the entire Panel met with the Program Committee of the Board during the week of Internal Review. These interactions served very effectively to build a base of understanding within the Panel prior to the intensive phase of the Review. I commend TAC for its willingness to invest the resources to assure the Panel's success in developing an adequate understanding of the Center's programs.

The Review focussed heavily on progress of the Center since the 1977 Quinquennial Review, on the impact of CIAT technology and on the future plans of the Center. Particular attention was paid to the development of the outreach program which has evolved rapidly in recent years. The Panel reviewed the effectiveness of the Center's interactions with other IARCs with which it shares responsibilities for mandated programs, particularly with regard to the CIAT/IITA programs in cassava.

../.

Prof. Guy Camus
TAC Chairman
c/o World Bank
66 Avenue d'Iéna
75116 Paris
France

We feel privileged to have been selected to conduct the Review. We invested five weeks of our time in learning about, and hopefully commenting effectively on, the progress of this vital Center. To the extent we have succeeded, much credit goes to the Board of Trustees, and to the Directorate and staff of CIAT for their availability, cooperativeness and open attitude.

We give special thanks to the TAC Secretariat for making the services of Mr. Louk Ochtman available for the entire review.

On a personal note I wish to express my sincere appreciation to the members of the Panel who accepted the task with enthusiasm and great sincerity. Their cooperativeness made my task easy.

Sincerely yours,

Frederick E. Hutchinson

Frederick E. Hutchinson
Chairman
CIAT EXTERNAL PROGRAM REVIEW

AGR/TAC:IAR/84/12

THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

# REPORT OF THE

# SECOND EXTERNAL PROGRAM REVIEW OF THE

# CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL

# (CIAT)

Review Panel: Dr. F.E. Hutchinson (Chairman)
Mr. K.R.M. Anthony
Dr. J. Casas
Dr. H.M.L. Gallegos
Mr. R.M. Jones
Dr. C.L. Niblett
Dr. J. Ramalho
Dr. J.N. Rutger
Dr. A. von der Pahlen
Dr. D. Plucknett (CGIAR Secretariat)
Mr. L.H.J. Ochtman (TAC Secretariat)

TAC SECRETARIAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

August 1984

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ANNEXES

# EXECUTIVE SUMMARY

## 1. The External Program Review

The Panel was guided by TAC's Terms of Reference and Guidelines for External Program Reviews, a list of specific questions to be be addressed, the 1977 Quinquennial Review Report, and by the personal knowledge of the Panel members. The Panel spent one week participating in the Center's Internal Review and two weeks travelling to various countries and substations to view CIAT programs, as well as its impact on national research programs, prior to its two week intensive review at the Palmira headquarters.

## 2. The Report

The purpose of this Report is to assist the Center to carry out its mandate better, and to provide TAC and the CGIAR with information and recommendations that will facilitate their continuing assessment of and guidance to CIAT.

The recommendations in the Report were unanimously agreed upon by the Panel. The recommendations which appear in the Report are also summarized at the end of each chapter. Other guidance in the form of suggestions or endorsements appear in the text. The concluding chapter is a general assessment of CIAT, including observations about the future.

The External Program Review was conducted concurrently with the External Management Review (EMR). The Panels coordinated their reviews and this Report contains references to the EMR.

## 3. CIAT's Mandate and its Interpretation and Implementation

The Panel agrees that the broad mandate of CIAT, which in summary is to generate and deliver "improved technology which will contribute to increased production, productivity, and quality of specific food commodities in the tropics, principally countries in Latin America and the Caribbean", is still valid. CIAT for many years has accepted principal or global responsibility for beans and cassava within the CGIAR system, and regional responsibility for rice. The Panel agrees that this should continue. The situation regarding the fourth major commodity, tropical pastures, has not been as clear. CIAT has interpreted the pastures mandate as applying globally to lowlands in the humid and subhumid tropics with acid and infertile soils, but having specific responsibility to the American tropics.

The Panel accepts this interpretation but suggests it must be discussed and clarified with ILCA. The Panel agrees with CIAT's decision to restrict its focus by phasing out the Swine Program and concentrating the emphasis of the former Beef Program on Tropical Pastures.

Since the 1977 Quinquennial Review, CIAT, as discussed in section seven, has appreciably extended its outreach activities in accordance with the mandate for each commodity. Significant global expansion has been made by the Bean Program into Africa and the Cassava Program into Southeast Asia, and a regional expansion into the American tropics has taken place in all commodities. Noteworthy changes in CIAT programs in the regional context have been the increased emphasis on upland rice, the development of networking activities, and the plans to expand the Tropical Pastures Program into the humid tropics. All of these activities are clearly within the Center's mandate. The Panel does not believe that any new commodities should be allocated to the Center.

## 4. Impact

CIAT's impact on client countries has been attained primarily through the four commodity programs ard their supporting units. These programs have catalyzed formation and strengthening of national research programs.

Development of high yielding varieties (HYVs) in the Rice Program was the first and still the greatest success story to emerge from CIAT's work. National programs in Latin America have released some 40-50 HYVs derived from CIAT germplasm and/or IRTP nurseries. In 1981 these HYVs were grown on 2,286,000 hectares in Latin America, which represents 26% of the rice area in the region. If Brazil, with its largely upland rice area is excluded, the adoption rate is 70%. The increased value of production from the HYVs was US$850 million annually. Although the HYVs were developed for irrigated conditions, the figure of 2,286,000 hectares includes the unexpected adoption of HYVs on 661,000 hectares of upland rice area.

It is still too early to measure the impact of the approximately 40 bean varieties, based on CIAT Bean Program germplasm, that have been named in recent years by national programs in 16 countries in the Americas and two in Africa. Since the CIAT Bean Program concentrated its efforts on breeding for disease and insect resistance, the main impact is expected to be in stabilizing production rather than in yield increases *per se*.

The most significant impact of the Tropical Pastures Program has been the identification and distribution of improved tropical grasses and legumes. One grass (*Andropogon gayanus*), and three legumes (*Stylosanthes* spp.) from the Tropical Pastures Program have been released by several countries under a variety of names. Because of

the long-term nature of perennial forage evaluation, it will take several more years to adequately measure the economic impact of the Program on Latin American agriculture.

The impact of the cassava cultivars containing CIAT Cassava Program germplasm that have been released in 10 countries is not yet discernible in national yield statistics. However, their impact may be one of the reasons why cassava hectarage has increased in several Latin American countries. Impact on productivity in this crop is particularly difficult to measure, since it frequently is grown in small farms on marginal lands.

The Genetic Resources Unit (GRU) contributes to the overall impact of the commodity programs by providing germplasm of beans, cassava, and forage species. The Seed Unit has had a substantial impact through its service function for CIAT commodities and in providing seed of 49 varieties or lines of beans, rice, and tropical pasture species for 16 developing countries.

The impact of CIAT's training programs which have trained 2400 people in the 1969-1983 period, is being reflected in the strengthening of national programs as trainees return to their countries and apply their new skills and assume increased responsibilites. A recent survey indicates that 54% of former trainees remain active in the field for which they were trained. The additional contributions which former CIAT trainees will make over their careers will have a long-term and continuing effect on agricultural production in Latin America.

### 5. The Future

CIAT's Long Range Plan and its updates prepared for the EPR provide excellent working documents for operation of the Center during the 1980s. These documents will guide the Center well as it decentralizes its research from headquarters and extends its outreach program through Latin America and into selected activities in Asia and Africa.

As a result of decreased funding growth rates in the CGIAR system, CIAT will not be able to implement its plans as fast as originally desired. However, CIAT has shown flexibility in adapting to the funding shortfall, through modification of priorities both within and between programs, and through supplementation of core funds with extra-core funding.

Overall, the Panel anticipates that CIAT's impact on increased agricultural production in its mandated areas will grow at substantially faster rates than in the past. Large returns have already been realized from the Rice Program and more are expected. The other three commodity programs, which started later or have dealt with longer-lived crops or with crops for which infrastructures for

dissemination are still in development, have much germplasm and technology which is emerging from the pipeline and which can be expected to increase productivity as it moves into national programs.

Like all IARCs, CIAT must continually examine its role in the technology development and transfer process. As national programs gain strength and assume larger adaptive and applied research roles, CIAT must give more attention to basic research opportunities which complement national research activities. The challenge for CIAT, as for any agricultural research organization, is to select those basic research opportunities which have the greatest potential for ultimately increasing productivity on the farm.

## 6. Follow-up of the 1977 Quinquennial Review

The 1977 Quinquennial Review gave a broad endorsement to CIAT's programs and recommended that CIAT be given a period of stability and the opportunity to make uninterrupted progress without major changes. CIAT has accomplished this despite the financial pressure of recent years. The Center has also responded positively to the recommendations of the Quinquennial Review, and these responses are detailed in Annex V. The Panel has noted the beneficial effect of CIAT's positive actions during the current review. The only recommendation that CIAT did not follow was that on retention of senior scientists in animal health within the Beef Production Program. The Panel endorses CIAT's reasons, also listed in Annex V, for not following this recommendation.

## 7. Overall Assessment

The Panel finds CIAT to be a productive international agricultural research center with competent staff and administration. The Board of Trustees accepts its role responsibly and is directly involved in making major policy and program decisions. The inter-disciplinary commodity-oriented program structure has been successfully implemented in the Center. Open dialogue both within and between program staff is encouraged. However, communication between the financial administrative division and the scientists needs improvement.

CIAT moved more slowly in the development of an outreach program than did some of its sister IARCs. In recent years it has expanded this part of its overall program quite rapidly. One of its major achievements has been the development of effective networks of scientists in national programs in the region. The outposting of staff has been accomplished in a logical sequence following the Long Range Plan. Because of budget reductions most of this has been based on extra-core funding. The Panel accepts this as a short-term

reality, but encourages the Center to attempt to achieve a more proper balance on core funding in the long-term.

The Panel feels the future development of the Cassava Program should be guided by information concerning the potential for the crop as a source of human food and animal feed. Its competitiveness with cereal grains needs to be analyzed on a national, regional, and global basis. An external organization should be funded to conduct such a study as a basis for CIAT to decide the future scope for the Cassava Program.

In any agricultural research organization which is organized along interdisciplinary commodity lines there normally emerges a need for a scientific unit which conducts research in support of all of the commodity programs. The Panel feels strongly the time for such a unit has arrived for CIAT. A unit combining germplasm, tissue culture, virology, mycorrhiza microbiology, and other relevant specialities is suggested. An immediate task for such a unit would be to focus on the phytosanitary problems related to interchange of CIAT germplasm and breeding materials with other organizations.

CIAT interprets its mandate to imply a major focus on developing improved plant materials for minimum input conditions. The Panel feels this has resulted in inadequate attention to the exploration of yield potential, particularly with beans. It is hoped the Center will give more attention to yield potential in the future.

In general CIAT has developed excellent working relationships with other IARCs with which it shares joint responsibilities. However, the Panel finds the relationship between CIAT and IITA with regard to their cassava mandate to be unsatisfactory. The two Centers must be required to develop a satisfactory arrangement very soon, and if not achieved, a third party should be brought in to resolve the issues.

Considering the large amount of productive research being conducted at CIAT, the Panel finds the number of scientific publications to be disappointing. It is time for the staff to bring this part of their scientific activities into balance with the rest and for the administration to encourage them more strongly in that regard. The future credibility of CIAT as a leading agricultural research organization within the region and the world will in part depend upon this matter.

The relationships of the Center with the national programs in Latin America is uniformly excellent. Administrators and research scientists in the seven countries visited by the Panel consistently expressed strong support for the value of their collaboration with CIAT.

# CHAPTER I - INTRODUCTION

## 1. The Consultative Group on International Agricultural Research (CGIAR)

1. The Consultative Group on International Agricultural Research (CGIAR), founded in 1971, is an international consortium sponsored by the Food and Agriculture Organization (FAO), the United Nations Development Program (UNDP), and the World Bank. It seeks to increase food production in the developing world through research programs and through training of scientists and production specialists in these countries.

2. The Consultative Group is comprised of 39 donors, including 23 governments, 11 international organizations and development banks, and five foundations. In addition, ten developing nations representing the five major developing regions of the world - Africa, the Middle East, Asia, Latin America, and Southwestern Europe - nominated by the FAO Regional Conferences on a two-year basis are non-donor members of the Group.

3. The 13 institutions which the CGIAR supports are autonomous international research and training institutions with an international staff of scientists, supported by locally recruited support staff. Each is governed by its own international Board of Trustees.

## 2. The Technical Advisory Committee (TAC)

4. The CGIAR has an independent Technical Advisory Committee (TAC), entrusted with the periodic assessment of the achievements, appropriateness, and effectiveness of the programs of the International Agricultural Research Centers (IARCs). These reviews of individual Centers are conducted for TAC at approximately five to six year intervals. At its 30th meeting in March 1983 TAC, in consultation with the Center Director, agreed that CIAT should undergo the second External Program Review, which was ultimately planned for March 1984.

## 3. The International Center of Tropical Agriculture (CIAT)

5. Founded in 1967, CIAT began operations at its present site at Palmira near Cali, Colombia, in February 1969. Its headquarter facilities were inaugurated in October 1973.

6. In coordination with government institutions and other organizations dedicated to increasing the production and productivity of food crops basic for human subsistence, CIAT's goal is to contribute to the improvement of nutritional levels and the general welfare of the low-income urban and rural populations in the tropics.

7. Initially, CIAT worked with six specific commodities, i.e., cassava, field beans, maize, rice, beef, and swine, and concentrated its activities chiefly in the subhumid, lowland tropics of Latin America and the Caribbean. Over the years, CIAT's overall research program evolved to its present state, which encompasses four programs, i.e., beans, cassava, rice, and tropical pastures, with the objective "to generate and deliver, in collaboration with national and regional institutions, improved technology which will contribute to increased production, productivity and quality of specific food commodities in the tropics--principally countries in Latin America and the Caribbean-- thereby enabling producers and consumers, especially those with limited resources, to increase their purchasing power and improve their nutrition."

8. The Government of Colombia provides support as host country for CIAT and furnished a 522-hectare site near Cali for CIAT's headquarters. In addition, the Fundación para la Educación Superior (FES) made available a 184-hectare substation in Quilichao and a 73-hectare substation near Popayán. CIAT also co-manages with the Instituto Colombiano Agropecuario (ICA) the 22,000-hectare Carimagua Research Center in the eastern plains of Colombia. A new 30-hectare substation, in Santa Rosa near Villavicencio, has recently become operational.

9. An independent panel conducted the Quinquennial Review (QQR) of CIAT in April 1977 and submitted its report [1/] to both TAC and the CGIAR. It supported three major policy decisions taken by CIAT.

10. Firstly, CIAT had adopted as a primary objective of the Tropical Pastures Program the development of some 300 million hectares of the acid soil savannas, the largest potential land and food resource in Latin America. Nutrition of beef cattle had been identified as the principal factor in the development of this vast resource. Therefore, CIAT was embarking on an ambitious program of plant, soil, and animal husbandry research in close cooperation with national research institutions in Colombia and Brazil. The Panel supported CIAT's decision to postpone pasture research in newly cleared forest land until sufficient progress had been made on the main plains.

11. Secondly, CIAT had decided to retain a veterinary research component in the multidisciplinary beef production team to ensure that utilization of improved pastures was not limited by disease problems in cattle. The former separate and more comprehensive veterinary

1/ DDD/TAC: IAR/77/21.

component of the Beef Production Systems Program was phased out.

12. Thirdly, CIAT had terminated its small farming systems program; rather than have a separate program focusing on farming systems, it was recognized that this must be a concern of all the multidisciplinary commodity programs.

13. The recommendations of the 1977 QQR were endorsed by TAC, the CGIAR, and CIAT. The Review report served as a reference document for the second Review.

## 4. Terms of Reference

14. The External Review Panel was charged to conduct the review under the standard Terms of Reference for External Program Reviews of the International Agricultural Research Centers, revised by TAC at its 31st meeting in June 1983 1/. In general terms, the Panel was to assess the content, quality, impact, and value of the overall program of CIAT, and to examine whether the operations are being carried out in line with declared policies and to acceptable standards of excellence.

15. In pursuit of the above objectives, the Panel was to give particular attention to the mandate of the Center, to the relevance, scope and objectives of its program and budget, and of its forward plans,to the content and quality of its program, to the impact and usefulness of its activities, as well as to the constraints on them. Furthermore, the Panel was to address specific questions put forward by members of the CGIAR, the Center, and TAC.

16. While the Panel was free to make any observations or recommendations it wished, because the report is its alone, it could not commit the CGIAR or TAC to any consequent action.

17. The detailed Terms of Reference, including the list of specific questions are appended in Annex I.

## 5. Preparations for the Second External Program Review (EPR)

18. The preparations for the Second External Program Review started in June 1983 and were conducted in close cooperation with the Director General of CIAT. Details of the Review program and the composition of the Panel (Annex II) were discussed and agreed upon by TAC at its 31st meeting in June 1983 and its 32nd meeting in October 1983. Both CIAT and the TAC Secretariat provided the Review Panel with a comprehensive set of relevant briefing documents which are listed in Annex III.

1/ AGD/TAC:IAR/83/23

19. The Panel Chairman was invited to attend the 10th anniversary of CIAT in October 1983, where he had an opportunity to discuss the scope of the Review and related matters with members of CIAT's Board of Trustees and the Management.

20. During the 32nd TAC meeting the Panel Chairman had further discussions on the Panel composition and the Review program with the Chairman of TAC, CIAT Management, and TAC Secretariat.

## 6. Review Activities

21. In November 1983 the Panel Chairman and one member visited the ICTA bean and rice programs in Guatemala. The accompanying Panel member also visited the bean program in Costa Rica.

22. In January 1984 one Panel member visited the national cassava programs in Thailand and Indonesia. Another Panel member had discussions on CIAT related research programs with specialists of INRA, GERDAT, IEMVT and IRAT in Montpellier and Guadeloupe.

23. From 30 January to 3 February 1984 the Review Panel attended the annual Internal Program Review at CIAT. Following this review the Panel split up in two teams; one team visited in Brazil from 5-11 February 1984 the bean, rice, cassava, and tropical pastures programs of EMBRAPA: CPAC, CNPAF, and CNPMF at Brasilia, Goiania and Salvador; ICA and IRGA at Campinas and Porto Alegre. The second team visited from 4-10 February 1984 national programs in Costa Rica (beans of MAG, CNP, and ONS), Cuba (beans, cassava, rice, and pastures of MINAG), and Mexico (beans, cassava, rice, and pastures of INIA). One Panel member visited IITA on 7-8 February for discussion on CIAT-IITA collaboration in cassava research for Africa.

24. During the week from 5-10 March 1984, prior to the main Review at CIAT headquarters, the Panel split up again in two teams to visit ICA and CIAT program activities in various regions of Colombia, as well as ICA headquarters near Bogotá. From 11-23 March the Panel conducted the main phase of the External Program Review at CIAT headquarters in Palmira. Details of the entire program of Review activities are presented in Annex IV.

## 7. The Report

25. On 23 March 1984, the Panel presented its collective findings and recommendations to CIAT and provided them with the draft report for their comments.

26. The Review Panel accepts sole responsibility for this report, which does not commit in any way the sponsoring agency, i.e., the CGIAR/TAC.

27. The report is structured in such a manner as to reflect the Panel's findings with respect to the following key areas:

- the Center's mandate, its interpretation and its research strategy, as well as its status in Colombia (Chapter II);
- an assessment of the relevance, quality and impact of CIAT's commodity research programs (Chapters III-VI);
- a review of the other components of CIAT's program and their interrelationships with the commodity research programs (Chapters VII-X);
- a review of CIAT's international cooperation with national research programs and institutions, with other IARCs and advanced research institutions, and of its Long Range Plan (Chapters XI and XII); and
- an overall assessment of the Center's achievements, impact, and future plans (Chapter XIII).

28. The Panel's report was subsequently presented by its Chairman to TAC at its 34th meeting in June 1984 together with CIAT's response to the report. TAC formulated its comments, which together with the report and CIAT's comments were transmitted to the CGIAR for consideration at its meeting in November 1984.

# CHAPTER II - MANDATE, STRATEGY, ORGANIZATION, AND MANAGEMENT

## 1. Introduction

29. In the mid-1960s the Rockefeller and Ford Foundations collaborated to establish an international agricultural research center in Latin America. This resulted in an agreement signed by the Colombian Government and the Rockefeller Foundation on 12 May 1967, to create CIAT. The Center was officially decreed as a Colombian institution on 4 November of the same year, and CIAT headquarter facilities were dedicated on 12 October 1973. By that time it had been brought under the aegis of the CGIAR system.

## 2. Mandate and Interpretation

30. The original purposes of CIAT were defined as: "The Center shall have the right and power:

a. To carry out research on practical and theoretical problems related to increased production of basic food crops, both of plant and animal origin, especially in the tropical lowlands.

b. To train young technical people principally from South and Central America, under the direction of a staff of highly competent scientists.

c. To help develop educational and research institutions of the region by collaborating with national programs and giving assistance whenever convenient and mutually agreed upon.

d. To distribute improved genetic materials, of plant or animal origin, resulting from national or international research programs where such materials can be utilized in local improvement programs.

e. To publish and disseminate the results of the research of the Center.

f. To establish and operate a Center of Information and a library that will supply information and data on tropical agriculture for the use of the interested scientists around the world.

g. To organize periodical conferences, forums and seminars on important problems related to the development of tropical agriculture.

h. To participate in such other activities as may be related to those listed above." 1/

31. The original founders intended to create, 2/ "an institution serving tropical Latin America and the Caribbean."

32. The Board of Trustees eventually approved the following mandate for CIAT, as one of several agricultural research centers under the aegis of the CGIAR:

33. "To generate and deliver, in collaboration with national and regional institutions, improved technology which will contribute to increased production, productivity and quality of specific food commodities in the tropics, principally countries in Latin America and the Caribbean, thereby enabling producers and consumers, especially those with limited resources, to increase their purchasing power and improve their nutrition."

34. The Board further stated in 1977, "the CIAT programs have evolved to currently encompass the following responsibilities:

a. Principal responsibilities for beans (Phaseolus vulgaris and related species) and cassava (Manihot esculenta);

b. Principal responsibilities for tropical pastures (specific responsibilities for the acid, infertile soils of the American tropics);

c. Regional responsibilities for rice (specific responsibilities for the American tropics)."

35. The Panel understands the evolutionary process which has occurred since the creation of the Center, considering the subsequent move into the CGIAR system in 1972 and the broad mandate originally given to the institution.

36. The Panel agrees with the Center's interpretation of its mandate in terms of the four crops to be studied. It also accepts the principal responsibility being assumed for beans and cassava. With regard to tropical pastures, it is the Panel's understanding that the Program interprets its mandate as applying globally to lowlands in the

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1/ Act of the Foundation of the Centro Internacional de Agricultura Tropical (CIAT), October, 1967.

2/ From "CIAT as Originally Conceived and CIAT Today: Mandate, Objectives and Achievements," L. Hardin, October, 1983.

humid and subhumid tropics with acid and infertile soils, but having a specific responsibility to the American tropics. The Panel accepts this interpretation, but suggests it be discussed with ILCA, and it agrees that CIAT should not assume responsibility for all tropical pasture species.

37. CIAT should be commended for its decision to change the focus of its Animal Production Program by phasing out the Swine Program (1975-1979) and narrowing the Beef Program by transforming it into the Tropical Pastures Program. The 300 million hectares of acid savannas which the Tropical Pasture Program has concentrated on in Latin America warrant such attention because they hold great potential for expanded beef production if suitable pasture species can be identified and developed.

38. The major program changes at CIAT can be summarized as follows:

| | |
|---|---|
| Early 1970s | Change from disciplinary to commodity-based, inter-disciplinary approach |
| 1975 | Decentralization of training and conferences into commodity programs |
| 1975 | Small Farm Systems Program functions redefined and transferred to commodity teams |
| 1976 | Beef Program focus narrowed to tropical pastures, with major emphasis on acid, infertile soil regions of tropical America |
| 1979 | Swine Unit phased out |
| 1979 | Creation of Seed Unit |
| 1981 | Broadening of Rice Program focus from irrigated lands to include favored upland environments |
| 1983 | Acceleration in implementation of mandates for beans and cassava outside of Western Hemisphere. |

### 3. Strategy

39. The Center has developed a strategy which emphasizes enhanced production on farms with limited resources and on underutilized land areas. It focuses its programs predominantly on the American tropics and the commodities were selected for their importance to the region. It also recognizes that it represents only one segment of the agricultural research and development system, thus linkages with national research systems, basic research institutions in developed and developing countries, and sister centers within the CGIAR system are part of the strategy.

40. In recognition of the broader responsibilities assigned to CIAT by the CGIAR system for given commodities, the Center has differentiated its responsibilities as:

Principal

1. Assemble, maintain and make available the world germplasm collection.
2. Conduct specialized, strategic research.
3. Generate improved production technology components for, and develop cooperative activities with, national research systems in all regions in the developing world where the commodity is important, and no sister CGIAR center is assuming regional responsibilities.
4. Provide in-service training for professionals in the specialized/strategic areas of research on a global basis.
5. Provide specialized in-service and production-oriented training for professionals from countries where no other CGIAR center has regional responsibilities.
6. Collect, process and disseminate information on the commodity on a global basis.
7. Backstop the activities of other institutions with regional responsibilities for that commodity.

Regional

This category applies when a sister CGIAR center has principal responsibility for a commodity, and in close cooperation with that center, CIAT takes on selected responsibilities, especially No. 3 and No. 5. Together with national research systems it identifies principal production constraints and, in close collaboration with the center having responsibility, seeks to facilitate such activities as are required to overcome such constraints." 1/

41. CIAT has developed a sound strategy to implement the mandate. It appropriately focusses upon the farmers with limited resources and the Center's role in the CGIAR system.

42. The Panel is concerned by the interpretation in No. 3 that CIAT will "develop cooperative activities with national research systems in all regions in the developing world where the commodity is important and no sister CGIAR center is assuming regional responsibilities" for a commodity for which CIAT has principal responsibility. It would be preferable to state, "and no sister CGIAR center has been assigned regional responsibilities." 2/ Confusion about which center works with the national institutions in a country on a specific commodity must be avoided at all cost, and whenever possible this linkage should be with the regional center nearest to the country.

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1/ "Objectives, Strategy and Mandate." Background Papers, Vol. 1, External Program Review, CIAT, 1984.

2/ Suggested change in wording is underlined.

43. CIAT appropriately states its interest to develop linkages with basic research institutions in the developed and developing countries. The Panel notes the credible number of existing projects, but is not convinced these linkages, especially with developed country institutions, have been adequately explored and implemented. The Panel recommends that CIAT further explore this part of its strategy, with the intent of increasing the amount of basic research conducted in support of its programs.

44. The Center has achieved a proper balance between conducting research and serving its other functions of training, conferences and workshops, publication and distribution, and seed development. As the program continues to develop during the next ten years, it will be necessary to respond to changing needs and priorities within the region. The Long Range Plan attempts to anticipate those changes and charts a future course. For example, the Panel believes there will be an increasing demand for the Seed Unit to assist national organizations by assuring adequate supplies of certain new varieties which are not adequately produced by the national seed organizations. This will be particularly true with new tropical pastures varieties developed for the acid savannas. The role and administrative arrangements for the Seed Unit may need to be modified as it assumes future responsibilities for seed development in the Latin American region.

### 4. Legal Status

45. CIAT was originally incorporated under Colombian law and granted certain rights and privileges (Decree No. 301) which assured its right to operate as a quasi-international institution. It is now apparent steps should be taken to assure true international status. The Center is presently developing a plan to achieve such status by an arrangement with the three co-sponsors of the CGIAR (FAO, UNDP, World Bank) and the Colombian Government. All parties appear favorably inclined but several factors have delayed progress. The present status is not satisfactory for an organization of the nature of CIAT.

46. The Panel recommends that CIAT and its co-sponsors continue to pursue the attainment of international status with vigor and dispatch.

### 5. Organization, Administration, Management

47. CIAT headquarters is located in Palmira, Colombia. It is supported by three substations in Colombia and substantial CIAT collaborative research programs at five Colombian (ICA) stations. Some facilities have been added in recent years, including the Seed Unit and the communications support buildings, the IBM System 36

computer, and an auditorium. There are no plans projected for major facility additions in the future.

48. The Panel was impressed by the completeness of present facilities and the modest approach followed by management in establishing facilities at the substations.

49. The Center has an autonomous Board of Trustees composed of 18 members, four of whom are ex officio and one is emeritus. The members have three-year terms and they may be reappointed only once. Three of the members are nominated by the CGIAR and the others are selected by the Board itself. Balance of membership has changed over the years to appropriately recognize the broader mandate for Asia and Africa. The present Board has one member from each of those regions. The Panel notes the Board is large relative to other IARCs and raises the question of relative efficiency.

50. The Program Committee of the Board is the vehicle by which the Center's programs are evaluated annually. The Committee is part of the annual internal review process and then it formulates appropriate policy recommendations for consideration with the Executive Committee and ultimately the Board. This process appears to be very effective. It has led the center to make major changes in policy and program, such as those with beef, swine, training, upland rice, and decentralization.

51. The Director General is assisted by the Directors for Crops Research, for Resources Research and International Cooperation, and for Finance and Administration who have staff responsibilities as well as direct supervisory duties for the research and administrative functions of the Center. The research programs are each led by a Coordinator who works closely with senior staff in the program to achieve planning, implementation, evaluation, and dissemination of results. The organization structure of CIAT is presented in Figure 1.

52. The Panel is generally satisfied with the organizational structure with a few reservations. The division of responsibilities between the Directors of Crops Research and of Resources Research and International Cooperation is not clearly delineated and appears to be confusing to the scientific staff at times and also to those who cooperate with the Center. The Panel recommends that CIAT management reconsider the division of responsibilities assigned to these two positions.

53. The administrative style operating at top levels of management at CIAT is collaborative. The Director General meets regularly with the Directors and his assistant to discuss Center-wide policies and programs. All members of this administrative group are broadly knowledgeable on the programs of the Center and are capable of responding to concerns beyond the limits of their defined responsibilities. They appear strongly committed to the total program of the Center and its mandate.

54. The Management Review of CIAT was conducted concurrently with the Program Review and the two panels collaborated on questions of management. The Panel is generally in support of the recommendations made by the Management Review Panel. It strongly concurs with their recommendations concerning the administrative function.

55. At the time of the Review there were 56 man-years budgeted for international staff on minimum net core and 17 on extra-core.[1/] These figures are planned to increase to 64 and 29 in 1985 and to 73 and 24 in 1990 for the minimum requirements. These projections reflect a substantial decrease in the previously expected rate of growth of the Center's programs, and this trend appears realistic in view of anticipated levels of funding in the CGIAR system. The inclusion of an "optimum" core requirement has allowed staff to plan for long-term program needs should the funding situation become more optimistic. More specific manpower assessments appear in Chapters III, IV, V, VI, and XI.

56. Recruitment of international staff is the responsibility of the appropriate Director, as a line responsibility delegated by the Director General. The Director appoints a committee of three principal staff, always including the appropriate program coordinator, to advise and assist him in the process. The Director advertises the position and candidates are screened, with assistance of the committee.

57. The Center utilizes post-doctoral fellows effectively in its programs. It has a stated sabbatic leave policy but the Panel is concerned that frequency of such leaves appears low (seven during the last five year period). The Panel recommends that CIAT develop a plan to schedule sabbatic leaves on a regular basis.

58. CIAT submits a biennial budget proposal to the CGIAR which includes projections for the subsequent biennium. The donor members of the CGIAR provide funds on an annual basis for the Center's core operations and for capital expenditure. A member of the Group has the prerogative to support certain components of core operations and of capital requirements, and not others. This causes a differentiation between restricted and unrestricted core funding.

59. CIAT also has a number of extra-core special projects jointly with specific national programs and donors. CIAT has utilized this type of project very effectively to develop its outreach responsibilities in a number of countries for which present budgets would not have allowed development. The Panel commends CIAT for this imaginative approach and encourages it to continue its growth as long

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1/ For definitions of "optimum", "minimum", and "minimum net" core positions, refer to "Summary Modifications to Long Range Plan," CIAT, January 1984, p.2.

as the projects are evaluated carefully for appropriateness to CIAT's mandate and do not adversely affect the balance of core programs.

60. The Center's approved budget for 1984 is shown in Table 1, along with comparative figures for 1980, 1981, 1982, and 1983. There has been an obvious levelling off in budget growth in recent years. In fact, when compared with the 1980 budget, it shows a reduction in excess of one million dollars (US). This is a reflection of the funding available to the CGIAR. This is closely linked to the manpower growth reductions in the Summary, Modifications to Long Range Plan (January 1984).

## 6. Recommendations

61. The Panel recommends that CIAT further explore its stated responsibility for developing linkages with basic research institutions in the developed countries, with the intent of increasing the amount of basic research conducted in support of its programs.

62. The Panel recommends that CIAT and its co-sponsors continue to pursue the attainment of international status with vigor and dispatch.

63. The Panel recommends that CIAT management reconsider the division of responsibilities assigned to the Directors of Crops Research and of Resources Research and International Cooperation.

64. The Panel recommends that CIAT develop a plan to schedule sabbatic leaves for senior staff on a regular basis.

TABLE I: CIAT BUDGETS AND FUNDING, 1980-1984 [1/]
(US$ X 1,000 [2/])

| | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| Board Approved | 21,317 | 21,566 | 21,834 | 21,379 | 19,924 |
| Baseline | N/A | N/A | 21,834 | 21,379 | 19,924 |
| Incl. Forward List | N/A | N/A | 22,028 | 24,576 | 21,444 |
| At Bottom of Fallback | N/A | N/A | N/A | 20,416 | 18,946 |
| TAC Rec/CG Approved | | | | | |
| Single Figure | 20,639 | 21,231 | N/A | N/A | N/A |
| Top of Bracket | N/A | N/A | 22,028 | 20,829 | 20,336 |
| Bottom of Bracket | N/A | N/A | 21,209 | 19,931 | 19,411 |
| Emergency Fallback | - | - | 20,085 | - | - |
| Actual Funding | 20,624 | 19,990 | 19,967 | 19,051 | 19,324 [3/] |

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1/ Exclusive of special projects transferred to core

2/ In constant 1983 dollars

Inflation factors used:

| | | |
|---|---|---|
| 1980 - 1981 | 15.5 | |
| 1981 - 1982 | 12.8 | |
| 1982 - 1983 | 10.0 | |
| 1983 - 1984 | 3.5 | (current estimate budget request and approval based on 8.5%) |

3/ Current estimate

# CHAPTER III - BEAN PROGRAM

## 1. Background and Objectives

### 1.1. Background

65. CIAT has worldwide responsibilities within the CGIAR System for the improvement of bean (Phaseolus vulgaris) production. Beans are the most important grain legume for direct human consumption in the world. The crop is very important as a source of protein for the rural and urban poor in Latin America, its center of origin, and in East Africa, where a large amount of genetic variability has developed. It is predominantly grown by small farmers as a cash crop and for staple food in a wide range of cropping systems and in a large number of edaphoclimatic zones to which the crop is specifically adapted. A large proportion is intercropped with maize, and it is mostly grown on poor soils of difficult access.

66. In Brazil, Mexico, and Central America, beans constitute between 10-30% of dietary protein. In these countries and in East Africa beans are the main source of noncereal protein, because they are generally the most inexpensive form of protein. In countries such as Rwanda and Burundi, people derive more protein from beans alone than from all animal products combined. Static yields, and highly variable output and price, create a critical problem to millions of small farmers and poor urban consumers.

67. In some countries, such as Guatemala, Costa Rica, Nicaragua, and Cuba, the decline in production has halted. Guatemala, which had been an importing country, has begun to have an occassional small surplus for export as a result of the technology generated by CIAT in cooperation with the national institution, ICTA. However, in Latin America and Africa as a whole, per capita consumption is still less than it was some years ago. In Brazil it has decreased from 26 to 22 kg, thus further aggravating the problems of the poor. Brazil has an average production of 2.4 million tons, yet the yield per unit area is still decreasing. Under pressure from sugar cane and soybeans, beans are increasingly grown on poorer soils in the south of that country. Furthermore, beans are not favored in areas growing soybeans because both soybeans and beans are hosts of bean golden mosaic virus. As beans move to marginal land, soil-related constraints , such as soil acidity and associated lack of phosphorus availability, aluminum toxicity, and the inherent low capacity of beans for nitrogen fixation, become more important.

68. Beans suffer from diseases, pests, and climatic and edaphic constraints which result in very low and unstable yields (500-600 kg/hectare). Beans are among the most susceptible of the world's crops to diseases. Bean common mosaic virus, bean rust, anthracnose,

angular leaf spot, common bacterial blight, halo blight, and bean golden mosaic virus, can each cause losses as high as 80-100% on susceptible varieties. Similar losses can be caused by insect pests such as leafhoppers and pod weevils, although insects are generally considered less of a problem in beans than are diseases.

69. Most varieties have an undesirable plant type and have pods in contact with the soil at maturity, leading to increased disease and crop loss. Many bush habit types have early and intense flowering characteristics that contribute to yield instability. Added to all these constraints are local consumer preferences, such as seed taste, seed color, and seed size.

70. Recently sources of resistance have become available to breeders, as a result of the cooperation of the CIAT Bean Program with national bean programs of increased strength. This has resulted in more resistant germplasm and varieties.

71. The goal of the Bean Program is to increase bean yields in collaboration with national research efforts and to stabilize production at increased levels, by conducting research on the principal constraints in the Western Hemisphere and Africa. The Panel interprets this as meaning that CIAT, with apropriate research, can develop new technology which, in conjunction with the work of national programs, will lead to increased yield.

72. The specific objectives are:

"1) to develop, in collaboration with national research institutions, improved technology for common beans, particularly germplasm providing higher and more stable yields, which will lead to increased national production and productivity in those Western Hemisphere countries where the crop is an important food source;

2) to assist in achieving the same objectives in other regions, particularly Eastern Africa, through institutional arrangements in which CIAT can provide an input and allow advantages to be taken of work done in Latin America;

3) to selectively strengthen existing national bean research programs through training and the establishment of a bean research network of collaborating professional scientists" (CIAT in the 1980s).

### 1.2. Research Strategy

73. The primary focus in germplasm improvement has been on breeding for important disease and insect resistance or tolerance in a range of selected commercial grain types. The Program considers that this emphasis should continue throughout the 1980s and diminish as

national programs increase research in this area. It will then be possible for CIAT to give increased attention to providing more stable resistance sources and studying disease epidemiology. "In addition, the Program has increased attention to improvement of other germplasm characteristics. These include nitrogen fixation and drought tolerance and some soil-related constraints, particularly low phosphorus availability " (CIAT in the 1980s). Thus, the Program is placing more emphasis on research to raise the yield potential of improved varieties, an objective which will continue over time.

74. The Panel endorses these objectives and recommends that a larger effort should be given to breed for higher yield potential under higher inputs for the following reasons:

1) The objective of achieving higher yield stability is being achieved through the release of varieties with resistance to several of the main diseases. Diminishing risk factors will allow small farmers to grow high-yielding varieties at increased agronomic input levels.

2) Many small farmers have a flexible attitude when managing their enterprise. If the input/output relationship is favorable, they do not hesitate to use higher input levels to optimize profits. For instance, the small bean farmers of Southern Colombia use fungicides, insecticides, and fertilizers, and change varieties and other technology if they consider it profitable to do so. Similarly, the small bean farmers of Guatemala, when given the possibility to grow high-input but also highly profitable vegetable crops, have changed part of their land use to these crops by applying an intensive technology of which they were previously unaware, or considered too risky.

3) Consumers are also potential beneficiaries of new bean technology. It is imperative to enable the ever increasing numbers of urban poor to buy cheap good quality food. This is possible through cost-reducing technology. This objective could be attained by increasing yield capacity to allow the small farmer to have a sufficient profit while lowering the price of the product for the consumers and stimulating bean production by medium and large farmers.

4) The Bean Program has relative advantages in breeding for high yield potential: the critical mass of scientists; a large amount of genetic variability; the necessary facilities; and good international connections.

## 2. Program Activities

### 2.1. Germplasm

75. The bean germplasm collection comprises 33,290 accessions of the four cultivated species Phaseolus vulgaris, P. lunatus, P.

coccineus, and P. acutifolius, and 10 wild noncultivated species. About 29,000 of the cultivated accessions are P. vulgaris. This is an impressive and a very important collection. The Panel commends the Bean Program for assembling and utilizing this collection. The Program sees the need for further discussions with IBPGR for the definition of an appropriate descriptor list for the germplasm, including the development of a minimum list.

76. Although the collection is still growing, the Program considers that more emphasis should now be given to maintenance, classification, documentation, and evaluation. The facilities for maintenance are not adequate. The drying facilities can process a small amount of samples (60 per week) and only 3000 samples can be conveniently stored at -6 to -2°C. About 17,500 samples can be stored at 5-8°C. Because of absence of quarantine facilities only half of the collection can be evaluated for breeding purposes.

77. Although CIAT-Palmira has a postquarantine glasshouse for treated seeds from countries which have disease problems, such as bacterial wilt and virus diseases such as bean southern mosaic virus and bean mild mosaic virus, plants are only visually inspected. However, a Seed Health Laboratory has been created within the GRU which will utilize ELISA testing methods, enabling more reliable detection of disease. These diseases are only found in material from Puerto Rico and from European and African countries.

78. Currently about 100 breeding lines from Africa can be cleared per year for use at CIAT through USDA (Prosser, Washington) acting as a third country quarantine. To further increase the availability of African materials and make quarantined germplasm from the gene bank available, preliminary consultations have begun with USDA, Pullman, Washington. Contacts have also been made with Kew (U.K.), and Wageningen (Netherlands) concerning the possibility of using these institutions for third country quarantine.

79. The Panel recommends that a solution be found as rapidly as possible to allow any necessary movement of seeds from high risk to low risk areas and from Africa in order to implement fully the East African bean breeding project and to allow the possibility of evaluating the whole collection.

80. CIAT is able to evaluate routinely 16,500 accessions every time a new character is sought. The remaining half of the collection is held in quarantine and is unavailable.

81. It is planned to double the present cold storage facilities, but even that is clearly insufficient. The current requirement of the Colombian Government to save energy by requiring CIAT to reduce the expenditure of energy by 10% is an additional constraint to be resolved.

82. For reasons of security, an agreement with CENARGEN/EMBRAPA (Brasilia, Brazil) is to be signed which will allow a duplicate of

each accession in the collection to be stored in that institution which has good cold storage facilities. The Panel supports CIAT's moves to ensure the safety of the collection by storage of duplicate samples through arrangements similar to those pending with CENARGEN/EMBRAPA.

83. Through a special project, the lima bean collection is to be multiplied and documented.

2.2. Plant Breeding

84. In view of the large number of constraints to which the crop is subjected, a major effort has been made to incorporate resistance to diseases and pests, and tolerance to drought stress and acid soils, into different plant types. This is resulting in increased yield stability. Many desirable characteristics exist in breeding lines and/or varieties released in collaboration with national programs. The strategy now is to decentralize the breeding program by strengthening national programs through training and increasing the number of outposted staff. This staff will help national scientists to develop varieties adapted to the local conditions.

85. Establishment and maintenance of an international bean research network is the basis for the interchange of materials and information among national programs and between CIAT and national programs.

86. The principal means of international distribution of superior germplasm was originally the International Bean Yield and Adaptation Nursery (IBYAN). The IBYAN trials take into account local consumer preferences and agronomic requirements. Experimental lines, developed either by national programs or CIAT, as well as germplasm accessions, and check entries are compared. The objective is to identify superior material. In this way, varieties developed in one country have been adopted in another.

87. As national programs become strengthened, other network nurseries in addition to IBYAN have been developed such as the Preliminary Yield Trials (EP), First Uniform Nursery (VEF), International Bean Rust Nursery (IBRN), International Web Blight Nursery (VIM), International Anthracnose Nursery (IBAN), International Empoasca Resistance Nursery (IERN), International Drought Nursery, and International High Temperature Nursery. The next step has been to send out segregating material and parental lines as national programs strengthen further.

88. The networks, which are supported by outposted staff, visits of CIAT-Palmira staff, staff training, workshops and meetings, have created an international bean research community in Latin America which uses as efficiently as possible all the human and physical resources of the network. This model is also being developed in Africa. This enabled the national programs to release more than 40 varieties, each one of them combining the resistance to several

diseases, thus helping to achieve the stability objective in these countries. Resistance to rust, anthracnose, bean common mosaic virus, bean golden mosaic virus, common bacterial blight, halo blight, web blight, and pests such as leafhoppers, storage pests, bean pod weevil, and bean fly have been identified and incorporated into some varieties.

89. There is still a large amount of work to be done in this field. New sources of resistance have to be found or incorporated, and in some cases, the resistance within Phaseolus vulgaris is not satisfactory. Therefore, in collaboration with the Faculty of Agronomy of Gembloux (Belgium) and with the University of California, Riverside, interspecific crosses and multiple crosses with P. coccineus and P. acutifolius have been made and $F_1$ to $F_4$ and backcross material is being grown with the expectation of increasing the variability of P. vulgaris. In addition to the usual difficulties of interspecific hybridization, a particular difficulty in P. vulgaris is the small size of the chromosomes which result in a very small number of recombinations.

90. The Panel commends the work done by CIAT in breeding for resistance to the major pests and diseases and also CIAT's collaboration with developed country institutions in this field.

91. Photoperiod sensitivity has limited the movement of germplasm to high latitudes. Research on photoperiod insensitivity, temperature adaptation, and their interaction has allowed a clear understanding of their effects on bean growth. This understanding has decreased restriction of movement of germplasm between some regions, increasing the possibilities of the breeding work.

92. Breeding for other constraints such as for increased nitrogen fixation has continued in an indirect way, using Rhizobium strains selected by the microbiologist who left CIAT three years ago and which are maintained by a research assistant. The present situation is not satisfactory in view of the importance of Rhizobium in bean production. The Panel recommends that strong efforts be made to fill the vacant position of the microbiologist and, in the meantime, ways be found to further share the services of the microbiologist of the Tropical Pastures Program.

93. Some advances have been made in identifying high-yielding plant types which show real promise for increasing yield potential. As discussed under research strategy, the Panel has recommended that greater effort be devoted to breeding for high yield potential.

94. For this research the collaboration of a plant physiologist will be required, thus the Panel recommends every effort be made by CIAT to ensure that the plant physiologist position be filled.

95. The Bean Program has begun a limited effort in the breeding of snap or green beans, which it considers to be important. The Panel is not aware of data to support this assumption. Therefore, the Panel

recommends that a study on the importance of snap beans should be made before a commitment is made to a long-term program.

96. Breeding work done in Colombia is at CIAT-Palmira which concentrates mainly on crossing, plant architecture, rust, and BCMV resistance; at the Quilichao substation on tolerance to low soil fertility conditions and some diseases; in Popayan (under medium altitude) on resistance to diseases prevalent under those conditions; and in collaboration with ICA, at the ICA experimental stations of La Selva (2200 m) and Obonuco, Nariño (2700 m) under low temperature conditions. Breeding is now increasingly done in collaboration with national institutions in many countries of Latin America.

## 2.3. Plant Protection

### 2.3.1. Plant Diseases

97. Work in bean pathology has focused on breeding for resistance to the more important diseases and on integrated control. Three viral, two bacterial, and four fungal diseases in bean have been emphasized in breeding for resistance.

98. Bean common mosaic virus (BCMV) continues to be the most important viral pathogen. The existence of strains capable of inducing a hypersensitive necrosis constitutes a potential threat. Studying the epidemiology of bean southern mosaic virus (BSMV), has been difficult due to the symptomless-to-mild reaction and the lack of a highly specific antiserum. Both BSMV and BCMV are seed-transmitted. Bean golden mosaic virus occurs in many countries in the region. High levels of resistance are available in black beans and are being sought in other color groups.

99. The more prevalent fungal diseases studied are anthracnose, angular leaf spot, rust, and web blight. Some of the less widespread, but locally important, are Ascochyta leaf spot in the Andean zone, round leaf spot in the highlands of Mexico, and downy mildew causing severe damage in Mexico and Costa Rica. Web blight management strategies have been developed. They include the use of mulch created by weeds, previously killed by herbicides, in addition to application of the fungicide Benomyl. Rice hulls and fungicide also diminish the inoculum levels. Rotation with a nonleguminous crop (maize) or fallow also reduces disease. High plant density generally is conducive to high levels of disease pressure.

100. There is wide pathogenic variation in the anthracnose fungus from one area to another in Latin America. Work on this subject has been developed in a collaborative project with IVT (Netherlands). Most anthracnose-resistant materials (tested under both greenhouse and field conditions) have been grouped in the International Bean Anthracnose Test (IBAT).

101. With Ascochyta leaf spot, monoculture and intercropping with maize caused no significant differences in disease severity, except in

highly susceptible lines. Progeny from interspecific crosses of Phaseolus spp. provide encouraging results for resistance to common bacterial blight. The incidence and severity of halo blight in susceptible cultivars was greater in monoculture than when intercropped with maize. High plant density also increased disease levels.

### 2.3.2. Insects

102. The Bean Program has an active breeding program for insect resistance. The main pests identified include the whitefly, the vector of BCMV, leafhopper Empoasca, Apion, Heliothis pod borers, slugs, leaf feeding beetles, bruchids, African bean fly, and stinkbugs. The detrimental effect of these pests, and their biology and control, have been investigated and breeding projects for resistance have been commenced.

## 2.4. Microbiology

103. From 1977 to 1981 a microbiologist worked in the Bean Program. Rhizobium strains were selected which effectively nodulated with beans and were highly tolerant to acid soils. It was found that later-maturing beans fixed more nitrogen suggesting that the carbohydrate supply was the key to increase nitrogen fixation. Screening methodologies in segregating populations under greenhouse conditions and field evaluation methods involving addition of molybdenum, lime, and peat were developed. High nodulation and anthracnose resistance were combined.

104. The Program is continuing to select for high nitrogen fixation ability by inoculating with some of the selected strains and looking indirectly for vigorous plants under low fertility and acid soil conditions. However, as shown in the plant breeding section, the work conducted under these conditions is not satisfactory for a Center which must have a high standard of research; in the absence of a microbiologist the Rhizobium strains may get lost, and new strains and methodologies have to be identified.

## 2.5. Plant Nutrition

105. Research in plant nutrition is mainly in support of breeding for tolerance to moderately acid soils, low in phosphorus content. Fertilizer research is mostly confined to on-farm trials. Selection of segregating breeding populations is compared under high and low fertility in Quilichao and Popayan.

106. The Panel considers that research on phosphorus is needed to understand better the balance between vegetative growth and seed set.

107. In order to work with the breeding under higher input levels, or under unstressed nutritional conditions, extra support from a plant nutritionist/soil scientist is needed. The Bean Program is looking at present for a post-doctoral fellow in soil science to

strengthen the research of the soil scientist, stationed in Brazil, whose work load as liaison scientist allows for only part-time research on soil science.

108. As there is no vacant position in soil science to be filled, the Panel notes that it is desirable that the plant physiologist or microbiologist to be appointed have some soil science training to help in the elucidation of some of the plant nutrition problems until it is possible to recruit a soil scientist.

### 2.6. Agronomy and On-Farm Research

109. Most agronomic research on beans is location-specific and is best conducted by national programs. The agronomy research of CIAT consists mainly of on-farm research with a farming systems perspective (OFR/FSP). There are three principal linked objectives:

"a) The feedback of information to breeding programs on the performance of new technologies, especially varieties, in farmer's existing cropping systems.

b) The adaptation of methodologies for on-farm research to cropping systems which include beans," for use in training.

c) "The training of national program scientists in these methodologies." This is aimed at strengthening bean national programs with subsequent feedback information to CIAT's network.

110. "A fourth objective is expected gradually to increase in importance, namely the support of national program scientist conducting on-farm research in areas where beans are an important crop, through the formation of a network, initially in Latin America." (Internal Program Review, 1983).

111. Due to the variability of ecological conditions where beans are grown and the restricted adaptability of bean varieties, trials in numerous locations are necessary for the initial screening of germplasm. The choice made by the Bean Program to use on-farm trials for that purpose was opportune and economical.

112. The selection of the collaborative farms was done after brief and limited surveys in two diverse regions in the south of Colombia. Subsequently, trials have been made of varieties and new lines, and also of agronomic practices (different fertilizer levels, plant density, maize varieties where climbing beans were cultivated in intercropping, etc.).

113. These surveys gave a statistical description of the current bean practices, showing a surprisingly high percentage of farmers using chemical fertilizers, fungicides, and insecticides. But limited attempt was made to understand the place of beans in the complete system of each farm (which would have required observations on labor inputs, rotations, other agricultural and non-agricultural family

activities, etc.) or to do, at least, a provisional grouping of farms focussed on bean production.

114. The on-farm trials have been giving valuable feedback to the breeders and have been useful for the first on-farm short intensive course (1984). They also allowed an initial technical and economic evaluation of new bean technologies. However, the high profitability of these technologies, calculated after one year (1983), should have been interpreted more cautiously, due to the particular conditions of the collaborating farmers, who had guidance from research workers and had some "insurance" against the risk of failure.

115. In order to analyze the future direction of OFR in the CIAT Bean Program, a workshop was held in 1983 at CIAT. One of the conclusions was that it doubted if the two first goals could be simultaneously achieved with the current human resources (one agronomist and 0.4 economist), which is very low relative to other IARC's. Therefore, the workshop suggested, "the program should take a decision whether one or both goals to be given priority." It also recognized that at present, "the CIAT OFR Program is probably more readily prepared to offer training with an on-farm germplasm testing focus than whole farm OFR training." This is interpreted by the Panel as been more readily prepared to fulfill objective (a), and partially, (c).

116. The Panel agrees with this conclusion. In developing countries, national institutions are not adequately aware of existing farming systems. However, to provide adequate training in OFR/FSP, CIAT must first acquire more experience with a range of methodologies which can be compared (See Chapter XI). The Panel believes CIAT has not adequately clarified its objectives in carrying out on-farm trials.

### 2.7. Economics

117. The small economics team, comprised of one senior staff and two assistants, has divided its time more or less equally between work related to on-farm research (mentioned previously) and specific research on different topics.

118. Preliminary macroeconomic studies have been made on beans in Latin America, studying production, consumption, prices, international exchanges, agricultural policies, and the world bean market.

119. A study on bean consumption in Cali and Medellin, Colombia, carried out without direct participation of Colombian institutions, documented the degree of complexity of consumer preferences and gave information on the possible price movements of the different bean types as a function of supply. This information will be useful in the ex-ante economic evaluation of the transfer of technology to bean producers.

120. Such economic studies and continuing interchange among researchers has resulted in a critical analysis on the relationships among research, technology, and different social groups of bean growers, in particular small farmers. The Panel is of the opinion that this type of critical reflection can be of considerable importance in the orientation of research programs.

### 3. Staff and Facilities

121. At present there are 12 senior scientists core positions: one entomologist who works 90% of his time as Coordinator, three plant breeders, one pathologist, one virologist, one agronomist in Brazil, one agronomist in international germplasm, one agronomist in cropping systems, and one economist. One of the twelve positions, the microbiologist, is vacant and the physiologist position is currently filled by a visiting scientist. In addition there are four post-doctoral positions or visiting scientist, one of these being vacant. One Rockefeller Foundation funded anthropologist is stationed in Africa. There is a visiting scientist in plant pathology who will form part of the East African program. There are 25 research associates and assistants.

122. Outposted staff consist at present of nine scientists financed largely by extra-core funds: three scientists in Central America and Caribbean, a coordinator (pathologist), a cropping system agronomist, and one breeder funded by SDC; three in the Great Lakes area of Africa (Rwanda, Burundi, Zaire), one breeder, one pathologist, and one cropping systems agronomist (currently vacant) funded by SDC, and the above mentioned post-doctoral in anthropology. Funding for the other extra-core positions in East Africa (Ethiopia, Kenya, Uganda, Somalia) has been requested from the Cooperation for Development in Africa (CDA). Also, one agronomist is stationed in Peru under a bilateral agreement (see Chapter XI).

123. The expansion of outposted staff reflects the specific strategy of the Bean Program to strengthen local breeding programs, at the beginning with CIAT staff and afterwards, as the national institutions gradually strengthen, with the gradual phasing out of the CIAT staff. With this in mind, CIAT contemplates the gradual phasing out of the Central American and Caribbean Program with the exception of the regional liasion officer. The Panel commends the effectiveness with which this Program, led by an experienced senior scientist, has coordinated the human and physical resources of that area. It recommends that a similar model be used in other areas.

124. The recruitment of new staff has presented some difficulties as evidenced by the existing two vacancies; one has been vacant for three years, the other for five. However, the 1981-1982 budget constraints were responsible for CIAT keeping these positions vacant for more than two of these years.

125. The CIAT facilities are adequate at Palmira and in the substations and ICA collaborating research stations, with the exception noted in the germplasm section.

## 4. International Cooperation

### 4.1. Developing Countries

126. The Bean Program stresses the importance of strengthening the national programs by provision of germplasm, training and information. Finished breeding lines are provided for the small national bean research organizations and, as these develop, CIAT provides promising parental material and applied research methodology from which national programs generate their own finished varieties and associated cultural practices. Such decentralization and collaboration is clearly necessary to make efficient progress in bean improvement.

127. A good example is the Central America and Caribbean Project in which a bean research network has been formed that interacts positively with other countries of Latin America.

128. Horizontal transfer of varieties bred in one country has enabled other countries to release them, for example, Talamanca, a variety bred by ICA (Colombia) is one of the most important varieties in Costa Rica, and a variety released in Guatemala, ICTA-Quetzal, was also released in Argentina as DOR 41. A total of 476 local scientists and some extension personnel have been trained at CIAT. They speak the same scientific language, and have high regard for the CIAT liasion officer. The good working relationships between scientists has aided the solving of regional problems such as resistance to bean golden mosaic virus in Guatemala and Mexico, web blight in Costa Rica, and Apion in Honduras and Guatemala.

129. The Bean Program now faces a big challenge in Africa where, in time, a similar impact can be anticipated if the same ability to adapt to the local conditions is developed. In Africa, CIAT has requested funding from three different sources, SDC for Rwanda, Burundi, and East Zaire; CDA for Ethiopia, Kenya, Uganda, and Somalia; and SADCC for Southeastern Africa. Funding for the first project has been obtained. The Bean Program intends to place nine scientists in the three projects, coordinated by a scientist, possibly core-staff budgeted.

130. The initial research strategy is to test the most promising material in Africa and then make the appropriate crosses in CIAT-Palmira, followed by bulk breeding. Highly variable $F_4$ bulks, with appropriate disease resistance, are then sent to African national programs for individual plant and line selection. The national breeders will be assisted in this work by the project staff.

131. In general, the national bean programs visited by the Panel were very satisfied with the work of the Bean Program and were anxious to continue to collaborate. It is almost impossible for a national program to have the freedom of movement, interchange of ideas and materials which CIAT provides.

### 4.2. International Agricultural Research Institutions

132. CIMMYT provides advice on suitable maize material for trials with climbing beans bred in collaboration with the Instituto Colombiano Agropecuario (ICA). New maize germplasm for on-farm research, is provided by ICA, which works in close collaboration with CIMMYT.

133. With the AVRDC (Asian Vegetable Research Development Center), the Bean Program is breeding for resistance to the bean fly, a serious African pest. A good working relationship exists with IBPGR, especially since 1982 when the regional liasion officer for Latin America was posted at CIAT.

### 4.3. Other Institutions

134. Good collaborative research exists with Gembloux (Belgium), the University of California, Riverside, in interspecific hybridization and also with other CRSP (Bean and Cowpea Collaborative Research Support Program) universities, with the Institute for Horticultural Breeding (IVT), the Netherlands, in breeding for resistance to BCMV, and recently with several institutions in the United Kingdom. Also an agreement with INCAP (Guatemala) provides for selection for bean nutritional quality. The Bean Program should be complemented on the establishment of the linkages and encouraged to continue to seek additional joint relationships.

## 5. Review of Current Research Direction and Future Plans

135. The Bean Program continues to place its main emphasis on breeding for resistance, since it has the backup of two plant pathologists. The Panel considers that rapid progress in disease resistance breeding and improved understanding of disease variability should allow the Program to change gradually its emphasis as projected in "CIAT in the 1980s," as follows:

1) increasing its attention to yield potential under non-stress conditions;

2) tolerance to sub-optimal soil fertility (support from a soil scientist will be necessary);

3) increasing bean quality; improved knowledge and methodology is expected to become available, mostly through collaborative projects, which will enable the Program to breed for

improved protein content, reduced cooking time, and improved digestibility.

136. Further training on on-farm research has to be done to develop the capability of the national organizations to ensure that new technologies will perform well at the farm level. The Panel agrees with this, but suggests CIAT needs to clarify its thinking about on-farm trials and on-farm research.

### 6. Training

137. Training is considered a crucial component of the Bean Program strategy to promote the development of new bean technology. At the inception of the Program, two short multidisciplinary courses, aimed at national program research and extension specialists, were conducted annually. Subsequently, since 1978 the Bean Program has been offering only one annual course, of shorter duration (eight to five weeks), followed by a four month individualized, discipline-based training directed to researchers. Emphasis of the training has also changed for the better; previously much attention was given to the bean research network and the possibilities of germplasm and information exchange, but national problems are now taken more into account through the development of national program research leadership. In 1984 a new eight-week course in on-farm research methodologies has commenced, under Ford Foundation funding, as a pilot project.

138. Since 1978, 23 in-country courses have been organized (averaging six courses/year with about 25 participants over the last three years) by the Bean Program with decreased participation of CIAT staff. Their objective is to improve the capacity of national extension services to support the diffusion of newly released varieties and their appropriate associated agronomy.

139. Individual graduate research training in the Bean Program (M.S. and Ph.D. thesis preparation) has been useful to both the trainees and the Bean Program. The general assessment and recommendations on CIAT training activities, presented in Chapter IX, are relevant to the Bean Program.

### 7. Achievement and Impact

140. The Bean Program is a strong and active group. It has built an international research network in Latin America through the development of national bean programs and coordinates collaborative research work within and between countries. (See plant breeding section for more detail.) It also has accummulated a very important collection of bean germplasm.

141. It has provided lines and segregating material to the national research organizations, enabling them to release more stable varieties, resistant to the main diseases and pests. In the last years 40 varieties in 16 countries in the Americas and two in Africa were released, all being resistant to BCMV (which has been incorporated into all lines leaving CIAT). Some combine resistance to angular leaf spot, bean golden mosaic virus, anthracnose, common bacterial blight, and rust. Also many improved lines combine up to five desirable characters.

142. In 1982, the linkage between red seed color and susceptibility to BCMV was successfully broken, allowing the breeding of red-seeded resistant varieties.

143. The new varieties are beginning to be used by the farmers. For example: in Guatemala, according to preliminary data, 40% of farmers in certain regions have adopted the new varieties; in Costa Rica in one important bean area, over 50% of the farmers; in Nicaragua, it is estimated that from 20 to 30,000 hectares are planted to them; in Cuba, about 25,000 hectares, and in Argentina, 30,000 hectares. These varieties are beginning to spread to the other countries.

144. New plant types have been developed with improved plant architecture. The understanding of the temperature and photoperiod response and their interaction has provided an adequate methodology for breeding. Also new breeding methodologies have been developed.

145. In several countries productivity has begun to increase. However, because most national statistics for beans are weak, it is impossible to make accurate estimates. For that reason, the Program intends to have two research associate economists to evaluate the impact of bean improvement in Central America.

## 8. Constraints and Weaknesses

146. The following constraints are noted:

1) There is difficulty in recruiting senior staff, exacerbated by budget limitations during two and a half years.

2) The Bean Program core staff scientists each publish about one paper in scientific journals per year, less if the post-doctorals and visiting scientists are included. CIAT is developing important information on new breeding methodologies, new breeding material, new diseases and their control. However, CIAT does not sufficiently encourage publication of such findings in scientific journals, even though they are shared with other research workers in the "Hojas de Frijol," a bean newsletter, which is only published in Spanish. The Panel recommends that research staff should be encouraged to publish their work in international scientific journals.

3) Because of budgetary restrictions it is not possible to bring enough specialists from the developed world to CIAT for discussions. The Panel suggests that a special effort be made to invite eminent scientists to CIAT to discuss the work of CIAT staff to strengthen the ties with the international community.

4) There is a lack of continuity of the professionals in the national organizations, and the lack of contact between national research, extension and seed producing institutions, retard the progress of the Bean Program.

## 9. Assessment

147. The Panel considers that the Bean Program has made important progress and is fulfilling its stated objectives in collaboration with the national programs. The Panel approves the expansion of the Program into its mandate in Africa with the qualifications about such expansion given in Chapter XI.

### 9.1. Implementation of the Recommendations by the 1977 QQR

148. A third plant breeder for P. lunatus was recommended but the recommendation did not receive TAC's endorsement. The third plant breeder was hired for breeding in P. vulgaris.

149. It was recommended that better information be obtained on the location and extent of the different ecological zones in which beans are grown. A preliminary classification of bean growing areas into 110 microregions based on climatic data has been made and a data base on climate, soils, and cropping systems assembled.

150. As recommended by the 1977 QRR a new postquarantine greenhouse for screening seed lots was built. There still exists some quarantine problems as mentioned in the section on germplasm.

151. Training courses for the production and multiplication of clean seed have been given by the Seed Unit.

152. Problems with the identification of new diseases have been solved.

## 10. Recommendations

153. The Panel recommends that a greater effort should be made in breeding for higher yield potential under conditions of higher soil fertility.

154. The Panel recommends that a solution be found as soon as possible to allow the movement of seeds from high risk to low risk areas, in order to allow the evaluation of the whole bean collection and to facilitate the movement of seeds, especially from Africa. (Also see seed pathology proposal in Chapter VIII and Chapter X.)

155. The Panel recommends that strong efforts be made to fill the vacant position of the microbiologist and plant physiologist. In the meantime, ways should be found to further share the services of the microbiologist of the Tropical Pastures Program.

156. The Panel recommends that a study of the importance of snap beans should be made.

157. The Panel recommends that publication of the important results be encouraged in international scientific journals.

# CHAPTER IV - CASSAVA PROGRAM

## 1. Background and Objectives

158. Cassava originated in the Americas where it has been a major staple food in the tropical lowlands since the pre-Colombian period. It spread quickly from Latin America to Africa and Asia where it has become important as a human food and for processed products. During the colonial period it was developed for export as starch or tapioca pearl or as a famine reserve crop.

159. Today cassava continues to be a food crop for humans in Africa, and parts of Asia and Latin America. In the tropics it ranks fourth, after rice, sugar cane, and maize, as a source of carbohydrates produced and consumed in the tropics. For Thailand, it has also become a major export commodity for animal feed, and has been considered a potential raw material for ethanol alcohol production. It can be used in bakery products as a partial substitute for wheat flour.

160. Cassava is grown mostly by small farmers, mainly under subsistence conditions, although some large farms produce it also. It is well suited to acid, low fertility soils, and was long considered a "poor man's crop". It tolerates drought well and can be left in the ground for long periods.

161. Because of its hardiness and adaptation to marginal conditions, cassava has readily found a place in shifting cultivation and on farms where multiple cropping is practiced. In Latin America, where 60% of cassava farmers cultivate 10 hectares or less, about 45% of the cassava area is intercropped. Maize is the most common intercrop. Few or no purchased inputs are used to grow the crop, and land preparation and labor are usually the major costs for farmers growing cassava.

162. World cassava production is about 130 million tons, of which about one-fifth is produced in Latin America (75% of this in Brazil), and about 40% each in Africa and Asia. Brazil is the largest producer followed by Thailand, Indonesia, Zaire, Nigeria and India. In general, while world production is rising, annual production gains are lower than in the major cereals,and entirely from increase in area planted. In Latin America, where cassava is principally used directly for human food, production is about static or even decreasing.

163. Cassava has a limited research history. Few scientists were involved in cassava research before World War II, and these persons were isolated so that information exchange was limited. Therefore, when CIAT and IITA were established and given research responsibilities for cassava, knowledge concerning the crop was limited. A whole new

cadre of scientists had to be mobilized to comb the literature, consult with older researchers who had pioneered in Asia, Africa, or Latin America, and begin to assemble germplasm. Impressive progress has been made since that time.

164. One of the first challenges was to learn as much as possible about cassava as a crop plant, its growth and yield potential, its behavior under different types of management, its breeding behavior, pests and diseases.

165. New breeding programs were established, building as much as possible on the experiences of past programs in the colonial period and in Brazil. At first CIAT adopted a strategy of wide adaptability, but this proved unsuccessful, and a shift was made to developing cultivars for specific conditions. As research progressed, old ideas about cassava had to be discarded. Despite its hardiness, cassava can be attacked and damaged severely by pests and diseases, and it responds to fertilizers and to weeding. Researchers continued to confirm its high yield potential under conditions less favorable for other crops. When studied further, cassava turned out to be a hardy, productive plant with considerable genetic potential for improvement and quite well adapted to improved management.

166. Since its inception in 1971, the CIAT Cassava Program has made considerable advances in research and training and in encouraging the development of national research programs. They have built a sizable germplasm collection which has been useful in breeding.

167. The breeding program has distributed improved material which is in an advanced stage of selection and evaluation by countries in Latin America and Asia. However, while rice production in Latin America during 1960-1980 rose 3.4% annually, maize by 2.9%, and sorghum by 11.4%, cassava production increased only 1.7% per annum. In the same period cassava production in Asia rose 7.8% annually.

168. The main explanation for the virtual stagnation of cassava production in Latin America is that traditional markets for the crop are more or less in equilibrium. New end-uses have to be found if demand is to increase but the greater use of cassava by industry will depend on government policies. For example, subsidies on locally produced and imported wheat make it difficult for cassava to compete as a substitute for cereal flours in bakery products. In the last decade food consumption patterns have changed and a result has been major growth in the poultry industry. However, this coincided with easy availability of international credit which allowed Latin American countries to purchase grain at very competitive prices on the world market. At present the situation is changing and these countries may increasingly be forced to find a substitute for imported grain.

169. This situation has influenced the current CIAT Cassava Program. Thus in Latin America emphasis is on methods to improve cassava utilization, particularly on the development of methodology for small-scale production of dried cassava for animal feed (for

poultry and swine) and on extension of shelf life as a possible means of increasing consumption of fresh cassava. These are simple technologies which may have application elsewhere.

170. In Asia the situation is different. Compared with Latin America the outlook for cassava is relatively buoyant with a great variety of end-uses for home consumption and for export and domestic markets. There CIAT has a more traditional role of generating improved varieties and production technology.

171. The Cassava Program possesses a highly motivated and experienced staff, a considerable body of research information and technology where little existed before, an impressive and important germplasm collection, and a network of former trainees, particularly in Latin America and Asia. It wishes to use these advantages to improve cassava production around the world. Its present objectives and future plans have been developed with that goal in mind.

172. The objectives of the Cassava Program are to: (1) develop germplasm and cultural practices based on low-input levels and responsive to improved management to increase cassava productivity in areas where cassava is presently grown; (2) develop germplasm and cultural practices based on medium-input levels to increase cassava production in the acid, infertile soils of the lowland tropics; (3) develop systems to reduce perishability of cassava and allow more efficient use of cassava for direct and indirect human consumption; (4) strengthen national cassava research and development programs so they may more effectively carry out their role.

173. The principal ways in which CIAT plans to achieve its objectives are by: (1) developing a strong research program; (2) transferring both the technology of improved production systems and of improved genetic materials to national agencies for further development and application to local situations; (3) contributing to the training of scientists and personnel of development institutions in national programs, at CIAT and in the countries concerned; (4) cooperating with national institutions in promoting the integration of research in production, utilization, and marketing of cassava by supplying technical advice.

174. The Program has changed its objectives slightly since the 1977 QQR, placing more emphasis on reducing losses of the perishable roots by processing and on strengthening national programs and improving international cooperation. The Program considers that reduction of root losses because of perishability is such a major need that improved genetic materials and production practices may be wasted unless food end-use or processing are considered as an integral part of production.

## 2. Program Activities

175. The Cassava Program comprises biological, economic, and processing activities.

### 2.1. Agroecological Studies

176. The cassava breeding program began with the objective of breeding for wide adaptability. This was soon found to be unrealistic given the wide range of environmental conditions under which cassava is grown, and led to the characterization of cassava-growing systems into six edaphoclimatic zones (ECZ) based on climatic and soil factors and each with its characteristic pest and disease complex. The six zones are (1) lowland tropics with long dry season, low to moderate annual rainfall, high year-round temperature; (2) acid soil savannas with moderate to long dry season, low relative humidity during dry season; (3) lowland tropics with no pronounced dry season, high rainfall, constant high relative humidity; (4) medium altitude (800-1500 m) tropics with moderate dry season and temperature; (5) cool, tropical highland (1600-2200 m) areas with mean temperatures of approximately 17-20°C; (6) subtropical areas, with cool winters and fluctuating daylengths. All but ECZ6 are found in Colombia. This permits decentralization of the selection process. It enables CIAT to send collaborating countries germplasm matched to their specific environmental factors. Greatest emphasis is put on breeding for ECZ1, followed by ECZ2. A limited input is put into ECZ5 and ECZ4 which are relatively unimportant in terms of world cassava production. More effort than at present needs to be put into ECZ3 and ECZ6. Zone 6 screening is done temporarily in Cuba, but this is seen only as an interim measure until resources are available for the Program to establish work in a better location.

### 2.2. Germplasm

177. Since the 1977 QQR the cassava germplasm collection has increased from about 2400 to 3400 accessions. In addition to storage as seeds in a cold room, two-thirds of the collection is held in *in vitro* culture. CIAT, in collaboration with the IBPGR and national programs, plans to continue collections of wild and cultivated cassava with major emphasis on material from edaphoclimatic zones poorly represented in the collection.

178. Basic descriptors for cassava have been defined by an IBPGR working group and more than half of CIAT's collection has been evaluated using these descriptors.

179. Germplasm evaluations have shown that extensive variability exists for all important agronomic traits so that genetic improvement will play a key role in increasing productivity. Yield potential of most accessions is low. Although cassava as a species is adapted across a wide range of environmental conditions, most individual clones are narrowly adapted to the conditions of the region where they

evolved. Levels of resistance to diseases and pests combined with high yield capacity in current varieties are generally not adequate for the more intensive production systems envisaged for cassava in the future.

180. Work on cryogenic storage at the Prairie Research Laboratory in Canada, with the collaboration of CIAT and funded by IBPGR, aims at storing cassava meristem tips in liquid nitrogen as a basis to achieve long-term storage of vegetative materials. Plants have been recovered, though at a low rate, from meristem tips maintained in liquid nitrogen for brief periods.

### 2.3. Plant Physiology

181. Plant physiology research has provided a sound basis for breeding and management work. The characterization of an ideal plant type has aided breeders in their search for suitable parents to be used in making crosses. The ideotype also provides a basis for comparison between plant types in studies on effects of temperature, moisture stress, daylength, and plant injury.

182. Water stress studies have shown that when water is not available, cassava reduces leaf production and, in the end, raises harvest index. Stomata of cassava are very sensitive to changes in the humidity of the air, leading to very high water use efficiency in the crop and relatively high yields under low water conditions.

183. When soil nutrients are limiting, cassava maintains the nutrient content of the leaves but reduces leaf area index and increases harvest index.

184. At low temperatures leaf area development is reduced, and leaf life and harvest index are increased. Varieties can be separated into genotypes for different temperature conditions; one set of genotypes serves for temperatures of 20-22°C and above, another for temperatures of 20°C and below.

185. The effects of photoperiod on cassava, which is known to be sensitive, have been further elucidated. Long days bring about increased top growth and thereby decrease dry matter distribution to the root.

186. Cassava can tolerate some insect and disease attacks because it has the capacity to recover after damage. A major finding is that near ideal plant types are able to recover less easily than less ideal types, and therefore ideal type plants suffer more irreversibly from damage. Therefore, high yield potential must be coupled with greater sources of resistance, or greater levels of plant protection, if stable yields are to be maintained.

### 2.4. Plant Breeding

187. The basis of a successful breeding program is a broad-based,

well maintained, and thoroughly evaluated source of genetic variability. The cassava germplasm collection is a primary resource for CIAT in its improvement work.

188. Basic breeding methodology is designed to improve source populations gradually and progressively by recurrent selection. The parental material evaluations are made in the major ECZs.

189. Over 100,000 hybrid seeds per year, each seed being a potential variety, are produced by a combination of controlled and open-pollinated crosses in specially designed polycross blocks. About one-third of the hybrids are used in the Colombian-based programs, the rest go to cooperating countries and IITA. Hybrids pass through a standard series of evaluation from individual $F_1$ plants through regional trials for advanced selection. For each ECZ, the selection criteria are good germination ability, erect plant type, moderate branching, high yield, high harvest index, and high root dry matter content.

190. Stability of performance across years is critical to the process of selection of a new variety, and any clone coming through the selection process has had a minimum of five years of evaluation before being recommended to national programs for testing. The lead time from seed to release of a successful variety may be 10-12 years. Thus, materials distributed in 1974 or 1975 are just beginning to be released by national programs.

191. Best local materials with improved management give twice the yield of those materials in traditional systems. Best CIAT materials combined with improved management practices yield three to four times the levels of traditional systems.

192. Several disciplines, mainly entomology and plant pathology, work closely with the breeding programs, providing screening methodology and support.

### 2.5. Plant Protection

193. Work in cassava pathology has focussed on problems related to botanical seeds, vegetative propagation material, the crop during the growing cycle, and preharvest root rots.

194. Since 1978, seven viruses, one mycoplasma, two bacteria, and three fungi that cause diseases in cassava have been identified and the etiology described for some. The epidemiology has been worked out only for some of these diseases.

195. Crops grown from meristem culture taken from the traditional cropping system have substantially higher yields than crops planted from unselected stakes taken from the same source. The reason is not understood. It could be related to a latent virus complex, underscoring the need for follow-up studies on the cause and practical application of these findings.

196. Recent work has shown that the incidence of viral diseases in the Americas has been underestimated. Several viruses affect the yield potential of cassava. This has implications for the movement of germplasm between countries.

197. The cassava common mosaic virus occurs in South and Central America. It is readily sap-transmissible and has been purified. Thus antisera are available so that indexing presents no problem. Unfortunately, this is not true for other potentially damaging viruses. A suspected virus disease, frog skin, reported for the first time in 1971 in the Department of Cauca, had caused a 90% reduction in the area planted to cassava in one area by 1982, although cassava area is increasing again as a result of an integrated control campaign by ICA in collaboration with CIAT. The virus is transmitted by the whitefly and thus has an epidemic potential both in Colombia and tropical Africa.

198. The situation with regard to Caribbean cassava mosaic disease is also threatening. The cause is not known and therefore no reliable indexing procedure exists for this disease. In addition to these two diseases for which the etiology is yet to be determined, two viruses have been recorded in Brazil and a latent virus found recently at CIAT is reported to affect a high percentage of cassava clones existing in the Americas. CIAT has asked for ODA support in contracting research at the Scottish Crop Research Institute to elucidate the complex of viruses in cassava and to develop indexing methods. This work will be highly important for reducing the risk of disease transmission in cassava. The Panel suggests that this project should be linked to the African virus complex and that close liasion be maintained with ongoing virus work in the Netherlands which is in support of IITA. Meristem culture can be used to eliminate some viruses from propagative materials, but the efficiency of this procedure varies with the pathogen.

199. In the short-term, CIAT must balance the possible danger of disseminating diseases of unknown etiology with the potential benefits arising from the release of germplasm. The Panel considers this a matter of significant importance for CIAT and IITA to address concerning the exchange of germplasm. It is recognized that no phytosanitary precautions can be fully risk-free, and if precautions are so strict as to make it very difficult to exchange germplasm, others will circumvent the rules increasing the chances of spreading pests and diseases. The Panel recommends that CIAT and IITA meet at an early date to redefine firm guidelines which reduce the risk of spreading diseases to an acceptable minimum. The Panel calls the attention of TAC to this issue as one that it believes should be further examined in the context of establishing firm guidelines on phytosanitary precautions for the Centers, which must be seen to be beyond reproach in this matter.

200. The cassava entomology program directs its efforts largely to seeking resistance to mites, thrips, whiteflies, mealybugs, and lace bugs. Studies are made of resistance mechanisms. Varying levels

of resistance have been identified for thrips (excellent), mites (acceptable), and whiteflies (acceptable in terms of virus transmission). Preliminary indications are that varietal resistance to mealybugs exists.

201. Special emphasis has been given to the biological control of the mealybug, mites, and the cassava hornworm. CIAT collaborates with IITA and the Commonwealth Institute of Biological Control, Trinidad, to identify parasites and predators of mealybugs and mites for introduction into Africa where mealybugs and mites were introduced, probably on infected material, in the 1960s and are now causing large losses in production. CIAT has sent several biocontrol agents to IITA.

202. Tests are underway on use of a virus disease to control the cassava hornworm. Bacillus thuringiensis can also be used for its control. Regarding the virus biocontrol work in hornworm, the Panel recommends that, before the work is taken to larger-scale trials, testing of the virus for its safe use be carried out by an appropriate institution with special expertise in this field.

### 2.6. Agronomy

203. CIAT has developed a complete package of low cost practices for cassava "seed" production including agronomic and phytosanitary management and storage. It has been shown that the spatial arrangement of planting can be changed without affecting yield, a finding which has implications for multiple cropping and for erosion control.

204. Some of the factors affecting optimum plant population are plant type, rainfall, soil fertility, and the probable final use of the roots. Research indicates that for the majority of plant types, climatic and soil conditions, and required root size, a density of not less than 10,000 plants/hectare at harvest is adequate. For low fertility soils and where dry season stress may result, around 15,000 plants/hectare may be needed since plants will grow smaller than under better conditions.

205. Stake length and stake planting position have been studied and lead to the recommendation that the length be no less than 20 cm. Stake selection and treatment can dramatically increase yields. For stake selection simple criteria such as selecting healthy plants with good production and no virus symptoms, selection of cuttings with no diseases or discoloration, with minimum requirements for thickness and node number, coupled with cheap fungicidal and insecticidal treatments are the key to obtaining good stands and high yields in cassava. A successful storage method for stakes has been worked out that permits storage for up to six months. In some CIAT experiments, vertical planting of stakes was found to yield up to 22% more than horizontally planted cassava.

206. Ridge planting is suggested for higher rainfall areas and in

poorly drained soils. Otherwise, cassava may be planted on the flat. Weed control is important mainly in the first 90-120 days of growth.

207. In Latin America and Asia cassava is frequently planted on steep slopes, where soil erosion can be a problem. Trials at Mondomo (Colombia) where slopes are 40% showed most promising treatments to be (1) planting in a hole without plowing, with added fertilizer and weeds cut and left as a mulch; (2) planting double rows narrowly spaced apart on plowed ground, but without plowing of the intermediate strips, and fertilized.

208. About 40% of cassava in the world is intercropped. Mixed cropping with cassava is complex and was not well understood. Since the 1977 QQR, CIAT has developed basic management practices for cassava intercropped with beans, cowpea, groundnut, and maize.

### 2.7. Mycorrhiza

209. Cassava is generally grown on soils with very low available phosphorus (P) content and is very efficient in obtaining P from these soils. The reason is the beneficial association of cassava with mycorrhizal fungi that live on plant roots and which are present naturally in many soils. In very poor soils, mycorrhizal strains may not be very efficient. CIAT has collected approximately 300 strains of mycorrhiza, mostly in Colombia, and has found that some strains are much more efficient than others. Seventy of these have been evaluated in the greenhouse. Competition studies between the strains have also been conducted. Substantial yield responses have been obtained in cassava by inoculation of mycorrhiza using unsterilized soil in experimental plots.

210. The adaptation of mycorrhizal strains to different soil temperatures and to different P application levels, field inoculation trials, and the effect of agricultural practices on the native mycorrhizal population are being studied and provide a valuable basis for future work.

211. The Panel commends CIAT for its work on mycorrhiza and urges that it be continued at about the same level. The Panel wishes to caution, however, that since mycorrhiza cannot presently be cultured in the laboratory on artificial media but are entirely dependent on soil or plants for survival, that extreme care be taken to ensure that soil-borne plant pathogens are not spread through use of mycorrhizal inoculum or cultures.

### 2.8. Plant Nutrition

212. Most fertilizer trials in Latin America show the greatest response of cassava to phosphate, followed by potassium and nitrogen. The crop has been found to be particularly susceptible to magnesium and zinc deficiencies, although large varietal differences exist in the requirements for these two nutrients.

213. It has been shown that zinc deficiency can cause severe yield losses in cassava. Zinc deficiency is widespread and can be partially corrected by dipping stakes in a zinc sulfate solution.

214. Although cassava gives some yield at extremely low fertility when many other crops fail, it responds well to fertilization under certain conditions. The most efficient methods and times of application have been determined for most nutrients.

215. Cassava is very tolerant to acid, infertile soil conditions but it has been found that the crop may respond to lime, and more so when the soil fertility is raised by application of fertilizer.

216. Cassava grows well on poor soils; however, it cannot continuously be grown without special attention to maintenance of soil fertility. The Program has developed fertilizer regimes that can maintain high levels of productivity of cassava on poor soils. Fertilizer may be required in the first year of cropping, even though no response is obtained, if good yields are to be obtained in subsequent years.

217. Screening of germplasm for tolerance to acid and low-P soils has been done in the Colombian Llanos and at Quilichao where there is less disease pressure. Some clones show tolerance; breeders are now using them as parents and will be evaluating their progeny.

### 2.9. Economics

218. The lack of active demand for alternative uses of cassava in Latin America has recently been the main concern of the economics group and economic studies have been done. 1/

219. In Latin America the fresh cassava and starch markets are expected to remain stable. The markets for cassava as a substitute for wheat flour and as animal feed show promise. In Asia the cassava export market is presently stable. The use of cassava for alcohol production results in a 70% energy waste in the current process, and therefore the future of cassava as a source of energy is questionable.

220. About 65% of cassava world production is for human food. However, the proportion for human consumption varies greatly among continents. Cassava is of major importance for human food in Africa. In the Americas cassava is used mainly for human food, with some off-take for animal feed, while in Asia it has a wide variety of end-uses for human consumption both on the domestic market and as an export crop. In all three continents it has less importance as an industrial crop.

221. The developing world has undergone a virtual explosion in

1/ For example: J.K.Lynam and D. Pachico, Cassava in Latin America: Current Status and Future Prospects (unpublished, Cali, November 1982) and J.K. Lynam, Cassava in Asia (unpublished, Cali 1983).

the demand for and production of livestock products, even in land-scarce Asia. The largest growth rates have occurred in poultry. Poultry numbers have increased at a 6.1% annual rate in South America and 3.7% in Africa in the 1975-1981 period. This has generated a rapidly expanding demand for coarse grains, much of which has had to be met by imports. Debt burdens of many tropical countries are now severely limiting the ability of these countries to sustain these growth rates in meat production through imports. Cassava may provide a practical way of meeting this demand through increases in domestic supplies.

222. Althoug efforts were made to persuade the Panel that potential demand for cassava was likely to increase substantially, the Panel sensed that there was variability between CIAT staff about the adequacy of existing information on cassava demand. None of the papers shown to the Panel provided convincing evidence for a likely significant upturn in the cassava market in the forseeable future.

223. Some further studies on potential for cassava need to be done in order to understand better the markets for human food and livestock feed. The Panel recommends that such a study be carried out and that CIAT uses its results to help determine the scope and direction of the Cassava Program. The study should examine cassava's present and potential competitive position relative to other basic energy sources for human food and animal feed, both in world markets and more importantly in the internal national markets.

224. It is envisaged that the national programs should be involved in a meaningful way in the study. CIAT should use the results of the study to decide where it will go in the future with the Cassava Program. A crucial matter is the demand for cassava products in Latin America, since CIAT places heavy emphasis on its work in Latin America. The analysis should be done by an external institute or agency, in collaboration with CIAT, and should pay attention to agronomic, processing, and socioeconomic aspects of cassava's competitivity.

225. The Panel suggests that several alternatives are possible depending on the outcome of the study: (1) If the study shows a possible increased demand for cassava in the world, and particularly in Latin America, CIAT should consider a full scale program focused on Latin America and providing germplasm and aspects of improved technology to Asia and, in cooperation with IITA, to Africa. (2) If the study shows little hope of increasing demand for cassava, particularly in Latin America, CIAT should consider tailoring its program to meeting its responsibilities as a major germplasm center for the world, giving priority to collection, characterization, evaluation, and prebreeding of germplasm targeted for specific needs of national programs. Such a program would take full advantage of the excellent team of scientists currently working at CIAT and would provide a major scientific resource for training. (3) If the study is inconclusive, CIAT should consider moving toward the germplasm model discussed in (2) until the time conditions warrant a change.

Meanwhile the Panel recommends that until the study is completed the Cassava Program should remain at current core-funded position levels, so as to provide necessary flexibility for action after the Center decides on the future course of the Cassava Program.

### 2.10. Cassava Processing

226. Cassava roots will start to deteriorate in as little as two days after harvest. A TDRI (formerly TPI) project co-financed with CIAT has developed a simple storage method which is well suited for use by small farmers and wholesalers and could lead to greatly reduced marketing margins and increased consumption. It consists of packing roots in plastic bags to prevent physiological deterioration and the use of a small amount of fungicide to prevent microbial deterioration, the fungicide is of extremely low human toxicity and approved by FDA of the United States.

227. CIAT is participating on the Atlantic Coast of Colombia in a cooperative project with the Integrated Rural Development Program of Colombia and the CIDA, which has established small-scale plants for the production of dry cassava for animal feed. Some modification and improvements have been introduced. The number of plants is increasing as well as the size of the concrete floors where cassava chips are dried. This example has stimulated interest elsewhere. Panama and Mexico have built drying systems and Dominican Republic, Cuba, Ecuador, Venezuela, and Jamaica are interested in the system.

228. Research and development work is now being carried out on through-circulation-bin-drying of cassava chips with the aim of being able to introduce drying in areas of the tropics with high relative humidities or prolonged wet seasons. The choice of fuel to heat the drying air will depend on local availability and cost.

229. Even though the results to date have been promising there is a need to keep in mind the risks that will be involved as the numbers of small drying plants increase. Variation in quality, particularly of moisture content, could be a constraint.

230. The objectives of the CIAT postharvest utilization storage program are specific and emphasize the following principles: (1) small-scale drying, (2) storage of fresh roots for human food, (3) flour or feed as end-products of processing. These objectives appear to be practical and reasonable.

## 3. Staff and Facilities

231. The Cassava Program is staffed by eight senior scientists, one of whom is Program Coordinator, supported by 19 associates and assistants and 112 other staff members. In addition, two post-doctoral and two visiting scientists are working with the team. The Coordinator is a plant physiologist and the senior staff consists

of an entomologist, a pathologist, a breeder, a plant nutritionist, an agronomist, an economist, and an outposted research breeder in Asia.

232. The Long Range Plan projected a Cassava Program consisting of 10 headquarter-based senior staff positions in 1982, rising to 11 in 1983, to 12 in 1985, and 13 in 1986. In total, this represented 15 core-funded senior positions by 1986. Due to budgetary limitations in 1982, two filled senior staff positions were lost (utilization specialist, international cooperation and regional trials), reducing the Program to eight positions as at 1983.

233. For its work at CIAT headquarters the team has laboratories for physiology, pathology, and entomology. The virology laboratory is shared with the Bean Program. The Program is serviced by the Meristem Culture Laboratory and there is a small utilization laboratory. Biometric services and greenhouse facilities are available. There are ample field facilities available at CIAT-Palmira, Carimagua, Popayan, and Quilichao stations, as well as on-farm sites that cover five out of the six ECZs. Support services are available at all stations for the various components of the Program.

### 4. International Cooperation

234. CIAT has played an important role in the establishment of national cassava programs. Different strategies are used in assisting these programs, depending on the size of the country and the resources each program commands. The Program is also actively engaged in collaboration with donor-funded projects in the developing world.

235. A crucial relationship is that with IITA. At present, relationships are less than those desired. The Panel recommends that CIAT and IITA meet soon to iron out their respective working relationships and responsibilities. This matter is discussed in more detail in Chapter XI (International Cooperation).

### 5. Training

236. Training is an essential component of the Cassava Program. At the inception of the Program, mainly long duration (a year or more) general courses were provided. The first trainees often became responsible for establishment of cassava programs on their return home. Subsequently, this type of training has continued but more emphasis was given to training courses in which short-term intensive instruction in cassava production and research was followed by disciplinary training. Specialized courses have been given on meristem culture techniques, pest control, and processing. CIAT has helped some countries hold their own in-country training courses, which usually are short duration production courses.

237. At a higher level of training, associate researchers and visiting scientists have the opportunity to do their Ph.D. and M.S. thesis research at CIAT. General assessment and recommendations on the type of training activities are presented in Chapter IX.

## 6. Response to the 1977 QQR

238. Five recommendations regarding cassava were made by the 1977 QQR Panel. These were: (1) Strengthen cassava linkage with IITA. An agreement was signed between the two centers in November 1978; however, "the nature and level of cooperation need improvement." (2) Further collection of cassava and wild species. Although more collections are planned, considerable progress in collection was made in coordination with IBPGR and national programs. (3) Continuing studies on long-term effects of cassava cultivation on status of plant nutrients in soil. A full-time cassava nutrition scientist was added, and long-term experiments were initiated in Quilichao and Caicedonia, and on the North Coast. (4) Expand work on storage technology at small village and small farmer level (not industrial use). Progress has been made in developing improved storage technology for fresh cassava roots and village-level chipping and drying methods. (5) Storage of cassava foliage (silage, etc.) and large-scale cattle feeding trials to be continued and expanded. Some work on cassava silage was conducted before budget cuts forced its discontinuation. Cattle feeding trials with cassava foliage were completed in 1978. The Panel observed ensiled cassava in Brazil and Cuba.

## 7. Achievements and Impact

239. The Program has accomplished a great deal scientifically since the 1977 QQR. A strong scientific team has gained valuable new information concerning the cassava plant and its behavior as a crop, a significant accomplishment when one considers the paucity of information on cassava when the Program began. Some of the notable scientific achievements have been:

1) Elucidation of the physiology of cassava and its response to temperature, daylength, drought, leaf or stem damage. The definition of the plant ideotype has been helpful for breeders and for scientists who need a basic plant to use for comparative studies. The findings that stomata of cassava are very sensitive to air humidity and thereby protect the crop during drought stress, and that cassava has considerable elasticity in recovering from damage, are important.

2) Work in plant pathology has identified seven viral, one mycoplasmal, two bacterial, and three fungal pathogens since 1978, and their etiology has been established. Rankings of importance of diseases in each of the five ECZs have been completed.

3) Numerous insects and mites attacking cassava have been identified in Latin America where pest diversity is greatest. The biology and ecology of these pests have been worked out by CIAT or its collaborators.

4) Evaluation of the germplasm collection has identified sources of resistance to several pests and diseases. Superior, high-yielding clones have been identified and have been distributed to national programs. Some varieties based on CIAT germplasm are being released by national programs. Edaphoclimatic zones (ECZs) have been delineated to provide a better basis for breeding and specifying materials for use by national programs.

5) Mycorrhizal relationships in cassava have received considerable attention and a collection of mycorrhiza from Colombia has been assembled. The finding that some lines of mycorrhiza are more efficient than others in obtaining phosphorus from less soluble P forms has promising implications for areas with infertile soils.

240. A considerable body of knowledge concerning potential improved cassava production in Latin America has been developed. Despite this knowledge, however, the impact of the work in Latin America is limited. Because of the 10-12 years lead time required to develop new varieties, new lines based on CIAT germplasm are just now being released by national programs. Cuba has adopted CIAT germplasm and production technology of cassava growing on a large number of state farms and cooperatives. This consists of careful selection and treatment of planting material, planting on ridges, reduced irrigation and insecticide applications. Cuban officials claim substantial production increases, as a result of the use of the "Colombian system" and also by use of early varieties introduced from CIAT, which have extended the period of the year when cassava is available. However, it should be noted that available statistics indicate that increased production has resulted largely from increased production on state farms.

241. On the North Coast of Colombia the use of improved technology,as well as CIAT-developed varieties is spreading. A survey in the early 1970s suggested that yields were of the order of five tons/hectare in the region. Preliminary results from another survey presently underway suggest that yields are now of the order of eight to twelve tons/hectare.

242. Several countries have established national cassava programs with CIAT's help. The CIAT training program has played a key role in this. The training of Thai, Indonesian, and Malaysian cassava breeders at CIAT has been a major factor in the establishment of cassava breeding programs in these countries. Asian countries receive $F_1$ seed from the Center and material of CIAT origin is at an advanced stage of evaluation and is likely to dominate forthcoming releases of clones to farmers.

## 8. Future Plans

243. The overall strategies of the Program were outlined previously in the objectives section. The only major addition has been the placing of more emphasis on the development of integrated production, processing, and marketing projects by individual countries in Latin America.

244. Plans (selected areas shown in parenthesis below) are to continue work in physiology (water relations, photoperiod, and techniques for synchronous flowering); plant nutrition and soils (including mycorrhiza and screening for low soil fertility); entomology (integrated control of major pest complexes, natural enemies, evaluation of host plant resistance); plant pathology (viruses, cultural control, safe international exchange of seeds, host plant resistance); and germplasm development (meristem culture, evaluation of the germplasm collection). An Integrated Cassava Production Systems Group is proposed to integrate research in production, utilization, and marketing of cassava. The Regional Cassava Program in Asia, where about 40% of world production occurs, will be staffed by a breeder and a regional liaison scientist, the former arrived in Bangkok in May 1983. A Regional Cassava Program in the American Subtropics would station a regional liaison scientist and a breeder in Brazil to establish a strong working base in ECZ6 which is not now being served as effectively as is desired.

245. The Panel considers the scientific work directed toward germplasm at headquarters and in the regions to be central to CIAT's work of supporting and strengthening national programs. Work that improves screening procedures for specific traits and the knowledge of cassava both as a plant and as a crop, can only enhance the exploitation of the germplasm collection for the benefit of tropical countries and strengthen training and cooperation.

## 9. Assessment

246. CIAT has assembled an impressive and capable team of scientists who have worked very hard to understand cassava and make it more productive. Much valuable scientific work has been done, and more is known about this previously neglected crop. The Panel commends the Cassava Program for its achievements in providing new information on cassava and its potential. The research in physiology, entomology, plant pathology, mycorrhiza, breeding, economics, germplasm, soils, agronomy and processing has provided insight for better production and utilization of cassava by the national programs. Some impact of improved germplasm is just beginning to be felt here and there. The question of potential future demand for cassava needs to be answered before CIAT can decide on its long-term directions for the Cassava Program.

## 10. CIAT's Comparative Advantage in Cassava Research

247. The Panel would like to make a few observations on CIAT's possible future role in cassava research which, of course, should be based on the comparative advantage of CIAT in this area. As the Panel sees it, CIAT has a number of advantages in cassava research: (1) a strong and experienced scientific team, (2) good research facilities across all but one of the six ECZs in Latin America, (3) a major germplasm collection, (4) considerable knowledge of cassava both as a plant and as a crop, (5) a good library, (6) a considerable number of former trainees in numerous countries, many of whom are or probably would be willing to cooperate in research.

248. For the long-term, it would appear that CIAT will increasingly assist national programs by providing superior or evaluated germplasm to meet their specific need. To do this will require systematic and careful scientific investigations to fully exploit the germplasm collection, which is probably the Program's most precious and important long-range resource and its major comparative advantage in working with national programs. Other assistance to national programs may be in working out screening methodology, providing fundamental information on sources of resistance, important pests and diseases, and sources of tolerance to stress. In addition, the Program can assist cassava networks, provide communications assistance and training.

249. To sum up, the Panel considers germplasm evaluation and prebreeding, the generation of knowledge, networking, and communications and training to be CIAT's major comparative advantages in cassava research.

## 11. Recommendations

250. The Panel recommends that IITA and CIAT meet at an early date to redefine firm guidelines, in the light of new techniques and knowledge, for sending cassava material to other countries without risk of spreading diseases.

251. Regarding the virus biocontrol work for cassava hornworm, the Panel recommends that before the work is taken to larger-scale trials, testing of the virus for its safe use be carried out by an appropriate institution with special expertise in this field.

252. Some further studies on potential for cassava need to be done in order to understand better the markets for human food and livestock feed. The Panel recommends that such a study be carried out and that CIAT use the results of the study to help determine the shape and direction of the Cassava Program; furthermore, CIAT should make arrangements with an appropriate independent institution experienced in such studies.

253. A crucial relationship is that with IITA. At present, relationships are less than are desired. The Panel recommends that CIAT and IITA meet soon to iron out their respective working relationships and responsibilities.

254. Regarding staffing, the Panel recommends that until the market study discussed is completed, the Cassava Program should remain at current core-funded position levels, so as to provide necessary flexibility for action after the Center decides on the future course of the Cassava Program.

# CHAPTER V - RICE PROGRAM

## 1. Background and Objectives

### 1.1. Background

255. Rice is a primary source of calories and protein in Latin America, especially among low income groups. Apparent per capita consumption of rice averages 51 kg. Total area planted to rice is about 8.8 million hectares, of which 24% is irrigated, 4% is rainfed lowland, and 72% is in various categories of upland rice. Respective average yields for these three rice ecologies are 3.5, 2.5, and 1.2 tons/hectare.

256. The relatively small Rice Program, which has been in operation since the beginning of CIAT, already has had major impact in increasing rice production in Latin America. Thus, the introduction of germplasm-based technology has led to additional rice production currently valued at 850 million dollars per year. CIAT also has had a large role in training, having trained 274 Latin Americans, representing 23 countries, in its Rice Program in the 1969-1983 period.

257. CIAT's mandate for rice, as stated in the Rice Program Report (30 January 1984) is: "CIAT has regional responsibility for rice in the Western Hemisphere within the CGIAR system. This regional responsibility implies that IRRI has principal responsibilities for rice on a global basis and that CIAT works in close collaboration with that center. CIAT takes on selected responsibilities especially (1) to generate improved production technology components for, and develop cooperative activities with, national research systems; and (2) to provide specialized in-service training for professionals from the countries in a manner which is fully coordinated with IRRI." Unique features of rice production in the Western Hemisphere, which indicate the need for regional research are listed in section 4.1.

### 1.2. Objectives

258. Specific objectives, from the Rice Program Report, are: "(1) to produce germplasm-based technology developed to overcome constraints of the irrigated system; (2) to develop new germplasm-based technology to improve productivity and stability of supply, particularly in the region's more favored upland rice environments; (3) to collaborate actively with IRRI, especially in the IRTP activities; and (4) to help strengthen national rice research programs through training and consultative visits, and to support the network of researchers which has been in effect for the last 10 years."

## 2. Program Activities

259. Program activities were directed at irrigated rice systems until 1982, when the upland rice effort was implemented. To better define rice systems CIAT has performed an agroecosystem analysis, in which six main cropping systems have been identified:

- irrigated rice, 2.1 million hectares;
- rainfed lowland rice, 0.4 million hectares;
- highly favored upland (no water stress, fertile soils), 0.9 million hectares;
- moderate favored upland (some water stress, fertile soils), 1.1 million hectares;
- unfavored upland (pronounced water stress and/or infertile soils), 3.4 million hectares;
- subsistence upland, 0.9 million hectares.

260. Breeding has been a principal component of the Rice Program from the beginning, with emphasis on semidwarfism, and disease and insect resistance. An agronomy program was added in 1971, initially for irrigated rice but now almost exclusively for upland rice. In 1976 CIAT and IRRI formalized the IRTP program for Latin America, to evaluate and distribute germplasm from IRRI and promising materials from CIAT and Latin American national programs. Plant pathology was added to the Program in 1977 in order to better address the changeable race situation in rice blast (Pyricularia oryzae). Economics has been addressed by a three-year post-doctoral appointment. Plant nutrition problems, which are largely iron and aluminum toxicity, have been handled by breeding for resistance.

## 3. Staff and Facilities

### 3.1. Staff

#### 3.1.1. Core Staff

261. The 1981 Long Range Plan (LRP) projected a core research staff of six: (1) an irrigated rice breeder (on board), (2) an upland rice breeder (on board), (3) an agronomist working full-time on upland rice (on board), (4) a pathologist divided equally between upland and irrigated systems (position temporarily vacant), (5) a physiologist for upland rice to be appointed in 1984, and (6) a projected economist position proposed for 1985. As a further part of its minimum core CIAT plans to provide a full-time Coordinator in 1985, in order to handle increasing regional responsibilities and projected growth in

extra-core activities. The Program has proposed the addition of two more core positions in the next two years: a breeder for the acid savannas (1985) and an outposted breeder for the Southern Cone subtropics (1986).

#### 3.1.2. Extra-Core Staff

262. The Rice Program has two extra-core funded staff: the IRRI-CIAT liaison scientist who handles IRTP activities and is stationed at CIAT headquarters, and the co-leader of the Peru-INIPA bilateral rice project who is stationed in Peru. Two more extra-core funded positions are projected for 1985: a regional coordinator for a proposed Caribbean Regional Network Project, and a CIAT-IRRI-EMBRAPA liaison scientist, to be located in Brazil.

### 3.2. Facilities

263. Facilities in Colombia include field, grain quality laboratory, greenhouse and screenhouse space at CIAT-Palmira, which is now used mainly for the crossing program and some evaluation services. The principal breeding site of the core program was moved from CIAT Palmira to Santa Rosa and La Libertad, in order to place the breeding program in a location more representative of the problems of the overall Latin American tropical area.

264. The Santa Rosa station, acquired in 1983, is the breeding site for favored upland and irrigated rice. Also in 1983, ICA provided long-term use of 16 hectares of acid savanna on its La Libertad station, adjacent to Santa Rosa, for upland rice, along with another La Libertad site for iron toxicity screening. Another Colombian site, at Nataima, is used for selection under irrigated conditions. CIAT also has access to two locations in Panama (Rio Hato and Tocumen), made available by IDIAP for collaborative work on upland and irrigated materials, as well as selection sites in Peru, made available by INIPA, for upland and irrigated rice work. Thus, most field research is now decentralized from CIAT headquarters.

## 4. International Cooperation

### 4.1. CIAT-IRRI Relationship Regarding Rice in Latin America

265. CIAT and IRRI have successfully collaborated in rice research for Latin America since the establishment of CIAT. Thus, the semidwarf variety IR8 from IRRI was released in Colombia in 1968 through a collaborative CIAT-Colombian rice research program. Many other semidwarf varieties, all tracing back to the semidwarfing source in IR8 or its DGWG ancestor, subsequently were released by national programs.

266. IRRI and CIAT collaborate under a memorandum of understanding, which notes, among other things, that IRRI has the

world mandate for rice research and training, while CIAT's mandate is for rice research and training in Latin America.

267. The need for a regional research program for Latin America is justified by the distance from IRRI and by factors unique to rice in Latin America:

- large-scale mechanization, little transplanting;
- specialized grain quality;
- acid soils, resulting in iron and aluminum toxicities;
- more variability in blast, especially in the acid soil-upland rice system;
- hoja blanca virus and its insect vector;
- greater severity of Helminthosporium, dirty panicle, and other diseases;
- highly developed infrastructure.

### 4.2. CIAT-IRRI-IITA-WARDA-IRAT Relationships Regarding Upland Rice

268. It appears that the collaborative roles among the IARCs for upland rice will be analogous to that for irrigated rice, i.e., IRRI has global responsibility while CIAT has regional responsibility in Latin America. IITA, WARDA, IRAT, and IRRI share regional responsibility for upland rice in Africa. A memorandum of understanding on IRRI-CIAT-IITA-WARDA-IRAT roles in upland rice has been signed. Collaborative efforts between CIAT and IITA on upland rice have already begun, and selected IITA materials have been found to have tolerance to the acid savanna soils of Latin America.

269. In general, the need for regional research on upland rice in Latin America is determined by the same unique factors as for irrigated rice (section 4.1).

270. The area of upland rice in Asia, Latin America, and Africa was estimated by IRRI (Report of the Second QQR of IRRI, p.81)[1/] to be 19, 5, and 2 million hectares, respectively. However, in the comparison between Asia and Latin America it is important to recognize that the percentage of upland rice, expressed as a portion of the region's total rice, is much lower in Asia (about 15%) than in Latin America (about 70%). Research proportions are in similar alignments: IRRI estimates that one quarter of its resources and 13% of its senior staff time is devoted to upland rice, while CIAT estimates that two-thirds of its rice effort currently is on upland rice.

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1/ AGD/TAC: IAR/82/9.

## 5. Review of Current Research Direction

271. Until 1981 CIAT's research was entirely on irrigated rice. In that year CIAT began shifting its emphasis to upland rice research, especially on favored uplands, to the present alignment of two-thirds upland and one-third irrigated. Within upland rice, about 50% of the effort is on adaptation characters (drought, iron toxicity, aluminum tolerance), 25% on disease resistance, and the remainder on architecture for yield potential, grain quality, and insect resistance. Within irrigated rice, about 60% of the effort is on disease resistance, 10% on grain quality, 10% on early maturity, and the remainder on lodging resistance and yield potential, adaptation to soil stress, and insect resistance. The sudden and unexpected resurgence of hoja blanca virus disease in both irrigated and upland rice throughout tropical Latin America, as well increasing amounts of Helminthosporium, is keeping the effort on disease resistance breeding, which had been expected to decline, at a high level.

## 6. Training

272. Training of professionals is an important component of the Rice Program. Such training is accomplished through courses at CIAT, in-country courses, regional courses, thesis and research supervision, and conferences. Training is provided in the areas of agronomy, breeding, pathology, and production. A total of 274 Latin Americans, representing 23 countries, have received training in the CIAT Rice Program in the 1969-1983 period. The training period averaged nearly four man-months per trainee during this period. In 1983, 32 professionals (95 man-months) were trained. Also in 1983, one post-doctoral, five B.S., one M.S., and one Ph.D. student were associated with the Rice Program. These accomplishments compare very favorably with the training activities of other commodity programs.

273. The new memorandum of understanding being negotiated between IRRI and CIAT also projects an increase in degree work in Latin America.

274. Future training plans in the Rice Program for the period 1984-1988 begin with a bold experiment and departure from previous methods in terms of courses at CIAT. The trainees will spend only three weeks in lectures and use of audiotutorials at CIAT headquarters and then four and a half months in lectures and gaining hands-on field experience at the Santa Rosa station in Villavicencio. This approach, which will be evaluated after one year, is endorsed by the Panel. The Rice Program proposes to devote 12% of senior staff time to training in the 1984-1988 period. This ranks third of the four commodity programs and appears quite adequate considering the small number of senior staff in this Program. There will be a serious impact on

training if the two additional senior staff cannot be added to the Rice Program by 1985.

## 7. Achievements and Impact

### 7.1. Introduction

275. The Rice Program has already had a major impact on rice production in Latin America, principally through the development of high-yielding semidwarf varieties (HYVs). By 1981, the last year for which data are available, HYVs were grown on 2,286,000 hectares, or 26% of the total rice area. If Brazil is excluded, the adoption was 70% compared with the 40% noted in the 1977 QQR. Brazil often is excluded from Latin American rice figures because its large upland rice area is not well suited for the original irrigated rice technology of CIAT.

### 7.2. Diffusion of HYVs

276. Some 40-50 HYVs which are derived from CIAT germplasm and/or IRTP nurseries have been nominated by national programs in Latin America. An unexpected spin-off of the irrigated rice breeding program has been the adoption of selected lines in upland production. Thus, in 1981/1982 HYVs were grown on 661,000 hectares of upland rice, or about 10% of the total upland area in Latin America. If Brazil is excluded, the HYVs adoption on upland areas was 60%. The 661,000 hectares of upland rice planted to HYVs were distributed as follows: 163,000 hectares in Brazil, 140,000 in Venezuela, 80,000 in Mexico, 70,000 in Costa Rica, 64,000 in Colombia, 50,000 in Panama, with the remaining 97,000 hectares being grown in seven additional countries.

### 7.3. HYVs Contributions to Production

277. CIAT estimates that the realized yield advantage of the HYVs over the 2,286,000 hectares on which they are grown is about 1.2 tons/hectare. Thus, for 1981 the increased production from use of the HYVs was estimated to be 2.7 million tons for Latin America. The value of this added production for 1981 was estimated to be 850 million dollars. Interestingly, 35% of the increased production resulted from the spillover effect of irrigated HYVs into upland rice systems. Therefore, CIAT has made large contributions to increased upland rice production even though all research emphasis up to 1981 was on irrigated rice.

### 7.4. Benefits and Returns to Rice Research

278. Costs of rice research in Latin America for the period 1970-1981 were estimated to be 9 to 10 million dollars annually, of which CIAT research costs were no more than 1.5 million dollars per year. An analysis of the net benefits and returns of rice research by CIAT and the national programs for the period 1968-1981, showed that

the internal rate of return was 89%. This means that every dollar invested generates another 89 cents per year from the time it is invested. Only 25% of the estimated benefits were included in the evaluation, since costs of transferring technology to farmers and additional costs of production due to higher use of inputs were not included in flow of costs.

### 7.5. Scientific Achievements for the Period 1977-1983

279. Scientific achievements for the period 1977-1983 fall into four categories: rice pathology; elucidation of the resurgence phenomenon of the hoja blanca virus disease and its vector, Sogatodes oryzicola; IRTP achievements in Latin America; and rice breeding.

280. In rice pathology the achievements included: improvement of disease evaluation methodology for blast, grain discoloration, sheath blight, and stem rot; identification of resistance sources to blast, grain discoloration, and eyespot; studies on disease management and control; and disease monitoring.

281. In the hoja blanca virus-Sogatodes oryzicola vector situation, achievements included identification of virus resistance sources, identification of a dryinid parasite-predator of Sogatodes; discovery that wild taxa of Oryza may be overwintering reservoirs for Sogatodes; confirmation that the virus was not seed-transmitted; and an elegant analysis that may explain the cyclical nature of the reappearance of the virus every 15-20 years.

282. The IRTP achievements included provision of material to national programs which resulted in release of several entries, identification of useful parents for hybridization, and identification of germplasm resistant to iron toxicity and of germplasm resistant to straighthead.

283. Rice breeding achievements included: use of mutation breeding to dwarf unproductive tall varieties, and thus make them better suited as donor parents; improvement of grain quality through irradiation; utilization of genetic male sterility for recurrent selection; identification of broad-spectrum resistance to foliar pathogens; and identification of sources of seedling resistance to hoja blanca.

284. The Panel commends the vigorous attention that the Rice Program has given to the resurgence of hoja blanca virus disease, including the search for sources of resistance to both the virus and its vector, Sogatodes, and to the efforts to determine why the virus recurs in cyclical nature every 15-20 years. The Panel also commends the Program for its constant monitoring of the blast situation, and for its monitoring of a myriad of formerly minor diseases which are becoming increasingly serious, including dirty panicle, and those caused by Rhynchosporium, Helminthosporium, and Rhizoctonia.

285. The Panel similarly commends the positive attitude being given to seeking applications of biotechnology which will increase breeding efficiency. The current example is in use of anther culture to quickly develop homozygous lines and thus shorten the breeding process.

286. In connection with the scientific achievements, the Panel recommends that more effort be devoted to publication of research results in scientific journals. Knowledge of studies described above which would be of interest to the scientific community include the analysis of the possible cause of resurgence of the hoja blanca virus disease, the procedures being used in the search for durable resistance to blast, the application of genetic male sterility in recurrent selection for disease resistance, and the applications of induced mutuation for semidwarfism and improved grain quality.

## 8. Constraints and Weaknesses

287. Three major constraints to the Rice Program were identified:

1) Staffing - There has been a turnover in two senior staff positions in this small Program. It is imperative that highly competent professionals be recruited as soon as possible to maintain this productive program in its position of prominence.

2) Coordination - Despite the small size of this Program it is necessary for the Coordinator to spend a significant portion of time on administrative matters. This should be reduced to a minimum in all programs.

3) Travel time - The increased decentralization of the Rice Program will necessitate additional travel and detract from time available for research.

## 9. Future Plans

288. Simply stated, future plans are to concentrate on ecosystems for which greatest returns can be achieved on the research investment. In this work the challenge is to seek the appropriate balance of research between irrigated and upland systems. Thus, irrigated rice presently occupies only 24% of the rice area in Latin America, but through high average yields of 3.5 tons/hectare, accounts for 46% of the total production. Rainfed area is only 4% but, with yields of 2.5 tons/hectare, accounts for 11% of total production. The various combined categories of upland rice occupy 72% of the area, with average yields of about 1.2 tons/hectare, and account for 43% of total production.

289. The general strategy of the Rice Program is to complement the large research effort on upland rice (presently two-thirds of resources) with research on situations where irrigated rice technology can be expected to apply. Within the upland rice effort, emphasis in the current breeding position is on favored upland ecologies, characterized by fertile soils and high rainfall. These favored upland ecologies still represent a diversity of environments in which there are large genotype by environment interactions, and which have high disease pressures. In addition to the favored upland breeding effort, a modest program is underway for upland improvement for the well-watered acid savannas where the major constraints are diseases, aluminum toxicity, and other nutritional stresses. Vast areas of presently underutilized acid savannas in Mexico, Colombia, Venezuela, and Brazil could be converted to productive rice areas if this breeding effort is successful. (Promising germplasm from Africa has recently been identified.) Since the two present core program breeders are fully occupied with breeding for irrigated and favored upland rice, the Rice Program proposes that a third core program breeder be added to work on rice for the acid savannas.

290. The Panel strongly recommends that higher priority be given to the establishment of the third core breeder position, for acid savannas, than for the economist position. In a germplasm-oriented technology program, breeding obviously is a key component, and is a long-term effort which needs to be started at an early date. The Panel also recognizes the need for an economist, but feels that the functions of this latter position could be fulfilled by the appointment of a visiting scientist for a 2-4 year period.

291. In the second category (situations where irrigated technology may apply), three opportunities that have been identified are:

1) The Caribbean, which has rainfed lowland rice and small amounts of upland. Slow but steady progress is anticipated in the region. The Panel suggests that the proposed Caribbean Regional Networks Project be expanded to include Central America since there are many rice production problems common to the Caribbean and to Central America. However, the Panel also recognizes that the urgent need for increased rice production in the Caribbean may justify a Networks Project specifically for this region.

2) Brazilian varzeas areas, which are poorly drained and periodically flooded lowlands. Brazil is estimated to have 20 to 30 million hectares of varzeas of which perhaps one million hectares have been provided with drainage and have been levelled. It is felt that breeding objectives for the varzeas are similar to those for irrigated rice, and that great potential exists for increasing production in the varzeas areas.

3) The Southern Cone, subtropical-to-temperate region of Southern Brazil, Uruguay, Argentina, and Paraguay. High yields are achieved in this area (4.5 tons/hectare on the 650,000 hectares in Rio Grande do Sul, for example), but there is potential for increasing yields to 6-7 tons/hectare. Four germplasm problems must be addressed to raise yields: tolerance to low temperature, iron toxicity, grain quality, and straighthead (a physiological disease). An outposted core breeder has been requested for this region (section 3.1.1).

292. The Panel has recommendations regarding staffing for these last two opportunities.

293. First, the Panel recommends that the requested extra-core CIAT-IRRI-EMBRAPA liaison scientist position be established as soon as possible. Such a position would strengthen the collaboration between CIAT and IRRI on both upland and irrigated rice, and with Latin America's largest rice growing nation, Brazil. The Panel also suggests that the scientist's research emphasize development of germplasm for the varzeas, and thereby complement existing research in Brazil and other rice ecologies.

294. Second, regarding the requested outposted core breeder position for the Southern Cone subtropics, the Panel believes that the needs of this area can be adequately served by further introduction of rice technology and germplasm from North America and from CIAT. Therefore, the Panel recommends the following approaches in lieu of the outposted breeder position: (1) that CIAT, through consultations and visits, provide assistance to the Southern Cone on improved agronomic practices including weed control, stand establishment, and fertilization; and (2) that CIAT, in conjunction with the IRTP, accelerate efforts to integrate cold tolerant, North American germplasm into breeding efforts in the Southern Cone.

## 10. Assessment and Recommendations

295. The Rice Program has had a major impact on rice production in Latin America, and is to be commended for its success. The Program is dynamic and has shown the capability to modify directions as needed. The decentralization of rice research from CIAT headquarters to sites more representative of Latin American rice areas enables the program to deal more effectively with significant problems of rice in the region, but at the same time places greater strains on resources. The termination in 1983 of the Rockefeller Foundation breeding-pathology position also reduced program capabilities. Therefore the Program is requesting increases in both core and extra-core positions.

## 10.1. Implementation of the Recommendations by the 1977 QQR

296. There were no specific "recommendations" for rice in the 1977 QQR, but the QQR did suggest "...that early emphasis be given to upland rice with particular emphasis on disease resistance ..." This suggestion was implemented in 1982 with the hiring of an upland rice breeder. Currently it is estimated that two-thirds of Rice Program resources are on upland rice, and one-third on irrigated, which represents a major shift in the last few years. There is concern that the shift may have been too far in the direction of upland rice, but there is a small number of scientists, and it was generally felt that an individual's time should be devoted mainly to one system or the other.

297. The increased efforts on upland rice are expected to interface well with the needs of Brazil, which has 75% of the total rice area, and 88% of the upland rice area, in Latin America. It is hoped that the increased emphasis on upland rice research ultimately will result in fewer references to Latin American rice production statistics which "exclude Brazil." Such references are frequently made on the grounds that CIAT's rice technology applies only to irrigated rice. Actually, CIAT's irrigated rice technology already has had beneficial spillover effects on upland rice production. Thus, HYVs are now planted on about 10% of the Latin American total upland rice area. Furthermore, of the estimated increased production of 2.7 million tons of rice per year due to CIAT-IRTP technology, 35% has come from increased upland rice production.

## 10.2. Recommendations

298. 1) The Panel recommends that more effort be devoted to publication of research results in scientific journals. Several valuable studies of scientific interest have been or are being conducted at CIAT, but knowledge of this has not been made adequately known in scientific channels.

299. 2) The Panel strongly recommends that higher priority be given to the establishment of the third core breeder position for acid savannas than for the economist position. In a germplasm-oriented technology program, breeding obviously is a key component, and is a long-term effort which needs to be started at an early date.

300. 3) The Panel recommends that the extra-core CIAT-IRRI-EMBRAPA liaison scientist position be established as soon as possible, in order to strengthen collaboration between CIAT and IRRI on both upland and irrigated rice, and with Latin America's largest rice growing nation, Brazil. The Panel also suggests that the scientist's research emphasize development of germplasm for the varzeas, and thereby complement existing research in Brazil on other rice ecologies.

301. 4) The Panel recommends the following approaches in lieu of the requested outposted core breeder position for the Southern Cone

subtropics: (a) that CIAT, through consultations and visits, provide assistance to the Southern Cone on improved agronomic practices including weed control, stand establishment, and fertilization, and (b) that CIAT, in conjunction with the IRTP, accelerate efforts to integrate cold tolerant, North American rice germplasm into breeding efforts in the Southern Cone.

# CHAPTER VI - TROPICAL PASTURES PROGRAM

## 1. Background and Objectives

### 1.1 Background

302. Beef, milk, and dairy products are important components of the diet in Latin America and comprise between 21%-37% of total expenditure on food by the lowest income quartile. However, the productivity of cattle is low. Steers grazing the major areas of savanna, the Cerrado and Llanos, take from 4.5 to 5.5 years to reach slaughter, and live weight gain is only some 20 kg/hectare/year or less. Yet there is considerable potential for beef production in these areas as rainfall is in excess of 1000 mm. It is quite a reasonable expectation that improved legume/grass pastures could raise animal productivity per hectare by a factor of 10.

303. Consequently CIAT commenced the Beef Production Systems Program in 1969 which had the very wide mandate of increasing "cattle productivity in the lowland tropics of Latin America." A review of this program in 1973 found that the mandate was too wide and that concentration was needed in priority areas. This Program, however, did establish that forage quality was the prime limitation to animal production.

304. Accordingly, the redefined Beef Production Program was initiated in 1976. This Program emphasized the collection and use of adapted germplasm, definition of fertilizer requirements and sequential evaluation of accessions to the stage where successful legume/grass mixtures could be successfully incorporated into farming systems. A deliberate decision was made to concentrate the research effort on the large areas of undeveloped savanna and grassland, typified by the Cerrado and Llanos.

305. To reflect this change of focus the program was renamed the Tropical Pastures Program in 1979. Since then the research and program objectives have been basically unaltered, as recommended by the 1977 QQR. The change of the program title was justified as it better reflects the main thrust of the program and also allows for the role of pastures in improving milk production. However, it must also be recognized that the end product of the Tropical Pastures Program is to provide an economic way of improving animal production. Pastures are only a means to an end and not an end in themselves.

### 1.2. Objectives

306. Thus the stated overall objectives of the Program are:

"(a) to increase beef and milk production and productivity,

(b) to promote economically and ecologically sound expansion of the agricultural frontier in tropical America, and

(c) to release more fertile land for expanded crop production." 1/

307. The Panel interprets this to mean that CIAT, through its appropriate research and collaborative activities, will assist in meeting these three objectives.

308. The strategy of the Program has been to avoid the use of large amounts of fertilizer but to adopt a low cost, low fertilizer input approach of selecting grass and legume species which are adapted to acid infertile soils and resistant to existing pests and pathogens. The tropical pastures cultivars available in the late 1970s were soon found to inadequately cope with these conditions, particularly the legumes, necessitating a large input into germplasm collection and evaluation. Further studies on promising accessions defined their requirements for establishment, fertilization and, in part, management practices have been developed which enable promising species to be successfully used in persistent and productive pastures. The emphasis has been solely on beef cattle. These pastures are then to be incorporated into effective production systems, along with complementary animal practices.

309. This policy must be reconsidered due to a number of factors, primarily the following:

1) The majority of cattle in Latin America (69%) are in the less acid areas. For example, of the 26 million head in Colombia, eight million are in the Llanos, although the Llanos comprise 64% of Colombia. Brazil has the highest concentration of animals on acid soils; 42% of the national herd are in the acid soil areas (60% of the land area).

2) There is increasing evidence that cropping, currently of considerable importance in the Cerrado, will increase in the Cerrado and probably the Llanos, at least in Venezuela. The interaction between crops and livestock has been of benefit throughout the tropics and will modify the requirements for pasture research and technology and affect the rate of technology adoption.

3) There is a continuing national pressure for clearing forests in the humid tropics and increasing concern about the severe degradation of pastures established in

1/ CIAT in the 1980s, A Long Range Plan, p. 110.

these areas.

4) With the progress made in developing improved pastures for the savanna ecosystems, as outlined later in this chapter, CIAT must consider whether it is now opportune to gradually reduce its input in these areas. This would allow the Program to commence research in other areas where small-sized farms predominate.

5) There has been a marked improvement in the research capabilities of Latin American countries in the field of tropical pasture research since the 1977 QQR, and this trend is continuing. Some of these improvements are attributed to CIAT's influence. Brazil, which has the largest national research network, is estimated to have more than 100 pasture scientists trained to Ph.D. or M.S. level. Throughout Central and South America there are approximately 175 research workers studying pastures on acid soils.

6) There has also been sustained development in rangeland and pasture research in ILCA and many national research institutes in the tropics outside of Latin America. The question arises as to what extent the program should extend its mandate into parts of Africa and Southeast Asia with acid soils and high rainfall.

### 1.3. Special Features of the Pastures Program

310. It must also be recognized that research in the Tropical Pastures Program is not concentrated on a single species, as is basically the case for the other commodity programs at CIAT, but covers a wide range of undomesticated species and even genera. Furthermore, although the final aim is to improve animal production, most measurements have to be plant-based. Likewise, improved legume/grass pastures have an extra degree of difficulty over an annual crop in that they must be managed and fertilized for persistence and productivity over an extended or indefinite time span. This inevitably lengthens the time span required for adequate evaluation.

## 2. Program Activities

### 2.1. Germplasm

311. Since the 1977 QQR there has been a large increase in the germplasm collection of tropical forage plants, from 3000 (1977) to approximately 11,300 (October 1983). There has been increasing cooperation between CIAT and other national institutions in germplasm collection. In 1977 only 23% of the CIAT collection had been obtained

through collaborative collection, but this increased to 43% in 1983. This trend is supported by the Panel. Some 90% of the collection are legumes, the majority being from tropical America, particularly from areas of acid infertile soil. The collection of grasses has increased from 124 (1977) to 1134 (1983), most of these being from Africa and obtained through exchange from other institutions.

312. However, CIAT is not planning to and should not attempt to become the world germplasm center for all tropical pasture species. CIAT's germplasm mandate should still be to Latin America and on species for acid soil conditions in the higher rainfall tropics. ILCA is gradually building up its germplasm collection and will obviously become the major center for some collections such as that for the Trifolium species from the African highlands. CSIRO (Australia) has a large germplasm collection, with particular emphasis on species for drier conditions.

313. In practice, it would be impossible to rigidly define boundaries for each major collection, either by region or by species, as there will always be some overlap of interest. The objective should be to retain the best possible relationship with other germplasm centers, with some assistance from IBPGR, so as to avoid unnecessary duplication, competitive collection or waste of resources. CIAT could also consider holding back-up or "last resort" reserves in long-term storage at other reliable centers in case of extremely unlikely circumstances resulting in the loss of the CIAT-Palmira collection.

314. At this point there has been limited regeneration of the collection, as it is of relatively recent origin and is held under relatively good conditions, though better facilities for long-term storage would be desirable. However, this need will undoubtedly increase in the future. There are particular problems in regeneration of outcrossing grass species, as individual lines of such species must be grown far apart, which is difficult to organize in practice, or else in pollen-proof glasshouse type units. The potential problems arising from a lower level of outcrossing in some legume species must also be recognized. The Long Term Plan of the Pastures Program, supported by the Panel, is for the continuation of the germplasm position on minimum core.

### 2.2. Plant Breeding

315. The emphasis within the Tropical Pastures Program is primarily on the collection and description of existing variability rather than initiating breeding (hybridization) projects at an early stage. This strategy is supported by the Panel on two main grounds. Firstly, it is premature to commence breeding to combine characters until there has been a reasonably wide screening of the genetic base to discover what variability already exists, and in what combinations. Secondly, it is only after accessions have been widely grown that it is possible to clearly define, and give priority to, plant breeding objectives.

316. The only work on grasses to date has been to make preliminary studies of genetic variability for agronomic traits in the recently released Andropogon gayanus CIAT 621. This information will not only be of use if further selection is initiated, but may be helpful in understanding the genetic drift that is likely to occur in CIAT 621 when released as a cultivar in different countries and therefore subject to different selection pressures in different environments and seed production systems.

317. The emphasis in breeding has been with legumes. In Centrosema the objective of crossing C. macrocarpum and C. pubescens was to retain the adaptation to grazing of C. pubescens while incorporating greater tolerance of low soil pH and low calcium and/or high aluminum, and also of diseases, in C. macrocarpum. The project on Leucaena also had the primary objective of increasing adaptation to acid soils. The program on Stylosanthes capitata was aimed at combining desirable qualities found in different accessions. All these projects are no longer funded by CIAT but are being continued at CPAC-Brasilia. The progeny are in the later stages of selection ($F_4$ or subsequent) and the final lines warrant evaluation at different sites, comparing them with the main parent lines, the best available accession of that species, and with the best alternative species for that environment.

318. The current plant breeding program on Stylosanthes guianensis is aimed at combining the anthracnose resistance of the "tardio" types with the high seed yield of the common types. High seed yield is an important characteristic in reducing seed costs and may also be important in ensuring that sufficient seedling regeneration takes place under grazing for long-term persistence. The first $F_2$ populations in this program have been established at Carimagua and CPAC.

319. There is currently no need for major new initiatives in plant breeding although the Stylosanthes program should continue. The appointment of a second plant breeder is only marked as optional in the Long Term Plan, and higher priority is not warranted by present needs. At the same time, it is desirable to have the services of one plant breeder/geneticist within the core Pastures Program.

### 2.3. Plant Protection

320. At the time of the 1977 QQR the Program was without the services of a plant pathologist and an entomologist. Since their appointment, very useful information has been collected and CIAT is well recognized internationally for its expertise on diseases and pests of tropical pasture plants. The major impact has been to build up knowledge on the interaction between pest or disease by accession by environment. This survey has pinpointed key problems and helps to guide the choice of germplasm to be evaluated in different regions where there are different pest and disease problems. For example, some ecotypes of S. guianensis, susceptible to anthracnose in the

Llanos and Cerrado are proving resistant to this disease in the humid tropics ecosystem, despite the presence of pathogenic races.

321. Possibly the most serious insect problem, particularly in the Cerrado, lies in the susceptibility of Brachiaria sp., particularly B. decumbens, to spittlebug. Three ways of attacking this problem are being investigated: use of biological control by a fungus, selection of tolerant or resistant Brachiaria accessions, and manipulation of grazing pressure.

322. The plant pathology position has been designated as continuing minimum core and in view of the importance of disease, particularly anthracnose, the Panel strongly supports this. The Program has planned to outpost a second pathologist, stationed in the Cerrado, on minimum core from 1986. The Panel supports the proposal for this second pathologist. The focus of attention must be on the broad species by environment by race of pathogen complex. It would be desirable if a plant pathologist from EMBRAPA-CPAC could also be involved in this project.

323. The Panel assumes that, if sufficient need arose, a limited amount of time could be given by the virologist within the Bean Program. There is currently a visiting nematologist studying the serious problem of stem gall nematode in Desmodium ovalifolium. Addressing this problem may require longer than the present two year plan.

### 2.4. Microbiology

324. As the CIAT approach to pasture improvement is based on the use of legumes, a microbiologist working with Rhizobium has been a minimum core position. From the practical viewpoint, it is highly desirable that legumes nodulate promiscuously, thus reducing or eliminating the need for farmers to inoculate legumes and the problems associated with supply of quality peat culture. However, it would also be illogical to eliminate promising legumes just because they did not nodulate with native Rhizobium.

325. Thus, the microbiology section maintains a substantial Rhizobium collection and is evaluating a promising technique where rhizobia are screened for effectiveness in undisturbed soil cores. With the continued introduction and evaluation of legumes, especially in new regions (section 9.3), there will be a continuing need for this expertise and the microbiology position is designated as continuing minimum core. However, the microbiologist has been able to give some assistance to the Bean Program and this is commended by the Panel.

326. Promising results have recently been obtained from research on mycorrhiza by a postdoctoral fellow. Clear but, to date, short-term responses to inoculation of pasture plants with mycorrhiza have been obtained with unsterilized soil in the field. It is not proposed to appoint additional core staff to continue this study, but to continue with existing resources. The Panel supports this, but

believes it is certainly premature to move into technological aspects of production of mycorrhizal inoculum. CIAT should not move into basic mycorrhizal research, but continue to seek to have this supported at research institutes in developed countries.

### 2.5. Plant Nutrition

327. The study of the nutrient requirements of the low fertility demanding species under test in the Cerrado and Llanos has been a key part of the Program. CIAT has identified species, such as Andropogon gayanus and Stylosanthes capitata, which can persist and produce under low fertility conditions where species such as Panicum maximum grow poorly. Satisfactory levels of basal fertilizer application have been defined, and some progress has been made in determining needs for maintenance fertilizer. Responses to maintenance phosphorus, sulfur, and potassium have been measured in different areas. The need for continued research on maintenance fertilizer is of high priority. Consideration should be given to incorporating maintenance fertilizer levels as a variable in grazing experiments, with associated measurements of animal production. The present use of small grazed areas, or of fertilizer treatments within exclosures in grazing experiments, is supported by the Panel.

328. There has been no evidence of requirements for trace elements in the Llanos or Cerrado, and a check for belated onset of these deficiencies is being kept on older long-term pastures. There has been no evidence of iron or manganese toxicity in pasture plants, apart from manganese on isolated areas of atypical soil at Quilichao.

329. The Pasture Program has been based on low fertilizer input although low is a relative term; what is "low" in the Cerrado or Llanos would be considered as "high" in other areas where soil fertility is not so limiting. However, some key species, such as Andropogon gayanus, have also shown that they are responsive to higher levels of fertilizer. In view of the increasing crop/livestock in the Cerrado and the Venezuelan Llanos and the projected move into moderately acid soils and the humid tropics (sections 9 and 10), this finding is encouraging. The Panel suggests that the Program needs to consider this approach in earlier phases of evaluation and be more concerned with the full response range of fertilizer inputs and not just the "low" end.

330. Prior to 1982 there were two core-funded positions on plant nutrition. Currently only the Colombian position is core-funded and the Brazilian position is funded outside of CIAT but is integrated with the CIAT/CPAC program. The Panel recommends that this input of two scientists should be maintained and, if need be, the second position should go back to core funds. The Panel gives the position of the second soil/plant nutritionist position higher priority than the proposed position for regional cooperation based at ILCA (section 4.2).

## 2.6. Pasture Evaluation, Pasture Development, and Animal Production (Llanos and Cerrado)

331. The different stages of evaluation have been defined by the Pastures Program as:

I- Accessions in rows for one year, primarily descriptive;

II- Accessions in pure swards under cutting for two years;

III- Accessions under intermittent grazing, usually in mixtures, for more than three years;

IV- Grazing experiments with grazing mixtures with measurements of animal production, for more than three years;

V- Grazing experiments characterizing the profile of a species either on research stations or farms, this being followed by cultivar release by national programs.

332. These categories are, quite appropriately, not considered as a rigid system. CIAT diagrams indicate a decreasing involvement of CIAT from category I to V where national programs dominate. In the Llanos there has been no clear involvement of ICA at any stage, while in Brazil CIAT and CPAC have worked together at all stages. Typically in any year there are some 900 lines in category I at Quilichao, and 700 category II, 30 category III, 10 category IV, and 5 category V at Carimagua. Numbers are lower at CPAC.

333. The availability of first round releases or promising lines effects future evaluation in two ways. Firstly, in some cases it will be clear what attribute is being sought in a certain species; for example, resistance to stem gall nematode and false rust in D. ovalifolium. Secondly, if there are no such clear cut objectives, as is often the case for grasses, evaluation is more difficult and is slower.

334. The Program is proposing to move the agronomy and pasture development positions at Carimagua from minimum core to optimum core in 1987 and 1989, respectively. The Panel agrees with the underlying principle that the input into evaluation at Carimagua could be reduced towards the end of the decade. This implies that some of the evaluation experiments, currently run by those positions, must be wound down prior to those years. Thus, the current flow of new accessions through the evaluation program in the Llanos cannot be maintained.

335. Considering CIAT's mandate, the present germplasm collection and stage I evaluation, with the concurrent seed increase and storage, should be continued. This collection can then be made available to CIAT or national programs; the demands from the latter are likely to

increase and they will become more specific in their requirements. CIAT will still be involved in evaluation at its new research sites (section 9), but will reduce its input into evaluation in the Llanos where more emphasis could be placed on new species or plant types, such as browse.

336. Trials in the Llanos have investigated the merit of different techniques of introducing legumes or grasses into both sown grass and native savanna. These have provided ways of reducing the risk of failure, initial costs, and erosion hazard associated with pasture establishment. However, when some of these experiments are completed, the Panel suggests that establishment studies should be initiated on undersowing with crops.

### 2.6.1. Grazing Methodology

337. Experiments at Carimagua and Quilichao, funded by IDRC, are studying various aspects of the methodology of evaluation under grazing. These experiments are supported by the Panel but the results, although useful, could be site-specific, and careful consideration about the principles that emerge will be required. However, the Panel commends the Program for their interest in improving research methodology, and see this as an appropriate role for CIAT.

### 2.6.2. Pasture Persistence and Animal Production

338. Some very encouraging results are coming from these experiments. One experiment was sown in 1978 to Brachiaria decumbens alone or with strips of kudzu. In 1983 the animal production from yearling grazers was 114 kg on Brachiaria alone and 196 kg on Brachiaria with kudzu. Such trials are investigating the effect of different stocking rates and grazing systems on the persistence of pasture species and on the animal production from different pastures. These studies on the Llanos and those on grazing methodology are primarily controlled by the pasture quality and animal production position, which is projected as continuing minimum core.

### 2.6.3. Ecophysiology

339. In grazing experiments there are usually changes in pasture composition and species persistence which are measured, but not explained. It is then more difficult to extrapolate away from the experimental site. For this reason the Program will, from 1984, replace the existing minimum core position on pasture management and productivity by an ecophysiologist who will give more insight into the reasons for some of these changes. It is visualized that the appointee will, to a considerable extend, work within existing grazing experiments. This move is supported by the Panel and it is suggested the emphasis be more on ecology than physiology.

## 2.6.4. Cattle Production Systems and Economics

340. This project is based on a new core experiment at Carimagua where three breeding herds are run without any sown pasture and with a small (900 $m^2$ per animal unit) and large (1800 $m^2$) allotment of sown pasture in conjunction with native grassland. The sown pasture treatments are run at minimal and intensive management. Measurements are being taken of reproductive parameters and of the mineral status of animals. Early results clearly show that animals given restricted access to sown pasture still require mineral supplements.

341. The remaining experiments include on-farm trials in which a total of about 100 hectares of improved pastures were sown on each of eight farms on some 5-10% of the farm area. There was good economic data from these farms before the incorporation of sown pastures and the Program has followed the changes in management practices and output following the partial pasture improvement. Different farmers have utilized the pastures for different purposes as they desired: improving reproductive performance, allowing for early weaning, etc. Results are encouraging; one farm with 5.5% improved pasture has almost doubled its stocking rate in animal units/hectare with an internal rate of return of over 31%. The Panel supports these studies but would like to see an input from the national research programs and an increased use of these farms within the training program.

342. This impact of improved pastures can be more fully assessed because of the very interesting farm surveys, carried out by CIAT, GTZ (German Agency for Technical Cooperation) and the Technical University of Berlin,in the Cerrado, and Llanos of Venezuela and Colombia, in 1979-1981. These have given valuable data on farm resources, cattle management practices, animal production, farm tenure, use of labor, and farm inputs and output. They provide a good baseline for following the economic impact of new technology.

343. The Pastures Program is also running a small 300 hectare family farm at Carimagua but this is a "research station small farm" and the information is biased. The input of research advice and services are higher than for the typical small farm, and risks are much lower. However, the Unit is providing encouragement and some useful experience to research workers, especially with the current change to a dual product (milk and meat) output.

344. When considering all aspects of the Program that deal with pasture evaluation, development, and assessment the Panel commends the Pastures Program for its achievements. The Panel recommends that germplasm collection and characterization continue at approximately the present level and also that the Program gradually decrease the evaluation and development studies on the Llanos, and that ICA, the relevant national organization, be approached to join in the later stages (Categories III, IV and V) of evaluation. This would be of positive benefit to ICA in that their staff would gain experience with

potential cultivars. This participation of ICA would also help to ensure that the CIAT-based technology was appropriately considered in planning by the Colombian Government for development of the Llanos.

345. It should be emphasized that even if both the pasture agronomy and pasture development positions were phased out, Carimagua would still be the major site for the Pasture Program and the greater part of the program activities would remain there. This would include the programs of three staff positions involved in grazing studies (ecophysiologist, pasture quality, and cattle production systems) apart from the many other senior staff with experiments there (e.g. plant breeding), and studies by visiting scientists, postdoctoral scientists, etc.

346. The Cerrado CPAC site is not just a second savanna site, as the Cerrado ecosystem is appreciably different for the Llanos in such important characteristics as soil type, length of dry season, pests and diseases, etc. Consequently the continuing use of this site for some stage I studies is justified, although the number of accessions evaluated there will continue to be less than on the Llanos. Such activities are in accord with CIAT's mandate. However, it is visualized that CIAT's role in later stage evaluation at CPAC will gradually decrease.

### 2.7. Seed Production

347. The seed production section has three aspects: seed multiplication, the primary activity; applied research on seed production, particularly of new cultivars; and training. Most of the work input into seed multiplication is for the CIAT Pastures Program, some is for the RIEPT network (described in section 4), and a small amount for supplying basic seed, etc., to national institutions. Relations between the seed production section of the Pastures Program and the Seed Unit are very good.

348. Obviously supply of seed is critical to the whole CIAT Pastures Program and effective seed production from a wide range of grass and legume species, with a vast array of divergent seed production problems, is essential. Likewise, seed supply for the RIEPT network has been crucial for the successful operation of the network.

349. However, the Panel recommends that there should be more input in applied research into seed production. When new cultivars of species, unknown in terms of commercial seed production, are released, applied seed production research can make all the difference between a released species being widely used or just being a theoretical release which is unavailable commercially at realistic prices.

350. Applied seed production research on Andropogon gayanus has, for example, increased the seed production of the crop by defining appropriate crop management prior to harvesting, and by improving

manual and mechanical harvesting procedures. With the inevitable trend for release of further cultivars, the Panel considers that applied research into seed production be given higher priority. Such research would enhance seed production in the commercial sector and national institutions. Extra support for research into seed production could, for example, be given through the appointment of a post-doctoral fellow.

351. Although training in seed production has been given some limited attention to pasture plants, the Pastures Program will be offering specialized training courses in seed production of pasture plants, both at CIAT and in-country, from 1984 onwards. The Panel supports this action. The senior scientist also plans to spend more time discussing research on seed production with national research institutes. An increase in applied seed production research at CIAT must also be used as an opportunity to train national scientists in seed production research as distinct from seed production.

### 3. Staff and Facilities

352. Since the 1977 QQR, senior staff positions in the Tropical Pastures Program peaked at 20 core staff in 1979-1982, but were reduced to 16 following financial pressure. The senior staff is supported by approximately 5 visiting scientists or postdoctoral fellows.

353. Most senior staff are based at CIAT-Palmira, two (agronomy and pasture development) at Carimagua, and one (agronomist) is outposted at CPAC-Brasilia. There are three bilateral staff positions, not on CIAT core funds, two are in Brazil (Brasilia and Belem) and one in Panama.

354. The facilities at CIAT-Palmira are used for seed storage, limited seed multiplication, glasshouse and environment room studies, and for specialist laboratory research (e.g., in plant pathology). The CIAT-Quilichao substation, 60 km from Palmira, is on acid ultisols and carries a small cattle herd, and is used for initial characterization and multiplication of germplasm, methodological research, and seed production. Facilities are adequate for these purposes.

355. The main experimental site is at Carimagua, where the major experiments on pasture evaluation and development are carried out. Facilities on the station are good and although there have been occasional problems of slow service from Palmira, support has now greatly improved. Also there were minor difficulties in meeting occasional peak demands for labor which could perhaps be met by increased flexibility of funding for temporary assistance.

356. The facilities used by the outposted agronomist at CPAC-Brasilia are good, although there are occasional problems in getting adequate assistance for maintenance of small plots.

357. The senior staff of the Pastures Program are organized into three groups, each with a head scientist. The groups are germplasm development (seven scientists), pasture evaluation and development (six), pasture evaluation in production systems (three). The groups meet formally and informally to discuss progress and plan experiments. The Coordinator frequently meets with the three heads, in addition to normal discussions with individual scientists, but they play an advisory role and no administrative or decision making role. The complete program, including visiting scientists and research associates, meets informally once a week and formally six times a year. At the minimum, planned experiments are discussed by the scientist concerned, group head, and program coordinator.

358. On paper, this arrangement of groups has the drawback that it splits a continuous program into somewhat arbitrary sections and could well reduce communication across the program. However, in practice there appear to be no such problems, so groups can remain as they are. But groups should not be seen as having an administrative role, which is suggested by their inclusion in the CIAT Organizational Structure Plan.

359. On the average each senior scientist has two professional support staff (research associate or assistant with an M.S. or Ing. Agr. degree), three technicians ("tecnicos" or experts) and five to six laborers or specialized laborers. The supporting staff are highly regarded. There is adequate provision for short specialized courses for support staff.

## 4. International Cooperation

### 4.1. RIEPT

360. International cooperation on Tropical Pastures throughout Latin America is largely through the International Tropical Pasture Evaluation Network (RIEPT). Since 1979 the network has aided coordination of evaluation trials and the flow of information between countries, assisted with funding from the International Development Research Centre (IDRC) since 1982. A senior scientist, core-funded, is in charge of coordinating CIAT support to the network. A second position on minimum core funds has been proposed for Central America in 1985 and this is supported by the Panel. When including the support given by other scientists, RIEPT would then be taking at least three and one-half CIAT core positions in terms of senior scientist time.

361. The first evaluation trials were established during 1979 and were of two types, A and B. In the A trials a large number of entries are evaluated in a few sites, whereas in the B trials a restricted range of lines are evaluated at several sites within each main ecosystem. In both these categories, entries are evaluated in small plots according to detailed guidelines. At the end of 1983, 25 type A

trials and 65 type B trials had been established. The first stage C trials (eight), examining the effect of grazing management in small plots, and the first stage D trials (nine), measuring animal production, have also been sown.

362. The network has an advisory committee, made up primarily of national research leaders. As a service to RIEPT, CIAT produces a quarterly bulletin with reports on research information on pastures gathered from CIAT workers, network participants, or outside sources. The bulletin, published only in Spanish, goes to 900 workers. CIAT also publishes the data collected in the Network trials. The CIAT Tropical Pastures Program plays a major role in providing seed for the network.

363. While there is no doubt the network is fulfilling a very useful role, the Panel offers the following comments:

1) The use of "International" in the network title is unfortunate. The network is confined to Latin America and results are published only in Spanish. Thus, it is of little value in Africa and Southeast Asia. The Panel commends plans to publish the newsletter in English. A pasture network for Southeast Asia is in the detailed planning stage by CSIRO, although on a smaller scale than RIEPT, and newsletters could be exchanged between the working centers. The same could be done if a newsletter was published in Africa.

2) While coordinated multi-site trials are currently a good concept, care must be taken that the continuing large input of CIAT and by national institutions, is justified. Multi-site trials, which were an integral part of the network when it was established, may in time be of decreasing importance as national programs focus on their own priorities.

3) Standardized operations between sites in A and B trials, while desirable, can cause problems in that what is appropriate and possible in one site may be inappropriate or impossible in another.

4) The publication of network material by CIAT is a very useful service to national programs. Likewise, CIAT assistance in network meetings serves a useful role in bringing together pasture workers in Latin America.

364. In summary, while the Pastures Program's initiative and involvement in RIEPT are to be commended, the Panel points out that care should be exercised that the network does not become too large a demand on CIAT resources.

### 4.2. International Cooperation Outside of RIEPT

365. CIAT plans to appoint an outposted liaison scientist on minimum core position at ILCA in 1986. The Panel does not support this and recommends that any decision be left until the implementation of the planned headquarters forage agronomy program at ILCA has been fully effected; the reasons for this are given in Chapter XI. For similar reasons the Panel does not endorse the outposting of a CIAT scientist, projected for 1989, to Southeast Asia. The Panel believes that CIAT Tropical Pastures Program should concentrate its effort in Latin America, although supporting cooperation with ILCA and other institutions in such activities as exchange of information, provision of germplasm, and pooling of resources for plant collection, etc. Even if the Pastures Program's CGIAR mandate is extended globally to lowlands in the humid and subhumid tropics with acid and infertile soils (see Chapter II), this does not necessarily mean that scientists must be outposted.

## 5. Training

366. Since the objectives of the Pastures Program were clearly defined in 1977, training has concentrated on building up the expertise of pasture research workers, particularly from regions with acid soils. Between 1977-1983, 255 pasture scientists received some training at CIAT, with the biggest representation from Brazil (44), Colombia (43), Peru (21), Cuba (20), and Panama (19). Sixty-eight percent of the trainees came for an intensive 10-week course, usually followed by a three to four month period when the trainee is closely associated with one particular aspect of the research program. Many of the trainees have subsequently been involved with the RIEPT Network, so the close contact with CIAT has been maintained.

367. The second major group of trainees were visiting researchers studying for a Ph.D. (13 trainees) or M.S. degree (19). These represent 14% of all trainees. Usually the research is conducted at CIAT and the course work studies at the cooperating universities. With the increasing emphasis on later stage evaluation experiments, where there are usually pastures of contrasting species and/or fertilizer levels and/or stocking rates, there was a commendable trend to carrying out detailed thesis studies on plants or plant/animal relationships within these experiments.

368. Since 1977, 18 post-doctoral fellows have been attached to the Program. Some of these have later become senior staff and the advantages and disadvantages of this are discussed in Chapter XIII. Comments on the relevance of training procedures are in Chapter IX.

## 6. Achievements and Impact

369. After the failure of the accepted tropical pasture cultivars in the Llanos and Cerrado during the late 1970s, CIAT initiated a successful search for suitable germplasm and has found out much of the information required to form successful pastures out of these new species. The main achievements of this Program have been the following:

1) Four cultivars of tropical pasture plants, specifically selected for use in the lowland tropics of America, have been released. The most widely used is Andropogon gayanus (CIAT 621) which has been released by five countries under different names. The area sown to Andropogon has continued to expand, and in Colombia much of this expansion has been outside the Llanos areas where it was developed as a pasture cultivar. A survey made of 57 "early adopter" farms in Colombia showed that the area sown to Andropogon had increased from 42 hectares in 1979 to 5000 hectares in 1983. Such a rapid acceptance is very gratifying.

2) Another new cultivar released as a result of CIAT research is Stylosanthes capitata (CIAT 10280) as cv. Capica by ICA in 1983. Basic seed of this species is currently being sold by ICA to commercial seed producers. Two recent releases by EMBRAPA in Brazil are S. guianensis "tardio" type (CIAT 2243) as cv. Bandeirante and S. macrocephala (CIAT 1281) as cv. Pioneiro. There are also several other promising accessions of legumes and grasses under test, including S. guianensis (CIAT 136) which is at the release stage in Peru.

3) Along with the increase in the germplasm collection, there has been a buildup in the collection of Rhizobium strains and considerable knowledge has been accumulated about the susceptibility of different accessions to pests and diseases.

4) Much of the land surface of South America has been classified into five major ecosystems. While this had been done in part by national institutions, CIAT has put together the existing studies on a common basis and carried out extra survey work. This classification is being used to select the most appropriate experimental sites. At the farm level, good base data has been obtained on the resources and mode of operation of farms in the Llanos and Cerrado. The profitable impact of improved pastures is being documented on some of these farms.

5) Good progress has been made in defining the establishment, fertilizer requirements, effects of management, and carrying capacity of pastures based on recently released and other promising species. The early results from animal production trials have been very encouraging. Contrasting with annual gains of 15 kg live weight/hectare from the native Llanos savanna, improved pastures have produced up to 300 kg/hectare. There are encouraging indications that

sowing improved pastures on a small proportion (10%) of a holding formerly based on grazing only native pastures can have a meaningful impact on farm output and yield a very satisfactory rate of return.

6) There has been an appreciable impact of CIAT on enhancing national research programs in tropical pastures. This is evidenced by the number of trainees from these programs that have gone to CIAT, the substantial collaboration of national institutes in the pasture network, and the release of CIAT lines as cultivars by national institutions. CIAT has also played an important role in initiating and maintaining the tropical pasture network (RIEPT) which is serving a very useful function in Latin America.

## 7. Weaknesses and Constraints

370. Senior staff interviewed were basically content with facilities and support given for the Program. Provision of funds for travelling to conferences is perhaps marginally limiting and must not be further restricted, particularly for travelling to major conferences such as the International Grasslands Congress held every four years.

371. Access to the computer system has been somewhat difficult, but with two terminals due to be installed in the Program's offices this difficulty should decrease. There have been some problems with Administration, particularly dealing with supply of goods. This position should improve as action is taken along the lines recommended in the report of the Management Review.

372. Up to 1984 the publication record for the senior scientists in the Pastures Program represents less than one paper or technical report per person per year. If publication is inadequate scientists may jeopardize their own careers, and also the scientific merit of the Program is not adequately recognized. The other value of publication is obviously that scientists are forced into a much more detailed assessment of their results. This should, in turn, lead to better planning of future research. This problem has been noted within the Pastures Program and a committment has been made to greater publication. The Panel endorses this move; whether this can be achieved will depend on there being an equal committment to doing less research work or more unpaid overtime.

## 8. Future Plans

373. No basic change was contemplated in the Pastures Program's basic philosophy based on the use of legume-grass pastures. The Program has not envisaged any changes in the minimum core status of the headquarters research group except that two positions in the Llanos would become optimum rather than minimum core in 1987 and 1989 and the entomology position would become optimum in 1988. From the

one outposted position in 1983 and projection of two in 1984, there was a projected increase to eight in 1989-1990. The increase of seven positions, over the present position in the Cerrado, would be due to one in the Cerrado, two in the humid tropics, one in Central America (RIEPT), one in moderately acid soils, one in Africa (ILCA and regional cooperation), and one in Southeast Asia (regional cooperation).

374. Bilateral programs, funded outside of CIAT, were projected to increase from three (Brazil and Panama) in 1984 to five in 1988 (the humid tropics and Central America).

## 9. Assessment and Recommendations

375. The overall conclusion of the Panel is that, particularly over the last three years during which there has been no staff turnover, the Pastures Program, based on a cooperative team effort by competent and keen scientists, has made good progress.

### 9.1. Implementation of Recommendations by the 1977 QQR

376. As this review was undertaken soon after the reorganization of the Beef Production Program, there were few specific recommendations for this Program.

377. One major recommendation (item 300) was that sufficient senior scientists in the field of animal health should be retained in the Beef Program. This recommendation was not followed by CIAT, their reasons being given in Annex V, and this Panel supports their decision. However, it must be recognized that the development of improved pastures opens options for new herd management practices so as to best utilize these pastures. The Pastures Program, for example, plans to commence experiments in 1984 with early weaned calves grazing improved pastures. It would be appropriate if this were undertaken jointly with ICA, as the national research institutes should be encouraged to join in work of this type.

378. The 1977 QQR also commented on mineral nutrition of animals (item 192 dd). CIAT and ICA already have sufficient data to show that cows grazing solely or primarily on native pastures have markedly higher fertility when provided with phosphorus licks. There is evidence, from outside of CIAT's mandate, that animals may still be phosphorus deficient when grazing 'good' Stylosanthes pastures grown on low fertility soils. The present policy of providing mineral licks within grazing experiments to supply any deficiencies in sodium, phosphorus, and other elements is supported. However, there is a need to study the phosphorus and mineral requirements of animals grazing on improved pastures for extended periods of time, preferably cooperating with ICA.

379. In item 293 the 1977 QQR recommended that the mineral balance needed to be monitored in low input situations to ensure that there was adequate maintenance of nutrients in low fertility systems. Two soil/plant nutritionists were then appointed to the Tropical Pastures Program (section 2.5), and studies have been carried out on maintenance fertilizer needs. However, it is not necessary to move into a full study of nutrient cycling as implied by item 293. Measurements of cycling inevitably involve measurements of rates between different nutrient pools and this is extremely time-consuming. Measurements of states and not rates would be adequate at this stage.

380. In items 193 and 195 attention was given to the use of improved pastures within farms. CIAT is studying the integration of improved and native pastures within the Llanos. As additional knowledge is acquired about improved pastures, such action will be of continuing importance, preferably being done in collaboration with, or eventually mainly by, national institutions. However, CIAT has not given adequate attention to the cropping/pasture interface (item 193 bb).

### 9.2. Crop/Livestock Interactions

381. Where there is a mixed farming system there must be adequate appreciation of the livestock/cropping interaction in pasture research. For example, productive species with a limited life span may be quite unsuited for use as perennial pastures but may be ideal for a pasture phase in cropping rotations. Pastures can also aid in control of erosion. The CIAT/GTZ surveys have shown that in the Cerrado and Venezuelan Llanos there were significant crop/livestock interactions,with crop stubbles, from upland rice and sorghum respectively, being important in dry season grazing. This, for example, could effect the seasonal demands that farmers are going to impose on sown pastures and hence, the choice of species and wet season grazing management. Such interactions are likely to increase.

382. Also pastures can be sown with or underneath cash crops. This gives quick cash returns from fertilization and may enable higher rates of fertilizer to be used allowing the growth of more demanding pasture species. CIAT has carried out considerable research on pasture establishment, but no attention has been given to undersowing.

383. Thus, without directly engaging in farming systems research, the Program must take into account current and likely changes in farming systems.

### 9.3. Regional Priorities for Pasture Research

384. The Pastures Program to date, with the exception of RIEPT activities, has been directed to the frontier and highly acid Llanos and Cerrado, and thus will mainly benefit large-scale farms. However, the Pastures Program has initiated a proposal, with a minimum core position in 1988, to commence work on the moderately acid soils that are generally associated with small farms in more closely settled

areas with mixed farming systems throughout Central and South America. Some of the technology developed in the acid savannas will be appropriate but certainly some new ideas will be required (establishment, choice of germplasm for evaluation, use of browse shrubs, etc.). The potential for short- to medium-term adoption of pasture technology in these areas could be higher than it is for the savannas.

385. It is also proposed to commence work in the humid tropics with two positions (one in 1984 and one in 1986). The work is to be based in Peru, in an area where the typical farm size is 30-50 hectares with a livestock-cropping base. Both the moderately acid soils and humid tropics offer the possibility of aiding dual purpose (meat and milk) animal production.

386. The case for moving into the humid tropics is based on the increasing degradation of cleared forest land. It is estimated that half of the six million hectares of cleared forest land is already degraded and this can only enhance the pressure for further clearing. The objective of this project is to develop technology to avoid degradation and reclaim degraded land. The latter objective is particularly difficult but is a large and increasing problem which warrants CIAT's attention. It is more appropriate to commence this project now that good progress has been made with the savanna projects. This qualification was also made by the 1977 QQR (point 187 cc) which considered this topic.

387. The Panel recommends that both the moderately acid soil and humid tropics projects go ahead, with the provision that both projects be linked in with and given some parallel support by national institutions. The humid tropics project must focus on degraded or degrading land and not on clearing of new land. They would be organizationally similar to the successful CIAT-CPAC project. Additional support for both these projects will be required from headquarters (i.e., supply of seed, studies and advice on soil fertility, Rhizobium, etc.). Thus, the impact on the Program will be greater than the three positions directly involved. The Panel endorses the decision to postpone indefinitely work on the poorly drained savannas, drier regions, and the chaco ecosystem. With this new input there may have to be a decrease in the Llanos work as is predicted in the revised Long Range Plan. Nevertheless, sufficient resources would still be available to consolidate the Llanos project.

### 9.4. Recommendations

388. The recommendations made throughout this Chapter are as follows:

1) The Panel recommends that the Program retain the two soil/plant specialists in nutrition. If the current bilateral position at CPAC is not renewed after 1985, as is indicated by CIAT, the position should be on minimum core funds. The position need not

be retained in the Cerrado, but may be needed to support the two new regional projects.

2) The Panel recommends that the germplasm collection and characterization of germplasm continue, and also that the Program gradually decrease the evaluation and development studies on the Llanos and ICA be approached to assume more of this role.

3) The Panel recommends that applied research into seed production be increased, taking opportunity of this increase to train personnel from national programs, and also that liaison with national institutes on seed production be increased.

4) The Panel recommends that the proposed minimum core position for an outposted scientist at ILCA be delayed until planned reorganization of the headquarters forage program at ILCA has been fully effected. The proposition should then be reexamined in consultation with ILCA.

5) The Panel recommends that both the projected moderately acid soil and humid tropics projects go ahead with one and two core funded scientists, respectively. The proviso is that both projects be linked in with, and given some parallel support by national institutions. The humid tropics project must focus on already cleared areas and not on clearing of new lands.

# CHAPTER VII - SEED UNIT

## 1. Background and Objectives

389. The rationale for the Seed Unit at CIAT is described in the Seed Unit Position Paper (April 1983):

390. "The need for a Seed Unit grows out of two overlapping problem areas that impinge negatively on rapid progress in agricultural development based on improved production technology: limited availability of improved seed, and a but incipient seed industry at the national level which is in need of determined and systematic outside assistance in order to further develop."

391. This need was recognized in 1977 when CIAT Management determined that it would be beneficial to establish a unit to assist in training and development of programs for seed activities in Latin America. The Rockefeller Foundation granted the assignment of an experienced seed specialist and US$25,000 in support funds to initiate such activities. In November 1978 the Swiss Development Corporation (SDC) granted US$3,354,000 to create and fund a Seed Unit at CIAT for five years (1979-1983). This grant recently was extended by SDC for the period 1984-1986 in the amount of US$2,284,000. Supplementary support for the Seed Unit has been provided by CIAT (US$179,500, facilities and equipment), various equipment suppliers (US$38,949, gifts and loans of equipment), Mississippi State University/AID (US$124,000, technical assistance), Caribbean Food Corporation/EEC (US$33,912, training grant), and the German Foundation for International Development (US$25,000, training grant). Non-monetary support has been provided by many individuals and organizations.

392. The objectives of the first agreement with SDC were:

"To create a Seed Unit at CIAT to:

a) Train personnel in government and private institutions, primarily from Latin American and Caribbean countries, in various aspects of seed industry and seed program development.

b) Extend technical collaboration to countries in the region interested in seed program development, with the aim of expanding the production of high quality seed of improved cultivars at all levels, from the breeder to the commercial stage, with main emphasis on, but not restricted to, the commodities with which CIAT works.

c) Conduct specific research in seed technology highly relevant to CIAT commodity interests and relevant to problems of the impact areas.

d) Provide CIAT with a single unit to cooperate with commodity programs in multiplying, processing, storing, and distributing advanced experimental material, or breeder and basic seed, to collaborating countries for their further multiplication."

393. The objectives of the second agreement with SDC are discussed later in Section 8, Future Plans.

## 2. Organization and Activities

394. The Seed Unit was initially supported as a special project at CIAT but now is funded through restricted core project funds. It is organized into two sections, Seed Production and Industry Development, and Seed Technology and Quality Control. Both are administered by the Head of the Seed Unit, who reports to the Director of Crops Research. As described in the Seed Unit Position Paper, "The activities engaged in by the Unit are nonconventional for an International Agricultural Research Center in that they are not directly related to research, but, rather are in the areas of training, development, and promotion of national seed programs and enterprises."

## 3. Staff and Facilities

395. There are two senior staff positions in the Seed Unit. It is headed by a Senior Seed Specialist, and the Seed Production and Industry Development Specialist position (occupied for three and a half years) is currently vacant. The functions of training, production, drying and conditioning, quality control, and communication are performed by five Colombian university graduates. Clerical and field responsibilities are performed by three full-time and some part-time personnel. Production and quality control activities are performed by two technicians and two laborers (these four positions are paid from seed production and conditioning revenues). The services of the Seed Health Laboratory in the Genetic Resources Unit are available to the Seed Unit for routine testing and assisting in training activities.

396. Existing CIAT buildings were remodeled and there was some new construction to develop 1164 $m^2$ of space for the Seed Unit. A seed conditioning plant and a solar collector were constructed, and an existing grain handling facility moved and improved. These steps plus the addition of other donated and purchased items have resulted in facilities and equipment at the Seed Unit being valued at approximately US$500,000. A deliberate effort has been made to purchase or construct simple, but adequate, facilities and equipment in order to remain relevant to the Unit's mission and the local situations of the trainees.

## 4. International Cooperation

397. The role and function of the Seed Unit in international cooperation is described in the internal working document entitled "CIAT's International Cooperation Strategy" (30 January 1984):

398. "The availability of good quality seed of the improved varieties coming from the national and international research programs is basic to the ultimate impact of the CIAT cooperation strategy.

399. National programs have the primary responsibility in developing effective seed programs and industries, but many countries in the region are having difficulties building a cadre of trained people, in establishing clear strategies, and in developing strong seed production systems."

400. Country profiles developed by the Seed Unit indicate that only seven of 22 Latin American and Caribbean countries have clearly defined seed policies. Thus, there exists a significant role in international cooperation, especially in training, technical collaboration, and basic seed production, for the Seed Unit at CIAT. Another aspect of international cooperation is communication. This is being handled effectively in the region by the Seed Unit with its newsletter "Semillas para America Latina" (in Spanish, with a circulation of 1500).

401. The Seed Unit works with other Centers and agencies with programs in the region (CIMMYT, CIP, ICRISAT, IICA, World Bank, and IDB). All of these agencies have contributed to workshops, and the Unit assists CIMMYT training activities.

## 5. Training

402. Training has been the first objective and priority of the Seed Unit. Training activities include courses at CIAT, in-country courses, in-service training (individualized), workshops, and thesis and research supervision. There have been six intensive (seven to nine weeks) courses and four advanced short (four weeks) courses offered at CIAT in the 1979-1983 period. There were 167 participants in the intensive courses and 116 participants in the short courses. These participants represented at least 26 countries. In-country and subregional courses have been offered 12 times to 267 participants. Individualized in-service training has been provided to 15 participants. Five workshops have been held at CIAT and two regional workshops were co-sponsored. The number of participants and countries represented in the workshops at CIAT exceeded 320 and 26, respectively. Thesis and research supervision to date has involved candidates for five M.S. and one Ph.D. degree. Visiting scientists, specialists, and consultants to the Seed Unit have averaged about five persons per year.

403. Excellent course materials, audiotutorials, and publications, prepared by CIAT staff, often with outside assistance from visiting scientists, specialists, and consultants, are significant components of the training program. CIAT now has 16 different audiotutorials developed on various aspects of seed production, propagation, and technology. Over 425 copies have been sold.

404. Although evaluations are made following individual courses, all former course participants have been asked to evaluate the effectiveness of Seed Unit courses in preparing them for their current activities. Their responses will be used to facilitate changes, where beneficial, in future courses. The Panel commends the quality and scope of the Seed Unit's training programs.

## 6. Achievements and Impact

405. The major achievements of the Seed Unit include its establishment and construction of facilities, the development of a training program, and the production of basic seed of several species.

406. The impact of the Seed Unit has been considerable, especially in view of its five year existence. The impact of its training program has been felt in at least 26 countries through their personnel's participation in courses, in-service training, workshops, and thesis and research supervision.

407. Training in the five year period was planned for 402 individuals, but more than 870 have been trained. Following this training many of these individuals have assumed important positions in their domestic seed industry and are in turn training others.

408. Through technical collaboration some national program policies and strategies are improving, new seed associations are forming, improved guidelines for seed production are being developed, and more and better quality basic seed is being produced.

409. The impact of basic seed production by the Seed Unit has been realized in three of the four commodity areas at CIAT. Seed of 49 varieties or lines of beans, rice, and tropical pasture species, totalling 152 tons and valued at US$191,000, has been produced and supplied to 16 different countries. Seed of important germplasm or species also has been increased to complement efforts in the commodity programs, especially for the Tropical Pastures Program.

410. From these combined efforts, the Seed Unit is helping the development of four seed networks, national seed programs and former trainees, subregional efforts, universities with an emphasis on seed production and technology, and seed associations. A working technical committee on seed matters now exists because of Seed Unit efforts. Similar plans are underway in the Andean Zone. A collaborative

agreement signed with a seed technology and training center in Southern Brazil can contribute significantly to work in the Southern Cone.

411. The motivation of former trainees and the Unit's efforts have resulted in new seed trade and technology associations forming in Costa Rica, Guatemala, Panama, and Dominican Republic. Similarly a subregional association has started in Central America and the Caribbean, and a region-wide Latin America Association of Seed Experts is being initiated with the Seed Unit to act as its secretariat. A total of 15 associations are now operative in the region.

412. The Workshop on Improved Seed for Small Farmers was attended by 65 participants. The Workshop stimulated an awareness of what is required to assist the small farmer in improving his seed for planting. The Panel endorses the Seed Unit's emphasis on the needs of small farmers.

## 7. Constraints and Weaknesses

### 7.1. Staffing

413. The limited number (2) of senior staff and the important role of this Unit necessitate that the Seed Production and Industry Development Specialist position be filled.

414. The Panel recommends that this position be filled as soon as possible.

415. Outposted staff members are necessary in both the Andean region (Peru) and Central America (Costa Rica) to provide follow-up assistance with trainees, to assist basic seed production efforts, to work in the development of seed enterprises in countries, to contribute to improving seed supplies to small farmers, and to strengthen subregional networks.

416. The Panel suggests that consideration be given to establishing two outposted staff positions for the Andean and Central America regions. This could be approached on a step-wise basis with extra-core funding.

417. An individual with seed production experience should be appointed to the Experimental Station Operations Unit and assigned to oversee seed growing activities at all CIAT locations, if extra-core funding can be obtained. This would facilitate and greatly increase the efficiency of the total seed production effort through the Seed Unit in cooperation with commodity programs.

418. The Panel supports this appointment, but funding should be from extra-core sources.

419. Activation of the senior fellow program would be beneficial to the Seed Unit and all other CIAT programs.

### 7.2. Facilities

420. Additional air-conditioned seed storage space is essential. The reduction of the space initially proposed has already resulted in improper storage and rapid loss of germination of *Andropogon gayanus* seed (US$15/kilo production costs).

421. Capacities for seed cleaning, holding, and drying must be increased.

422. As the production effort increases, additional highly productive land must be made available to the Seed Unit both at Palmira and appropriate off-station locations to facilitate efficient production of basic seed. In certain situations this land may be outside of Colombia. It may be desirable to contract some seed production functions.

423. The Panel *recommends* that the required additional physical facilities and land be provided to the Seed Unit.

### 7.3. Research on Seed Production

424. The uniqueness and diversity of the plant species researched at CIAT require that research be done on seed production methods *per se*. Some research can be done within the Seed Unit when fully staffed. Limited complementary research is being done on tropical pasture species by the senior seed scientist of that program. More seed production research could be done by that scientist if additional time and technical assistance are made available by the Tropical Pastures Program for this purpose. The close working relationship between this scientist and the Seed Unit is noted by the Panel and might be examined and emulated to the degree necessary by the Bean and Rice Programs.

425. The seed technology research now done in a few universities in the region is totally unrelated and the results are not readily available. The Seed Unit needs to play a more direct collaborative role with other regional bodies to identify priorities, catalyze research efforts, and serve as an information and data base for work done. Key areas for research include seed pathology, economics of seed production and marketing, drying, packaging, and storing seed in the tropics, and constraints in seed supplies for small farmers.

### 7.4. Communication

426. Greater follow-up with trainees is necessary. This could be accomplished by appointment of the two regional outposted senior staff or an additional senior staff position at CIAT-Palmira.

427. Greater understanding is necessary among the CIAT staff of the nature and value of a good seed program to their own commodities and to development of the region.

428. More technical information is needed in Spanish in easily accessible form through bulletins, handbooks, training manuals, and audiovisual materials.

429. Better communication and coordination are necessary with the regional FAO seed program.

430. The Panel recommends that better communication on seed matters be established between FAO and the Seed Unit.

## 8. Future Plans

431. The future plans of the Seed Unit for the 1984-1986 period are described in the Memorandum of Agreement with SDC. These include:

1) increasing the number and competence of seed technologists in the region through a continuation of the basic, and development of more advanced, training opportunities;

2) strengthening seed programs and enterprises within countries through technical collaboration with former trainees and the developing seed networks;

3) stimulating seed production and accelerating the use of the best varieties and hybrids available;

4) performing research on those problems limiting seed production and distribution;

5) disseminating information on seed activities, advances in seed technology, and the existence and availability of desirable new materials in the region.

432. Concurrently, the Seed Unit will continue to provide centralized support for the production, processing, and distribution of seed of improved materials and to assist national program efforts to produce and distribute improved seed developed in the CIAT/national commodity research programs.

433. It is clear that a need will exist after 1986 for the

activities performed by the Seed Unit. In fact these activities will probably increase and be necessary on a global basis, especially in the area of international development activities. Therefore, a mechanism must be found to enable the Seed Unit organization and mission to evolve with that increasing need. A more autonomous role may be necessary so that the Seed Unit may serve in a more consultative or coordinating role on a regional and global basis for the establishment and operation of similar units.

434. One possibility is that the Seed Unit become a semi-autonomous unit of CIAT, still under the umbrella of CIAT's Board of Trustees, but with its own Board, chosen to represent the broad activities and regions of service of the Seed Unit. This possibility also is discussed by the EMR in its report.

435. The Panel recommends that a study be done to determine whether the Seed Unit could best fulfill its functions as part of the CIAT core budget, by becoming a semiautonomous unit, or by a combination of these or other possibilities. This is especially pertinent in regard to the necessary future international development activities of the Seed Unit, and perhaps the whole CGIAR system.

## 9. Assessment and Recomendations

### 9.1. Assessment

436. The Seed Unit has made a very significant impact on the seed industry of Latin America in a period of only five years. It has responded to a major need of the region by developing an excellent training program, improving seed technology, providing basic seed, and increasing communication among seed professionals. The continued evolution of the activities of the Seed Unit demonstrates that it is dynamic and responsive to the needs of its clientele. The Panel commends the staff of the Seed Unit and those who have contributed to its development.

### 9.2. Recommendations

437. The Panel recommends that a study be done to determine whether the Seed Unit could best fulfill its functions as part of the CIAT core budget, by becoming a semiautonomous unit, or by a combination of these or other possibilities.

438. The Panel recommends that the Seed Production and Industry Development Specialist position be filled as soon as possible.

439. The Panel recommends that the required additional physical facilities and land be provided to the Seed Unit.

440. The Panel recommends that better communications on seed matters be established between FAO and the Seed Unit.

# CHAPTER VIII - NEW INITIATIVES

## 1. Introduction

441. The staffing structure and commodity (rather than discipline) orientation of CIAT has undoubtedly contributed significantly to the cooperation and rapid progress of the commodity programs. The Panel recognizes and commends this. However, can the commodity approach alone adequately provide the necessary supporting research in specialized areas such as tissue culture, virology, and microbiology?

442. This subject was addressed recently by Director General Nickel ("Agricultural Research Management", presented at the Workshop on Agricultural Research Policy and Management in the Caribbean, Port of Spain, Trinidad, 26-29 September, 1983), when he stated that "even in a large organization with few commodities to cover, it may not be possible to assign scientists in highly specialized disciplines to each program on a full-time basis. A useful compromise is to organize most of the institution along interdisciplinary, commodity program lines and to conduct the more specialized research within a scientific support unit serving all programs."

443. During the EPR the Panel determined a need for two new, but related, initiatives at CIAT.

## 2. Proposed Interdisciplinary Research Unit

444. The Panel held extensive discussions on the concept of CIAT modifying its organizational structure to the degree necessary to develop a small, new unit comprised of those disciplines which will interact increasingly with all commodity programs in the future. For example, tissue culture, an aspect of applied biotechnology, is being used in the Cassava Program to free germplasm of pathogens; promising forage species of the Tropical Pastures Program are being regenerated from callus cells; culture of anthers from $F_1$ hybrids of rice has shown great potential for accelerating the breeding process for this commodity; and interspecific crosses necessary in the Bean Program can be facilitated by embryo rescue and plant regeneration from protoplasts and callus cells. These and additional applications of tissue culture such as screening for stress tolerance, somaclonal variation, protoplast fusion, and uptake of genetic material will become increasingly important to all commodity programs in the future.

445. However, the current structure at CIAT and the work load on the scientist directing the tissue culture program do not permit the optimum use of tissue culture by any of the programs; nor do they

allow the scientist time to concentrate on modification and development of tissue culture techniques which might be specific for one commodity or useful with all commodities. Other senior staff at CIAT facing this same situation to varying degrees are those involved with mycorrhiza, Rhizobium, and virology.

446. The development of a Science and Germplasm Resource Unit (SGRU) at CIAT and the transfer to it of a limited number of senior staff would provide greater and more capable responsiveness by these disciplines to the needs of commodity programs. Components of the SGRU might include the Germplasm Resources Unit, applied biotechnology, the seed pathology position proposed below, virology, mycorrhiza, and Rhizobium, with the latter two perhaps grouped as microbiology. Interaction between commodity programs and the SGRU would be via Research Associate level staff, whose support and first loyalty would be in the commodity programs. The number of Research Associates utilized in this manner and in which disciplines of the SGRU would be determined by the current needs of a particular commodity program. Post-doctorals and visiting scientists would be retained to advance knowledge in critical research areas in which continuity was not essential.

447. The structure and method of operation for the proposed SGRU would cause a minimum amount of reorganization, no relocation, and no disruption of ongoing research. It not only addresses the reality of future limitations in the number of senior staff positions, but also generates the critical masses of scientists working in advancing research areas and increases the bi-directional flow of skills and information between the constituent disciplines and the commodity programs. It also would accommodate the future addition of other needed disciplines, such as nematology.

448. The Panel recommends that CIAT give serious consideration to establishing a SGRU-like structure on a trial basis for three to five years. The SGRU could be administered by a current core-funded senior staff member in one of the disciplines, the proposed senior staff person to coordinate Research Services, or the position could rotate among the constituent scientists during the trial period.

### 3. Proposed Seed Pathologist

449. There is an increasing awareness in all of the commodity programs at CIAT of the hazards associated with the possible importation or exportation of diseased plant materials. There also are several problems of seed health and their impact on crop establishment and seed production. Yet there currently is no mechanism to address these problems CIAT-wide. The Seed Health Laboratory in the Germplasm Resources Unit (GRU) represents a beginning, but it will be unable to deal at the professional level with all the current and potential needs of all commodity programs.

450. To address this need the Panel recommends that a new senior staff position of Seed Pathologist be created and filled as soon as possible. The responsibilities of this position would be to direct the Seed Health Laboratory, assist the commodity programs and the GRU and Seed Unit in areas of seed health and phytosanitary measures, and to develop rapid and sensitive techniques for the detection and identification of pathogens in plant propagules.

451. The Panel believes that CIAT could assume international leadership in the area of phytosanitary measures, which is of increasing concern to all the IARCs.

### 4. Recommendations

452. The Panel recommends that CIAT give serious consideration to establishing a Science and Germplasm Resources-like structure on a trial basis for three to five years.

453. The Panel recommends that a new senior staff position of Seed Pathologist be created and filled as soon as possible.

# CHAPTER IX - TRAINING AND CONFERENCES, COMMUNICATIONS AND INFORMATION

## (A) TRAINING AND CONFERENCES

### 1. Background and Objectives

#### 1.1. Background

454. Since 1976, CIAT's training and conference activities (TCA), formerly an independent program, have been carried out within each commodity program. A coordinating Head serves on a Center-wide basis and nine training associates have been appointed, two to each commodity program and one to the conference section. This small staff provides organization and methodological support for the courses, helps in developing training materials, and assists in the conduct of in-country courses.

455. The percentage of estimated time that senior staff devote to TCA varies from about 11 to 17% for the four commodity programs, with additional contribution from some supporting units (especially the Biometrics Section). TCA comprised only 4.3% of the CIAT core budget (1983). This percentage was much higher before 1982 (6.1% in 1980), but the decrease in CIAT's contribution has been compensated for by extra-core funds (UNDP, Swiss Government, GTZ, etc.) and direct funds for some national research and development institutions.

#### 1.2. Objectives

456. The objectives of TCA were revised in 1976 and are stated as follows:

- "To contribute toward developing cooperative networks on field beans, cassava, rice, beef, maize, and swine for the purpose of validating, adapting, and disseminating technology from the Center.

- To help national institutions strengthen their agricultural research and development capabilities regarding CIAT's commodities."

457. Later, in May 1981, the CIAT Program Committee proposed a narrower definition amalgamating the two aforementioned objectives: "Through a program of advanced level training and conferences, to help prepare scientists with leadership capabilities for collaborative research in the areas of CIAT's commodity mandate, thereby strengthening networks of professionals who can exchange, test, validate, and generate improved germplasm."

## 2. Training Activities

458. CIAT offers a wide range of options to meet the training needs of the national research and development institutions in its mandate commodities. These options have developed in accordance with the evolution of CIAT's overall activities, and of each of its commodity programs and the Seed Unit, and also with change in national research and development institutions. In recent years, increasing emphasis has been given to research training at CIAT and to assistance with in-country training.

459. Most training has been organized on a group basis, groups being organized in different ways:

1) Short intensive courses in seed technology and production, directed to specialists employed by public and some private Latin American enterprises.

2) Short multidisciplinary commodity courses organized, normally once a year, by each commodity program, attended by research and development workers.

3) Commodity training programs, commenced in 1978, combine the above short multidisciplinary commodity course with a subsequent period of individual training. This specialized training is more and more directed to young national research scientists.

4) In-country training courses for extension workers are organized outside of CIAT on a national or regional basis.

460. The individualized training activities include degree (M.S. and Ph.D.) related training and in-service internships of postgraduate and post-doctoral fellows.

461. These activities, the relative importance of which are shown in Table 1, will be analyzed in turn.

### 2.1. Short Intensive Courses

462. The short intensive courses on seed technology and production, generally organized twice a year, meet the strong demand of public and private enterprises of Latin America and other regions. Attendance at these courses comprised about 25% of total CIAT trainees (10% of total months) in recent years. The collaboration between CIAT senior and associate staff and highly experienced national seed specialists makes these courses very effective and appreciated. The Panel endorses the quality and the approach taken by these courses.

463. The short multidisciplinary commodity courses are mostly attended by young scientists of national research institutions and

Table 1. Number and Man-Months of Professionals Trained at CIAT in 1982-84, by Training Category in Each Commodity and Support Unit

| PROGRAM OR UNIT | GROUP TRAINING | | INDIVIDUAL TRAINING | | | | |
|---|---|---|---|---|---|---|---|
| | | | Degree Training | | Visiting Researchers (VR) | | |
| | Multidisc. Intensive Courses | Commodity Training Programs | M.S. | Ph.D. | Visit R. (graduate) | V.Associate R. (with M.S.) | Total |
| 1982 | No.(month) | No.(month) | No.(months) | | No.(months) | | |
| BEANS | 9( 9) | 11( 56) | 10( 60) | 5( 44) | 7(17) | 1( 6) | 43(192) |
| CASSAVA | 5( 5) | 11( 41) | 2( 24) | 3( 26) | 17(25) | 1( 4) | 39(125) |
| RICE | 3( 6) | 12( 56) | 3( 30) | | 1( 1) | | 19( 93) |
| T. PASTURES | 2( 4) | 14( 70) | 8( 62) | 6( 52) | 13(18) | 5(11) | 48(217) |
| SEEDS | 75(122) | 2( 13) | | | 4( 4) | | 81(139) |
| OTHERS | | | | | 6(19) | 1( 1) | 7( 20) |
| TOTAL 1982 | 94(146) | 50(236) | 23(176) | 14(122) | 48(84) | 8(22) | 237(786) |
| TOTAL 1983 | 130(155) | 40(192) | 19(104) | 14( 86) | 39(143) | 8(32) | 250(712) |
| TOTAL 1984 (provisional) | 114(156) | 60(320) | 20(200) | 15(150) | 12(112) | 13(72) | 234(1010) |

universities, although some key specialists of national extension and development institutions also attend. There is evidence that these current courses cannot accommodate the specific needs of these two types of participants who usually have different backgrounds and interests in science and technology. Therefore, the Panel emphasizes the need for separating training for these two types of participants.

464. The Panel strongly suggests that:

1) the current short multidisciplinary course be reserved for young scientists, and also the subsequent specialization phase (see Section 2.2.);

2) CIAT meets the existing demand for training of key extension and development specialists with new specifically planned short course for extension and development specialists. These courses should involve only a minor participation of CIAT's senior staff, and a rather major participation of the best national Latin American professionals in extension and development within CIAT's commodities. These courses should preferably take place outside of CIAT and be organized on an in-country, regional, or continental basis as is appropriate.

465. The Panel commends the initiation of the first on-farm research short course held recently by the Bean Program. The Panel suggests CIAT considers whether it should initiate a new course dealing with on-farm research. This could commence with a general section dealing with all commodities, followed by specialization in the different commodities. This initiative would necessitate the recruitment of a specialist in on-farm research, possibly with the support of extra-core funds.

### 2.2. Commodity Training Programs

466. The annual "short course plus specialization" combination has become CIAT's main training activity during recent years (about 30% of the total trainee months). These programs begin with a multidisciplinary phase or group intensive course of four to ten weeks, a review of the "state-of-the-art" on each commodity, followed by an individualized phase of specialization in a single discipline applied to the same commodity.

467. Program participants are, with few exceptions, young research workers, mostly from Latin America, nominated by their respective institutions. Their selection is carried out by an internal CIAT committee formed by the Training Head and associates, and potential discipline research supervisors, taking into account the profile of studies and experience of the applicants, institutional and country needs, and availability of institutional financing . On the average, one of every two applicants is selected. Over the last few years, the participants' prior professional experience increased

from an average of 1.5 years in the 1975-80 period to 3.5 years in 1983.

468. The teaching procedures during the intensive first phase of the course have been improved. The ratio of lectures to laboratory and field practices has currently decreased to 50:50. More materials, such as audiotutorial units, mimeographed papers, and books are being used, making the teaching process more dynamic and interesting. Senior staff participate less in teaching, are partially replaced by research assistants, and are able to dedicate more time to seminars and direct interaction with the participants. The gradual reduction in the duration of the intensive course, with the corresponding increase in the specialization phase, also has been an improvement, at least for the Bean (from 8 to 5 weeks) and the Tropical Pastures Program (from 12 to 10 weeks).

469. The specialization phase which follows may last from three to seven months depending on the commodity, and it involves typical research activities. Each participant works side-by-side with a CIAT researcher, on a discipline-oriented subject, related wherever possible to his/her country's needs.

470. The Panel commends the favorable changes in the commodity program training, especially in the first short intensive period, over the last years. The Panel urges that this effort be pursued. The reserving of this course for young national scientists, as proposed above, would allow CIAT to better meet their needs. In this respect, the Panel suggests:

1) An even greater reduction in the multidisciplinary phase, made possible due to greater professional experience of the participants, and a corresponding increase in the specialization phase, allowing participants to become more actively engaged in research. This would avoid the impression that some trainees have had in the past of being considered as "technicians" working for CIAT researchers. This year the Rice Training Program can be considered as a good example of change toward the desired balance between these phases.

2) A continued attention to increased training of participants on research methodology which gives more consideration to the problems and work conditions of their respective countries. This would imply a critical or analytical presentation of CIAT research activities and sometimes its methodologies, as these reflect CIAT's international mandate and may be less appropriate to national programs. Care must be exercized not to overemphasize network activities within training courses which may lead to national scientists participating in networks of limited value to their respective countries.

3) That to insure that young scientists appreciate the importance of key development and extension issues in assessing research priorities, some discussions on relevant issues should be included in the training program through invited specialists.

### 2.3. In-Country Training

471. In-country training on CIAT's commodities is considered an effective means of bridging research with extension. Assistance is offered to interested national programs to organize and conduct two to eight week courses for personnel in extension, credit, and other development services. In all cases these courses are timed to coincide with introduction of new varieties and other technologies with high potential for making an impact on production. These in-country training activities have developed rapidly during the past few years (Figure I). CIAT restricts its contribution to a limited participation in instruction (about 20%) and the contribution of teaching materials such as articles and audiotutorials. Normally, CIAT's participation is limited to the first course in each country, subsequent courses being under the complete responsibility of national specialists. However, in certain countries CIAT has had to reasume its participation due to changes in national personnel and leadership.

472. The Panel commends the attention CIAT is giving to in-country and regional courses and especially to regions where it is expanding its activities, such as Southeast Asia and Africa. In these regions, CIAT takes note of both national needs and the different regional and cultural contexts.

473. However, taking into consideration the lower scientific requirements of these in-country training courses and the existence of an appreciable number of well trained and experienced national specialists in research and development, the Panel proposes a rapid reduction of senior research staff participation in in-country training courses, compensated for by the greater participation of specialists of other countries. These personnel could be proposed by CIAT to the respective national program and given CIAT assistance. Thus, the horizontal cooperation among countries would be favored and, at the same time, the senior staff could devote the time saved to other activities.

### 2.4. Degree-Related Training

474. The conduct of M.S. and Ph.D. research studies at CIAT is considered of high importance in relation to the development of scientific staff in national programs. In the 15 years since CIAT's founding, 85 and 89 trainees, respectively, have conducted their M.S. and Ph.D. research at CIAT. Relationships for such training have been established with 21 universities or graduate programs in 12 countries of North America, Europe, Africa, and Latin America. Of these, 79 M.S. and only 29 Ph.D. trainees have come from Latin America and other developing countries. CIAT considers these numbers to be very low in

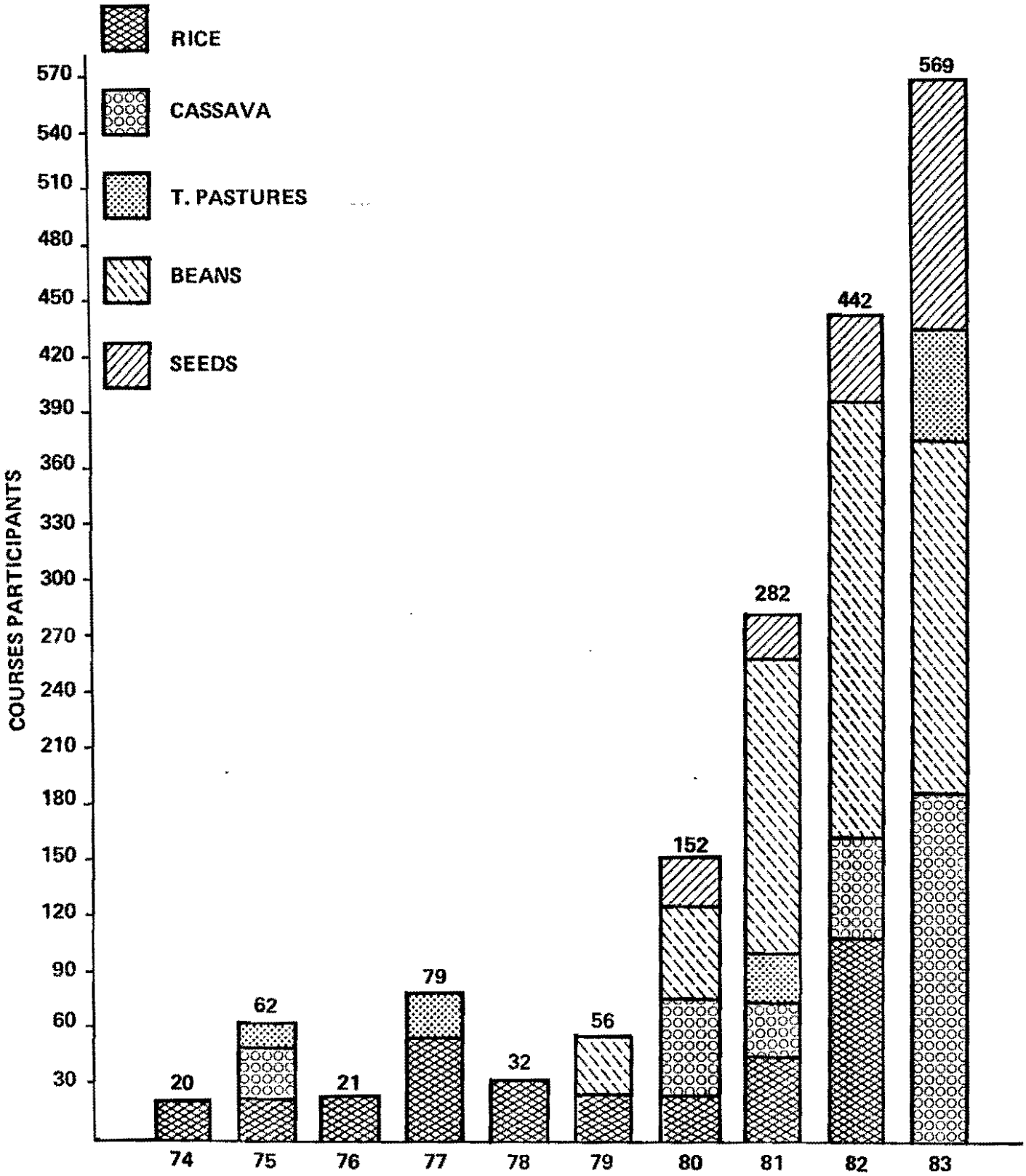


FIGURE 1. NUMBER OF PARTICIPANTS OF IN-COUNTRY TRAINING COURSES ASSISTED BY CIAT 1974 – 1983.

relation to the needs of national programs and CIAT's training capacity. The main reason for these low numbers is lack of financial support for academic degree studies in developed countries.

475. The Panel notes the importance of the degree-related training activities and it supports the focus CIAT wants to give to this form of training in the long-term. For that purpose, the Panel urges that CIAT continue its efforts to sponsor academic studies with extra-core funds, and recommends that it explore the possibilities of relationships with advanced universities which allow flexibility or have no fixed academic course requirements in the academic programs for postgraduate degrees. The Panel also suggests that CIAT ensure that more scientific publications are written from the thesis studies carried out at CIAT.

### 2.5. Post-Doctoral Fellows

476. Initially CIAT's objective was to train new Ph.D. graduates of national programs in research work on the commodities of CIAT's mandate. However, the marked shortage of these professionals caused CIAT to use large amounts of the core-budget to train new Ph.D.s from developed countries. The goals were to: (1) to increase the number of scientific personnel trained in CIAT-mandated commodities, and (2) identify possible new senior staff members. Some of these post-doctoral fellows (four out of 17 in 1983) are financed by other funds (IDRC, GTZ, etc.). The Panel suggests that CIAT attempt to increase, when possible, the proportion of the extra-core funds for this activity.

## 3. Conference Activities

477. Conferences and international seminars are organized by CIAT, their frequency having increased in recent years. These have a dual purpose:

1) to exchange updated scientific information on either broad or specialized subjects, always related to CIAT's programs;

2) to support the operation of the international networks promoted by CIAT (IBYAN, IRTP, RIEPT), with discussion of research methodology and strategy.

478. Senior staff consider these activities very beneficial and they could be even more so if there were greater financial possibilities of inviting eminent international scientists. The Panel supports this concept as it would stimulate scientific discussion and reduce the risk of inbreeding due to the very high proportion of CIAT-trained participants in international meetings organized by the Center.

## 4. Results and Achievements

479. In fifteen years, about 2400 persons from 55 countries have been trained at CIAT programs and units, 1772 since 1977, with significant consequences on the strengthening of national programs, the transfer of CIAT technology, and the growth and operation of international networks.

### 4.1. Strengthening of National Programs

480. Almost all national programs for all four commodities, and their counterparts in the Cassava and Bean programs in Asia and Africa have had a major part of their research staff trained at CIAT. This result was obtained in spite of the large turnover of ex-trainees into other activities. According to a survey done by CIAT, about 54% of the professionals trained in research during the 1970s remained active in research on their commodity. More recent trends indicate more permanency of CIAT-trained scientists in their programs in several, if not all, countries.

481. Some of these national programs have already proved their maturity by releasing new technologies, taking increasing responsibility toward self-sufficiency in applied research, and taking up, on a national or regional basis, more of the work previously performed by CIAT.

### 4.2. Transfer of CIAT Technology

482. Researchers trained at CIAT have been instrumental in collaborative research and interinstitutional transfer of research methodology, germplasm, and new technology. Numerous examples of such transfer are presented in the commodity chapters.

### 4.3. Contribution to the Growth and Operation of Research Networks

483. As stated by CIAT (Training and Conferences: A Strategy Document, 8 May 1981): "A very large proportion of the members of research networks, formal or informal, on beans, cassava, rice and tropical pastures, and on seeds are CIAT alumni. Their communication, exchange of information, and consolidation of common research and development strategies are promoted and assisted by means of periodic conferences (workshops, seminars, meetings), an effective and efficient mechanism to foster cooperative research and accomplish technology transfer. Both training and conferences have thus contributed much to the development and operation of those networks."

### 5. Future Plans

484. Future plans propose the continuation of current activities with the following changes:

- expansion of training giving more attention to regional and subregional problems, especially in Africa and Asia;
- further expansion in assistance to in-country courses (mostly for production);
- assessing national needs and proposing short- and long-range plans for development of scientific capability in beans, cassava, rice, pastures, and seeds;
- giving more attention to degree-related training.

485. The Panel agrees with all these changes, but has a qualification for the second change. While there is a need for expansion of in-country production-oriented courses, the structure of these courses should be changed as suggested in 2.1.

### 6. Assessment and Recommendation

486. The Panel believes that CIAT's training activities and conferences have been very valuable in the development of science and technology in the commodities of its mandate, especially in Latin America. The Panel commends the overall dynamic training strategy that CIAT has been developing in the past and proposes for the future. The Panel emphasizes the consistent efforts made by CIAT to evaluate its training activities in order to improve them, and CIAT's very important production of scientific and technical audiotutorials which are not only used in the courses organised by CIAT but also in an increasing number of in-country courses organised without direct CIAT participation.

487. To assist scientific staff in national programs, the Panel recommends that CIAT explore the possibilities of relationships with advanced universities which allow flexibility or have no fixed academic course requirements for postgraduate degrees.

## (B) COMMUNICATIONS AND INFORMATION

### 1. Introduction

488. CIAT's information strategy is to manage agricultural

information in a way that makes it as accessible as possible to CIAT staff and the other members of the commodity research networks. CIAT contributes to the transfer of technology to appropriate audiences in 55 countries. This is done through a set of information services:

1) annual CIAT and program reports;
2) network publications and newsletters;
3) books, technical reports, materials and teaching journal articles;
4) seminar and conference proceedings;
5) abstracts. journals, and bibliographic services;
6) Pages of Contents;
7) specialized information centers.

## 2. Staff and Facilities

489. The Communication and Information Support Unit (CISU), which is responsible for all the corresponding activities at CIAT, is staffed by a Head, two senior scientists, one visiting scientist, one supervisor, and supported by 79 other staff members.

490. The CISU budget represents 6-7% of the CIAT core budget, and has been maintained even in years of economic restriction, demonstrating the priority assigned by CIAT to these activities.

491. The library houses a large collection of books (45,000 in 1983) and many other documents, including approximately 3500 for tropical pastures, 6000 for beans, 6500 for cassava, 3200 for agricultural economics, 1100 periodicals, 1620 microfiches, 61 CIAT-produced audiotutorial units, 6900 slides, maps, microfilms, etc. Access to DIALOG computerized data bases (Lockheed, California) will be completed with the acquisition of adequate computation and telecommunication equipment.

## 3. Achievements

492. There is worldwide praise of CIAT's documentation program. It has been adopted as a model by several institutions in the world, including IITA and ICRISAT.

493. The CISU publishes the CIAT annual program reports, newsletters of the research network, books, technical reports, scientific journal articles, manuals and proceedings, key journals, and pages of contents. Documentation and information on beans, cassava, rice, and tropical pastures is offered as a specialized service through the commodity-oriented Documentation Center which is being substantially reinforced by a special project funded by IDRC.

494. Most of these publications are sold. During 1983, books were purchased by 27 countries, bestsellers being those on cassava, biological nitrogen fixation, rice, and seeds. Others are distributed free of charge or on an exchange basis.

495. Services such as photocopies and specific bibliographic searches are charged; however, CISU gives such services free of charge to research institutes in developing countries that form part of CIAT's networks or to those who are unable to pay.

496. Audiotutorial training was offered to communication specialists of nine national institutions: ICA, INIAP, VALM, IBTA, VCR, MAG, EAP, ISA, and INIA, which have assembled audiotutorial design and production units.

497. The Pages of Contents Service of SNICA (Sistema Nacional de Informacion en Ciencias Agropecuarias) was organized on the model of CIAT's service and is using CIAT's Pages of Contents as a base.

### 4. Future Plans

498. The principal proposed changes are the following:

1) Each commodity program will take over the production of its Annual Program Report, and present it as a "working document." The Panel endorses the future proposal of annual working document plans. Complete and definitive program reports on specific areas should be published only when the accumulated information warrants publication in either monograph or scientific paper form.

2) New publication efforts in the Bean Program will be directed to English and French speaking countries of Africa and the Caribbean.

3) In the Cassava, Rice, and Pastures Programs, emphasis will be given to the improvement of their newsletters by including more technical and scientific information from CIAT and national programs. Some of these newsletters, currently only available in Spanish, will be published in English.

4) The Unit needs to assess jointly with the respective programs the needs for region-specific information/documentation support in relation to the Regional Commodity Projects and Networks, particularly for beans in Africa and cassava in Asia.

## 5. Assessment and Constraints

499. 1) The Unit is adequately equipped and changes in its physical structure are not visualized in the short-term.

500. 2) The CISU is very active. According to CIAT researchers and national programsit works well and is very efficient in disseminating information about CIAT's activities and achievements. Thus, it contributes actively to the Commodity Research Networks as well as to CIAT's prestige and reputation with outside institutions . The Panel recognizes the value of CISU activities and commends the attention paid to them by CIAT administration.

501. 3) In view of the deficiencies in communication activities of many national research institutions, CISU has been providing highly valuable services to national institutions and researchers. The Panel approves particularly the frequent free-of-charge services offered to national research institutions of developing countries.

502. 4) The Termatrex system of information recovery, acquired as a result of recommendations of the 1977 QQR, is presently inadequate. The large amount of manual work required to register documents highlights the need for computerizing this information. Therefore, the Panel recommends that the Computation Unit and the BiometricsSection carry out the studies necessary to solve the computation needs of the CISU. Due to the type of activities conducted, the Panel considers that the Unit should also be supplied with the necessary word processing equipment.

503. 5) The Unit does not have an English or French editor; these needs are currently covered by the services of a senior staff member.

504. 6) The Audiotutorial Materials Section should ideally be under the responsibility of a permanent staff member. Currently it is under the responsibility of a visiting scientist. Therefore, the Panel recommends that the Audiotutorial Materials Section be managed by a permanent staff member in close consultation with the Training Program. It also suggests assessing the feasibility of contracting earliest an English editor.

505. 7) With the continued information expansion of commodity programs, there will inevitably be an increase in the need for information and communication support. The Panel recommends that, whenever possible, regional and special projects should provide funding to support these activities, e.g., publication of newsletters and workshop materials, translations, etc.

## 6. Recommendations

506. 1) The Panel recommends that the Computation Unit and the Biometrics Section carry out the studies necessary to solve the computation needs of the CISU. Due to the type of activities conducted, the Panel considers that the Unit should also be supplied with the necessary word processing equipment.

507. 2) The Panel recommends that the Audiotutorial Materials Section be managed by a permanent staff member in close consultation with the Training Program. It also suggests assessing the feasibility of contracting earliest an English editor.

508. 3) The Panel recommends that regional projects include the necessary components for information/communication support to assure success of regional programs. When regional projects are financed through special projects, such expenses should not be borne by CIAT's core budget.

(Note that there also is a recommendation in Section 6, Assessment and Recommendations, of Subchapter A).

# CHAPTER X - SUPPORTIVE RESEARCH, SERVICES AND FACILITIES

## 1. Introduction

509. In order to achieve an efficient performance of research activities, it is necessary to provide the researchers with the essential support services to successfully carry out their projects.

510. An analysis of the accomplishments and needs of the supportive research services and facilities of CIAT is presented below.

## 2. CIAT Headquarters

### 2.1. Organization and Administration

511. Under the Director General are three Directorates: Crop Research (DCR), Resources Research and International Cooperation (DRRIC), and Finance and Administration (DFA). (See Organization Chart, Chapter II, Figure 1.)

512. The structure of the administrative division is functional, based on division of work by a detailed assignment of functions, norms, and procedures. Decisions are centralized with defined lines of authority, and communications are predominantly vertical.

513. Administration and research areas are horizontally linked through committees. This structure has the advantage of promoting discussion and interaction between administrators and scientists.

### 2.2. Headquarters Facilities and Staff

514. The Center's headquarters are on a tract of 522 hectares located between the cities of Cali and Palmira, Colombia. The land is leased to CIAT, at a nominal fee, by the Instituto Colombiano Agropecuario (ICA). The present lease runs through the year 2000, with no difficulties foreseen for further extension.

515. The headquarters installation include complexes for food and housing, conferences, administration, laboratories and office space for scientific staff, warehouses, motor pool, greenhouses, screenhouses, germplasm resources, graphic arts production, communications, recreational facilities, and field experimentation.

516. All facilities are kept in very good condition. It appears that, apart from a few specific exceptions mentioned below, the infrastructure is fully adequate to meet the research, administration, and training needs of CIAT.

517. There are 954 staff members at the Center, comprised of 76 international staff (senior staff, visiting scientists, post-doctoral fellows), 115 professional support staff (associates, assistants, general administration), and 763 other support staff.

### 2.3. Constraints and Weaknesses

518. The current approach of the Directorate of Finance and Administration is viewed by the staff as being overly bureaucratic. Steps should be taken to review financial and control processes and to improve communication at all levels between the administrative and the scientific staffs.

519. Except for the addition of a long-term germplasm storage facility and one greenhouse, referred to later in this chapter, no major additional facilities are required at headquarters.

### 2.4. Assessment

520. The CIAT headquarters in Palmira are well maintained. The buildings and gardens are impeccably clean and well ordered. The offices, conference rooms, and visitors' accommodations are comfortable, functional, and adequate.

521. The activities carried out within the administrative area provide important support for research. Efficiency, discipline, and a good collaborative spirit were observed at all levels within research support administration. These were later confirmed when the activities were analyzed in depth. Relationships among staff are respectful and cordial. The research administration has shown great interest and accomplishment in personnel development.

522. Even though the research facilities,requiring maintenance activities,have increased substantially, the number of personnel assigned to those activities has not increased in the same proportion. This reflects a higher productivity, perhaps a consequence of improved preparation and better educational opportunities for personnel.

## 3. CIAT's Off-Campus Research in Colombia

### 3.1. Research Locations

523. From the beginning the Palmira farm was recognized as being an excellent site for CIAT headquarters and some limited field research facilities; however, subsequent experiences and program changes made it necessary to develop modest substation facilities in other agroecosystems.

524. Other locations in Colombia include:

CIAT-Quilichao

525. This 189-hectare farm, located 40 km south of Cali, is dedicated to the preliminary screening of germplasm (especially cassava and forage species) and plant nutritional studies. The station has 14 resident farm staff. Additional staff assignments by commodity programs are: Tropical Pastures, 35; Cassava, 10; and Bean, 4. Minor users are CIMMYT, INTSORMIL, and formerly, the IFDC Phosphorus Project.

CIAT-Popayan

526. This station, about 100 km south of Cali, is at a higher altitude (1700 m). The site, 72 hectares, provides excellent conditions to screen bean and cassava for diseases which cannot be adequately tested at lower altitude. Bean and cassava personnel commute to these stations; all farm operations are done by 16 resident support staff. (Popayán and Quilichao stations were purchased and subsequently leased to CIAT at a nominal fee by the Fundación para la Educación Superior - FES.)

CIAT-Santa Rosa

527. In 1983 the station was made available to CIAT by FEDEARROZ (Federation of Colombian Rice Growers). The 30-hectare station is the main breeding site for favored upland and irrigated rice. The development of this site and collaborative experiments using 16 hectares of the nearby La Libertad (ICA) station represent a key element of CIAT's extension of efforts into upland rice. Three ecosystems are available within a short distance.

CNIA-Carimagua

528. Occupying 22,000 hectares in the Colombian Llanos, this is the main station for the Tropical Pastures Program research and is administered jointly by ICA and CIAT. The director is an ICA employee. Two senior scientists live in Carimagua while other scientists visit from Palmira. There is an annual "scientific" review of the ICA and CIAT Pastures and Cassava Programs. CIAT provides 75% of the scientific input to the program and of the 20 technicians, 16 are from CIAT (Pastures Program, 15; Cassava Program, 1); ICA supplies all the labor and is reimbursed by CIAT. The station employs 300 laborers.

529. Through specific cooperative agreements CIAT conducts research at the ICA-Caribia, ICA-La Libertad, ICA-Obonuco, and ICA-La Selva stations and at CPAC (EMBRAPA) in Brazil. Therefore, research is performed over a wide range of agroclimatic zones.

530. At all the stations the Panel was pleased to see that the facilities of housing, storage, roads, fencing, irrigation, etc., are well developed and maintained. In general, the good team spirit of program personnel was much in evidence. There were many encouraging

features and results of experiments at all sites. The Panel is pleased to see the good cooperation existing between ICA-CIAT staff at Carimagua and other stations and urges CIAT to continue giving this important relationship the attention it deserves.

### 3.2. Constraints and Weaknesses

531. The back-up support from Palmira to Carimagua is adequate but could be improved in the case of unforeseen circumstances when prompt attention is required.

532. The scientists working in the Cassava Program in the area of Media Luna have poor facilities and accommodations. The Panel recommends that if CIAT is to continue working in that area, a solution be found to the problem of housing. One solution would be to provide small trailers for temporary living quarters for staff.

## 4. Genetic Resources Unit (GRU)

### 4.1. Background

533. The objectives of the Genetic Resources Unit (GRU) are to collect, evaluate, maintain, document, and distribute the germplasm of Phaseolus beans, tropical pastures, and cassava in support of the crop improvement programs of CIAT. These activities are designed to allow full utilization of the valuable genetic resources and at the same time to provide for their conservation.

534. To date the Phaseolus collection contains over 33,000 accessions and is the most complete worldwide. Since the GRU's inception Phaseolus bean germplasm has increased from 12,896 to 33,295 accessions in 14 species including an increase in germplasm exchange from 6500 to 17,042. There are more than 11,000 accessions of tropical pastures species and 3400 accessions of cassava. Given the nature of the GRU, its continuous interaction with the commodity programs, especially with the breeders, is of paramount importance.

535. The GRU has been organized into three sections: Phaseolus bean, tropical pastures, and cassava. The new section of Seed Health Testing is charged with the application of rapid indexing techniques to monitor the phytosanitary status of the germplasm in the Unit.

536. In 1978 the GRU became established in a remodeled preexisting building. A new tissue culture laboratory was developed in 1984 in the west wing laboratory building and controlled environmental rooms for long-term in vitro germplasm storage, especially of cassava, are part of this facility. A glasshouse was added to the GRU in 1979.

537. Isolated field plots in Palmira, Popayan, and Dagua are utilized to increase germplasm accessions. The Acting-Head of the GRU

is a senior scientist who specializes in tissue culture. There are two research associates, six research assistants, nine technicians, twelve laborers, and one secretary. The IBPGR Regional Coordinator for Latin America is located at GRU. The arrival of an FAO expert is expected soon.

538. Expeditions since 1977 to Spain, Portugal, and Latin American countries have yielded valuable collections of Phaseolus germplasm. In addition there is continuous receipt of germplasm from collection expeditions funded by IBPGR to Africa and Asia.

539. The last release of 5000 accessions was in December 1981, following clearance through ICA quarantine regulations. Released material is usually made available at the rate of 1800 per year.

540. After the first meeting of the Bean Advisory Committee (comprised of five IBPGR appointees and one member from CIAT) in 1976, the GRU recommenced the characterization of available germplasm. Classification of the increased germplasm of P. vulgaris is underway by using passport information (country of origin, CIAT entry No., etc.) and seed characterization data. In the five years up to February 1984 the GRU has distributed 98,686 samples of Phaseolus germplasm.

541. During the last few years, the GRU has been increasing collaboration with the Tropical Pastures Program. The whole tropical forage germplasm collection is now maintained by the GRU under short/mid-term storage conditions. The pasture collection comprises more than 11,500 accessions, 90% of which are non-domesticated tropical legume species. The rejuvenation of entire collections of a series of species has become a routine activity, and is carried out in the field and/or in the GRU greenhouse.

542. During the first two months of 1984, approximately 1500 samples have been distributed to other institutions. The GRU documentation activities are limited to: (1) updating and periodically producing a computerized germplasm catalogue; (2) maintaining and updating of a reference herbarium.

543. The tissue culture work with cassava at CIAT has resulted in an in vitro scheme to free cassava stocks of pests and diseases. In the last four years 745 cassava lines have been rendered free of frog skin disease, and of other viral, bacterial, and fungal diseases. In the last five years, 1348 cassava lines have been transferred to CIAT in the form of meristem cultures. With these introductions, CIAT's cassava collection has increased to over 3400 accessions. During this period over 400 cassava lines also have been shipped to several countries. Germplasm, particularly hybrids, are increasingly being sent as true seed.

544. A technique, "minimal growth storage", has been devised to minimize the vegetative growth of meristem-derived cultures. Meristem tip culture techniques have been developed to micropropagate

Andropogon, Pennisetum, and Brachiaria spp. Differentiation of plants from cell/callus cultures of Stylosanthes guianensis and S. capitata has been achieved. Work with anther culture has resulted in the production of homozygous diploid lines with many conventional $F_1$ hybrids of rice.

545. The Panel commends the increased work on in vitro storage of cassava germplasm and the use of in vitro culture in freeing cassava lines from disease.

### 4.2. CIAT's Relationship with the IBPGR

546. An agreement between CIAT and IBPGR has permitted the stationing of the IBPGR Latin American Regional Coordinator at the Genetic Resources Unit since the beginning of 1982. This has strengthened CIAT-IBPGR collaborative efforts in various aspects of genetic resources.

547. In 1983, a short course in genetic resources for 15 Latin American scientists was offered at CIAT.

548. Collection of Phaseolus bean germplasm through specific annual expeditions to Latin America as part of multicrop expeditions has been ongoing since 1982. An analysis of existing germplasm of wild Phaseolus species is being made by a scientist in Belgium.

549. A report has been published on germplasm resources of Manihot spp. in Latin America. Collections of germplasm have been made in Central America, Mexico (INIA), Brazil (CENARGEN), and Paraguay (IAN). Clones have been transferred from national programs and collection expeditions via in vitro cultures.

550. Support from IBPGR will permit scientists of CENARGEN, INIA, and CIAT to study problems of propagation and conservation using in vitro embryo and meristem tip culture to exchange, propagate, and conserve the wild species.

551. Tropical pasture species, particularly legumes, have been collected in Southeast Asia (Thailand, Malaysia, and Indonesia) since 1979. Several collection trips throughout Latin America have resulted in a large collection of native legume species. Through interchange CIAT has amassed a valuable germplasm inventory of grasses from Africa.

### 4.3. Constraints and Weaknesses

552. The estimates made in 1975-1976 of the potential size of the CIAT germplasm collection have been greatly exceeded in the last few years. Should this rate of growth continue to 1990, a conservative estimate of the final collection size will be 50,000 accessions of Phaseolus beans, 20,000 of tropical pastures, and 6000 of cassava. Thus, adequate provision must be made in the physical facilities and staffing of GRU to enable them to handle these large and important

collections. The major constraints are as follows:

General

553. The position of Head of the GRU has been vacant for an extended period. The Panel recommends that this position be filled as soon as possible.

554. Additional greenhouse space (approximately 400 $m^2$) will be needed. There is a major limitation on data handling. Current updating and compiling of germplasm data is unnecessarily slow. A computer terminal to interact with the mainframe computer at the Data Services Unit, needs to be stationed within GRU. In addition, the daily management of several germplasm inventories, seed viability tests, planting plans, in vitro storage inventories, etc., requires that a microcomputer (which can also serve as terminal) be located at the GRU.

Phaseolus bean

555. Following necessarily strict ICA regulations on germplasm introductions has caused a bottleneck for material coming from the so called "high risk" countries. ICA does not have facilities to handle a large number of accessions.

556. The Panel recommends that provision for the use of a "third country quarantine" be made to overcome this risk and constraint. (See also Chapter III.)

557. Germplasm storage is both short-term (5-8°C, 12-14% seed moisture) and long-term (-6° to -2°C, 5-8% seed moisture). However, at present only 60 samples can be handled per week. Improved infrastructure for short- and long-term storage is needed. In addition, adjustments in the refrigeration system are needed to lower the long-term room temperature to at least -10°C.

Tropical Pastures

558. The inadequate support staff situation makes it impossible to efficiently handle the large collection of tropical forage species. Sufficient resources should be sought to multiply seed for long-term storage.

Tissue culture

559. New research should be carried out to explore applications of in vitro techniques to breeding problems of cassava as well as beans.

560. The rate of putting the cassava germplasm into in vitro storage should be increased. The Panel does, however, indicate its awareness of the possibility of genetic modification of germplasm under storage in tissue culture. This must be monitored regularly.

## 4.4. Future Plans and Assessment

561. The future plans of the GRU are:

1) to continue to expand collaborative efforts with the IBPGR;

2) to continue collection expeditions, especially for wild types of *Phaseolus*;

3) to continue to transfer to CIAT both existing and new collections of cassava from Latin America;

4) to identify places and procedures in developed and developing countries for long-term storage of duplicate samples of CIAT's *Phaseolus*, cassava, and pasture collections;

5) to conduct clustering studies with bean germplasm to determine the range of genetic variability existent within the *Phaseolus* collection;

6) to develop long-term storage techniques for all germplasm;

7) to completely implement the Seed Health Testing Section at the GRU;

8) to study the potential of protein and enzyme electrophoresis as a means to characterize the genetic variability of the germplasm collections;

9) to continue to transfer the cassava collection from the field to an *in vitro* tissue culture bank;

10) to develop *in vitro* culture techniques to facilitate wider interspecific crossing of *Phaseolus* spp. using embryo rescue technique;

11) to develop *in vitro* culture methods to regenerate plants from cell/callus cultures of *Phaseolus* bean.

562. The Panel commends the strengthened CIAT-IBPGR collaboration efforts in all the aspects of genetic resources.

563. The Panel believes the GRU has been very productive and is forward looking in its planning, but it is constrained by staff and facility deficiencies. The Panel therefore recommends that due to the projected increase in the germplasm collection, the necessary measures be taken to provide additional staff, an additional greenhouse and improved storage and refrigeration facilities.

## 5. Research Services Unit

### 5.1. Objectives

564. The Research Services Unit provides the following services: (1) routine analyses of soil, plant tissue, water, and fertilizer samples submitted by program scientists for research purposes; (2) routine quality evaluation and consumer acceptance of CIAT's commodities, especially beans and cassava; (3) management and maintenance of CIAT's greenhouses, screenhouses, and growth rooms, including soil storage and sterilization facilities; (4) maintenance and repair of all CIAT laboratory instruments and equipment, and coordination of the use of laboratory facilities.

### 5.2. Organization

565. Each CIAT Commodity Program has been assigned laboratory facilities to carry out specific research activities. Also, there are some laboratory facilities which are shared by two or more sections within a program, or by more than one program. Certain equipment, especially the more expensive items, is also shared by programs. For example, the new electron microscope is shared according to arrangements agreed upon by the Research Service Committee which consists of one scientist of each commodity program.

566. In order to properly manage all these facilities, the Research Services Unit has been organized into the following sections: (1) Analytical Services Laboratories; (2) Commodity Quality Laboratories; (3) Greenhouses, screenhouses, growth rooms and related facilities; (4) Instrument Maintenance Service.

567. These activities are supervised, on a part-time basis, by various senior staff members who are part of the Research Service Committee.

### 5.3. Activities

#### Analytical Services Laboratory (ASL)

568. Routine analyses of soil, plant tissue, fertilizer, and water samples are conducted for all programs at CIAT. During 1983 a total of 135,385 determinations were made (60% plant samples, 37% soil samples, and 3% proximal analysis). The scientist in charge of the ASL also oversees the Central Services Laboratory and the Research Laboratory.

#### Commodity Quality Laboratory

569. This facility evaluates nutritional quality and consumer preference factors for the Cassava and Bean Programs. The former uses the laboratory for quality evaluation related to the CIAT/TDRI root

storage project. The latter uses it for routine analysis of approximately 300 entries per year. The only nutritional evaluation is that of protein content.

### Greenhouses, Screenhouses, Growth Rooms, and Related Facilities at CIAT Palmira

570. The wire greenhouses, screenhouses type I and II, wire-mesh greenhouses, growth rooms, and the complementary sections at the head house facilities are adequately equipped, well-managed, and contribute significantly to the research program.

## 5.4. Assessment and Recommendations

571. The requirements of the GRU for extra glasshouse and storage facilities have been considered in Section 4. The Panel urges that CIAT give appropriate attention to the maintenance and repair of instruments and sampling equipment, especially with the recent additions of expensive and sophisticated equipment. To ensure proper management and maintenance, the Panel recommends creation and filling of a staff position for Coordinator of Research Services.

# 6. Data Services Unit

## 6.1. Biometrics Section

572. The Biometrics Section is one of the three sections that currently comprise the Data Services Unit. The other two are the Computing Section and the Agro-ecological Studies Unit.

### Functions

573. The functions of the Biometrics section are (1) to provide statistical consultancy in the stages of planning, design, data collection, analysis, and interpretation of research projects; (2) to provide consultancy and analysis in mathematical programming, econometrics, and simulation; (3) to provide a statistical computing service, to implement the computer programs required in the analysis stage, via statistical packages or specific programs developed in the section; (4) to work on methodological projects in collaboration with the research programs and units; (5) to provide training in statistical methods to visiting research fellows, participants in training courses and CIAT staff.

### Personnel

574. There are three consultants supporting the Head of the Section and five statistical technicians (one budgeted under each of the four commodity programs, and one in the Biometrics section).

575. Each consultant is assigned a group of projects; as far as it is possible, the same consultant attends all of the researchers of one program so that he can become acquainted with its specific research methodology and objectives. New projects are initially discussed with the Head of the Section and are then assigned to one of the consultants. It appears that there are differences between programs in the extent to which statistical advice is sought during planning of experiments.

576. The statistical technicians aid consultants during the programming and implementation of the programs in the computers in addition to aiding the training associate staff in the use of programmable calculators.

Achievements and Future Plans

577. For the last five years the Biometrics Section has been responsible for providing consultation and advice on experimental design and data analysis. The Panel believes this service has been rendered in an effective manner within the constraint of personnel available.

578. It is planned to develop the use of field recorders to collect experimental data in the form of computer readable files. Three new SAS products will be made available for data management and analysis.

579. Courses on the use of microcomputers in agricultural research will be given. Two audiotutorials are considered on "The Role of a Biometrician" and "Principles of Experimental Design."

## 6.2. Computing Section

Objectives

580. The objectives of the Computing Section are:

1) to provide and maintain appropriate computer hardware to serve the scientific programs;

2) to provide and maintain appropriate computer software for the scientific programs, including systems software, compilers, packages, and applications programs;

3) to provide adequate documentation to investigate aspects of work at CIAT which might benefit from computerization;

4) to keep abreast of current developments in computing;

5) to write suites of programs of general applicability;

6) to provide required training within and outside the Unit;

7) to provide the hardware and software to build and maintain scientific data bases and ensure availability and security.

Facilities

581. In 1983 CIAT computing facilities included an IBM 4331 - Group 2 computer and 15 Terminals, with five additional terminals on order.

582. Computer use by programs (IBM 4331, CPU hours) was Pastures 22%, Beans 17%, Cassava 8%, Rice 4%, Genetic Resources 4%, Communication and Library 4%, Finance 17%, Data Services 13%, and others 11%.

Future Plans

583. In the future the IBM 4331 will be used exclusively for research functions, and the newly purchased IBM System 36 will be used for administration and finance functions.

Constraints and Weaknesses

584. There has been an increased demand for service on the Computing Section with little prior discussion or understanding between the Section and the Programs. Hence, to some degree an overload situation may have developed and contributed to what was perceived as an attitude problem. Recent steps to update the hardware and the creation of the new Scientific Programs Computer Users Group (contains one representative from each program) should alleviate any such problems.

## 6.3. Agroecosystems Analysis

Background

585. Research in the area of agroecological analysis was begun at CIAT in 1978 with specific focus in the zones of interest to the Tropical Pastures Program, and to a lesser extent of the Bean Program. A formal section was not established and limited funding was provided through existing visiting scientists in the core budget.

586. In 1983 the section was finally formed as a core activity with the appointment of an agrometeorologist.

Objectives

587. Objectives of the Unit are:

1) to develop a system for environmental and economic assessment of the conditions in the production areas of future importance in each CIAT commodity;

2) to develop an agroecological information system which can be integrated with the germplasm development process;

3) to develop a data system which would permit the evaluation of responses of new genetic variability when exposed to a wide range of selected conditions in terms of meteorological, edaphic, and agronomic factors;

4) to develop a data system which provides a firm base for comparative socioeconomic studies on the wide diversity of production zones.

Staff

588. The Unit is staffed by two system analysts, one of whom is a researcher, two technicians, and one supporting staff.

Achievements

589. In defining land systems, the American tropical lowlands have been classified in various ecosystems. Studies have provided a valuable lead in defining sites for the germplasm evaluation of the Pasture Network (RIEPT).

590. The location of primary sites for two stages of bean germplasm evaluation were defined. A climatic analysis of 110 microregions allowed an assessment of crop temperature conditions prevailing in each microregion in Latin America. It also verified that growing season temperature conditions at CIAT-Popayan and CIAT-Palmira are clearly representative,and characterize major portions of the production zones with respect to temperature, a key discriminating factor in Latin America.

591. Upland rice areas in South and Central America were identified and mapped. An agroecological inventory of rice production areas was produced.

592. A set of maps has been prepared showing cassava hectareage throughout the subcontinent. The cassava growing regions have been tentatively classified into six edaphoclimatic zones.

Future Plans and Recommendations

593. It is envisaged in the CIAT Long Range Plan that a further senior staff position and appropriate support staff be added. This staff position will take over the land system and soils aspects of the Unit's work. It is obvious, therefore, that the Unit is at present well below its eventual staffing level and cannot hope to fulfill all

demands placed upon it. Current projects emphasize definition of microregions and environmental classifications for cassava and upland rice. It is hoped that within two years these projects should be completed and attention may turn to regions other than Latin America. The Panel recommends that a core-funded Land Systems Specialist position be added to the Agroecosystems Analysis.

594. Continuing and concurrent activities are data base design and implementation under IDMS, continued maintenance and upgrading of the meteorological data base. Further work needs to be done on stochastic rainfall modelling and estimation of data missing from the meteorological data base.

## 7. Recommendations

### 7.1. Administration

595. CIAT should continue to give high priority to cooperation with the national institutions, not only at a high level, but also in areas where there is more interaction among the scientific personnel, such as at the substations CNIA-ICA-CIAT, etc.

596. The Panel recommends that adequate housing facilities be provided at Media Luna for the staff who periodically visit their experimental work on cassava.

### 7.2. Supporting Research Services

597. The Panel recommends that provision for the use of "third country quarantine" be made as soon as possible to enable the receipt by CIAT of collections from those countries considered by ICA as "high risk".

598. The Panel recommends that the position of Head of the Germplasm Resources Unit be filled as soon as possible.

599. The Panel recommends that additional staff, an additional glasshouse, a computer terminal and microcomputer, and improvements in storage and refrigeration facilities be provided to the Germplasm Resources Unit.

600. The Panel recommends creation and filling of a staff position for Coordinator of Research Services.

601. The Panel recommends that a core-funded position be created and filled with the proposed Land System Specialist for the Agro-ecological Studies Unit.

# CHAPTER XI - INTERNATIONAL COOPERATION

## 1. Background

602. International Cooperation in research that supports agricultural development is the very essence of CGIAR philosophy. Each IARC is but one unit of a research matrix embracing its sister institutions, national and regional research organizations, as well as centers of excellence in developing and developed countries. Center activities are largely in applied research and directed to the generation of improved technology in support of national research organizations. Research is in fields where each Center can best make a contribution because of its critical mass of interdisciplinary expertise, germplasm collection, information back-up, and financial resources. The international status and apolitical nature of the Centers enable them to take a lead role in research activities across national boundaries. CIAT is no exception.

603. By its very nature, the whole of CIAT's research and development activities can be described as international cooperation. In the sense of this Review, international cooperation is more narrowly defined as CIAT's relationships with other institutions.

604. In the proposal by the Ford and Rockefeller Foundations for the establishment of CIAT it was envisaged that, from the beginning, the Center would work in close collaboration with national programs in all its research activities. Early links were established with national programs and commended by the 1977 QQR Panel. At the time of the QQR these links were being further strengthened through the creation of the crop field testing networks. Subsequently they have become stronger as CIAT has made germplasm available for potential release by national programs and as the Center's work has gained credibility.

605. Since the 1977 QQR, there has been radical rethinking about CIAT's role, the development of its program and organization. This has come about by an increasing realization that there was a flaw in the assumption by the founding fathers that the Center could develop germplasm adapted to a wide range of environments. Their thinking was influenced by the impact made by the semidwarf wheat and rice cultivars developed by CIMMYT and IRRI. It was forgotten, in the euphoria of the time, that the environments for which these cultivars had been bred existed or could be created over great areas. The same rules were found not to apply for CIAT's crops (forages are also crops), normally rainfed and grown under very diverse ecological, institutional, and socioeconomic conditions. Cassava, alone, is grown throughout the developing world from sea level to above 2000 m.a.s.l., and both for subsistence and a wide variety of end-uses for domestic and export markets.

606. Materials and technologies therefore had to be adapted to a wide range of conditions and against a background of often weak national programs. Even the wide range of environments found in Colombia, while making the country an ideal host for CIAT, was not enough.

607. This new thinking is outlined in "CIAT in the 1980s" and further elaborated in "CIAT's International Cooperation Strategy" (CIAT Internal Working Document, January 1984). The emphasis is on decentralization of CIAT's activities and on networking. However, while the formal expression of the policy is new, to a large extent it represents rationalization of a process that had its origin seven years ago in the start of the Bean Program's involvement in Central America.

## 2. CIAT's Strategy

### 2.1. Principles

608. The basic principle of the new CIAT strategy is that the Center's main function is to strengthen and complement the activities of national programs. In doing so the Center concentrates on activities in which it has a comparative advantage compared with other institutions or organizations. The work of the Center must be transferable to large areas and relevant to the more important production problems of the commodities on which it works. It has to take full account of the strength of national programs and the potential for development of each commodity. Activities range from strengthening of national commodity programs by support activities, through to catalyzing the establishment of regional and subregional networks with progressive reduction of CIAT input. The Center's way of working will change as its relations with national systems change.

### 2.2. Staffing

609. There are three categories of outposted staff: research, regional cooperation, and bilateral. 1/

610. Research staff are outposted only when the research problems to be solved are significant to a region; the research problems occur under environmental conditions not represented in Colombia, and there is a regional or national organization in the area that gives high priority to solving the research problems and can provide effective research support to the outposted staff. Outposted staff have a training as well as research function and help to further commodity research networks.

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1/ Staff provided for bilateral research projects not funded by CIAT.

611. Regional cooperation staff are assigned to specific regional programs to assist commodity programs, develop training courses, provide liaison between national programs and CIAT, and help in the development of networks. They and outposted research staff will fill core positions though, at least in the short-term, the majority of these posts will have to be supported by special project funds.

612. Bilateral contract staff are appointed on short-term contracts, at the request of individual countries or subregional research programs, to strengthen an institution,while national staff are trained,to fill their position. For management and support reasons, CIAT has decided that no more than 12 such staff should be appointed. The Panel is glad that the implications of appointing too many bilateral contract staff have been considered and would encourage CIAT not to exceed this number which the Panel considers to be a little high.

### 2.3. Networks

613. The aim of the current strategy is to catalyze the development of self-sustaining commodity research networks exchanging information, technology, and breeding materials and, hopefully apportioning effort for greater economy of resources. While outposted CIAT staff would be required in the early development of such networks they would be progressively withdrawn except for the liaison scientist. The Central America bean network is approaching this stage. In the development of other networks the emphasis would continue to be on CIAT's role as catalyst and backstop, but not as leader.

614. Training would be increasingly decentralized, each network having its own training program. Regions would also be assisted to establish their own information networks. The possibility of establishing a regional information network in Africa, in collaboration with another center, is being explored and would go hand-in-hand with modification of publications for the region.

### 2.4. Agricultural Research Management

615. The view was expressed to the Panel by senior scientists of one of the countries in CIAT's region that CIAT should help in strengthening national research management. The Panel agrees with CIAT that the Center does not have a comparative advantage in this field. However, the Center does have a good background of the region's problems and agriculture,and could serve an effective advisory role in support of ISNAR or any other organization serving Latin American countries in the improvement of agricultural research management.

### 3. National Programs

616. CIAT provides direct support to national programs through training, germplasm exchange, technical consultation, provision of information and consultancy services, and efforts are made to gear these to the strength of each program. It is the Center's policy to appoint so-called bilateral contract staff as local members of individual countries research programs at the request of, and in consultation with, the country concerned.

617. Currently CIAT has five bilateral contract staff funded by donors or the country concerned. Two are in Peru (beans and rice), two are in Brazil (pastures), and one is in Panama (pastures). There seem to be good reasons why CIAT should support four of these posts, because of the relevance of the work to the needs of the core program or the potential for increased production. The justification for appointing a bean scientist to Peru is less clear as bean production there is not large. The Panel cautions that if CIAT resources are to be used to the best effect bilateral programs must be selected according to the priority of the problem not the availability of funds. Priority should be given to support of national programs that are linked to a CIAT regional program.

618. Members of the Panel were able to assess the feelings of national scientists towards CIAT by visits to national research institutes in Brazil, Colombia, Costa Rica, Cuba, Guatemala, Indonesia, Mexico, and Thailand. In Colombia the whole Panel met with the Director General and senior department heads of ICA. Panel members were impressed by the widespread appreciation and expressions of confidence in CIAT they listened to in all countries. It is clear that the Center's relationships with national programs are very good. The only problem sensed is the danger of a paternalistic relationship between the Center and national programs; when national scientists are young and inexperienced there is a tendency for them to become over-reliant on CIAT. In contrast, when experienced scientists are involved, paternalism provokes hostility. Center staff are mostly aware but need to remind themselves continuously of this risk, which could delay the emergence of strong self-reliant national programs.

### 4. Regional Programs

619. Currently CIAT has few outposted regional cooperation staff. The Cassava Program has a breeder, based in Bangkok, to serve the Asian region. The Tropical Pastures Program has an agronomist/liaison scientist in Brazil and the Bean Program has three regional scientists based in Guatemala and Costa Rica to serve the Central America and Caribbean region, and an agronomist in Brazil. Two additional bean projects are being set up in Rwanda-Burundi (three scientists) and East Africa (four scientists).

620. The Central America and Caribbean bean project, now staffed by a regional liaison scientist/plant pathologist, a cropping systems agronomist, and a breeder, and funded as a special project by the Swiss Government, has been a notable success. It serves a number of small countries with similar ecosystems and initially weak bean research programs. The project has helped to strengthen national programs, foster a team spirit, and establish linkages between the countries concerned so as to draw upon their relative strengths. Thus, work on web blight is concentrated in Costa Rica, bean golden mosaic virus in Guatemala, and Apion in Guatemala and Honduras. New varieties have been developed for the region. While the region had the basis for a successful regional project - research systems at about the same level of development and with common problems - an essential ingredient of success was the choice of project leader. It is envisaged that two of the positions can be phased out over the next five years leaving a liaison scientist. The Panel commends CIAT on the progress made by the Central America and Caribbean Regional Bean Project.

## 5. Other Advanced Institutions

621. CIAT has a wide range of collaborative activities with other advanced institutions. They range from those with centers with which they share responsibilities for a common commodity (IRRI, IITA, ILCA) to those with which they have a common interest (CATIE, ICRAF), centers or institutions which they host (CIMMYT, IBPGR, CIP, IFDC, INTSORMIL, and INTSOY), and developed country institutions with which there are collaborative agreements.

### 5.1. International Agricultural Research Centers - Common Commodity

#### 5.1.1. IRRI

622. Under an existing CIAT-IRRI Agreement, an IRRI liaison scientist is stationed at CIAT with responsibility for the International Rice Testing Program in Latin America. The arrangement works satisfactorily but the agreement between the Centers is presently being revised in the wider context of achieving closer collaboration and joint activities.

#### 5.1.2. IITA

623. CIAT and IITA have common interest in rice and cassava. Collaborative rice activities go well. The two Centers exchange breeding material to their mutual advantages as the conditions under which rice is grown in Africa and Latin America are similar. In contrast, cassava research is a source of some friction between the Centers.

624. Following on the recommendation of the 1977 QQR Panel that CIAT strengthen the cassava linkage with IITA a new agreement between the two Centers was signed in November 1978 setting out guidelines for their collaboration in cassava research and training. The agreement took account of the large percentage of world cassava production taking place in Africa; the phytosanitary constraints on the movement of vegetative cassava planting material between Africa and Latin America due to the distribution of pests and diseases between continents; and the special environmental, biological, socioeconomic, and cultural factors which make it important that IITA has a regional responsibility for research training and other related activities in Africa.

625. It was agreed that CIAT has the responsibility for cassava improvement and the development of technology to enhance cassava production and utilization in the Americas, Southeast Asia, and Oceania. CIAT also has responsibility for collection of information and establishment of a documentation center, collection and maintenance of the world's main cassava germplasm bank, and coordination and publication of the Cassava Newsletter to which IITA should contribute an African section. IITA has responsibility for cassava improvement and development of technology in Africa. In countries where cassava mosaic disease is a problem, as in the case of India, the two Centers should consult with appropriate officials in these countries to determine the most effective means for cooperation by each institute. The division of responsibilities in terms of supporting disciplines and training took account of the special problems in each Center's region of responsibility.

626. Provision was made for consultation when one Center received requests for germplasm from institutions or individuals in the other's region of responsibility. Where cassava mosaic disease was a problem, IITA, with the knowledge of CIAT, would make available germplasm as requested by the recipient country. Provision was made for a joint review of programs and future plans in cassava research to be held every three years with the venue alternating between the two Centers. To improve communication a member of each Center's cassava program would attend the cassava portion of the other's Annual Program Review.

627. Nevertheless, though collaboration in some fields (e.g., biological control and supply of seed from CIAT to IITA) has been good, in general it is unsatisfactory. The Panel has examined the causes and concluded that it is now more important to look to means for establishing a close working relationship between the two sister Centers than to establish rights and wrongs.

628. Preferably, an attempt should not be made to improve cooperation between CIAT and IITA by an imposed solution. Cooperation can only be achieved through agreement between the two Centers, reached in a spirit of goodwill. To this end, the Panel recommends that the Directors General of CIAT and IITA meet as soon as possible to agree on means of improving cooperation between the two institutions. Senior staff from each Center should meet first for

preparatory staff work and to pave the way for agreement. The existing agreement between the two Centers seems a good basis for collaboration but needs to specify in detail each Center's particular responsibilities. The Panel recommends that TAC pay particular attention to the issue of CIAT/IITA relationships to ensure a satisfactory solution is reached as quickly as possible.

### 5.1.3. ILCA

629. Cooperation with ILCA has grown in recent years, with particular interest in germplasm exchange. Much of the ILCA programs are on areas drier than covered by CIAT, or are on less acid soils, or are in higher and cooler conditions. Furthermore, the ILCA pasture program is running on a more decentralized basis than the CIAT program and, generally speaking, ILCA operates in an area where community ownership of land is of major importance. This must inevitably have some effect on the procedure used for evaluation and development of pastures. Much of the area to which CIAT germplasm could be suited is affected by tse-tse fly. For these reasons, while the Panel welcomes the close relationship between CIAT and ILCA, and particularly recognizes the value of their collaboration in the collection of germplasm in Africa, it cannot agree with the CIAT plan to place a senior scientist at ILCA in 1986. However, the Panel understands that changes are being planned in the headquarters forage agronomy program of ILCA. When these have been fully effected, it may be opportune to re-examine this question.

## 5.2. International Agricultural Research Institutes Hosted by CIAT

630. CIAT provides a base for regional staff of CIMMYT (maize), IBPGR, the International Fertilizer Development Centre (IFDC), CIP, the International Sorghum and Millet Collaborative Research Support Project (INTSORMIL), and the International Soybean Program (INTSOY). Relationships between CIAT and CIP, INTSORMIL, and INTSOY are those of landlord and tenant; CIAT provides, on payment, accommodation and supporting facilities. There is no active collaboration.

631. An IBPGR regional coordinator is based at CIAT under a CIAT/IBPGR collaborative agreement. He helps with germplasm collection and collaboration is excellent. The support given by IBPGR to the collection of cassava, bean and forage germplasm is noteworthy.

632. CIMMYT is also hosted by CIAT. There is no formal agreement for technical collaboration between the Centers nor was there technical collaboration at the time of the 1977 QQR. However, there is active informal collaboration between the CIMMYT team (two scientists) and CIAT's Bean Program. CIMMYT provides advice on suitable maize cultivars for use in on-farm research, as well as material for trials on-station. CIAT and CIMMYT staff exchange ideas on on-farm research activities. The Panel welcomes this evidence of positive informal collaboration between the two Centers.

633. There is also excellent collaboration between the IFDC phosphorus project and CIAT's commodity research programs, and a fertile exchange of ideas on on-farm research. The Centers are currently preparing proposals for joint research.

### 5.3. Other International Agricultural Research Institutions

634. Similar informal collaboration exists between the Bean and Tropical Pastures Programs and their counterparts at the Center for Tropical Agriculture and Training (CATIE), Costa Rica, and it is hoped that these may develop into joint work on Silvopastoralist and Animal Production Systems. Talks are also underway with the International Center for Research in Agro-Forestry (ICRAF) on the possibility for collaboration on Pasture/Farming Systems.

### 5.4. Other Advanced Research Institution

635. CIAT has established significant and increasing collaboration with other Centers of excellence which enables the Center to draw upon the resources of universities and national institutes in developed countries in support of its own research programs. For example, such work includes interspecific hybridization in beans (Gembloux, Belgium); the chemical basis of storage insect resistence in beans (Durham University and TDRI, UK); screening of the collection of Desmodium ovalifolium for resistance to root knot nematodes (North Carolina State University, USA); and the collection and evaluation of mycorrhizal strains and the development of field inoculation techniques (University of Goettingen, Germany). The Center relies upon donor support for such work. Valuable informal relations are also maintained with numerous other institutions, for example, CSIRO, IRAT, TDRI, and universities such as the University of Florida, the University of the Philippines, and San Marcos University, Peru.

636. The Panel supports CIAT's policy of establishing collaborative projects with other scientific institutions for back-up research in furtherance of its work. By this means the more sophisticated resources of developed country institutions can be enlisted, in a very practical way, towards the solution of problems in the developing world. The Panel encourages CIAT to make even greater use of such collaboration.

## 6. Achievements

637. It is evident from visits paid by Panel members within the host country and to other countries in Latin America that CIAT has established excellent relationships with the countries in its region. In all the countries visited the wish was expressed for continued CIAT support. This is a measure of the impact made by CIAT germplasm, described in the earlier commodity chapters.

638. A major achievement has been the effect of CIAT's work on the morale and enthusiasm of national scientists who, for the first time, have access to greatly improved germplasm and, because of the training provided them, know how to handle it. National commodity research organizations have been strengthened and CIAT's staff seem to have well adjusted themselves to working with these organizations. That by now, so many national research workers, at all levels, have been trained at CIAT has ensured easy relationships and mutual respect. In most cases there was no sign of paternalism in CIAT-national scientist relationships. In some countries it was indicated to the team that this had not always been so, but relationships between the Center and the national organizations had matured as the latter gained strength and as its scientists found they could speak to their CIAT counterparts on equal terms.

639. In Asia CIAT has made small impact and that only through the Cassava Program. A regional cassava breeder was not appointed to Bangkok until May 1983. However, the team was impressed by the way in which he is already interacting with national cassava research workers. In this, the fact that many senior cassava breeders in Asia had been taught by him while he was stationed at CIAT-Palmira, was a major contributing factor. No other CIAT program has direct contact with Asia.

640. An interest has been aroused in CIAT's Bean Program in East and Southern Africa but CIAT involvement is still in its infancy. The first program, for Rwanda-Burundi, with three regional scientists, has only recently been initiated but CIAT expects soon to have a bean project in East Africa (a coordinator and three other scientists) and a regional project in Southern Africa is in the pipeline.

641. CIAT has been a late starter among the centers in establishing outreach programs. An exception is the Central America and Caribbean Regional Bean Program described previously. The Program is evolving into a fully collaborating network, in the true sense of the term, and will provide a model for future international cooperation.

## 7. Constraints

642. It is unfortunate that the time CIAT was ready to begin to extend its outreach program coincided with the beginning of a critical financial situation in CGIAR. However, by the support of national and regional cooperation through special projects, funding should not be the major problem in the future. The major obstacle to the development of CIAT's programs will be the availability of senior research scientists of the right calibre. Staff who are appointed as regional liaison scientists or as leaders of regional research projects, as well as being recognized as good scientists in their own right, should have worked at CIAT for a number of years to establish their knowledge of the Center's programs and its facilities, their

loyalty to CIAT, and to make them already known to national scientists in CIAT's region through training programs and advisory visits. They must possess the right personal qualities. A regional liaison officer should possess great qualities of tact. He must influence by persuasion and not by imposing his views. This implies the use of existing core staff to fill regional positions wherever possible. There is no reason why special project funding, per se, should influence the success of the off-campus program but it will do so if, because of lack of experienced core staff as leaders, the links with the mother center are weak.

## 8. Future Plans

643. It is planned that CIAT's International Cooperation Program will develop according to the strategy outlined above. It aims at an evolutionary process beginning with the strengthening of national organizations through backstopping by outposted scientists and with the objective of fostering self-sustaining commodity networks with their own information and training services. CIAT's regional scientists would catalyze and support such networks but gradually be withdrawn as the networks acquired strength. This is looking far ahead and CIAT is only beginning to move along that path but the example of the Central America and Caribbean Regional Bean Project, and CIP's similar but more advanced regional programs, provide models and cause for optimism.

644. In the establishment of regional commodity research programs it will be necessary to involve national scientists from the beginning in their planning and the identification of problems. This the Center appreciates. For example, CIAT and the ESCAP Regional Coordination Center for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre) are collaborating in a workshop to be held in Bangkok in June 1984 on cassava marketing potential in tropical Asia and the role of new technology in cassava production. This workshop will involve national research scientists and economists in identifying their own needs. A similar workshop has been held in East Africa to prepare the way for the Bean Program.

## 9. Assessment and Recommendations

### 9.1 Assessment

645. The Panel commends CIAT on the excellent relationships it has established with national programs.

646. The Panel, in principle, endorses CIAT's strategy for international cooperation and decentralization of activities and the emphasis on catalyzing regional research collaboration. This makes

good sense in relation to the wide range of biological and socio-economic environments in which the crops for which CIAT has responsibility are grown. However, the Panel urges caution in the Center's pursuance of this policy. There will be a need to adhere to the following basic and largely well understood principles. It is important to:

1) Recognize that donor preference and availability of funds must not be allowed to distort CIAT's planning.

2) Ensure that a satisfactory balance is maintained between off-campus regional and headquarter activities in order not to impair CIAT's long-term scientific capacity and ability to generate new technology. Provision will have to be made for adequate administrative and scientific support of regional staff, for example, in providing germplasm and information, back-stop visits, and routine administrative back-up. It is not possible for the Panel to specify the correct balance. It has to be established by Board and Management for each commodity in relation to the whole of the Center's activities and working outwards from the critical mass of headquarter's programs, and what they can service. Decentralization implies some reduction in headquarters staff. The basic needs of relatively small but effective headquarters scientific teams must determine the number of administrative and scientific staff at CIAT-Palmira.

3) Accept that involvement in regional projects should be long-term and ensure that the principle of long-term support is acknowledged by donors. This implies detailed study of the long-term implications of taking on each new project for the support the Center will need to provide.

4) Ensure that national governments are involved from the beginning in definition of their needs and all stages of project planning. In feasibility studies, account needs to be taken of the full implications of new projects in the wider context of national plans. In regions favored by donors it is often very easy for countries, under pressure from donors and commodity pressure groups, to take on too many projects and overload their capacities.

5) Monitor the progress of regional projects to ensure that they are kept flexible in response to changing circumstances and that timely decisions are taken on the Center's manpower input and how and when it can be phased out.

647. Special project funding will be needed for the implementation of CIAT's strategy. This issue has been discussed in section 7. The Panel concludes that it may lead to weakening of regional links with CIAT unless activities in each region are coordinated by outposted experienced core staff. This will be a key factor in the implementation of CIAT's international cooperation program. The Panel recommends that every effort be made to fill coordinator/liaison positions only by experienced staff.

## 9.2. Recommendations

648. The Panel recommends that the Directors General of CIAT and IITA meet as soon as possible to agree on means of improving cooperation between the two centers.

649. The Panel recommends that TAC pay particular attention to the issue of CIAT/IITA relationships to ensure a satisfactory solution is reached as quickly as possible.

650. The Panel recommends that every effort be made to fill coordinator/liaison positions only by experienced staff.

# CHAPTER XII - LONG RANGE PLAN

## 1. Introduction

651. CIAT's Long Range Plan (LRP) for the 1980s was developed over a two year period from 1979 to 1981, "... by an interactive process involving CIAT's management and staff, its Board of Trustees, and leading representatives of collaborating national agricultural research institutions in the Western Hemisphere." 1/

652. The guiding principles throughout the LRP are the reconfirmed overall objectives of CIAT: "To generate and deliver, in collaboration with national institutions, improved technology that will contribute to increased production, productivity and quality of specific basic food commodities in the tropics - principally countries of Latin America and the Caribbean - thereby enabling producers and consumers, especially those with limited resources, to increase their purchasing power and improve their nutrition."

653. The LRP laid out CIAT's global and regional strategies in relation to food and income, other institutions, its four major commodities (cassava, beans, rice, tropical pastures), international cooperation, new initiatives, and budget projections. As a result of these considerations, CIAT's mandate has evolved to include the following responsibilities:

> "1) Principal responsibilities for beans (Phaseolus vulgaris and related species) and cassava (Manihot esculenta);
>
> 2) Principal responsibilities for tropical pastures (specific responsibilities for the acid, infertile soils of the American tropics);
>
> 3) Regional responsibilities for rice (specific responsibilities for the American tropics)." 2/

654. CIAT's selection of crops provides a reasonable balance in meeting both production and nutritional goals in Latin America, and the research strategies for each commodity are consistent with the overall socioeconomic goals.

## 2. The Updated LRP

655. For the present EPR, CIAT prepared a number of documents

1/ CIAT in the 1980s. A Long Range Plan for the Centro Internacional de Agricultura Tropical, Series 12E-5, November, 1981.
2/ CIAT Report 1983.

which update the LRP to reflect current priorities and budget projections. 1-7/

### 2.1. Modifications in Overall Center-wide Objectives and Strategies

656. In the Background Papers CIAT adds two minor modifications to the LRP. First, CIAT notes: "The first paragraph on page 58 (of the LRP) gives more emphasis to the danger of diversion of resources from the American tropics than we would today, since we consider expansion of efforts in cassava to Asia and beans to Africa of sufficient priority that considerable management time and some core resources are applied to these activities without apology." In the LRP it had been assumed that such expanded efforts could be handled by working through FAO and other international and regional organizations, but attempts to work with FAO and SEARCA failed. Second, CIAT suggests an addition to the section on evaluation and feedback mechanisms on page 63 of the LRP: "In order to encourage and strengthen national program efforts in on-farm research CIAT will conduct methodological research, training, and workshops in an attempt to develop a network of scientists engaged in farm-level characterization and technology evaluation activities."

657. Both of these modifications were discussed by the Panel, which generally endorses them, although there was concern about the difficulties of operating the distant (from CIAT) programs in Asia and Africa (see Chapters on International Cooperation and General Assessment).

### 2.2. Modifications Forced by Reduced Rates of Funding Growth

658. Several program modifications to the LRP were forced by reduced rates of funding growth in the CGIAR system and hence in CIAT's budgets. For example, the LRP projected a senior staff of 72 by the end of 1983, rising to 85 in 1987. However, the funding shortfall in the 1982-1983 period forced CIAT to reduce its senior staff from 62 positions to 54 by the end of 1983. Since the CGIAR has adopted upper and lower brackets for funding, CIAT's current position projections are presented in terms of "minimum" and "optimum" numbers. Center-wide staff positions are presented in Table 1 (from the Summary Modifications to The Long Range Plan, January 1984). In this table, minimum net core requirements are the minimum projections minus the core-type positions which can be funded from extra-core sources, i.e.,

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1/ Background Papers,Volume I, item v, 1984.
2/ Cassava Program Report, 30 January, 1984.
3/ Bean Program Report, 30 January, 1984.
4/ Rice Program Report, 30 January, 1984.
5/ Tropical Pastures Program Report, 30 January, 1984
6/ CIAT's International Cooperation Strategy, 30 January, 1984.
7/ Summary Modifications to the Long Range Plan, January, 1984.

projects either presently funded or likely to be negotiated with donors. However, most of discussions on positions focus on minimum core requirements rather than on minimum net core.

Table 1. Projected Center-wide resource requirements (senior staff positions) in the modified plan for CIAT.

| Category | '82 | '83 | '84 | '85 | '86 | '87 | '88 | '89 | '90 |
|---|---|---|---|---|---|---|---|---|---|
| Optimum Core Projections | NA | NA | 63 | 76 | 88 | 89 | 89 | 89 | 89 |
| Minimum Core Projections | 64 | 56 | 60 | 68 | 72 | 73 | 73 | 73 | 73 |
| Minimum Net Core Requirements | 62 | 54 | 56 | 64 | 68 | 70 | 72 | 73 | 73 |
| Long Range Plan (1981) | 67 | 72 | 74 | 79 | 84 | 85 | 85 | 85 | 85 |
| Extra-Core Funded Projections | 7 | 10 | 17 | 29 | 30 | 28 | 26 | 25 | 24 |

659. The current estimates of minimum core requirements through 1990 rise only to 73 positions which is 12 positions below the maximum projected in the LRP.

660. The changes which CIAT has proposed within each of its four commodity programs is a reflection of the overall priorities among the four programs. For 1990, for example, CIAT's current projections are shown in Table 2.

Table 2. Positions projected for 1990

| Commodity | In LRP | In current modification (minimum core requirements) | Net change in projections |
|---|---|---|---|
| Cassava | 16 | 11 | -5 |
| Beans | 19 | 17 | -2 |
| Tropical Pastures | 23 | 20 | -3 |
| Rice | 6 | 7 | +1 |
| Administration and Support | 21 | 18 | -3 |
| Total | 85 | 73 | -12 |

661. Decreases are also projected in the Administration and Support Units (Table 2). The Panel commends CIAT for its efforts to reduce administrative and support costs in proportion to cuts in the overall budgets; indeed, because of increases in extra-core positions, administrative and support services must be increasing in efficiency.

662. Extra-core funded projections included in Table 1 show that substantial growth is expected in this category, to which no reference was made in the 1981 LRP. In the 1984 documents it is noted that a maximum of 30 such extra-core positions is projected. Virtually all of these extra-core positions appear to be for off-campus activities. To some degree CIAT is using these extra-core positions to make up the shortfall in the number of positions optimistically projected in the LRP. While it obviously would be better in terms of continuity to have these positions core-funded, realities of funding projections leave little choice.

### 3. CIAT's Comparative Advantages and Clarifications of its Functions in the 1980s

663. CIAT has prepared a figure (Figure 1 in the LRP and reproduced here as Figure 1) which very nicely depicts its place in the agricultural technology development process for the responsibilities within its mandate. This spiral shows that CIAT's role includes a modest activity in basic research which has high pay-off potentials, assumes its largest activity in the applied research quadrant, and extends into the adaptive research quadrant to a degree inversely proportional to the capabilities of national institutions. CIAT does not get involved in agricultural production. This cleverly conceived spiral can be rotated clockwise to reflect situations where national institutions are weak or have not had time to properly develop, as in tropical pastures. As national institutions gain strength, the spiral can be rotated counter-clockwise to reflect the larger role that CIAT should take in basic research. Rice probably is a commodity for which CIAT should be considering a counter-clockwise twist since it is the oldest program and consequently has had more opportunity to strengthen national programs through training. Within a given commodity situation, the spiral also may be rotated to reflect CIAT's most appropriate role with individual countries, depending on whether a country has weak or strong national programs.

664. A good pictorial example of further clarification of CIAT's role in the technology development process is presented by Figure 2 in the Tropical Pastures Program Report, the right-hand half of which is presented here as Figure 2. This figure shows that CIAT concentrates strongly in identification of potential germplasm, and assumes decreasing roles as material is moved down the inverted pyramid and into the range of the capabilities of the national programs, which release the completed product—new cultivars—to farmers.

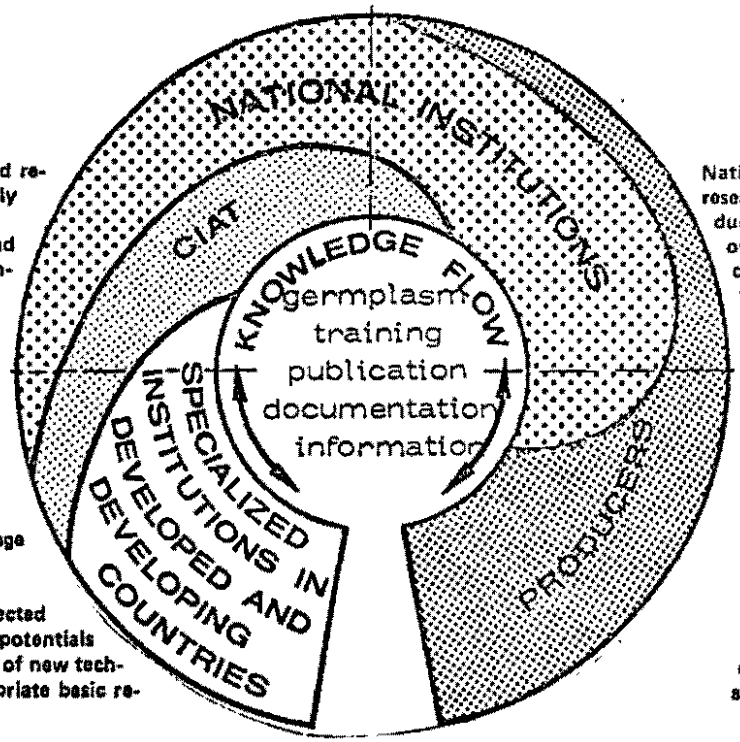
**APPLIED RESEARCH**

National institutions conduct applied research. CIAT's activities are primarily found in this quadrant.
CIAT emphasizes applied research and development of basic elements of technology in collaboration with national research institutions.

**BASIC RESEARCH**

National institutions, and especially those more developed ones, also engage in basic research.

CIAT assumes responsibilities for selected aspects of basic research having high potentials for pay-off later in the development of new technology, in collaboration with appropriate basic research institutions.




**ADAPTIVE RESEARCH**

National institutions involved in commodity research and development are seen as conducting adaptive research based on their own applied research or the technology developed by others including international centers.
While predominantly working in production *per se*, to varying degrees producers also conduct applied and adaptive research. Their research activities range from the private seed producer who is developing new hybrid varieties to producers associations which maintain their own experimental farms and stations.

**PRODUCTION**

National institutions are involved in selected production activities including on farm trials, demonstration projects and certified seed production.

**Figure 1. CIAT's location in the agricultural technology development process.**

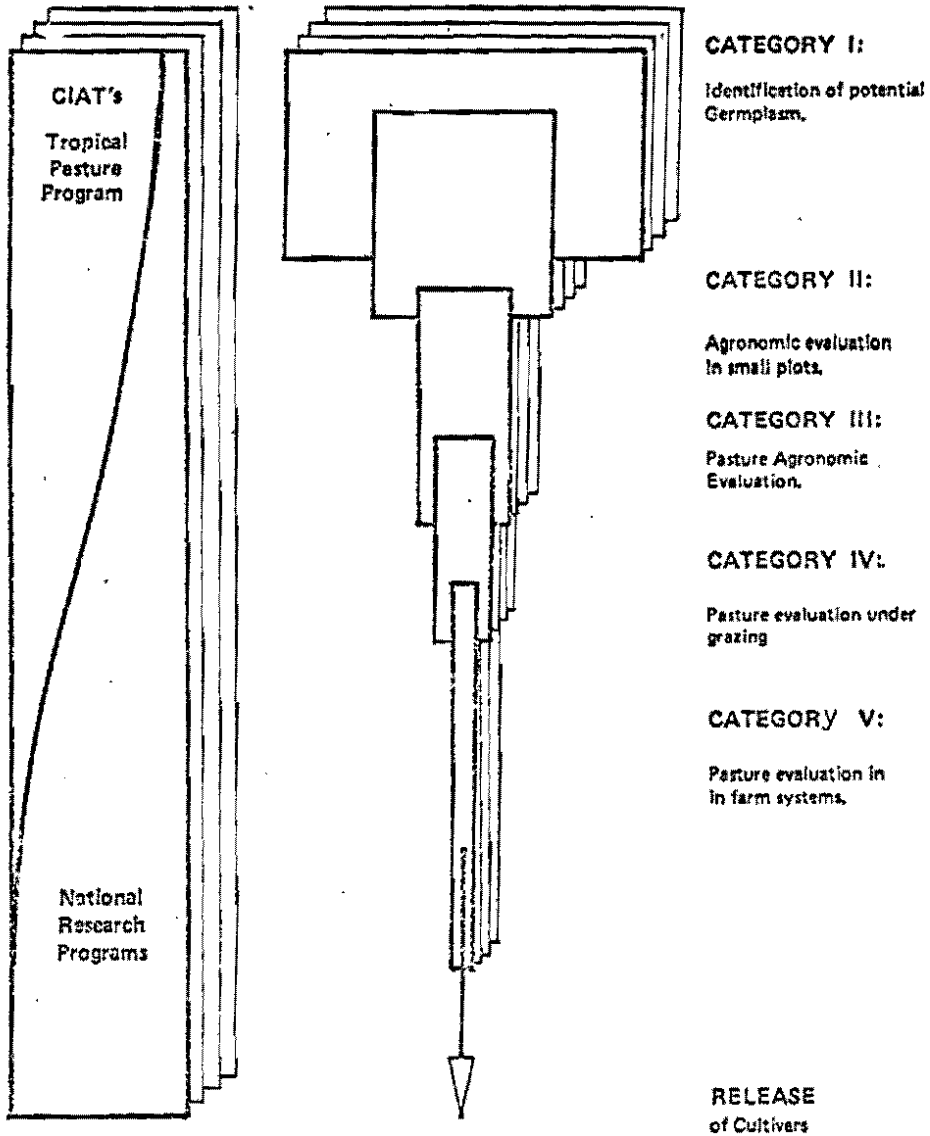



Figure 2 Organizational structure of the Tropical Pastures Program, germplasm flow and interaction with National Research Programs.

## 4. Research Directions within Commodities

### 4.1. The LRP and Subsequent Modifications

#### Beans

665. CIAT also uses figures to depict relative emphases on research directions within commodities. For example, a quick inspection of the figure for beans (Figure 3 in the LRP and reproduced here as Figure 3), shows that breeding for disease resistance is expected to greatly decline in the 1980s, as sources of resistance to the numerous diseases affecting the crop are identified and incorporated into improved germplasm. Scientific effort released from disease resistance studies can then be turned to the needs for increasing yield and quality factors in the crop, things which necessarily had to be assigned lower priority until its was possible to keep the crop alive during the growing season. Such handy figures provide ready benchmarks to measure progress in program shifts. In beans, for example, the 1984 Internal Program Review presentation left the impression that no decline had occurred in the disease resistance effort.

#### Rice

666. No doubt it will be necessary to fine-tune the LRP projections from time to time to reflect problem changes which could not be predicted for a decade in advance. For example, the sudden and unexpected resurgence of the hoja blanca virus disease of rice in the last year, as well as increases in Helminthosporium, probably means that breeding for disease resistance in the irrigated areas of this crop will have to be kept at a higher level than anticipated at the the time the LRP was prepared. Nevertheless, Figure 4 on page 102 of the LRP provided an excellent starting point for planning research directions during the 1980s.

667. Although individual figures were presented in the LRP for relative emphases within irrigated rice, and within upland rice, no attempt was made to show the projected balance of efforts between these two types of production ecologies. This is understandable in view of the fact that in 1979-1981 CIAT was still deciding on how much effort should be placed on upland rice, which was not designated as a separate objective until 1981. The current balance between these two ecologies is about two-thirds upland to one-third irrigated, a ratio which seems a little high in view of the opportunities for achieving greatest return on research investment (see Chapter V, Rice).

#### Cassava

668. Relative emphases in the 1984 revision of the Cassava Program follows the projections shown in Figure 2 on page 79 of the LRP. The effort on production of finished lines for testing and

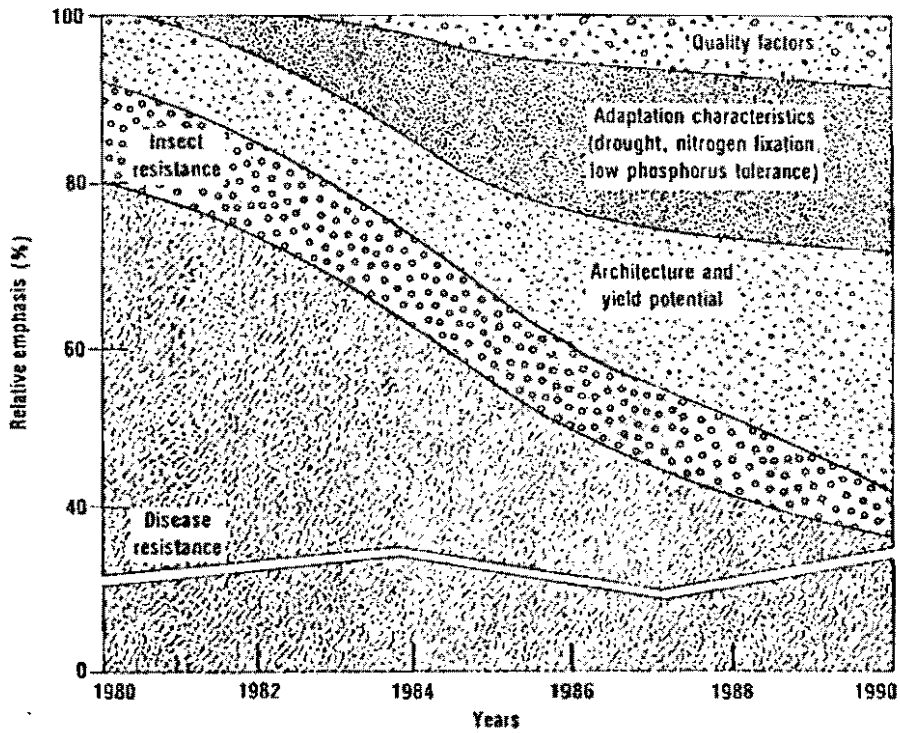



Figure 3. Relative emphases the Bean Program will place on various aspects of technology development in the 1980s. Changes in emphases will be reflected in the proportions of crosses in the breeding projects designed for general groups of constraints.

release by national programs has decreased over time as the production of elite germplasm for national breeding programs has increased. Similarly, and as projected in the LRP, emphasis on management practices for cassava in existing production systems is declining as practices related to cropping systems, long-term fertility, etc., increase. However, as the experimental work on establishment of small-scale plants for the production of dry cassava for animal feed proceeds, the work in cassava utilization is increasing a little faster than projected in the LRP. The work with national programs in the development of pilot projects such as this, requires a close association of research and development activities. Overall, however,the changes from the LRP were not large and were only the necessary adjustments required over time.

Tropical Pastures

669. In the LRP the Tropical Pastures Program predicted that work in the well drained savannas, which took 100% of the work input in 1980, would decrease to approximately 70% in 1985 and 60% in 1990. Initially, the next move was to be into the poorly drained savannas, which were to take 15% of work input in 1985 and 1990. Work in the humid tropics was planned to commence later, but would be up to 15% of the effort in 1985 and 25% in 1990. These changes were reflected in priorities given to germplasm collecting and, with a lag phase, into grazing studies.

670. Following the financial constraints of the early 1980s, staff numbers declined instead of increasing, and there was no movement into new regions. The 1984 modified plan still predicts some outreach. The input into the humid tropics will go ahead and it will be initiated later and represent about 10% of total input in 1990. The proposal for the work in the poorly drained savannas has been deleted. Instead a program in the moderately acid soils will be initiated in 1988 and take only 5% of the program input in 1990.

### 4.2. Assessment of the Modifications

671. The modified plans of all commodities seem to be reasonable, and are discussed in detail in the appropriate chapters.

## 5. Flexibility for Handling New Initiatives.

### 5.1. Initiatives Adopted Since the LRP Appeared

672. With its history of having had to make several shifts in commodities during the 1970s (i.e., dropping swine, restricting beef program to acid, infertile soils, phase-out of the small farms program, etc.), CIAT has been cognizant of the need to maintain flexibility in its programs. Thus, in its LRP CIAT outlined how two initiatives are to be incorporated into the core program in the 1980s. First, the Seed Technology and Training Project, which began

as a special project, is projected for inclusion in the core unit in 1986. Second, the LRP proposed the addition of an Agroecosystems Analysis section which has been at least partially achieved.

### 5.2. A Proposed New Initiative

673. The EPR proposes a new initiative to add a Scientific and Genetic Resources Unit to CIAT's programs (see Chapter VIII).

## 6. Overall Assessment of the LRP

674. TAC asked the Panel to determine if, "... the strategies, conclusions, and recommendations of CIAT's LRP are sound, relevant, and useful in the determination of research priorities." The Panel's overall assessment follows.

675. The interactive process by which the LRP was developed meant that it incorporated the best thinking available at the time. Obviously it is not possible to draw up a 10 year plan which accurately projects all technology development and transfer, but CIAT has done a better job on this than most organizations have.

676. The original strategy of the LRP is unaltered - what has changed is the speed with which it has been implemented, and these changes are largely the result of decreased funding growth rates in the CGIAR system.

677. Compared with the other IARCs, CIAT's outreach activities got off to a late start and hence got caught in the funding bind. This caused a delay in the process until additional donors could be identified (see Chapter on International Cooperation). CIAT has shown flexibility in adapting to these funding changes, through modification of priorities both within and between programs, and through the route of securing additional extra-core funding to supplement core funds. The Panel offers a word of caution regarding the extra-core funding, namely that the need for donor support should not be allowed to distort overall priorities of the center. Similarly, the Panel urges that CIAT make maximum use of core staff in the regional coordination programs in order to assure that CIAT is represented by experienced people familiar with CIAT's overall objectives (also see Chapter on International Cooperation). Finally, it should be kept in mind that the increased outreach efforts must eventually lead to a greater administrative load on CIAT headquarters.

678. The Panel's overall impression is that the LRP is very good. The Panel commends CIAT for the considerable thought and effort devoted to not only developing the LRP but also to implementing it.

# CHAPTER XIII - GENERAL ASSESSMENT

## 1. Overall Assessment

679. CIAT is a productive and well managed international center. Its staff, administration, and Board of Trustees are competent and highly dedicated to the programs. The Center operates with an openness which fosters dialogue and critical self-analysis. Continual communication among all levels of research administration and programs is evident. This has resulted in several changes in programs which continue to evolve.

680. CIAT has made major progress in the period since the 1977 QQR. The achievements of the Tropical Pastures Program have justified the concentration of its efforts on the acid, infertile soils of the Llanos and Cerrado. The Center has broadened its Rice Program to include upland rices in favored environments. The Cassava Program has initiated activities in Southeast Asia. The Bean Program has established a very successful network of scientists and activities, and begun to extend these activities to the important bean growing areas of Africa.

681. CIAT's work on on-farm research with a farming systems perspective is still young and with limited resources. The Center needs to obtain more experience. The Panel believes that CIAT has not yet adequately clarified its objectives in this field and commends CIAT's efforts in seeking collaboration with workers in other organizations to share experience on methodologies. The Panel commends also the recent creation of the informal "Agricultural Production System Coordinating Group" within CIAT with scheduled regular meetings aimed to stimulate scientific debate. Some studies in international economics (production, markets) have given valuable preliminary information for directing the commodity programs and evaluating their current or potential impact.

682. CIAT germplasm is present in many new crop varieties being released by national programs in many countries, primarily in Latin America. This impact is most notable with rice, and is increasingly present in new bean varieties. The impact of the tropical pastures technology is less visible at this point because the program did not become focussed until the mid 1970s. However, a relatively large number of grasses and legumes have been collected, characterized and brought into advanced stages of evaluation under grazing conditions, and some exhibit excellent suitability for the acid savannas. Some impact of improved cassava germplasm is beginning to appear, but response by farmers has not been as strong as might be expected.

683. Progress in establishing strong linkages with national programs and with international research institutes has been very

good. The national program staffs in many Latin American countries expressed vigorous support for CIAT and its value to their programs. Many collaborating projects with other institutions are now operating, particularly in thesis and basic science areas appropriate to the programs.

684. The Center has established its presence in appropriate regions of the world by outposting staff strategically in countries and programs. Since CIAT developed its outreach activities later than some IARCs it has attempted to move rapidly on this front in recent years. Budget constraints in the CGIAR have forced the Center to seek extra-core funding for these activities.

685. The need to find extra-core funding creates its own problems. Donors have to be identified and the bureaucratic process of negotiating projects makes it difficult to plan precisely and with certainty. Not many donors can give a firm guarantee of the long-term support needed for the full development of CIAT's outreach programs. The successful implementation of these programs will depend on the ability of the Center to post experienced core staff to fill regional coordinator positions.

686. Training and communication have received strong support from all programs within the Center, and an impressive number and array of individuals have participated in its courses, workshops, and conferences. A high proportion of the trainees have returned to positions in national research programs where the Panel was informed of the relevance of the training from their country's perspective. Many ex-trainees now lead their country's commodity research programs, which they had often been responsible for establishing. Training at CIAT has provided national scientists with the knowledge and confidence to handle the improved germplasm that has become available and enabled them to develop their own national varieties.

687. Many countries now pay the greater part of the costs for the continuing support of their staff who participate in CIAT training courses. The Training Program is appropriately changing its approach by teaching fewer courses at CIAT and assisting more courses presented in-country.

688. The genetic resources and seed programs are extremely effective in meeting their responsibilities to the Center. The numbers of plant accessions have increased rapidly in recent years and now represent a major resource to breeders working with beans, cassava and tropical pasture legumes. In seed production and training, CIAT has become a leader among the IARCs and is appropriately considering ways to evolve this program into a more autonomous unit in the future.

689. The Center is well served by most of its service units, such as facilities and equipment, station and substations, publications, and analytical laboratories. Some improvement in communication between the management and scientific divisions is desirable to assist fiscal management and to attain more prompt delivery of supplies and

of computing services. The Management Review has looked at this problem and the Panel strongly supports their findings.

690. Long range planning has been institutionalized within CIAT. This process led to the development of a Long Range Plan (LRP) which was completed initially in 1981. The Plan has already been updated (1984), and there is good evidence the updated plan will become part of an ongoing process. The Plan is clear, concise and adequately detailed. The updated version is specific as to manpower allocations from core and extra-core funding sources. Even more important than the Plan itself is the Center's acceptance of the need for planning in response to ever-changing circumstances: the development of its programs, the resources at their disposal, national development needs, and the relative strengths of national research programs. Thinking and planning ahead are now part of a continuous process.

2. Scientific Staff

691. International staff are drawn from many nationalities and this is considered appropriate by the Panel. Bilingualism is stressed and has been achieved to a very commendable degree. Policies regarding national staff have been carefully formulated in context with Colombia. The "rankless" system for senior staff is well accepted. The Panel endorses the high value accorded merit in the Center.

692. Not as a matter of policy, but in practice, the Center recruits a large number of senior staff initially as post-doctorates, and occasionally as visiting scientists. The Panel supports this approach as one alternative to be utilized in a recruitment strategy, but overuse, particularly by some programs, may lead to a predominance of inexperienced senior staff, professionally brought up to accept the Center's philosophy. The Panel considers it most important that there be continual recruitment of experienced professionals, bringing with them new ideas and challenging accepted concepts and procedures. Only thus can the Center maintain its vitality.

693. The Panel also is concerned by the fact that a number of senior staff positions have gone a long time without being filled. Admittedly some of these positions are in highly specialized fields, but the Center must improve upon this record in the future because these prolonged vacancies in key positions have a serious impact on continuity and productivity of the program.

694. The Panel endorses the sabbatical leave policy of CIAT but urges that administration take a more aggressive posture in encouraging senior staff to plan for such leaves at an appropriate institution. In the absence of an ongoing schedule for such leaves their occurrence becomes random and erratic. It must be accepted that such leaves become the cornerstone of a senior staff development program, along with attendance at professional meetings and in-service seminars and workshops.

695. There is no clearly stated policy on publications by staff at CIAT. The administration supports publication as one element of staff evalution, but many senior staff are confused as to the relative importance they should place on publishing versus other aspects of their responsibilities. The Panel urges CIAT to develop a clear policy statement which gives more encouragement to staff to publish. The preparation of a paper for publication is a valuable self-discipline. Staff are made to look critically at their own efforts. Supporting staff, statistical consultants, and collaborating national scientists should be given co-authorship of papers if they have contributed substantially to the work.

### 3. Organization

696. CIAT is administratively organized along lines similar to most other IARCs. The Director General (DG) carries primary responsibility for operating the Center in accordance with the mandate given by the CGIAR/TAC and the policies established by the Board of Trustees. This Center has modified the typical structure somewhat by dividing the responsibility for research administration between two directors, although one of these carries primary responsibility for international cooperation as well. In fact, the Directors and the DG operate in a collaborative style which shares day-to-day responsibilities broadly. This appears to operate effectively within the administrative group but creates some confusion among staff and external organizations which collaborate with CIAT. The Panel feels the Center should re-evaluate this element of administration.

697. The commodity programs are structured as interdisciplinary teams each of which is administered by a coordinator. The Center has been successful in implementing the interdisciplinary approach in a very effective manner. The Panel is satisfied the present arrangement is correct for CIAT, with two caveats. First, the coordinator positions of the four commodity programs should be made full time, so that the individual is not expected to carry primary scientific responsibility for any element of the program. However, they should be provided with some support to maintain a moderate research program while in the coordinator position. Second, the Panel feels it is time for CIAT to create a scientific unit of highly specialized biological scientists to support all of the commodity programs. The GRU should be an integral part of such a unit.

### 4. Achievements and Impacts

698. The achievements of the Center and the impact made on client countries have been attained primarily through the activities of the four commodity programs and those units which support them. In all cases these programs have had a major impact in catalyzing and

promoting stronger and more effective national commodity research programs.

### 4.1. Rice Program

699. The first and still the greatest success story to emerge from CIAT's work was the development of high-yielding rice varieties (HYVs) for production under irrigation. The first impact was made in Colombia by the release of IRRI varieties but CIAT's own breeding program, based on imported material, mostly from IRRI, soon took off. About 40-50 lines of HYVs derived from CIAT germplasm and/or IRTP nurseries have now been released to rice farmers in most Latin American countries.

700. The impact of CIAT's achievements on the production and utilization of its mandate crops has been quantified in some instances. Semidwarf HYVs of rice from the CIAT germplasm were grown on 2,286,000 hectares in Latin America in 1981. That is 26% of the rice area in the region and 70% of the area if Brazil, where the large upland area is not favorable for adoption of CIAT technology, is excluded. An average yield increase of 1.2 tons/hectare over previously grown varieties resulted in an increased value of US$ 850 million in the region in 1981 alone. Although, the HYVs were developed for irrigated conditions, the figure of 2,286,000 hectares includes the unexpected adoption of HYVs on 661,000 hectares of upland rice, which is 10% of the upland area in Latin America and 60% of that outside of Brazil.

### 4.2. Bean Program

701. Improved bean lines have been developed, many incorporating multiple resistance to the major diseases and tolerance to specific stress conditions. In recent years about 40 varieties (based on CIAT germplasm or transferred from one country to another after identification in IBYAN trials) have been named by national programs in 16 countries in the Americas and in two African countries. Bean yields in the region have not risen in recent years, but it is too early yet to know the impact of the new varieties. National programs are optimistic at this point. The creation of the Central America and Caribbean network of collaborating bean scientists is a notable achievement.

### 4.3. Tropical Pastures Program

702. Good progress has been made in a number of areas and notably in the definition of different management practices on recently released and promising species and on the collection of resource data. However, the most significant impact is being made through the release of tropical pastures plants.

703. Four cultivars from the Tropical Pastures Program, one grass and three legumes, have now been released by national institutions.

Andropogon gayanus has now been released in five countries and its use is increasing rapidly .

4.4. Cassava Program

705. The Cassava Program has added substantially to knowledge of the crop, previously at a low base. A complete package of low cost practices has been developed for cassava stake production including agronomic and phytosanitary management and storage. Simple technologies have been developed for storing cassava roots destined for fresh consumption and for the small-scale production of dry cassava for animal feed. CIAT has played a notable part in the identification and collection of parasites and predators of mealybugs and mites for introduction into Africa where these pests cause massive damage.

706. Cassava cultivars which contain CIAT germplasm have been released in 10 countries. The impact is not yet discernible in cassava yields, but they may have contributed to the reasons why cassava hectarage has increased in several countries in Latin America.

4.5. GRU

707. The GRU provides the stock of germplasm on which the success of the commodity programs depend. Major world collections of beans, cassava, and forage species have been developed and are being increased. The Unit's active role in describing accessions is of value to breeders worldwide.

4.6. Seed Unit

708. The establishment of a Seed Unit to promote and strengthen seed production activities in the tropics is an imaginative initiative. The Unit also provides a service function for CIAT and has provided seed for three of the mandate crops.

709. The seed of 49 varieties or lines of beans, rice, and tropical pasture species has been produced and supplied to 16 developing countries.

4.7. Training

710. CIAT's impact through training is very substantial. A total of 2400 individuals have received training at the Center, with 1772 of those trained since 1977. Students from Latin America have conducted thesis research at the Center for 79 M.S. and 29 Ph.D. degrees. A recent survey of former trainees indicates that 54% remained active in the field of research for which they were trained, with many of these returning to national programs which sent them. Meetings held by Panel members with administrative and research staff in Brazil (EMBRAPA), Colombia (ICA), Cuba, Guatemala (ICTA), Mexico (INIA), Indonesia (NRCP), and Thailand (FCRI) indicated an overwhelming support for the positive impact CIAT training courses and programs

have made upon their national research programs. Training in the Seed Program has resulted in the development of four seed networks and 15 seed trade associations within the region.

### 5. Constraints

711. The major constraints to the wider and more rapid diffusion of CIAT's new technologies are external to the Center and beyond its control. Diffusion depends on such factors as the strengths of national research and extension systems, the existence of regional organizations which may make it easier to establish networks, the scale of farming enterprises and the state of the rural infrastructure. It is linked to communications and the accessibility of farms, and to the ease with which farmers can obtain credit, pure seed, chemicals, and equipment. It depends on rural marketing facilities, crop prices, and government policies.

712. Increased cassava production in Latin America is constrained by a stagnant market for the crop. This may be related to such factors as the availability of international credit and the livestock feed industry's preference for an assured supply of imported grain, as well as government policies relating to subsidies on home-produced and imported grain.

713. Beans and cassava are grown by large numbers of small-scale farmers, each his own decision maker. Their crops are often grown on poor soils and under unpredictable rainfall so that there is a major disincentive to rapid change. Farmers cannot afford to take risks and need to be fully assured of the advantage to them of adopting a new variety or cultivation technique. Often they do not have ready access to informed advice and, if they do, find it difficult to secure the inputs they need and to pay for them. Under such circumstances acceptance of new technology is slow.

714. The Panel endorses the reminder of the 1977 QQR that it takes about 10 years to develop a new technology and, in the developing countries, another 10 years before it can be seen to make an impact. CIAT must be judged against this scale.

### 6. International Cooperation

715. Through its international cooperation activities the Center has created scientist and commodity networks for beans, rice, and tropical pastures. These have facilitated horizontal transfers of technology in many cases, for example, in enabling varieties released in one country to enter production in another country. The networks will facilitate sharing of scientists among the Latin American countries for purposes of teaching training courses and preparing publications.

716. CIAT has intensified its efforts to outpost staff in the appropriate areas of the region and world in recent years. This has come at a time when budget constraints in the CGIAR system became severe and the support base has been built primarily through extra-core funding which is frequently short-term. The strategy for these positions is sound, but the Panel feels CIAT should now plan to place an appropriate portion of these positions within the core program. Generally the Center has been careful not to allow availability of extra-core funding to involve them in projects for which they do not have a competitive advantage, but the Panel notes there is one project which comes close to violating that principle.

717. The Center has developed collaborative relationships with a number of institutions of scientific excellence around the globe. Overall it appears to be doing this quite well, but efforts should be increased in some areas such as the emerging biotechnology field. This type of collaboration will increase the scientific credibility of CIAT's programs in future years.

718. In most instances CIAT collaborates very effectively with its sister institutions in the CGIAR system. Good examples are its cooperation with IRRI in rice, with CIMMYT in maize, with ICRISAT in sorghum, with IBPGR and ILCA in genetic resources, and with several IARC's in seed technology. Unfortunately the collaboration with IITA in cassava has been less than satisfactory, a fact which was noted by the 1977 QQR. The Panel cannot judge the causes of this lack of collaboration but feels strongly that the two Centers must resolve this problem in the very near future. If not, a third party must be engaged to bring about such an agreement. Hopefully that will not be necessary.

## 7. Future Plans and Related Staff Requirements

719. CIAT's strategy for the future is logical. It takes account of the wide range of biological and socioeconomic environments for which it works and the need to decentralize its activities.

720. The LRP has already been modified once, and it will need to be modified further at intervals, not to change the main strategy but to take account of changing circumstances. The rate of its implementation will depend on the extent to which donors make extra-core funds available for off-campus activities. The use of extra-core funds to supplement core activities and positions is legitimate, even if unsatisfactory. It makes planning and continuity of activities difficult. However, CIAT has little option but to follow this course if it is to implement its proposals. In doing so, the Center should not allow donor aid preferences, and the availability of funds for some areas/activities and not others, to distort its priorities and the planned extension of its activities.

721. Under these circumstances the numbers of extra-core (but

core type) positions to be filled can only be speculative. The Panel thinks that the 25-30 positions projected to be funded in this way in the late 1980s is the maximum the Center can reasonably expect to be able to service and it may be difficult to find appropriately experienced staff to fill senior regional positions. The build-up will thus need to be gradual.

## ACKNOWLEDGEMENTS

The External Review Panel found the task of reviewing CIAT a challenging assignment, especially as particular emphasis was to be placed on the impact of CIAT-generated technology on increased production, productivity, and quality of the Center's mandated commodities in the tropics, principally countries in Latin America and the Caribbean, but also in Africa and Asia.

The support given by the Board of Trustees, the Management, the scientific and support staff of CIAT, during both the preparatory phase and the actual Review greatly helped the Panel in the execution of its task. The Panel wishes to thank all of them for the comprehensive preparation and the efficient arrangements made for the Review, as well as for the valuable interaction and the generous hospitality provided during the entire Review process.

The Panel gratefully acknowledges the informative assistance and hospitality of the Colombian, Brazilian, Costa Rican, Guatemalan, Cuban, Mexican, Thai and Indonesian Government officials, as well as of the Directorate and senior staff of IITA, and of officials of donor aid agencies during related in-country visits.

Finally, the Panel is particularly grateful for the diligence and efficient assistance of the secretarial staff, provided by CIAT, especially of Maria Eugenia Cobo, Delia de Franco, Margarita Pulgarin, Maruja de Bejarano, Lynn Menendez and Adriano Romero. They painstakingly assisted in the preparation of the consecutive drafts; their loyal support enabled the Panel to complete the report on time and to provide copies to the Board of Trustees and the Management at the conclusion of the Review.

ANNEX I

# THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

## TECHNICAL ADVISORY COMMITTEE

## EXTERNAL PROGRAM REVIEWS OF

## THE INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

### A. TERMS OF REFERENCE[1/]

1. CHARGE

The Consultative Group on International Agricultural Research (CGIAR) has charged its Technical Advisory Committee (TAC) with the conduct of External Program Reviews of the value and effectiveness of its International Centers. [2/]

2. PURPOSE AND SCOPE

The major objective of such Reviews has been defined by TAC (in agreement with the Directors of the International Centers) and adopted by the CGIAR as follows:

> "on behalf of the Consultative Group, to assess the content, quality, impact and value of the overall program of the Centers and to examine whether the operations being funded are being carried out in line with declared policies and to acceptable standards of excellence".

It is hoped that the Review will *inter alia* assist the International Centers themselves in planning their programs and ensuring the validity of the research priorities recognized by the Boards of the Centers.

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1/ This version, which was approved at the 31st TAC Meeting, replaces that approved by the 24th TAC Meeting.

2/ "Center" for the purpose of this document comprises the board, the director and staff of all CGIAR institutions, including Boards, Centers, Institutes, Programs and Services. The consultative process for External Program Reviews involves appropriate officials from Center management and/or Board as relevant to the issue in question. It is in such understanding that the term "Center" is used herein.

3. DETAILED ITEMS OF ENQUIRY

In pursuance of the main objectives, defined above, the Review Panel is requested to give particular attention to the following aspects:

(i) The mandate of the Center, its appropriateness, internal consistency and interpretation with respect to:

(a) the immediate and long-term needs for improved food supply and human welfare in developing countries;

(b) present and possible future areas of work.

(ii) The relevance, scope and objectives of the present program and budget of the Center and its forward and long-term plans in relation to:

(a) its mandate, and criteria for the allocation of resources as defined by TAC;

(b) the ongoing activities of other international institutes and organizations, and of the relevant national institutes in cooperating countries and in others where the work of the institutes has bearing;

(c) the policy, strategy and procedures adopted by the Center in carrying out its mandate, and the mechanisms for their formulation;

(d) the Center's rationale for its present allocation of resources, its present and future overall size, and the composition and balance of the program in the fields of research, training, documentation, information exchange and related cooperative activities.

(iii) The content and quality of the scientific and related work of the Center with particular reference to:

(a) The results of the Center's research, particularly that done since the last Review;

(b) the current and planned research and the role of the scientific disciplines therein;

(c) the information exchange and training programs, their methodologies, their specialization and decentralization, and the participation of the research staff therein;

(d) the adequacy of the research support and other facilities;

(e) the management of the scientific and financial resources of the Center and the coordination of its activities. 1/

(iv) The impact and usefulness of the Center's activities in relation to:

(a) agricultural production and the equity of distribution of benefits from increased production;

(b) its information exchange and training programs;

(c) cooperation with national research and development programs;

(d) cooperation with other international institutes and organizations.

(v) Constraints on the Center's activities which may be hindering the achievement of its objectives and the implementation of its programs, and possible means of reducing or eliminating such constraints.

(vi) Specific questions which concerned members of the CGIAR, cooperating institutions, the Center's Director or its Board of Trustees, may request TAC to examine. 2/

## 4. GENERAL CONSIDERATIONS

In the early stages of a Center's development, the External Program Reviews must be devoted to assessing the scientific excellence of the Center, but with the passage of time, the scientific reputation of the Centers becomes widely known and Panels are expected to give more attention to the outcome and impact of the Centers' work and less to detailed comments on the research itself, which is reported elsewhere. Other aspects of paramount importance are the priorities within and between research programs, the balance among programs, the balance between headquarters and off-campus activities, and relationships with national programs.

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1/ The Panel is not expected to institute a detailed management review which will be undertaken, usually concurrently, by a Panel especially commissioned by the CGIAR Secretariat for such purpose. The External Program Review Panel is expected to cooperate closely with the Management Review Panel.

2/ Questions relating to the Center under review will be collated and, when approved, will appear in this subsection.

5. REPORTING

On the basis of its review, the Panel will report to TAC its views on:

(a) the Center's effectiveness and impact;

(b) the relative importance of the various activities of the Center;

(c) means of improving the efficiency of operations;

(d) the need for any changes in the basic objectives or orientation of the Center's program elements; and,

(e) proposals for overcoming any constraints.

The Review team should feel free to make any observations or recommendations it wishes, because the report is its alone. Equally, it should be clearly understood that the Panel cannot commit the CGIAR or TAC to any consequent action, and Centers should bear this in mind when considering implementation of the Panel's recommendations before the report has been discussed by TAC and the CGIAR.

# LIST OF SPECIFIC QUESTIONS RELATING TO CIAT

[REF. 3 (vi) Terms of Reference]

## Results of the First Quinquennial Review

1. What was the impact of the recommendations of the first Quinquennial Review?

## Mandate of CIAT and Research Priorities

2. Is the relative importance given by CIAT to the different crops of its mandate in accordance with changing global needs for these crops? Is there scope for a better identification of research needs and concentration of research means on particular mandate crops and their ecology? Are the strategies, conclusions and recommendations of CIAT's Long-Term Plan sound, relevant and useful in the determination of research priorities? How does CIAT coordinate its global mandate for cassava, tropical pastures and field beans with its regional one for rice in view of its primary regional orientation to Latin America?

3. How does CIAT interpret its mandate and role with respect to cassava, tropical pastures and rice? How does CIAT cooperate with other Centers concerned with these crops (IITA, ILCA, IRRI)? What formal or informal mechanisms are in place and how do they work? Improvement of tropical pastures and cassava may both have significance in Asia. How does CIAT operate in this area?

4. Cassava is not only a staple subsistence food crop, but is also in some parts of the world, a commercial crop of rapidly increasing importance. Given that different regions of the world have differing needs and expectations from improved cassava technologies (e.g., germplasm, agronomy, post-harvest/processing technology, etc.), how does CIAT allocate its resources to respond to these differing needs? What order of priority is given to cassava among the CIAT responsibilities? How are these priorities translated into action in Asia, Africa and Latin America?

## Cooperation with National Programs

5. CIAT initiated an off-campus program somewhat later in its development than most other IARCs of similar age and as a result, much of the costs are covered by special project instead of core funds. In view of this, how effective is the dialogue and influence of associated national agricultural research systems on the program development of CIAT? Are the national programs satisfied with CIAT's response to their identified requjrements not only in research, but in training and information flow? What are the current specific

relationships with the national research systems, including universities?

6. How much direct contact does CIAT have with national programs outside Latin America? How are relations fostered?

Balance of Core and Special Project Activities

7. What is the proportion of special project to core program? How is the core program influenced by special program activities?

Pasture Program

8. What were the driving motives for phasing out the beef program and introducing the pasture program in view of the recommendations of the first Quinquennial Review? What is the impact of the socio-economic studies on tropical pastures? What is the likely outcome and who is likely to gain from these studies in the long run?

Soil Fertility and Soil Conservation

9. To what extent does CIAT's current work focus on fertilizer efficiency and/or attempts to improve availability of soil nutrients? Are efforts put into work on fertilizers and those on biological nitrogen fixation adequately balanced? To what extent does CIAT take into consideration soil conservation techniques in its farming activities? With what success?

Seed Production Unit

10. What is CIAT's plan for the Seed Production Unit? To what extent is this activity an important aspect of CIAT's work? Does the unit have any impact on countries outside Latin America? What are CIAT's plans for phasing it out by transferring this activity to national programs or ungrading it to a core activity?

Germplasm

11. What are CIAT's overall priorities and strategies with respect to germplasm collection and conservation? How have they been implemented? What interim measures have been instituted by CIAT since the loss of the staff member in charge of the germplasm unit? What are CIAT's plans for reinstitution of the position?

# COMPOSITION OF THE REVIEW PANEL

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Mr. L.H.J. Ochtman
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[1/] Attended from 13-16 March 1984

ANNEX III

## DOCUMENTATION FOR REVIEW PANEL

A. Documentation provided by TAC Secretariat

1. Terms of Reference and Guidelines for External Program Reviews;

2. List of Specific Questions Related to CIAT;

3. Brochure on the CGIAR System;

4. Report of the Second Review of the CGIAR;

5. Procedures for Management Reviews of the Centers;

6. Report of the Quinquennial Review of CIAT;

7. Extracts from 16th, 17th, 23rd, 26th, 28th, 29th, 30th, and 31st TAC Meeting Reports;

8. Report of the Second Quinquennial Review of CIMMYT;

9. Extract from Compendium of Off-Campus Activities of IARCs - 1980;

10. Extract from Draft Report of the Second External Program Review of IITA: Chapter 2 - The Mandate and Strategies of IITA, and Chapter 4 - Root and Tuber Improvement Program (TRIP);

11. Extract from the Report of the Second TAC Quinquennial Review of IRRI: Chapter IV - IRRI and Upland Rice Research, and from Chapter V - International Cooperation, Training and Conferences, paras. 381-388.

12. CIAT Special Projects 1983;

13. Farming Systems Research at the International Agricultural Research Centers, 1978;

14. Extracts from Main Conclusions Reached and Decisions Taken, (paras. 9 & 36) CGIAR Meeting, 31 October - 4 November 1983, Washington, D.C.

B. Documentation provided by CIAT

(i) BASIC DOCUMENTS ESTABLISHING CIAT

1. Act of the foundation of CIAT;
2. By-laws of CIAT;
3. Agreement between the Government of Colombia and the Rockefeller Foundation
4. Decree No. 301 of 7 March 1968.

(ii) MANDATE OF CIAT

1. Draft of mandate statement endorsed by the CIAT Board of Trustees at its meeting in 1983.

(iii) ACTIONS ON RECOMMENDATIONS OF FIRST QUINQUENNIAL REVIEW

1. Document entitled: "Review of actions taken by the Center on the recommendations of preceding quinquennial review."

(iv) (v) LONG-RANGE PLAN, UP-DATES TO LONG-RANGE PLAN, AND
(vi)(vii) PRINCIPAL ACHIEVEMENTS

1. CIAT in the 1980s: A Long-Range Plan;
2. Commentary on developments in center-wide aspects since publication of the Long-Range Plan;
3. Program reports:
   - 3.1 Up-date on objectives and strategies (i.e., up-date of Long-Range Plan);
   - 3.2 An analysis of the main achievements and the impact of the programs during the last seven years;
   - 3.3 An up-date of future plans (i.e., up-date of Long-Range Plan);
4. Modification of Chapter 6 in Long-Range Plan: Draft position paper on international cooperation strategies and projections.

(viii) RECENT PROGRAM & BUDGET DOCUMENTS

1. Program and Budget Proposal 1982-83;
2. Midterm Report, Program and Budget 1982-83;
3. Program and Budget Proposal 1984-85.

(ix) PROGRAM REVIEWS AND POSITION PAPERS

1. Proceedings of Workshop on Upland Rice;
2. Upland Rice Research for Latin America: A Report to the TAC Sub-Committee on Upland Rice (December 1979);
3. Upland rice in the Latin American Region: Overall description of environment, constraints, and potential. CIAT paper presented at Upland Rice Workshop, Bouaké, Ivory Coast, October 1982;
4. An evaluation of distribution of social benefits of rice and cassava research at CIAT and of foregone benefits of possible program reductions;
5. Potential for Field Beans in Eastern Africa: Proceedings of a Regional Workshop held in Lilongwe, Malawi, March 1980;
6. Cassava in Asia (1983);
7. Type and Level of Proposed CIAT Involvement in the Humid Tropics of Latin America (Document considered at the 1980 meeting of the CIAT Board of Trustees);
8. Training Position Paper (1983);
9. Seed Unit Position Paper (1983);
10. Target Area Evaluation Unit (Document considered at the 1980 meeting of the CIAT Board of Trustees);
11. Relevant sections from "Analysis of Cooperation and Coordination between the International Research Centers (CIMMYT, CIAT, CIP) and the National Center of Latin America," a report of a project conducted by Iowa State University for the Inter-American Development Bank (1982);
12. Background Documents for Internal Program Review 1983:
    (a) Bean Program, Annual Report, 1983;
    (b) Cassava Program, Annual Report, 1983;
    (c) Rice Program, Annual Report, 1983;
    (d) Tropical Pastures Program, Annual Report, 1983;
    (e) Seed Unit, Annual Report, 1983;
    (f) Training and Conferences, Annual Report, 1983;
    (g) Seed Unit: A Five-Year Report;
    (h) Strategies for Communication and Information Transfer in an Epoch of Increasing Collaboration and Decentralization;
    (i) VA Mycorrhiza Management: A new, low-cost, biological technology for crop and pasture production on infertile soils?

(x) AGREEMENTS WITH OTHER INSTITUTIONS CONCERNING MAJOR COOPERATIVE ACTIVITIES WITH CIAT

A. List of Collaborative Projects with Advanced Research Institutions;

B. Specific Agreements with Sister Institutions:

1. IITA (cassava);
2. IRRI (rice);
3. Bean/Cowpea CRSP;
4. INTSORMIL (sorghum);
5. INTSOY (soybeans);
6. IICA.

(xi) MAJOR NON-CORE PROJECTS

1. "Regional project to increase bean production and consumption, and to strengthen national bean research in the CDA countries of Eastern Africa," special project submitted for funding to CIDA, Canada, and AID, USA, in November 1983;
2. "International tropical pastures evaluation network: a mechanism for technology feedback, validation and transfer with and among national programs in tropical America, Phase II," special project submitted for funding to IDRC in October 1983;
3. "Improvement of bean production in the Central American and Caribbean region," extension of a special project funded by the Swiss Development Cooperation. Project duration: 1 January 1984 - 31 December 1986;
4. "Seed training, outreach and research unit, continuation of a special project financed by the Swiss Development Cooperation." Duration of project continuation: 1 January 1984 - 31 December 1986;
5. "Regional bean research project in the Francophone region of Eastern Africa," special project financed by the Swiss Development Cooperation for the period July 1984 - December 1985;
6. "Improved agricultural information exchange for the tropics," a proposal presented to IDRC in 1983, and likely to be funded for a 4-year period starting on 1 January 1984;
7. "Project on technology transfer on root and tuber crops," work plan and budget for Phase II of project (1982-1987);

8. Agreement CIAT-INIPA-World Bank regarding the stationing in Peru of national co-coordinators in beans and rice.

(xii) OTHER DOCUMENTATION

1. CIAT Report 1983;
2. Principal staff list;
3. Publications catalog;
4. Training materials catalog.

ANNEX IV

# REVIEW PROGRAM AND ITINERARY

## 8 - 10 October 1983

On the occasion of CIAT's Tenth Anniversary Dr. F.E. Hutchinson (Chairman) visited the Center and discussed the EPR with members of the Board of Trustees (BoT) and Management of CIAT.

## 28 October 1983

Dr. Hutchinson discussed the final Panel composition and Review Program in Washington, D.C. with the TAC Chairman, CIAT Management and TAC Secretariat.

## 28 - 29 November 1983

Drs. Hutchinson and H.M.L. Gallegos (Panel member), accompanied by Dr. G. Gálvez, CIAT Regional Bean Coordinator, visited the collaborative bean program in Guatemala.

28 Nov. Discussions with ICTA [1/] staff:

| | |
|---|---|
| Ing. C. Pinto | - General Manager |
| Ing. A. Fumagalli | - Assistant to General Manager |
| Ing. H. Juarez | - Technical Officer |
| Dr. P. Masaya | - Bean Coordinator |
| Ing. S.H. Orozco | - Farming Systems |
| Dr. S. Beebe | - Bean Breeding |
| Ing. J. M. Diaz | - Bean Research (field) |
| Ing. J. Salguero | - Bean Research (field) |
| Ing. G.A. Figueroa | - Bean Research (field) |
| Ing. M. Castillo | - Communications |

29 Nov. Discussions at Nutrition Institute. Discussions with farmers in Chimaltenango, Xeatzan and Tecpan (in highlands and lowlands).

## 30 November 1983

Drs. Gallegos and Gálvez (CIAT) visited bean experiments in Costa Rica; discussion with Ing. Bernardo Mora (Min. of Agriculture).

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1/ ICTA = Instituto de Ciencia y Tecnología Agrícolas, Guatemala City, Guatemala.

11 - 13 January 1984

Dr. K.R.M. Anthony (Panel member), accompanied by Dr. K. Kawano, CIAT Regional Rice Coordinator for Asia, visited the collaborative cassava program in Thailand.

11 Jan. Discussion with Mr. Sophon Sinthuprama, Head of Root Crop Section, Field Crop Research Institute (FCRI), Bangkok. Visit CIAT's Regional Cassava Program office.

12 Jan. Discussions with Dr. Amphol Senanarong, Deputy Director FRCI, and Mr. Panya Ekmahachai, Agronomist at Khon Kaen Field Crop Research Center.
Visit Mahasarakharm Field Crop Experiment Station, on-farm trials and cassava farms in northeast Thailand.

13 Jan. Discussions with Mr. Charn Tiraporn, Director and Cassava Breeder, and staff at Huai Pong Field Crop Research Station, Rayong, eastern Thailand.
Visit on-farm trials, cassava farms, and starch factory.

14 January 1984

Drs. Anthony and Kawano (CIAT) travel Bangkok-Jakarta.

15 - 18 January 1984

Drs. Anthony and Kawano visited the collaborative cassava program in Indonesia.

15 Jan. Travel Jakarta - Bandar Lampung (South Sumatra).
Visit Bandar Lampung with Dr. R. Soenarjo, Coordinator and Breeder, Root Crop Program. Visit cassava trials at Tamanbogo Experiment Station; discussion with Mr. Martin Sumanta, Head of Station.
Visit cassava farms and Cassava Plantation and Starch Processing Factory, Humas Jaya Farm; discussion with Mr. Setlowan Achmed, Director, and Ir. Hardono Nugroho, cassava plantation manager.

16 Jan. Visit cassava trials, including CIAT material, at Humas Jaya Farm.
Travel to Bogor, West Java.

17 Jan. Discussion with Dr. B.H. Siwi, Director, Central Research Institute for Food Crops (CRIFC).
Visit Muara Experiment Station.

Visit cassava crossing plots at Pacet Substation (alt. 1100 m).

18 Jan. Discussion with Dr. Shiro Okabe, Director General, Regional Coordination Center for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Center), and senior staff.
Visit Cickeumeuh Experiment Station.
Departure from Jakarta.

23 - 27 January 1984

Dr. J. Casas visited specialists in INRA, GERDAT, IEMVT, and IRAT in Montpellier and Guadeloupe to discuss CIAT related research programs.

23 Jan. Discussion with Dr. M. Leger in Montpellier on IRAT's research on beans, cassava, and rice.

24 Jan. Discussions with Drs. Devron, Plant Physiologist (INRA, Montpellier), and Fouilloux (Head, INRA Bean Program, Versailles) on rhizobium and bean research relations with CIAT and on their recent mission concerning the bean programs in Cuba, Nicaragua, and CIAT.
Discussion with Dr. P. Lhoste, Pasture Agronomist, GERDAT-IEMVT.

25 Jan. Travel Montpellier-Guadeloupe.

26 Jan. Discussion with Dr. C. Messiaen, Director of INRA Regional Center in Guadeloupe and Plant Pathologist Breeder, on the regional French bean research program and its relationship with CIAT.
Discussions with Dr. Degras, Plant Breeder and present Vice-President of the International Society for Tropical Root Crops, on cassava research and production in the Caribbean.

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1/ INRA = Institut National de la Recherche Agronomique

GERDAT = Groupement d'Etudes et de Recherches pour le Développement de l'Agronomie Tropicale

IRAT = Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres

IEMVT = Institut d'Elevage et de Médicine Vétérinaire des Pays Tropicaux

27 Jan. Discussions with Drs. C. Deverre and D. Ponchelet, Socioeconomists, on farming systems and rural development in the Caribbean.

Discussion with Dr. Touvin, Pasture and Forage Specialist, on pasture and forage research in Guadeloupe and French Guyana.

28 Jan. Travel Guadeloupe-Cali (Colombia).

28 January - 3 February 1984

Review Panel attended Annual Internal Program Review at CIAT, Palmira, Colombia.

28 Jan. Review Panel assembled at CIAT.

29 Jan. Discussion Panel Chairman and Secretary.
Panel sessions in morning and afternoon.

30 Jan. Opening session CIAT Internal Program Review by Dr. J.L. Nickel, Director General, and Dr. M. Piñeiro, Chairman Program Committee, Board of Trustees.

Presentations on Tropical Pastures Program by:

| | |
|---|---|
| Dr. J.M. Toledo | - Program Coordinator and Pasture Agronomist |
| Dr. R. Schultze-Kraft | - Agronomist, Germplasm |
| Dr. J. Lenné | - Plant Pathologist |
| Dr. R. Bradley | - Soil Microbiologist |
| Dr. C. Lascano | - Animal Scientist, Pasture Quality and Animal Nutrition |
| Dr. R. R. Vera | - Animal Scientist, Cattle Production Systems |
| Dr. J.E. Ferguson | - Agronomist, Seed Production |

Panel session in evening.

31 Jan. Presentations on Bean Program by:

| | |
|---|---|
| Dr. A. van Schoonhoven | - Program Coordinator and Entomologist |
| Dr. O. Voysest | - Agronomist |
| Dr. J. Woolley | - Agronomist, Cropping Systems |
| Dr. G.E. Gálvez | - Plant Pathologist and Regional Coordinator, Central American Bean Project |
| Dr. M. Dessert | - Plant Breeder, Francophone East Africa |

Panel session with Program Committee (BoT) in evening.

1 Feb. Presentations on Rice Program by:

| | |
|---|---|
| Dr. P.R. Jennings | - Program Coordinator and Plant Breeder |
| Dr. C. Martínez | - Plant Breeder |
| Dr. S. Sarkarung | - Plant Breeder |

Presentation on Seed Unit by:

| | |
|---|---|
| Dr. J.E. Douglas | - Head of Seed Unit |

Panel session in evening and dinner at Dr. Nickel's residence.

2 Feb. Presentations on Cassava Program by:

| | |
|---|---|
| Dr. J.H. Cock | - Program Coordinator and Plant Physiologist |
| Dr. C. Hershey | - Plant Breeder |
| Dr. A.C. Bellotti | - Entomologist |
| Dr. R. Howeler | - Soil Scientist, Soil and Plant Nutrition |
| Dr. R. Best | - Utilization |
| Dr. J.K. Lynam | - Agricultural Economist |
| Dr. K. Kawano | - Plant Breeder for Southeast Asia |
| Dr. J.C. Lozano | - Plant Pathologist |
| Dr. B. Ospina | - Betulia pilot project |

Panel session in evening.

3 Feb. Presentation on Priorities and Strategies in International Cooperation by:

| | |
|---|---|
| Dr. G.A. Nores | - Director, Resources Research and International Cooperation |
| Dr. F. Fernández | - Coordinator, Training and Conferences, Soil Scientist |
| Dr. S.C. Harris | - Head, Communication and Information Support Unit |

Presentation on Mycorrhiza Research by:

| | |
|---|---|
| Dr. E. Sieverding | - Soil and Plant Nutrition |
| Dr. S.R. Saif | - Soil Microbiologist |

Presentation on Applied Biotechnology by:

| | |
|---|---|
| Dr. W.M. Roca | - Acting Head, Genetic Resources, Plant Physiologist |

Closing remarks by Drs. F.E. Hutchinson, Review Panel Chairman, M. Piñeiro, Program Committee Chairman, and J.L. Nickel, Director General of CIAT.

During the following week the Review Panel split up as follows:

1) Drs. Hutchinson (Chairman), Jones, Ramalho, and Rutger, accompanied by Dr. G.A. Nores, visited collaborative bean, cassava, rice, and tropical pastures programs in Brazil from 5 - 11 February 1984.

2) Drs. von der Pahlen, Casas, Gallegos, Niblett, and Ochtman (Secretary), accompanied by Dr. G.E. Gálvez in Costa Rica and Cuba, and by J.H. Cock in Mexico, visited collaborative bean, cassava, rice, and tropical pastures programs in these three countries from 4 - 10 February 1984.

3) Dr. Anthony visited IITA in Ibadan, Nigeria, for discussion of CIAT-IITA collaboration in cassava research for Africa on 7-8 February 1984.

The program of the above mentioned Panel team visit to Brazil was as follows:

4-5 Feb. Travel Cali-Bogotá-Rio de Janeiro-Brasilia.

6 Feb. Drs. Hutchinson, Jones, and Ramalho, accompanied by Dr. G.A. Nores, visited Centro de Pesquisa Agropecuária dos Cerrados (CPAC), and had discussions with following:

| | |
|---|---|
| Mr. Elmar Wagner | - Director, CPAC |
| Mr. Edson Lobato | - Technical Director, CPAC |
| Mr. Guedes | - Administrative Director, CPAC |
| Dr. Derrick Thomas | - CIAT Forage Agronomist stationed in CPAC |
| Dr. Darci Tercio Gomes | - Program Coordinator, Animal Production |
| Dr. Jose Zoby | - Animal Nutritionist |
| Mr. Carlos Magno Campos da Rocha | - Regional Trials (grazing) |
| Mr. Ronaldo Pereire de Andrade | - Coordinator, Pastures-Seed Research |
| Mr. Ben de Sousa | - Breeding |
| Dr. Walter Couto | - Former CIAT Soil Scientist stationed in CPAC |
| Dr. Mark Hutton | - Plant Breeder |

Dr. Rutger visited Centro Nacional de Pesquisa em Arroz e Feijao (CNPAF) personnel, met with the same as those met by the larger group on 7 February (below).

7 Feb. Drs. Hutchinson, Ramalho, and Rutger, accompanied by Dr. G.A. Nores, visited CNPAF and met the following:

| | |
|---|---|
| Dr. Almiro Blumenschein | - Director, CNPAF |
| Mr. Arnaldo José de Conto | - Technical Director |
| Ms. Iracema Costa Magalhaes | - Library, Training and Publications |
| Dr. Ricardo Silva Araujo | - Microbiology |
| Dr. Robert Hansen | - USAID Microbiologist and Visiting Scientist |
| Dr. Francisco P. Zimmerman | - Statistics |
| Ms. Marlene Silva Freire | - Germplasm Bank and Rice Program |
| Dr. Nand Kumar Fageria | - Soil Fertility |
| Dr. Joao Kluthcouski | - Soil Fertility |
| Dr. Thomas de Aquina Portes e Castro | - Intercropping |
| Dr. Ricardo José Guazzelli | - Cowpea Research |
| Dr. Maria José de Oliveira Zimmerman | - Bean Program |
| Dr. Ann Prabhu | - Rice Pathology |
| Mr. Evaldo Pacheco Sant'Ana | - Rice Program |
| Mr. José Francisco Valente Moraes | - Rice Program |
| Dr. Adelson de Barros Freire | - Rice Program |
| Dr. Y. Tanaka | - IICA Rice Pathologist located in CNPAF |
| Mr. Paulo Hideo Nakano Rangel | - Rice Program |
| Mr. Emilio Maria Castro | - Rice Program |
| Ms. Marli de Fatima Fiore | - Rice and Azolla Program |
| Mr. Silvio Steinmentz | - Agrometeorology |
| Mr. Francisco Reyniers | - IRAT Agrophysiologist stationed in CNPAF |
| Dr. Michael D. Thung | - CIAT Bean Agronomist stationed in CNPAF |

Dr. Jones continued visits to CPAC.

8 Feb. Discussions (entire group) with Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) officials in Brasilia:

| | |
|---|---|
| Dr. Raimundo Fonseca | - Executive Director |
| Dr. Agide Gorgatti Neto | - Executive Director |
| Dr. José Maria Pompeu Memoria | - Head, International Cooperation |

Travel Brasilia-Porto Alegre (entire group), for discussions with Rio Grande do Sul officials and with officials and scientists at Instituto Rio-Grandense do Arroz (IRGA):

| | |
|---|---|
| Hon. Joao Salvador Jardin | - Secretary of Agriculture |
| Mr. Theodoro Saibro | - Asistant Secretary of Agriculture |

| | |
|---|---|
| Mr. Karl H. Moerdick | - Director of Research |
| Mr. Paulo Belchior da Costa | - President, IRGA |
| Mr. Marco Antonio B. Oliveira | - Technical Director, IRGA |
| Mr. Clovis H. Scherer | - Assistant to the Technical Director, IRGA |

9 Feb. Continued visits at IRGA station (entire group).

| | |
|---|---|
| Mr. Mauricio Pilzen | - Assistant representative, EMBRAPA-RS |
| Ms. María Suely Soares da Costa | - Technical Coordinator for Integrated Programs S.A., IRGA, EMBRAPA |
| Mr. José Alcen Infield | - Rice Bioclimatology, EMBRAPA, Pelotas |
| Mr. Arlei Laerte Terres | - Rice Breeding, EMBRAPA, Pelotas |
| Mr. José Galli | - Rice Breeding, UFPEL, Pelotas |
| Ing. Sidnei Bicca da Rocha | - General Coordinator, IRGA |
| Ing. Pedro Roberto de Souza | - Coordinator of Research |
| Ing. Paulo Sergio Carmona | - Plant Technology, IRGA |
| Ing. Brasil Aquino Pedroso | - Plant Technology, IRGA |
| Ing. Bernardo Iochpe | - Plant Technology, IRGA |
| Ing. Jose Carlos da Silva | - Plant Technology, IRGA |
| Ing. Jaime Vargas de Oliveira | - Plant Technology, IRGA |
| Ing. Dieter Kempf | - Plant Technology, IRGA |
| Ing. Jorge Kalil Abud | - Plant Technology, IRGA |
| Ing. Luiz Alberto Pinto Gondim | - Soils and Water |
| Ing. Marlene Souza Lopes | - Soils and Water |
| Ms. Marisa de Azevedo e Souza de Jesús | - Soils and Water |
| Ing. María da Graca Burgo Valerio | - Seeds |
| Ing. César Mariot | - Machinery |
| Ing. Valfredo García Basler | - Machinery |
| Ing. José Gallego Tronchoni | - Training |
| Ing. Mauricio Miguel Fischer | - Training |

10 Feb. Dr. Rutger travelled to Campinas, for discussions with rice and bean scientists at Instituto Agronômico de Campinas (IAC):

| | |
|---|---|
| Mr. Luiz E. Azzim | - Rice Breeding, IAC |
| Mr. Antonio Pompeu | - Bean Breeding, IAC |

10 Feb. Drs. Hutchinson, Jones, and Ramalho, accompanied by Dr. G.A. Nores, visited Centro Nacional de Pesquisa de Mandioca e Fruticultura (CNPMF) at Cruz das Almas, near Salvador, for discussions on cassava with:

| | |
|---|---|
| Dr. M.A.P. da Cunha | - Director, CNPMF |
| Dr. M.C.M. Porto | - National Cassava Program Coordinator |
| Dr. N. Alvarez | - Cassava Breeder |

11 Feb. Dr. Rutger continued visits at IAC, then returned home. Drs. Hutchinson, Jones, Ramalho, and Nores continued visits at CNPMF, then all returned home except Dr. Jones.

12-13 Feb. Dr. Jones visited EMBRAPA National Dairy Cattle Research Center, Juis da Fora, for discussion with:

| | |
|---|---|
| Dr. Margarida de Carvalho | - Plant Nutritionist |
| Dr. Andrew Gardner | - Pasture Agronomist |

The program of the abovementioned Panel team visit to Costa Rica, Cuba, and Mexico was as follows:

3 Feb. Travel Cali-Bogotã.

4 Feb. Travel Bogotã-San Josê, Costa Rica.

Accompanied by Mr. C. Rodriguez S., Agronomist, Bean Program, National Council for Production (CNP), visit to Foundation Seed (beans) fields in Cartago-Paraiso area.

Panel team session in evening.

5 Feb. Discussions in San Josê with national program officials from the Ministry of Agriculture and Livestock (MAG), the National Council for Production (CNP), and the National Seed Office (ONS), for discussions with:

| | |
|---|---|
| Ing. R. Alfaro M. | - Deputy Director Agricultural Research (MAG) and National Coordinator of the Bean Program |
| Ing. O. Ramírez B. | - Director, National Seed Office (ONS) |
| Ing. B. Mora | - Plant Pathologist, Bean Program (MAG) |
| Mr. C. Rodriguez S. | - Agronomist, Bean Program (CNP) |
| Mr. E. Abarca C. | - Agronomist, Bean Program (CNP) |
| Mr. Zamora M. | - Agronomist, Bean Program (CNP) |

Panel team session in evening.

6 Feb. Discussions with:

| | |
|---|---|
| Ing. J. Torres | - Vice-Minister, MAG |
| Ing. R. Alfaro M. | - Deputy Director Agricultural Research, MAG |
| Dr. L.C. González | - Dean, Faculty of Agriculture, Univ. of Costa Rica |
| Ing. E. Quiroz | - President, CNP |

Travel San José-Havana, Cuba

Dinner with Dr. P. Morales, Director of the Comité Estatal de Colaboración Externa (CECE), Havana.

7 Feb. Presentations by national program officials from the Ministry of Agriculture (MINAG):

| | |
|---|---|
| Lic. G. Cayado | - Director, International Relations |
| Dr. E. Ruiz | - Director of Science and Technology, and representative for Latin America and the Caribbean Region in the CGIAR |
| Ing. O. Gómez | - Director, Research Institute for Horticulture, Grains and Fibers |
| Dr. J. Trêmocs | - Director, Research Institute for Agrochemistry and Soil Improvement |
| Dr. F. Funes | - Director, Pasture and Forage Research Institute |
| Ing. A. Martínez | - Director, Seed Inspection and Certification Service |
| Ing. J.E. Deus-Rentería | - Plant Breeder, Rice Research Institute |
| Ing. M. Portieles | - Cassava Development |

Visit to the Grain Experiment Station "Tomeguin", Havana, and discussions with:

| | |
|---|---|
| Ing. L. Barreiro | - Station Director |
| Ing. M. Torres | - Maize Researcher |
| Ing. M. Irañeta | - Bean Researcher |
| Ing. T. Hernandez | - Bean Researcher |
| Dr. A. Jiménez | - Delegate of the Vice-Minister |
| Mr. M. Nieto | - International Relations, MINAG |

Visit to the Pasture and Forage Research Station "Niña Bonita", Havana, and discussions with:

| | |
|---|---|
| Dr. F. Funes | - Station Director |
| Dr. J.S. Paretas | - Deputy Director |
| Ing. R. Rabago | - Seed Production |
| Ing. E. Berra | - Head, Agronomy Department |

| | |
|---|---|
| Dr. E. Ruiz | - Director of Science and Technology, MINAG |

Panel team session in evening.

8 Feb. Accompanied by Drs. E. Ruiz and G. Cayado, visit to:

i) Matanzas Provincial Office of MINAG for discussions with:

| | |
|---|---|
| Mr. H. Hernández Cuesta | - Deputy Delegate of MINAG in the Province |
| Ing. R. Rodríguez C. | - Grain Specialist |
| Ing. L. Barreiro | - Director, "Tomeguin" Station, Havana |

ii) "Lenin" State Farm, Jovellanos, Matanzas Province, for discussions with:

| | |
|---|---|
| Ing. F. Jorrin | - Head, Agricultural Production and Delegate of MINAG in the Province |
| Ing. J.I. Rodríguez | - Deputy Director of Production, "Lenin" State Farm |
| Ing. A. Cañada | - Grain Technologist |

iii) "Victoria de Giron" State Farm, Matanzas Province, for discussions with:

| | |
|---|---|
| Ing. J. Sureda | - State Farm Director |
| Ing. J. Estupiñan | - Deputy Director |

Final discussion with Drs. Ruiz, Cayado, and Nieto at the International Relations Office, MINAG, Havana.

Travel Havana-Mexico City in evening.

9 Feb. Dr. von der Pahlen, accompanied by Dr. Cock (CIAT), travelled Mexico City-Villahermosa, Tabasco (Mexico) and visited:

i) CAEHUI[1/] Experiment Station in Huimanguillo and discussions with:

| | |
|---|---|
| Ing. M.C. Francisco Melendez | - Regional Coordinator |
| Ing. J.I. Lopez Naranjo | - Pasture Program |
| Ing. V.W. Gonzalez Lauck | - Cassava Program |

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1/ CAEHUI = Centro Agrícola Experimental Huimanguillo

ii) Ranch "El Destierro" of Mr. H. Navarro; trials on grasses and legumes, including Brachiaria decumbens.

iii) Ranch "Palo Borracho"; fertilization trials, including B. decumbens.

Meeting in the evening with:

| | |
|---|---|
| Ing. S. Contreras | - Cassava Coordinator |
| Ing. Gonzalez Lauck | - Cassava |
| Ing. F. Segoretta Padilla | - Cassava |
| Ing. D. Sánchez Esparga | - Cassava |
| Ing. J. Zuinga González | - Cassava |
| Ing. T. Gaytais Muñiz | - Cassava |
| Ing. S. Sánchez Gómez | - Cassava |
| Ing. J.I. López Naraujos | - Pastures |
| Ing. J.P. Flores Márquez | - Rice |
| Ing. Antelmo Contreras | - Rice |

9 Feb. Drs. Casas, Gallegos, and Ochtman, travel México City-Culiacán, Sinaloa (Mexico) and visited:

i) CIAPAN[1/] Agricultural Research Center at Culiacán for discussions with:

| | |
|---|---|
| Dr. J.M. Ramírez | - Director, CIAPAN |
| Dr. R. Lepiz | - Bean Coordinator, Central Zone, INIA |
| Dr. J. Armenta S. | - Rice Coordinator, Northern Zone, INIA |
| Ing. R. Salinas | - Bean Program, Ahome Experiment Station |

ii) Members of Rio Culiacán Farmers' Association, i.e.:

Ing. H. Saldoria
Mr. R.L. Ramos
Mr. F. Elias A.

10 Feb. Dr. von der Pahlen visited:

i) Experimental sites at Pato Escondido and El Quinez.

ii) Cassava drying plant "El Guacamoto".

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1/ CIAPAN = Centro de Investigaciones Agrícolas del Pacífico Norte.

Travel Villahermosa-Mexico City.

Discussions at INIA[1/] headquarters with:

| | |
|---|---|
| Ing. A. Ramos Sánchez | - Dep. Director of Research, Southern Zone |
| Dr. K. Yoshii Okuda | - Bean Program, Veracruz, Cotaxtla |
| Ing. N. Carrezales Mejía | - Bean Program, Chiapas |
| Ing. L. Hernández Aragón | - Rice Program, Experimental Station "Zacatepec", Morelos |

Dr. Casas and Mr. Ochtman travel Culiacán-Mexico City.

Panel team session in evening.

11 Feb. Panel members' departure from Mexico.

7-8 February 1984

Dr. Anthony during his visit to IITA, Ibadan, Nigeria, had discussions on the CIAT-IITA relationship regarding cassava research, with the following IITA staff:

| | |
|---|---|
| Dr. E.H. Hartmans | - Director General, IITA |
| Dr. B.N. Okigbo | - Deputy Director General |
| Dr. E.R. Terry | - Director, International Program and Training |
| Dr. S.K. Hahn | - Director, Root and Tuber Program |
| Dr. Y. Efron | - Director, Cereal Improvement Program |
| Dr. K. Zan | - IRRI Liaison Scientist |

2 March 1984

Dr. J. Casas visited Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux (IEMVT) and ORSTOM[2/] in Paris for discussions with:

| | |
|---|---|
| Dr. Provost | - Director General, IEMVT, Maisons Alfort |
| Dr. Andru | - Head, Pasture Program, IEMVT |
| Dr. Spire | - Head, International Cooperation with Latin America, ORSTOM, Paris |

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1/ INIA = Instituto Nacional de Investigaciones Agrícolas

2/ ORSTOM = Office de la Recherche Scientifique et Technique d'Outre-Mer.

3 March 1984

Review Panel reassembled at CIAT, Palmira, Colombia.

4 March 1984

Panel session.
Tour of CIAT Experiment Farm.

The Review Panel split up as follows:

1) Drs. Hutchinson (Chairman), Casas, Jones, Niblett, and Rutger visited Carimagua, Villavicencio, and Quilichao from 4-9 March 1984.

2) Drs. von der Pahlen, Anthony, Gallegos, Ramalho, and Ochtman (Secretary) visited Corozal, Santa Marta, Popayán, and Ipiales from 5-9 March 1984.

Drs. Hutchinson, Casas, Jones, Niblett, and Rutger, accompanied by Dr. J.M. Toledo, CIAT Tropical Pastures Program Coordinator, visited the following institutions and officials in Carimagua, Villavicencio, and Quilichao:

4 March Travel by air Cali-Carimagua (Meta). General overview of Carimagua Station.

5 March Discussions at Carimagua Station with:

| | |
|---|---|
| Dr. B. Grof | - Agrostologist and representing Director of ICA/Carimagua |
| Dr. R. Howeler | - Soil Scientist, CIAT Cassava Program |
| Dr. A.C. Bellotti | - Entomologist, CIAT Cassava Program |
| Dr. R.R. Vera | - Animal Scientist, CIAT Pastures Program |
| Dr. C. Seré | - Agr. Economist, CIAT Pastures Program |
| Dr. C. Lascano | - Animal Scientist, CIAT Pastures Program |
| Dr. J. M. Lenné | - Plant Pathologist, CIAT Pastures Program |
| Dr. R. S. Bradley | - Soil Microbiologist, CIAT Pastures Program |
| Dr. J.M. Toledo | - Pasture Agronomist and Coordinator, CIAT Pastures Program |

6 March Discussions at Carimagua Station with:

| | |
|---|---|
| Dr. R.R. Vera | - Animal Scientist, CIAT Pastures Program |
| Dr. C. Seré | - Agr. Economist, CIAT Pastures Program |
| Dr. C. Lascano | - Animal Scientist, CIAT Pastures Program |
| Dr. J.M. Toledo | - Pasture Agronomist and Coordinator, CIAT Pastures Program |

Visit to "Altagracia" ranch; discussions with Dr. A. Jiménez (owner).

7 March Travel by car Carimagua-Villavicencio (Meta); on the way visits to:

" Guayabal " ranch
" Las Margaritas " ranch
" Las Leonas " ranch
" El Viento " ranch

8 March Visit Santa Rosa CIAT Substation; discussions with:

| | |
|---|---|
| Dr. J. González | - Agronomist, CIAT Rice Program |
| Ing. A. Díaz-Durán | - Superintendent, CIAT Stations Operations |
| Dr. S. Sarkarung | - Breeder, CIAT Rice Program |

Visit La Libertad ICA Research Station; discussions with:

| | |
|---|---|
| Ing. I. Torrez | - Station Director, ICA |
| Mr. E. Jiménez | - Regional Manager |
| Dr. E. B. Owen | - Director of Regional Agricultural Research |
| Dr. Perez | - Pasture Research |
| Ing. E. Andrade | - Rice Breeder |
| Dr. D. Leal | - Rice Agronomist |

Travel by air Villavicencio-Palmira.

9 March Travel by car CIAT (Palmira)-CIAT Quilichao Station (Cauca); discussions with:

| | |
|---|---|
| Ing. A. Díaz-Durán | - Superintendent, CIAT Stations Operations |
| Dr. J.H. Cock | - Coordinator, CIAT Cassava Program |
| Dr. R. Howeler | - Soil Scientist, CIAT Cassava Program |

| | |
|---|---|
| Dr. J.W. Miles | - Breeder, CIAT Pastures Program |
| Dr. R. Schultze-Kraft | - Agronomist Germplasm, CIAT Pastures Program |
| Dr. C. Lascano | - Animal Scientist, CIAT Pastures Program |
| Dr. J.M. Toledo | - Coordinator, CIAT Pastures Program |
| Dr. J.E. Ferguson | - Agronomist, Seed Production, CIAT Pastures Program |
| Dr. S.P. Singh | - Breeder, CIAT Bean Program |

Travel by car CIAT Quilichao-Mondomo region, accompanied by Drs. J.H. Cock, R. Howeler, and J. Lynam, to visit and discuss:

- evaluation of mycorrhiza
- regional trials
- evaluation of fallow and fertilizers on long-term fertility
- erosion control

Return by car to CIAT-Palmira.

Drs. von der Pahlen, Anthony, Gallegos, Ramalho, and Ochtman visited the following institutions and officials in Corozal, Santa Marta, Popayán, and Ipiales:

5 March Travel by air Cali-Corozal (Sucre).

Accompanied by Drs. J.H. Cock and R. Best, Coordinator and Utilization Scientist of CIAT's Cassava Program, respectively, visited:

- Cassava natural drying plant, Montañitas Farm, of the Betulia Farmers Association (APROBE)[1/] and the pilot drying plant with circulation bin dryer and solar collector.

- Regional cassava variety trial, Montañitas.

- Cassava sowing date and harvest time trial at Montañitas.

- Commercial cassava lots, Montañitas, with improved technology, traditional technology, and traditional method of stake storage.

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1/ APROBE: Asociación de Productores de Betulia.

- Stake storage trial, Albania.

- Regional cassava variety trial, Albania.

- Cassava natural drying plant, Albania.

At above sites discussions with:

| | |
|---|---|
| Ing. C. Acosta | - Regional Director, ICA[1/] |
| Ing. R. Pérez | - Regional Director, DRI[2/] |
| Ing. E. García | - District Director, ICA |
| Ing. O. Medina | - District Director, CECORA[3/] |
| Ing. B. Donado | - Coordinator, Interinstitucional Cassava Project Team, CECORA |
| Mr. J. Ortega | - Manager, APROBE |
| Mr. S.M. Erazo | - Manager, APROALBANIA |

Travel by air Corozal-Santa Marta (Magdalena).

Panel team session in evening.

6 March Travel by car Santa Marta-Media Luna, accompanied by Drs. J.H. Cock (Program Coordinator), C. Hershey (Cassava Breeder), J.K. Lynam (Economist), J.C. Lozano (Plant Pathologist), Ing. R. Laberry (Associate Pathologist), and Ing. J.A. Puente (Cassava Program Operations on the Atlantic Coast), visit to:

- Breeding plots for cassava ecosystem ECZ-1.
- Regional trial.
- Long-term fertility trials.
- Production of virus-free materials.
- Ecological zones systems trial.
- Varietal distribution in the Media Luna area.
- Natural drying plant.

Return to Santa Marta.

Panel team session in evening.

7 March Travel by air Santa Marta-Popayán (Cauca), accompanied by Ing. A. Díaz-Durán (Superintendent Stations Operations), Drs. A. van Schoonhoven (Bean Program Coordinator), S.P. Singh (Bean Breeder), M.

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1/ ICA: Instituto Colombiano Agropecuario.
2/ DRI: Desarrollo Rural Integrado.
3/ CECORA: Central de Cooperativas de la Reforma Agraria.

Pastor-Corrales (Bean Pathologist), C. Hershey (Cassava Breeder), and Ing. R. Realpe, visit of CIAT Substation in Popayán.

Travel by air Popayán-Pasto (Nariño).

Panel team session in evening.

8 March Accompanied by Drs. A. van Schoonhoven (Bean Program Coordinator), J. Davis (Bean Breeder), J. Woolley (Bean Agronomist), Ing. Omar Guerrero (Acting Director of Station), Ing. N. Angulo (ICA Bean Breeder), Ing. L. Obando (ICA Bean Program), visit of bean trials at Obonuco Station.

Accompanied by Drs. A. van Schoonhoven, J. Woolley, D. Pachico (Economist), and Ing. N. Angulo (ICA), visit of on-farm trials (bush bean monoculture) in Funes.

Travel by car Funes-Ipiales.

9 March Continuation of visit to on-farm trial sites.

Travel by air Ipiales-Cali.

10 March Review Panel visit ICA headquarters at Tibaitatá (Bogotá); discussions with:

| | |
|---|---|
| Dr. F. Gómez | - General Manager, ICA |
| Dr. E. Alarcón | - Director of Planning |
| Dr. J. Navas | - Deputy Director of Research |
| Dr. M. Torregrossa | - Director of Agronomy |
| Dr. G. Manrique | - Director of Animal Production |
| Dr. J. Isaza | - Director of Rural Development |
| Ing. M. Brochero | - Director of Agricultural Production |
| Ing. R. Artunduaga | - Director of Administration |
| Ing. A. Ariza | - Director, Tibaitatá Station |

Return to CIAT in the afternoon.

11 March 1984

Panel session in morning.
Presentation by Mr. J. A. Cuéllar, Executive Officer of Administration, CIAT.
Panel session in afternoon.
Meeting External Management Review (EMR) and EPR Panels in evening.

12 March 1984

In-depth discussions and consultations with CIAT staff.
Report preparation in evening.

13 March 1984

Report preparation and consultations with staff.
Panel session in evening.

14 March 1984

Panel sessions morning, afternoon, and evening.
Report preparation.

15 March 1984

Report preparation and consultations with staff.
Panel attended presentation of External Management Review to CIAT.
Panel session in evening and report preparation.

16 March 1984

Panel sessions in morning, afternoon, and evening.
Report preparation and consultations with staff.

17 March 1984

Panel session in morning with Director of Crops Research, Director of Resources Research and International Cooperation, and four Commodity Program Coordinators.
Report preparation.
Panel session in afternoon with Director of Crops Research, Director of Resources Research and International Cooperation, and Cassava Program Coordinator.
Panel sessions in afternoon and evening.

18 March 1984

Panel sessions in morning, afternoon, and evening.
Dr. and Mrs. J.L. Nickel invite Panel for luncheon.
Report preparation.

19 March 1984

Report preparation and consultations.
Panel sessions in afternoon and evening.

20 March 1984

Report preparation and consultations.
Panel sessions in afternoon and evening.

21 March 1984

Report preparation and consultations.
Finalizing draft report.

22 March 1984

Draft report to Executive Committee, BoT.
Final checking draft report.
Panel sessions with Executive Committee in afternoon and evening.
Finalizing report.

23 March 1984

Finalizing report.
Presentation of EPR report by Panel Chairman to CIAT Executive Committee, Management and Staff in early afternoon.
Final Panel session in afternoon.
Dinner at Dr. J.L. Nickel's residence in evening.

24 March 1984

Departure EPR Panel.

ANNEX V

# REVIEW OF ACTIONS TAKEN BY CIAT ON THE RECOMMENDATIONS OF THE 1977 QUINQUENNIAL REVIEW

## PART A: ACTIONS RE: PRINCIPAL RECOMMENDATIONS AS PRESENTED ON PAGES 80-82 OF QQR REPORT

### 1. Stabilization of Policy

Recommendation:

That the Center be given a period of stability and the opportunity to make uninterrupted progress.

Action Taken:

This recommendation was followed by the various elements in the Center and CGIAR System so that no major program changes (except the elimination of the already small Swine Nutrition Unit) were made until 1982, when the financial crisis in the CGIAR interrupted stability.

### 2. Forward Planning

Recommendation:

That the Center should not be asked to detail long-term prescriptions for the separate programs.

Action Taken:

This recommendation was overtaken by the strongly expressed views of donors in 1978 that all Centers should develop long-range plans. Thus, during the two-year period from mid-1979 to mid-1981 a long range plan, entitled "CIAT in the 1980s" was developed. This included, in Chapter 5, long-term strategies and projections for each program.

### 3. Coordination of Regional Survey Activities

Recommendation:

That there be a positive effort to integrate and classify regional ecological, land-use and farming systems information.

Action Taken:

An Agro-ecosystem Unit has been established, which is compiling data bases of such information for each program and assists them in defining priority agroecological regions.

4. Assessment of Contribution

Recommendation:

That CIAT develop a method for monitoring its contribution to tropical agriculture.

Action Taken:

This activity has been recognized as one of the principal functions of the economist in each commodity team. Together, each year the program economists prepare a status report (copies of the reports for the past two years included with briefing information) to the Board of Trustees.

The summary of achievements which make up part of information compiled for the EPR constitute the most recent contribution in this respect. However, this is a continuing and large task which will become greater as CIAT technology reaches farmers in more countries. Therefore, it will be essential to enlist local assistance in various countries. The studies on bean technology adoption in Costa Rica and Guatemala, conducted by local university students under the supervision of the Bean Program economist, is a method which will probably be used more in the future.

5. Training of Trainees

Recommendation:

That a substantial part of the course program be devoted to methods for teaching the technologies which the students are learning.

Action Taken:

No formal element on this subject has been added to the courses, but the goal has been effectively achieved. An integral component of each course is an element on visual aids preparation and use and other communication skills. In addition large amounts of training materials have been developed. Also, individuals responsible for conducting training courses in their home countries have been given special training in course planning and organization. The result is that many (and those we consider clearly the best) of the growing number of in-country courses on beans, cassava, rice and tropical pastures are conducted by CIAT alumni, with heavy use of CIAT teaching materials. Communication specialists from several countries have also been given special training in the development and use of audiotutorial materials.

6. Training for Seed Production

Recommendation:

That training in the technology of multiplication and distribution of clean seed should have a high priority in CIAT programs.

Action Taken:

This is the principal function of the Seed Unit.

7. Avoidance of Soil Exhaustion from Low Input Cropping

Recommendation:

That nutrient balance studies for minerals be conducted to monitor CIAT recommendations for low-input cropping systems in infertile soils.

Action Taken:

Shortly after the last QQR two Soil Scientists were added to the Tropical Pastures Program (one in Colombia and one in Brazil) with the task of determining the nutrient requirements of the new pastures on Llanos and Cerrado soils and establishment of appropriate fertilizer levels for initial establishment and maintenance. One of these was subsequently lost--in the 1983 fallback cuts--but the work continues and very useful information on this subject has been developed.

In the case of Cassava macro and micro nutrient requirements have been established and deficiency symptoms identified. Also, long-term experiments were initiated in 1977 to monitor the fertility status of soils with various fertilizer practices. These continue. This will also be one of the chief responsibilities of the agronomist we hope to place in the Asia Cassava Program.

In the case of beans, screening methodology has been developed to identify genotypes which intrinsically require less phosphorus--as opposed to those which are merely more efficient in extracting it from the soil.

8. Improvement of Soil Conservation Procedures

Recommendation:

That higher priority be given by CIAT to the incorporation of well known soil conservation techniques into all its farming activities.

Action Taken:

The specific recommendation related to CIAT's own farming practices has been amply followed, especially on the more hilly substations of Quilichao and Popayan. Well known soil conservation practices were put in place when these farms were developed and have been substantially improved with experience.

While soil conservation research did not form part of the panel's recommendations, it is appropriate to point out that modest efforts have also been made in this field. Over the past several years the on-farm soils research at Mondomo has tested various living mulches and other agronomic practices to reduce erosion in cassava plantings in that hilly area.

A major effort has also been made in the Tropical Pastures Program to develop new pasture establishment technology which will minimize soil disturbance.

9. Increased Germplasm Collection in Beans

Recommendation:

The early engagement of an experienced plant collector as a temporary member of the bean team and that a third breeder be appointed to this team before 1980 in order to work on related species.

Action Taken:

The recommendation on bean collecting has been amply followed. Using temporarily hired collectors, and with support from the IBPGR to cover much of the costs of the expeditions--especially those incurred by the cooperating national programs--the following collecting trips have been carried out with direct CIAT involvement: Spain and Portugal, Mexico, Guatemala, Peru, Brazil. In addition CIAT has received material from IBPGR missions in Zambia, Malawi, Cameroon and other countries.

The Phaseolus species collection increased to 32532 accessions by December 1982 from 12896 in December 1976. In the existing collection 89% of the accessions are P. vugaris, 7.2% P. lunatus (lima beans), 3.3% P. coccineus (runner beans), and 0.5% P. acutifolius (tepary beans). In addition about 100 accessions of wild Phaseolus species have been added to the collection.

A third Senior Staff bean breeder was added in 1978. However, only a small portion of his time is dedicated to related species. Good progress with related species has been made with interspecific crosses through a collaborative project

with the University of Gembloux, combining basic research at the University with field work at CIAT carried out by Belgian, FAO Associate Experts.

10. Provision of Greenhouses

Recommendation:

That forward provisions for additional greenhouses be reviewed to insure the provision of:

a. A greenhouse with full containment facilities for insects and diseases.

b. A greenhouse for pasture legume breeding work.

c. A greenhouse for nitrogen fixation work in beans and forage legumes.

Action Taken:

The plans were revised and a special post-quarantine phytosanitary glasshouse and headhouse were added to the Genetic Resources Unit. In addition 3 new glasshouses and eight growth rooms were added to the glasshouse/headhouse complex to cater for the needs described above, along with others.

11. Animal Health Studies in the Beef Program

Recommendation:

The retention of sufficient scientists in animal health within the Beef Production Program in order that research work of immediate relevance to the health of herds on improved savannas be undertaken.

Action Taken:

This is one recommendation which has not been followed. With growing evidence that poor nutrition rather than animal diseases represented the key constraint to improved livestock production in acid, infertile frontier lands of Latin America, the CIAT management and Program Committee of the Board recommended an increased concentration on the development of improved pastures for this region. This was thoroughly debated and agreed upon by the Board of Trustees. As a result the program was renamed the Tropical Pastures Program and senior staff positions reallocated to best cover the most important fields of research related to this new focus. One of the results of this action was the reduction of senior staff animal health position from 2 to 1 in 1978.

Later, when it was necessary to reduce the number of senior staff in the Center to adjust to a reduced level of funding anticipated for 1983, the remaining animal health position was one of the casualties. This was because--for the reasons given above--it was considered to be a lower priority area of activity. While the Senior staff position was eliminated, the section was not closed down. Four professional veterinarians remain within the program, along with adequate laboratory facilities. Two of these professionals look after the health of the test herds and monitor the animal disease situation.

PART B: ACTIONS RE: RECOMMENDATIONS INTERSPERSED IN TEXT OF QQR REPORT (In May 1978, one year after the QQR, in response to a request by the Program Committee of the CIAT Board, CIAT management put together a list of all the recommendations in the QQR Report and commented briefly on what action had been taken by that time. A copy of that list, with additional current comments provided by CIAT, follows below.)

| Page | Paragraph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
|---|---|---|---|---|
| 14 (24 | 43 87) | Strengthen cassava linkage with IITA. | The Directors General of both Centers are arranging meetings for discussion. | A new agreement with IITA was signed in November 1978; however, this now needs updating. In spite of a number of meetings with the two successive Directors General of IITA, the nature and level of cooperation needs improvement. |
| 18 | 58 | Further collection of cassava and wild species. | Not yet implemented, but some collaboration is developing with Dr. Nassar in Brazil. | Cultivated and related wild materials have been collected in coordination with IBPGR in Mexico and Paraguay, and national collections in Brazil and Peru have been added to the CIAT collection through meristem transfers. Further collection missions are now being planned to priority areas of diversity with IBPGR funding. |
| 22 | 76 | Continuing studies on long term effects of cassava cultivation on status of plant nutrients in soil. | Full time plant nutrition effort added to Cassava Program. Long-term field experiments initiated. | These experiments continue. See also #7 in Part A of this Appendix. |
| 23 | 82 | Expand work on storage technology for small village and small farmer level (not industrial use). | Strategy being studied and position paper under preparation. | Much progress has been made in developing improved storage technology for fresh cassava roots and village level chipping and drying methods. |
| 23 | 83 | Storage of cassava foliage (silage, etc.) and large-scale cattle feeding trials to be continued and expanded. | Preliminary investigations started; detailed studies will await recruitment of PDF or Visiting Scientists in 1979-80. | Some work on cassava silage--including silage with foliage--was conducted by the Utilization section of the Cassava Program before that section was eliminated in the budget cuts. Cattle feeding trials with cassava foliage were completed in 1978. Cattle feeding stalls dismantled and building converted for use by Seed Unit. |

| Page | Para-graph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
|---|---|---|---|---|
| 26 | 96 | Expand information on the location and extent of different ecological areas in which beans are grown to aid in establishing priorities. | Competence in Base Data Analysis to be added. PDF to study ecologies, climate etc. on bean production with bean physiologist. | A total of 118 bean production microregions have been identified in Latin America. These serve as the basic units for the growing data base of edapho-climatic, agronomic and socio-economic information. This information is being utilized to define program objectives. |
| 29 (35 | 107 136) | Acquisition of new greenhouse to expedite the safe introduction and despatch of germplasm. | Special Plant Introduction greenhouse to be constructed adjacent to GRU. Plans drawn and bids have been let. | See #10 in Part A of this Appendix. |
| 30 | 112 | The third Phaseolus breeder (P. lunatus) appointment should not be delayed until 1980. | P. lunatus germplasm being actively assembled, collected and studied; 3 staff have peripheral interest. | The third breeder was hired, but work on P. lunatus was limited to building up and evaluation (by a predoctoral student) of a modest germplasm collection. CIAT considers work on P. lunatus of low priority, but cooperation with other agencies could stimulate more work in future at CIAT. |
| 31 (81 | 115 29) | Design course in production and multiplication of clean seeds. | This capability to be included in future bean training courses, and will also be included into new Seed Unit courses if and when funded. | Seed production and processing element are included in commodity training courses. See also #6 in Part A of this Appendix. |
| 31 | 117 | Solving problem "X" in Beans: assign full-time staff member. | Exhaustive studies in plant nutrition and pathology drew blanks; work by Biochemist strongly indicates herbicidal residues and drift, esp. 2,4-D and atrazine. | A full-time staff member has not been assigned to this, as it has become much less of a problem-probably because we are chiefly using genetic material resistant to this syndrome--which remains a mystery. The problem now appears largely eliminated. |
| 35 (81 | 136 296) | Experienced plant collector to be attached to Bean Program. | Agreement worked out with INIA and contractual arrangement made with C.L.A. Leakey to systematically collect in Mexico. Collection of collections is continuing. | See #9 in Part A of this Appendix. |
| 35 | 137 | Collaboration with ICA on breeding maize for beans. | Possibility currently under study-Management feels CIMMYT should be involved. | Cooperation with CIMMYT has improved on this, but still needs improvement. This was discussed between CIAT's Bean Program Coordinator and the new Director of CIMMYT's maize program when he visited CIAT in early 1984. |

| Page | Para-graph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
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| 39 | 156 | Suggests early emphasis on upland rice esp. disease resistance. | Workshop held 1st week of Nov. 1977; constraints identified; specific proposals made to Program Committee. | This has been implemented. |
| 41 | 160-2 | Problems in Maize for beans and downy mildew need to be addressed. | Discussions underway with CIMMYT (Sprague in Cali in Feb.'78). | See comments on 35-137, above. The downy mildew question is dealt with by CIMMYT. |
| 44 | 170 | Suggest growing some collections in neutral environment (like Kew) for safety. | Under consideration, especially in exchange of cassava germplasm with Africa/India. | Still under discussion. Beans are the most important problem area in this regard and we have been looking for third country quarantine for some years. It now appears that USDA Pullman, Washington will grow out African bean collections prior to entry of the seed into Colombia. Other opportunities may need to be found in other species from time to time. |
| 44 | 171 | Conduct physiological and biochemical investigations outside the GRU on account of fire hazards. | All chemistry work will be undertaken in main laboratories (West wing). | Recommendation fully implemented. |
| 45 | 175 | Mentions soil and water management of hillsides (and fragile ecologies) for SSU. | Preliminary studies underway, but other priorities being considered. | Work currently limited to cassava (See #7 in Part A of this Appendix. We are considering seeking special project funding for major research effort on hillside agriculture. |
| 48 | 187 | Comments on concern to concentrate too much effort at CIAT-Quilichao at expense of Llanos/ Cerrado. | Senior staff now living and working full time in Llanos (1) and Cerrado (3). Recruitment underway for legume agronomist to be assigned to Llanos, land at Quilichao now limited. | After initial surge of pasture research at Quilichao, level of activity levelled off as it was found that this location was not sufficiently representative of Llanos/Cerrado conditions for most work. Present balance seems appropriate. |
| 49 | 188 | Beef Program needs assured adequate back-up service in Biometrics, biochemical analysis and greenhouses. | Except for greenhouses (being developed), constraints not yet obvious in chemistry nor biometrics. | Greenhouses built (see #10 in Part A of this Appendix. Biometrics support services are adequate. Program Data basis being built using new Data Base Software (IDMS/Cullinane). Appropriate equipment for soil and tissue analysis have been purchased and methodologies adjusted for very acid soils and periodically controlled with other labs. |

| Page | Para-graph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
|---|---|---|---|---|
| 50 | 189 | Strengthening of forage agronomy and breeding is strongly supported; also work on other legumes, including Leucaena, is highly recommended; breeding objectives need to be clearly defined. | Active recruitment underway for tropical forage agronomists; Visiting Scientist recently assumed responsibility for legume breeding, and has initiated work with Leucaena. | Currently 5 (of 16) senior staff in Tropical Pastures Program (TPP) are forage agronomists. One forage breeder is on board and a second is projected in the Long-Range Plan. Active breeding efforts carried out with Leucaena from Jan. 1978 to Nov. 1982. This work continues at CPAC/EMBRAPA for the Cerrados ecosystem in which areas of better soils in which Leucaena can play a role are found. Best lines from CPAC will be tried in lesser acid soils/more fertile areas. Meanwhile, the program is planning to obtain existing collections (Hawaii, CSIRO,and Mexico) to subject accessions to systematic screening for adaptation under low and moderate input conditions in the two major ecosystems (savannas and humid tropics). |
| 51 | 190 | Support major effort in Beef to study plant nutrient status in oxisols and ultisols, primary emphasis on P and S; also Mo and Zn. | Extensive studies currently underway; one third (9) of present staff were trained in soils science. | Two current TPP staff are soil scientists conducting research on soil-plant nutrition, pasture establishment and nutrient requirements recycling with regard to major, minor and micro nutrients of individual species and mixtures under grazing. While most of their research is for the Llanos ecosystem, they monitor soil fertility and plant performance in regional trials with a network of soil labs using the same lab methods for soil and tissue analysis. In the Cerrados ecosystem the Program had a full time soil scientist until 1983 conducting similar types of research. Due to budget cuts CIAT phased out this position and the scientist was hired by EMBRAPA but keeps very close linkages with the Program. |
| 51 | 191 | Seed Production technology needs incorporation in training course. | Being activated. | See comment on 31-115. In addition, special pasture seed training courses are planned for 1984 and 1986, complemented by workshops on pasture seed technology. |

| Page | Para-graph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
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| 52 | 192 | Comments on inadequate test herd--confined to Bos indicus; advanced cattle management needs study, including health. | Recommendations have already been adopted; animal numbers are increased. | Animals in test herd are representative of those found in the region, and breed of bulls are rotated between Cebu (Bos indicus) and Criollo (Bos taurus) to maintain appropriate level of blood mix, and at the same time provide for animal standarization for experiments. |
| 54 | 196 | - Higher throughput of biochemical analysis. | Modern, batch-type lab equipment procured; consultant from NCSU contracted to present course on procedures. | Current throughput adequate. In 1983, senior staff members were reduced by 20% due to budget cuts. |
| | | - Mineral nutrition of cattle should be studied in context of soil-pasture-animal system flux. | Aspects are being considered and actively studied by Dr. Paladines. | Being studied by Nutrition Section of TPP. |
| | | - Evaluate greater range of legumes over wider environments. | Legume investigations expanding rapidly to Carimagua, Brasilia, Venezuela and elsewhere, with much longer numbers of entries. | Recommendation implemented. |
| | | - Healthy, well-managed, high-quality cattle essential to research. | Test herd is carefully chosen; subjected to advanced management; and health is continuously monitored. | 4000 animals in herd from which test animals are selected. |
| | | - Beef Program now requires time for uninterrupted progress. | Ojalá and Amen !! | Program objectives have remained stable and good progress has been made. |
| 58 | 206 | Maintain the Swine unit within core budget. | Will be reviewed by CIAT's management, Program Committee and full Board on 12 May, 1978. | After thorough study and extensive discussions Board decided to discontinue Swine Unit. |
| 59 (82 | 208 300) | Veterinary component of Beef remains strong and direct towards relevant problems: (i) P. flux in cattle; (ii) GI parasites and lungworms. | One veterinary scientist assigned full-time to monitoring of test heads; three ICA veterinarians assigned to Carimagua (includes Station Director), also a substantial animal health input by EMBRAPA at Brasilia. | See #11 in Part A of this Appendix. |
| 59 | 209 | Strong recommendation on CIAT collaboration in broader studies of cattle diseases in LA - to be supported by donors on a bilateral or international basis, and to include the economic analysis of impact of diseases and control. | The Title XII Consortium of U.S.Universities interested in animal health is developing a major program in which CIAT may have an active role. The DG has also made contact with relevant European institutions. | DG attended two planning meetings of consortium developing animal health CRSP to insure collaboration with CIAT. Project given lower priority than those which could be funded by BIFAD, to date. |

| Page | Para-graph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
|---|---|---|---|---|
| 61 | 213 | CIAT should exercise care in allowing too high a proportion of research staff time be allocated to training activities. | Needs for training and staff time devoted to it will be monitored by Management. | Staff time dedicated to training varies depending on year/program but it is being closely monitored by International Cooperation/Training. Estimates for quinquennium 1984-88 are available and range between 8% and 12% depending on programs and year. Development of audio-tutorials have reduced staff time dedicated to routine lectures so that more could be spent on interpersonal contacts. |
| 63 (80 | 221 289) | CIAT develops the means of monitoring its contribution to tropical agriculture. | This is a primary responsibility of commodity economists; also of the "Base Data Analysis" capability proposed to be added. | This is being done by the program economists as an integral part of their work. |
| 72 | 267 | Closer involvement of Biometrics in planning stage of investigations the date of which they will be involved with processing. | All scientific staff are urged to consult Biometrics when planning experiments. | They are still being urged--and do utilize this service. |
| 73 | 270 | Encourages CIAT to assist national programs in experimental design-often a weak area. | Biometrics is included in appropriate training programs specific design guidelines for bean research has been prepared (Feb. 1978). | In addition, the TPP is doing research on grazing trial methodology. Network workshops contribute greatly to exchange of views in this area. |
| 73 | 272 | Three additional greenhouses are required at CIAT-Palmira. | Plans drawn up for 3 additional greenhouses, improved hea.house service complex and 3 fold increase in meshhouses. | Done - See #10 in Part A of this Appendix. |
| 75 | 277 | Designating senior, respected scientist as "spokesman" for their discipline to ensure their less-experienced colleagues have the benefit of their help and advice; and to foster inter-program cooperation. Each laboratory should have a scientist in charge. | Under consideration by Management; but extensive intra-disciplinary across-program consultation already occurs, particularly in economics, physiology, and entomology. Also the same disciplines share laboratories to foster this interaction. Laboratory needs are administered by a special committee headed by an "executive" chairman. | No such formal step taken--but current informal procedures seem to be working well. |
| 75 | 278 | Management and maintenance standards of greenhouses and potting sheds are "below standard". | Well recognized! Total plans have been prepared to redevelop this entire area, expand construction, rationalize services, mechanize soil handling and provide independent assistance for this facility. | This has been fully implemented. The change in the quality of management and appearance of these facilities has been revolutionary. |

| Page | Paragraph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
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| 76 | 279 | Improving throughout of the Soils Laboratory; and more studies on water relationships for Beef, Cassava and Rice - requires soil physics expertise. | More efficient systems and equipment already in use, water relationships of prime interest to each program and being activated in various ways, eg. through visiting scientists. | Soils laboratory has been improved and services provided seem adequate. We see no reason to use scarce resources on a soil physicist. |
| 80 | 287 | The Centers should not be required to produce long-term "prescriptions" for separate programs. | Two-year budget for 1978-79 has been prepared some revision appears necessary. Four-year projections required by CGIAR appers about right. | Long-Range Plan completed in 1981. Suggested modifications have been prepared by each program and will be presented to Board after receiving EPR report. |
| 80 | 288 | There should be a positive effort to integrate and classify regional information on ecology and economic activity. | New unit will be proposed to be responsible for Base Data Analysis Unit. | Two staff positions were planned for the Agro-ecological Study Unit in agrometeorology and in land systems. These positions were temporarily filled with visiting scientists from 1978 to 1982. The first of these was finally included as a permanent core position in 1982. The second position is planned to be filled in 1985. The unit assists commodity programs in stratifying and defining macro and microecological regions using climatological and land systems common data and production systems and economic data collected by the respective programs. |
| 81 | 290 | CIAT must mainly aim to train instructors. | This is recognized, but is not that simple, and in-country training is already being planned by some programs. | Forty-three in-country courses were organized by the respective countries since 1978 to 1983 with the assistance of CIAT. Current plans emphasize training of trainers for in-country and regional research courses; and for in-country production courses for participants from extension/ development programs. The training materials unit will have produced by April 1984 a total of 99 audiotutorial units and aims at developing other training materials for use in such courses as well as in Universities. |

| Page | Para-graph | RECOMMENDATION | ACTION TAKEN (as described in May, 1978) | ADDITIONAL COMMENTS (Feb. 1984) |
|---|---|---|---|---|
| 81 | 292-3 | Avoidance of overdepletion of plant nutrients in soils with minimal input systems. | Major studies underway in Beef and Cassava; later in Rice and Beans. Two IFDC scientists are specifically focussing their effort on phosphorus. | Soil-plant nutrition research is carried out on a continuous basis by the cassava and pastures programs aiming at low input systems. P and mycorrhizal research aims at understanding interactions under low input conditions and to avoid overdepletion of critical nutrients such as P. Nutrient recycling studies under different input levels and soil management are currently studied for major ecosystems and are part of training courses. |
| 81 | 294-5 | High proportion of fragile ecologies in the tropics necessitate incorporating well-known soil conservation techniques into all farming activities. | All programs are aware of this danger; and Station Managers are introducing special measures to reduce erosion and improve moisture retention through mulch cropping, bunding, contouring and ridging. | Research and training on agronomy emphasize cultural practices for soil conservation and improvement in all commodity programs. Station Operations Superintendent working with programs to continually improve soil conservation practices on CIAT Station and sub-stations. |
| 82 | 300 | Maintain competence in animal health to embrace calf mortality, reproduction and parasitology; and make a thorough study of P availability to animals through the soil. | Full time animal health scientist is monitoring test herds; ICA and EMBRAPA providing considerable more competence at the senior staff levels at Carimagua and Brasilia; metabolic profiles studies in conjunction with soils investigations have been undertaken in the Llanos; other studies being done by Pasture Nutritionist at Quilichao and Carimagua. | In major screening sites animal health research is conducted by host institution scientists. In addition, at Carimagua the program maintains two-three junior veterinarians conducting animal management/pasture utilization research, and of monitoring animal health of test herds. Since P available from pasture intake varies with the composition of intake in terms of pastures and this varies with regions/systems, emphasis is placed on training in mineral supplementation requirements and research. |

ANNEX VI

# GLOSSARY OF ACRONYMS

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|---|---|
| AVRDC | Asian Vegetable Research Development Center |
| CATIE | Centro Agronómico Tropical de Investigación y Enseñanza |
| CDA | Corporation for Development in Africa |
| CGIAR | Consultative Group on International Agricultural Research |
| CIAT | Centro Internacional de Agricultura Tropical |
| CIDA | Canadian International Development Agency |
| CIMMYT | Centro Internacional de Mejoramiento de Maíz y Trigo |
| CIP | Centro Internacional de la Papa |
| CNP | Consejo Nacional de Producción |
| CNPAF | Centro Nacional de Pesquisa em Arroz e Feijao |
| CNPMF | Centro Nacional de Pesquisa em Mandioca e Fruticultura |
| CPAC | Centro de Pesquisa Agropecuaria dos Cerrados |
| B/C-CRSP | Bean and Cowpea Collaborative Research Support Program |
| CSIRO | Commonwealth Scientific and Industrial Research Organization |
| EMBRAPA | Empresa Brasileira de Pesquisa Agropecuaria |
| EPR | External Program Review |
| FAO | Food and Agriculture Organization of the United Nations |
| FES | Fundación para la Educación Superior |
| GERDAT | Groupement d'Etudes et Recherches pour le Development de l'Agronomie Tropicale |
| IAC | Instituto Agronomico de Campinas |
| IARC | International Agricultural Research Center |

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| IBPGR | International Board for Plant Genetic Resources |
| ICA | Instituto Colombiano Agropecuario |
| ICRAF | International Council for Research in Agroforestry |
| ICTA | Instituto de Ciencia y Tecnología Agrícolas |
| IDB | Interamerican Development Bank |
| IEMVT | Institut d'Elevage et de Médecine Vétérinaire Tropicale |
| IFDC | International Fertilizer Development Center |
| IFPRI | International Food Policy Research Institute |
| IITA | International Institute of Tropical Agriculture |
| ILCA | International Livestock Centre for Africa |
| INCAP | Instituto de Nutrición de Centroamérica y Panamá |
| INIA | Instituto Nacional de Investigaciones Agrícolas |
| INIPA | Instituto Nacional de Investigaciones y Promoción Agraria |
| INRA | Institut National de la Recherche Agronomique |
| INTSORMIL | International Sorghum and Millet Program |
| INTSOY | International Soybean Program |
| IRAT | Institut de Recherches Agronomiques Tropicales et des Cultures Vivriéres |
| IRGA | Instituto Rio-Grandense do Arroz |
| IRTP | International Rice Testing Program |
| IVT | Instituut voor Veredeling van Tuinbouwgewassen |
| ODA | Overseas Development Administration |
| OFR | On-Farm Research |
| SADCC | Southern African Development Coordination Conference |

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|---|---|
| SEARCA | Southeast Asian Regional Center for Graduate Study and Research in Agriculture |
| SDC | Swiss Development Cooperation |
| TAC | Technical Advisory Committee |
| TDRI | Tropical Development Research Institute |
| TPI | Tropical Products Institute |
| UNDP | United Nations Development Program |
| USDA | U.S. Department of Agriculture |
| WARDA | West Africa Rice Development Association |