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1986 PROGRAM AND BUDGET AND PROJECTIONS TO 1988

Centro Internacional de Agricultura Tropical

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CONTENTS

OBJECTIVES

The purpose and approach of CIAT—one of several agricultural research centers under the aegis of the Consultative Group on International Agricultural Research (CGIAR)—is given in the following statement of objectives:

> 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.

The CIAT strategy to accomplish these objectives is summarized by the following statements regarding resource emphasis, commodity choice, institutional role, and scope of activities.

Resource Emphasis

CIAT's strategy emphasizes enhanced production through increased resource productivity on farms with limited resources and on underutilized land areas. By contributing to the improvement of productivity on small- and medium-scale farms, the Center seeks to provide for increased rural income and employment, moderate and stable food prices, and improved diets, especially of the low-income, urban and rural population. Technology which contributed to expansion of agricultural production of suitable commodities on the less fertile frontier lands makes possible the release of the more fertile lands for maximum crop cultivation, thus achieving more efficient food and animal production using both poor and fertile land resources, to meet consumer demands.

Commodity Choice

Commodities to be included under CIAT's mandate are predominantly food staples. Each commodity has one or more of the following attributes: it is a relatively inexpensive source of calories; it is a relatively inexpensive source of protein; it is an important component in the food budget of low-income consumers in the geographic region of emphasis. Commodities are selected for their potential to augment the productivity and incomes of small farmers and/or to contribute to increasing agricultural production on existing cultivated lands or in the agricultural frontier.

Institutional Role

A basic premise of CIAT's strategy is that it represents only one small segment of the agricultural research and development matrix. All Center activities, therefore, are

viewed as complementary to those of other organizations. Linkage to other closely related activities is essential in developing effective research networks that capture economies of scale in research on the chosen commodities. Such activities include the following three groups: national research and extension systems, advanced scientific institutions, and related international programs.

The most important interface is with national research systems. In partnership with these programs, in order to capture economies of scale, CIAT concentrates on activities with a clear comparative advantage and in which the results have international transferability. Such activities include the assembly of germplasm banks, large-scale screening, crossing and selection, methodology development, and information services. CIAT attempts to strengthen collaboration and to encourage horizontal technology transfer among national programs by helping to develop and strengthen research networks. Active training and conference programs serve to fortify national research systems, as well as the network activities.

Basic research institutions in both developed and developing countries are linked with CIAT activities to provide basic research inputs and specialized research services that complement and support CIAT's more problem-solving research.

The principle of complementarity also applies to other international institutions, especially sister centers within the CGIAR System. Through informal discussions and formal agreements, cooperation and division of labor is defined to maximize the benefits of comparative advantage and minimize duplication.

Scope of Activities

CIAT's efforts are predominantly focused on the American tropics. Its commodities are selected for their importance in this region. Yet, within the CGIAR System the Center has been assigned broader responsibilities for given commodities. CIAT is differentiating functional responsibilities on the basis of the following categories: (a) Principal, and (2) Regional.

Principal

For commodities for which CIAT is assigned a principal mandate, CIAT assumes the following responsibilities:

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 where 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 institution(s), if any, with regional responsibilities for that commodity.

Regional

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

Current Mandate

In order to achieve the objectives and apply the strategy described above, and taking into account the results of socioeconomic studies and the mandates of other centers, the CIAT programs have evolved to currently encompass 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).

ORGANIZATION AND RESEARCH SITES

Organizationally, CIAT is comprised of three divisions. **Research Division I** consists of the Bean Program and the Cassava Program, the Biotechnology Research Unit, the Genetic Resources Unit, Station Operations, and Research Services (except Data Services). **Research Division II** comprises the Tropical Pastures Program, the Rice Program, the Data Services Unit, the Agroecological Studies Unit, the Seed Unit, and the Coordinating Office for Training and Conferences. A third division, **Finance and Administration**, is responsible for the general services and financial administration.

CIAT's research activities are concentrated at five locations in Colombia: the headquarters site at Palmira, near Cali; a site at Santander the Quilichao, 60 km south of Cali, characterized by acid, infertile soils; an intermediate altitude station at Popayan, 180 km south of Cali; a substation for upland rice research in Santa Rosa, near Villavicencio (Meta); and Carimagua Station in the Eastern Plains of Colombia. The last named station is co-managed with the Colombian Agricultural Research Institute (ICA). In addition, pasture research is also carried out in Brazil at the Agricultural Research Center for the Cerrados (CPAC) of the Brazilian Agricultural Research System (EMBRAPA). CIAT also maintains cooperative agreements with other national and regional institutions to help carry out regional and international testing activities at many locations. In some cases, these agreements help support outposted staff members who conduct research or support commodity networks.

SUMMARY OF ACHIEVEMENTS

In 1984, CIAT underwent its Second External Review. After an exhaustive review, the Panel fully endorsed the basic objectives, strategies, and approaches of the CIAT commodity research programs, and eloquently attested the solid achievements in research and international cooperation realized by CIAT since its first External Review.

All commodity research programs (beans, cassava, rice, and tropical pastures) have developed to the point where they can point to an ever-increasing pool of improved production technology components—components developed in close collaboration with participating national commodity research programs. In all cases, these components are increasingly becoming available to the producer community. While in rice the impact over the years of CIAT technology has been large and is well documented, the other CIAT programs are now entering the phase where their output is starting to have measurable impact at the level of national production statistics.

With the advent of strong commodity networks in place, more and more CIAT research activities can be, and are being, decentralized, thus allowing CIAT to assume a true backstopping role and to engage in those research and research support aspects for which the Center has comparative advantage.

Maturing research programs are also able to increasingly widen their geographic/ecosystems focus: the bean program is determinedly moving beyond Latin America and is rapidly expanding its research work in support of bean improvement in Africa; the cassava program is devoting much increased attention to Asia where some 35 percent of the world's cassava is grown, and is increasingly collaborating with IITA in improving cassava technology for use in Africa where IITA has regional responsibility; the rice program continues in its efforts to address the problems of the upland rice sector which, to date, has benefitted only little from improved rice technology designed primarily for the irrigated sector; and the tropical pastures program is seeking to adapt its technology developed for the savanna environment to humid tropics conditions where improved technology is in dire need to help recuperate degraded pastures.

Rice

The rice industry throughout the hemisphere continues to show a gratifying increase in production. Over 40 modern varieties are being grown in the irrigated and more favored upland ecologies. They now cover approximately 2.5 million hectares. These varieties, together with improved cultural practices, annually produce an additional 3 million tons of rice having a current market value of about 800 million US$. Much of the

recent production growth has occurred in the Southern Cone, particularly southern Brazil, which had lagged behind the tropical areas in adoption of modern technology.

It is now clear that continued growth in production requires concerted collaborative work with national programs in two general areas. Firstly, costs of production in recent years have increased more rapidly than the farm price for rice. Initial analysis of costs in Colombia, Peru and Brazil indicate two areas in which they can be reduced substantially:

- Appropriate, inexpensive machines, available from many sources, are required for large farms using expensive tractors, combines and airplanes, as well as small farms excessively dependent on hand labor.
- Seed, fertilizer, herbicide and pesticide costs can be reduced by improving control of weeds, the major biological yield constraint in the region. Since herbicides are generally available and effective, research focuses on systems of application combining metal tractor wheels with ultra-low volume applicators.

Secondly, varietal development must be oriented to ensure greatly increased disease and soil stress tolerances. Most modern varieties are characterized by a brief period of excellent farm performance, followed by rapid increase in disease problems. To this end CIAT has decentralized its breeding program from headquarters to selection sites in Peru, Panama, and Villavicencio, Colombia. These upland and irrigated sites cover an array of disease and soil stresses. Methods were developed to induce pressures in breeding materials. A flow of selections was organized across selection sites to facilitate identification of tolerances. Simultaneously, the IRTP (International Rice Testing Program) nurseries were reorganized to ensure provision of fewer but more rigorously selected materials for evaluation by national programs.

The breeding program has complemented conventional methods with anther culture directed initially to the varietal needs of the Southern Cone and upland unfavored rice. Modifications in the anther culture procedures now permit the regeneration of 20,000 plants per year. This mass production of fixed lines is screened at CIAT prior to the evaluation of a limited set of elite materials by national programs.

Beans

Advances in the genetic improvement of beans have been commensurate with the systematic efforts dedicated to it. Sources of resistance to practically all high priority bean diseases and insect pests are now available and have been incorporated into improved, commercially acceptable lines, either alone or in combination with other disease resistances. The successful breaking of the linkage between red seed color and virus susceptibility resulted in a large number of red-seeded lines with fully commercial and stable seed color. Concurrently, many of these lines are showing great promise in Central America. Advanced lines with multiple-gene bean common mosaic virus resistance are now available. Non-black seeded bean golden mosaic virus resistant lines are tested in Central America and the Caribbean region. In rust resistance breeding, the earlier discovered small pustule types (lines with only miniscule rust-induced pustules that appear to have little effect on bean yields) have increased in importance as heavy rust attacks have occurred, especially in the Caribbean. A control strategy using a mixture of genotypes with different rust reactions is being developed.

The race complex of diseases such as anthracnose and angular leafspot is better understood, and relevant resistance sources are now employed for the different ecological zones. The planting of crossing blocks (potential parents) and analysis of data from international disease resistance nurseries have allowed for the pinpointing of race distribution; the data indicate that no new races of these diseases have formed. Lines with multiple race and pathogen resistance are now available.

The interspecific *P. vulgaris* x *P. acutifolius* crosses made in the USA and progeny selected in CIAT have resulted in new, very high levels of common bacterial blight resistance in beans. Lines from these interspecific crosses are highly resistant, and have a high combining ability. CIAT and collaborating programs are using these lines heavily in varietal development programs.

Progress was also recorded for other disease control research. For example, increased levels of resistance to web blight and *ascochyta* leaf blight have been found.

Breeding for resistance to the leafhoppers has continued. Wild genotypes with high levels of bruchid resistance were crossed with cultivated forms, and progenies with good resistance have been selected. Earlier identified sources of resistance to the bean pod weevil (*Apion godmani*) have remained stable, but did not provide high yielding lines. The germplasm of Mexican origin has provided well adapted lines with high *Apion* resistance. High levels of beanfly resistance were obtained in segregates of interspecific hybrids involving a resistant *P. coccineus* parent. These and other materials will be deployed once the Africa projects are fully operational.

Beans have been underrated in their ability to resist drought. Under severe drought conditions, the best lines

have been found to yield above 1 t/ha, while most commercial cultivars failed in screenings at CIAT during the dry season.

A large number of lines combining several desired characters have successfully been advanced through the entire series of evaluation tests organized by the Bean Program. Commercially acceptable, improved lines are now available for all principal bean production areas in Latin America and most of Africa.

Selected impact/adoption studies have been made by the Center. Numerous improved bean lines are already available at the national level, and many of these lines have reached the bean producers and contribute to national production. Cuba has continued to plant around 24,000 ha of the variety "ICA Pijao". Nicaragua has a large acreage in private and state farms planted with the varieties "Revolución 81" (A40) and "Revolución 79" (BAT 41), principally.

In Costa Rica the variety Talamanca (ICA L10103), and to an increasing extent Brunca (BAT 304), are currently planted by over 70% of the farmers. They obtain over 25% more yield and appreciate these varieties for their erect growth habit. Costa Rican officials state that starting in 1985 no further imports are expected in this traditionally bean importing country.

Guatemala, which developed the BGMV resistant Dorado lines in collaboration with CIAT (and with which CIAT shared the 1984 King Baudouin Award for these achievements) has also reached self-sufficiency in bean production. About 60% of farmers who have been introduced to the new lines continue to use them but find that their maturity is later than desired.

In 1985 Argentina planted an estimated 45,000 ha to new resistant varieties. Yield gains in the "achaparramiento"-affected area are very high. Net gains accruing to farmers in 1984 due to the use of the new varieties were estimated at US$2.1 million.

New chemical disease control strategies developed and tested collaboratively with the Colombian national program in the small farmer, climbing bean production area of Antioquia, resulted in an estimated net benefit to farmers of US$2.6 million in 1984.

Cassava

Further advances have been made in the basic understanding of the cassava plant. This plant is known to be highly drought tolerant. The mechanism of tolerance has been shown to be related to the direct action of changes in air humidity on stomatal closure. This stomatal response or sensitivity is advantageous under stress conditions but is disadvantageous under conditions of plentiful soil water availability. Simple selection techniques for sensitive or non-sensitive stomata have been developed.

In the recent past, the germplasm collection has been greatly enriched with the addition of more than 800 clones from Brazil.

Elite germplasm is being widely distributed as sexual seed and many early crosses are now in final stages of evaluation in national programs. For the first time elite germplasm for the highland tropical areas have shown superiority over the best native lines. Elite lines in the other ecosystems (1 & 2) continue to out-yield native materials and the first major testing in the hot humid jungle areas gave promising results.

Cassava has somewhat undeservedly gained the reputation as a crop that causes soil erosion and depletes soil fertility. The crop is, however, remarkable in its ability to grow on soils that have been exhausted in terms of fertility and have been eroded. Attention has been turned to this problem and effective means of reducing erosion and maintaining fertility have been developed. In the case of phosphorus the efficiency of applied fertilizer use can be greatly enhanced by inoculation with mycorrhizal strains selected for their efficiency. In addition, lines that do well at low soil phosphorus levels have been selected and incorporated into the breeding program.

CIAT and IITA have recently signed a new agreement for closer research cooperation. Natural enemies of spider mites and cassava mealybugs collected at CIAT in the Americas are sent to IITA for testing. The *Phytoseiid* mites are proving particularly effective against the green spidermite.

Mechanisms have now been established to safely introduce IITA's elite African-Mosaic-Disease-resistant clones to CIAT (via indexing procedures in the U.K.). At CIAT they will be crossed with mite resistant clones and the progeny returned to Africa for testing.

Recent socioeconomic analysis has shown that fresh cassava is a preferred food with an elastic demand in Latin America. Decline in demand as Latin America urbanizes has been due to its lack of convenience which is related to its perishability. A simple, inexpensive, safe storage technology has been developed. Application of this technology can increase demand, by making cassava more convenient as a food, and decrease marketing margins by reducing middlemen's risk which will allow farmers to increase supply with no decrease in price. This technology has the potential of benefiting both producers and consumers.

The cassava pilot project for animal feed in the North Coast of Colombia has now expanded to more than 20

commercial plants, proving the economic viability of this type of small scale enterprise. In Mexico, 20,000 m^2 of drying patios are in an advanced stage of construction and one plant is now fully operational in Panama.

The regional program in Asia is now established and is effectively channelling CIAT germplasm appropriate to Asian conditions to that region. The variety Rayong 3 based on CIAT germplasm has been released in Thailand; in the Philippines several clones from CIAT are now being commercially grown although they have not been officially released.

Tropical Pastures

The Program has developed an inventory of land resources in the area of interest, with edaphic, topographic and climatic characterizations of the region organized in a systematic and easily retrievable manner. The Program also has assembled a germplasm bank consisting of more than 14,000 accessions. This germplasm pool is complemented by a parallel collection of *Rhizobium*. Furthermore, the Program has progressed to the stage where several genera and species have already been identified as being well adapted to conditions of one or more of the ecosystems of interest. These genera and species include *Andropogon gayanus, Brachiaria* spp., *Panicum maximum, Arachis* spp., *Stylosanthes* spp., *Desmodium* spp., *Pueraria phaseoloides, Zornia* spp., and *Centrosema* spp.

The potential productivity of a large number of pasture grazing alternatives in the savanna ecosystem has been determined. Various grass/legume associations in controlled grazing, low input experiments, have produced annual liveweight gains per animal of more than 150 kg. On a per-hectare basis some associations have produced more than 300 kg/year.

As part of the regional trial network there are, at present, 104 germplasm adaptation trials in selected sites of Latin America and the Caribbean. Also, several germplasm sets have been sent to requesting institutions from Asia and Africa. The most promising germplasm is already moving into grazing trials in several Central America and Andean region countries, as part of the International Pasture Evaluation Network, with partial support from the Canadian International Development Research Centre (IDRC).

Data obtained from regional trials in the humid tropics have shown that a large number of grass and legume species selected by the program are highly productive in this ecosystem with acid, infertile soils. These are showing promise for upgrading the degraded pastures sown with species which become unproductive after 4-5 years of clearing forest.

The highly promising *Andropogon gayanus* CIAT 621 released by Colombia as cv. Carimagua 1 and Brazil as cv. Planaltina, has also been released by Venezuela as cv. Sabanero, by Peru as cv. San Martin, and by Panama as cv. Veranero. The adoption of *A. gayanus* in central Cerrados of Brazil is rapidly growing and it is now estimated that more than 150,000 ha have been planted. In Colombia, about 25,000 ha have been established. As a result of the collaboration between CIAT and EMBRAPA, CPAC has nominated two legumes (*Stylosanthes macrocephala* CIAT 1582 cv. Pioneiro, and *S. guianensis* var. *pauciflora* CIAT 2243 cv. Bandeirante) for release while IVITA and INIPA in Peru have nominated *S. guianensis* CIAT 184 cv. Pucallpa for release for the Peruvian humid tropics during 1985.

Since the release of *A. gayanus* in Colombia the Program has put considerable emphasis on looking for a companion legume for this grass. This has been achieved for the Llanos with *Stylosanthes capitata* CIAT 10280, which has been released by Colombia as cv. Capica, a blend of five ecotypes. Seed of this legume is now being multiplied for commercial plantings. Seed production programs are already underway in both Brazil and Peru.

Training

To date, CIAT has provided training to some three thousand professionals. Throughout the years, CIAT has emphasized training in research methodology and production technology as related to the commodities in the Center's mandate. Recent survey data show that 60% of former CIAT training participants are actively working with the commodities on which they received training; an additional 15% continue to be active in agricultural research, albeit not directly related to CIAT's commodities. Nevertheless, the continued growth of national programs and the shift of their personnel to other institutions, including the private sector, continuously renews the demand for training of new personnel.

CIAT training has helped national programs of numerous countries in Latin America, Asia, and Africa to become stronger and increase their capacity to engage in applied, adaptive, and validative research. Increasingly, CIAT-trained scientists are playing major roles in the selection and release of new varieties and attendant technologies. Training has also been a key contributing factor in the establishment and development of international and regional research networks on beans, rice, tropical pastures and cassava. These networks facilitate exchange of germplasm and technical information, and

play an important role in the organization and conduct of cooperative research with CIAT and among participating countries.

Conferences are the principal tool for the exchange of information and the coordination and development of concerted research strategies in the networks. In the last two years the training and conference activities at CIAT were streamlined to focus more clearly than ever on concerted collaboration with national research programs and private industry to inter-link the various research efforts, and to get newly available technology moving towards the producers' fields. Three sets of action programs have been put into practice:

1) A progressive shifting of emphasis from courses at Palmira headquarters to in-country courses conducted by national institutions with the assistance of CIAT. Such courses are frequently coordinated with the release of new varieties and/or agronomic and plant protection practices.

2) The development of training plans based on expressed medium- and long-term interests of national programs and their scientific manpower needs with regard to CIAT's commodities.

3) The regionalization of courses to increasingly focus on the circumstances of specific regions.

Degree-related training continues to receive high priority but actual increases in this type of training are difficult to realize due to scarcity of funds for academic study.

After many years of predominantly focusing attention on training in Latin America, CIAT's increasing role in Asia (cassava) and Africa (beans) have caused the Center to receive an increasing number of professionals for training from developing countries outside of Latin America and to organize relevant training opportunities in the respective regions.

Through the Seed Unit, CIAT has assumed a lead role in Latin America in providing training on seed technology and contributing to the development of seed programs in the region through an active conference/-workshop program.

Communication and Information

During 1984, CISU (Communication and Information Support Unit) produced 65 publications, including four manuals, three conference proceedings, six research data reports, four progress reports, a research monograph, a reference guide, a technical bulletin, 23 newsletters, nine bibliographic volumes, 12 sets of contents pages and one directory. A total of 109,972 publications and 6283 audiotutorial units were distributed. Almost 20,000 documents were loaned and 2700 reference questions answered. In all, CIAT's information products reached 131 different countries.

Productivity has been enhanced by increasing sophistication in equipment for all phases of information management. Word processing and computerized photocomposition have significantly sped up the publication process. Computerized systems that are presently in the implementation phase are expected to similarly streamline bibliographic database management and acquisition of library materials.

As the commodity programs decentralize, and their breeding and technology development strategies grow more complex, it has become increasingly important to develop highly specific communication strategies that define both audience and purpose for each product. These strategies result from close collaboration between the commodity programs and CISU.

Areas with new research efforts (for example, East Africa, Indonesia, Malaysia, and the Philippines), receive particular attention.

Increasing attention is also being given to delivery systems in order to assure that information generated in CIAT's research programs reaches the end user. A publications catalog, an audiotutorials catalog, and a complete bibliography make all of CIAT's publications available by mail or through the CIAT bookstore. A multi-level, computerized mailing list is being upgraded to serve as a database of collaborators as well as a listing of information users. Computerized inventory control enables staff to study seasonal and geographical fluctuations in demand.

THE 1986 BUDGET REQUEST*

The budget request of CIAT for 1986 amounts to C$23,244,000. This total includes C$1,945,000 for transferred special projects.

The following table shows the budget for 1986 as compared with 1984 actual expenditures, the approved brackets for 1985 and the revised budget for 1985 (C$'000).

	1984 Actual	1985 Top of Bracket	1985 Bottom Bracket	1985 Revised	1986 Request
Operations	21,423	23,209	22,222	21,798	23,238
Capital	1,246	482	357	357	1,022
	22,669	23,691	22,579	22,155	24,260
Change in Working Capital					120
					24,380
Offsetting items					
- Income	375	575	575	600	621
- Funds Brought Forward	(16)	(39)	(39)	(39)	—
- Advance Payment Transf. Sp. Projects	537	1,220	1,220	1,220	515
Funds from Donors	21,790	21,935	20,823	20,374	23,244

* In this document the term C$ refers to current United States of America dollars of the year in question.

1986 Baseline Budget

The 1986 baseline budget for operations amounts to US$21,798,000 (equivalent to the revised 1985 budget for operations—without provision for cost increases between 1985 and 1986). The table below presents proposed program changes for 1986 to be effected at the baseline level. It shows reductions in Cassava Physiology and in Contingencies in order to make available resources for Cassava Utilization and for the full-year effect of positions left partially vacant in 1985.

1986 List of Program Changes

		M-Y	C$'000
1.	1985 Operations	63.3	21,798
2.	Program Reductions		
	a) Cassava Physiology	(1.0)	(189)
	b) Contingencies		(83)
			21,526
3.	Program Additions		
	a) Cassava Utilization	1.0	157
	b) Full-year cost of positions left partially vacant in 1985	1.7	115
	1986 Baseline Budget	65.0	21,798

Explanation of Change from Cassava Physiology to Utilization

It is fully recognized that CIAT—within its mandate to assume primary responsibility for research in cassava—must assume responsibility for physiology research in this crop. Over the years, CIAT's cassava physiology research has provided fundamental insights that proved crucial in the classification of edaphoclimatic production zones, and the definition of characteristics associated with high yield potential with special reference to stress conditions. Particular emphasis was placed on the ability of cassava to survive and produce under conditions of uncertain rainfall and prolonged drought.

However, given the current heavy emphasis on the systematic assessment of the potential of cassava in Latin America and elsewhere, an overriding need for cassava utilization research has made itself felt. Utilization research is of critical importance at this time to complement the economic assessment studies. While these studies may identify a large potential for cassava in the fresh root market (under the condition that practical solutions to the fresh root deterioration problems can be found), in the flour market for human consumption (especially bakery products), and in the animal feed market, research is needed to develop practical utilization processing technology so that this potential can indeed be realized.

Given the circumstance that within the reduced size of the Cassava Team no further flexibility can be identified to make room for the critically needed utilization research component, it is proposed that research on cassava physiology be temporarily halted in favor of an all-out effort in cassava utilization. Within the time span of a very few years cassava physiology research will be reinstated.

CIAT Work Program at the Level of the 1986 Budget Request

The TAC-approved work program for CIAT in 1986 amounts to C$23,244,000. The table below shows the program items included at the level of the 1986 budget request that are additional to the work program represented at the baseline budget. (No particular priority is implied in the listing of the items below.)

	M-Y	Operations	Working capital	Capital Items	Total
			C$'000		
1986 Baseline Budget	65.0	21,798		302	22,100
a) Inflation between 1985-1986		760	63	11	834
Plus:					
Program Items					
b) Additional Funds for Training Scholarships		117	10		127
c) Position for Africa-wide Coordinator for Beans	1.0	149	13	33	195
d) Position for Rice Economist	1.0	170	14	10	194
e) Training Materials		100	8		108
f) Position for Pasture Reclamation Specialist, Humid Tropics	1.0	144	12	36	192
Capital Items					
g) Expansion of Germplasm Resources Facility				250	250
b) Quarantine Glasshouse				80	80
i) Field Laboratory (430 m²)				180	180
j) Glasshouse				120	120
1986 Budget	68.0	23,238	120	1,022	24,380
Offseting Items					
-Income					(621)
-Advance Payment					(515)
Transf. Special Projects					
	Funds from Donors				C$23,244

Explanations for the items listed above are as follows:

(a) **Inflation.** Inflation between 1985and 1986 is calculated at 3.5%, and reflects the projected price changes for CIAT's market basket. This inflation rate is equal to the one experienced between 1984 and 1985.

(b) **Additional Funds for Training Scholarships.** In past years, reductions in core allocations for training scholarships could be offset by obtaining additional special project funds for training. The table below shows that in the period 1981-1984 the number of professionals trained at CIAT and the man-months of training provided has remained constant.

Year	No. Professionals Trained	No. of Total Man-months
1981	229	841
1982	237	785
1983	250	709
1984	273	933

There are indications to believe that in future years it will be difficult to maintain special project funding for training activities at current levels, and that it is unlikely that these levels can be further increased. To maintain current levels of training and even increase somewhat the

man-months of training offered by CIAT, monies for scholarships are proposed to be adjusted upward by US$117,000.

(c) **Position for Africa-Wide Bean Coordinator.** The CIAT Long-Range Plan for the decade of the eighties projected the need for a Regional Coordinator for the Bean Program in Africa. The proposed CIAT strategy for beans in that continent was supported by the EPR in 1984 and received the endorsement of TAC in their commentary on the CIAT EPR Report. In the meantime CIAT has developed two long-term extra core funded projects for Central and Eastern Africa while a third is under consideration for the SADCC countries of Southern Africa. The need for CIAT involvement directly in Africa in regional programs was recommended by participants from Africa at a conference held in Malawi in 1980 under CIAT auspices. The need for close integration of these projects in Africa on a long term horizon is clear. The creation of a position of Africa-wide coordinator for bean activities will ensure that research duplication is avoided, that training programs can be developed with economies of scales, that close cooperation with other IARC's and the national programs is achieved and that CIAT scientists in Africa maintain contact with CIAT headquarters while at the same time developing a degree of regional autonomy essential to day-to-day operations. Such a position within the CIAT core budget will allow a long term perspective to be given to this regional coordination.

(d) **Position for Rice Economist.** The position of Economist in the Rice Program was projected for 1982 in the Long-Range Plan. It was included in the budget for that year and endorsed by TAC, but later deleted due to funding shortfalls. It was included in all subsequent Forward Lists.

The main function of the Economist is to identify, in collaboration with the Agroecological Studies Section the potential sources of production growth in each country and to assess the economic viability area of expansion of different production systems under alternative yield/cost scenarios. He/she is to play a key role in providing the necessary information to define research, testing and training priorities, based on *ex-ante* economic evaluation of expected impact and distribution of benefits derived from rice research. In addition, a principal function of the Economist is to evaluate, on a country by country basis, policy constraints to adoption of available technologies, and to area expansion in different rice production systems. The incumbent of this position also is to evaluate production increases as they are taking place and the extent to which they are affecting prices, and the potential benefits captured by various income strata.

(e) **Training Materials Support Staff.** During the last six years, CIAT has developed—with the help of special project funds—a solid base for the design, development, and production of training materials on CIAT-generated technology. These materials are for the use by training participants at CIAT and in regional and in-country courses, and are also widely distributed to and used by collaborating national institutions. At this time, CIAT has available a set of more than 100 audiotutorial units covering topics in all four of the Center's mandated crops. CIAT has always recognized that such a systematic effort must be a continuous endeavor; new technical information becomes available that needs packaging; already existing training packages must be modified due to the changing knowledge base; and collaborating institutions are counting on a continuous flow of training packages. Hence, in past years CIAT has included in its long-term projections the core financing of the skeleton of the professional personnel (i.e., professional support staff) needed for this effort, with the understanding that any additional resources to be allocated to this work would need to be special project funded. This item contains resources to maintain a small group of professionals which is considered to be the minimum required size to keep the training materials effort viable: i.e., one training materials specialist for each of the four commodity programs at CIAT.

(f) **Position for Pasture Reclamation/Humid Tropics.** This position is put forth to deal with the problem of pasture degradation and ecological damage in the humid tropics—a problem regarded as critical by the countries in Central America, the Caribbean, and the Amazon and Orinoco basin. This position has been included in past Forward Lists.

The humid tropics ecosystem includes most of the acid soil regions in Central America, the Caribbean, the Amazon basin, and Orinoco basin. It has been estimated that in this ecosystem there are already 6-7 million hectares of pastures, of which more than one million hectares are in a stage of severe degradation, and with the remainder at different stages of degradation. This occurs because most pasture species presently being used are only adapted to the higher soil fertility levels which result from the burning of the forest biomass. Consequently, as fertility declines due to leaching, nutrient fixation in the soil, and nutrient extraction by the pastures, the pasture species gradually disappear, pastures are invaded by weeds, and the soil is left exposed to degradation and erosion. This process, in turn, leads to further deforestation. It has been estimated that 300,000 hectares of forest are cleared annually, mostly to compensate for the degradation of pastures planted to non-adapted species. As a counter measure, alternative new pasture species

adapted to the acid, high aluminum and low fertility characteristics of soils are urgently needed. Well-managed, adapted pastures have proved to be highly efficient in recycling nutrients in this environment. A high percentage of the accessions in the large forage germplasm collection of CIAT is potentially adapted to these soil conditions. Furthermore, it is likely that many of the materials in the collection are adapted to diseases and pests present in the environment. Preliminary results from several regional trials in this ecosystem confirm that this is the case.

The Pasture Reclamation Specialist is to be in charge of developing economically viable methods of incorporating adapted legumes into existing grass pastures and evaluating the recycling of nutrients in alternative pasture management systems. The work of this specialist will be supported by the other sections of the Tropical Pastures Program and by specialists in other disciplines from host national programs.

(g) **Expansion of Germplasm Resources Facility.** The existing cold room facilities for germplasm conservation in the Genetic Resources Unit (GRU) were originally developed through modifications to an existing building at CIAT. As such the facilities are adequate for the conservation of germplasm in the active collections with rapid turnover. The existing facilities are not, however, adequate for long-term storage at sub-zero temperatures both in terms of storage volume and temperature control. A new building specifically designed for the purpose has been projected which would include three cold rooms with a storage volume of 225m^3 each and an adjacent facility with capacity for seed storage using new liquid nitrogen technology. The building would be built adjacent to the existing GRU building. The space liberated through the new facility would provide sufficient space for future storage of further collections. Provisional estimates for capital fund requirements for this facility are projected in the Forward List for 1986.

(h) **Quarantine Glasshouse.** Of the more than 30,000 bean accessions in the CIAT germplasm bank, approximately half are not yet available for evaluation, characterization, and use in the CIAT Bean Program and elsewhere because they have not yet been cleared by the phytosanitary authorities (i.e., ICA) in Colombia. ICA has been and continues to be very cooperative and helpful in growing out new introductions and clearing them for CIAT use in their glasshouse facilities at Tibaitata. However, additionally needed glasshouse facilities at Tibaitata are the principal limiting factor to increase the number of bean accessions passing through the quarantine process. The budgeted amount under this item will suffice to repair and adapt an existing old glasshouse facility, which will then allow to increase ICA's capacity to clear new bean accessions. The External Program Review made a strong recommendation that something be done to speed up the phytosanitary clearing process. It is believed that the proposal made in this item will be adequate to effectively respond to this recommendation. ICA authorities have been informed of this possibility and fully support the proposal.

(i) **Field Laboratory.** Within the general mandate of CIAT, the center pursues the policy of making CIAT facilities available to sister institutions to enable them to pursue agricultural research objectives that complement and enhance CIAT's own objectives. The number of cooperating institutions using the facilities at CIAT is constantly growing. Presently, the following institutions have members of their staff posted at CIAT: IRRI, CIMMYT, IBPGR, CIP, IFDC, INTSORMIL, and INTSOY. This number is expected to increase. The hosting of such staff at CIAT puts an important strain on the availability of office and work space. In order to provide centralized and adequate office and work space for all staff from collaborating institutions, CIAT proposes the construction of a field laboratory with an area of construction of approximately 430 m^2. The site for this facility has long been identified and all necessary service connections are already in place.

(j) **Glasshouse.** CIAT has developed new, and modified existing, plant growth facilities in order to provide adequate growth room, glasshouse, and screenhouse facilities for all programs, including an increassing number of visiting research personnel conducting higher degree research at CIAT. Demand for these facilities from the programs is most pressing with respect to glasshouse space. A long-term plan for the glasshouse area was developed in 1979 which projected the need for one further glasshouse consisting of four units, each of 100m^2, which would then complete the overall plan. The proven performance of the new glasshouse design will ensure that the new unit will be highly appropriate for CIAT research. Capital funds for construction of one glasshouse are thus listed.

Contingency in Case of Underfunding

Should resources from donors fall short of the C$23,244,000 requested, CIAT would need to identify and implement corresponding reductions in its work program. In identifying items to be reduced or eliminated, CIAT would take into consideration the views it received from TAC on the TAC-perceived relative priorities of items added to the 1986 Baseline Budget, and would weigh these highly relevant views against the realities confronted at the time that budget reductions would need to be implemented.

PROJECTIONS FOR 1987-1988

In 1985 CIAT is publishing an up-date of the Long-Range Plan for the Eighties which was originally published in 1981. The up-date provides detailed projections of activities and program emphases for the years 1986 through 1990. The present budget for 1986 coincides in all respects with the projections published in the updated version of the Long-Range Plan.

The following are the senior staff positions projected to be added/substracted in 1987 and 1988.

PROJECTIONS FOR 1987

	M-Y	Total Requirements US'85$'000
ADDITIONS		
Beans:		
- Regional Liaison Scientist (Sub-Tropics, S. A.)	1.0	193
Cassava:		
- Breeder	1.0	292
- Regional Liaison Scientist (Africa, IITA)	1.0	188
Tropical Pastures:		
- Pasture Agronomist (C. America)	1.0	209
Biotechnology:		
- Virologist	1.0	201
Agroecological Studies:		
- Land Systems Specialist	1.0	229
TOTAL ADDITIONS	6.0	1,312
REDUCTIONS		
Beans:		
- Breeder (Central America)	(1.0)	(157)
Tropical Pastures:		
- Regional Trials Specialist	(1.0)	(178)
TOTAL REDUCTIONS	(2.0)	(335)
NET CHANGE	4.0	US$977

PROJECTIONS FOR 1988

	M-Y	Total Requirements US'85$'000
ADDITIONS		
Cassava:		
- Physiologist	1.0	238
Tropical Pastures:		
- Pasture Development Specialist (Cerrados)	1.0	244
TOTAL ADDITIONS	2.0	482
REDUCTIONS		
Tropical Pastures:		
- Agronomist (Carimagua)	(1.0)	(224)
TOTAL REDUCTIONS	(1.0)	(224)
NET CHANGE	1.0	US$258

THE RESEARCH PROGRAMS

BEAN PROGRAM

BEAN PROGRAM CORE RESOURCES

	Senior Staff					Scientific & Supervisory					Clerical & Other				
Personnel (Positions)	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
RESEARCH															
Soil Microbiology	1	1	1	1	1	3	3	3	3	3	8	8	8	8	8
Physiology	1	1	1	1	1	2	2	2	2	2	12	13	13	13	13
Breeding I	1	1	1	1	1	2	3	3	3	3	15	14	14	14	14
Breeding II	1	1	1	1	1	2	2	2	2	2	15	15	15	15	15
Breeding III	1	1	1	1	1	2	2	2	2	2	14	14	14	14	14
Entomology	1	1	1	1	1	3	3	3	3	3	11	11	11	11	11
Pathology I	1	1	1	1	1	3	3	3	3	3	12	12	12	12	12
Agronomy (Prelim. Trials)	1	1	1	1	1	2	2	2	2	2	13	10	10	10	10
Agronomy (Cropping Systems)	1	1	1	1	1	2	2	2	2	2	10	9	9	9	9
Agronomy Internat. Trials)	1	1	1	1	1	2	2	2	2	2	14	17	17	17	17
Virology	1	1				3	3				7	7			
Economics	1	1	1	1	1	3	3	3	3	3	4	3	3	3	3
Program Leader		1	1	1	1	1	2	2	2	2	1	4	4	4	4
TOTAL	12	13	12	12	12	30	32	29	29	29	136	137	130	130	130
REGIONAL COOPERATION															
Central America & Caribbean	3	3	3	2	2										
Africa-Wide Coord.			1	1	1								2	2	2
Subtropical South America				1	1									2	2
TOTAL	3	3	4	4	4								2	4	4

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	2,147	2,369	2,384
Supplies & Services	370	349	351
Travel	223	214	227
Replacement Equipment	132	21	21
	2,872	2,953	2,983

Budget Changes

Increases in personnel between 1984 and 1985 reflect filling of vacant senior staff positions, plus the addition of a full-time Program Leader. Reductions in supplies and services form part of the economy package imposed in 1985 due to budget restrictions. Peronnel costs for 1986 reflect the deletion of the senior staff position in virology (which is to be transferred to the Biotechnology Research Unit), and the addition of a position for an Africa-wide bean coordinator (see p. 14).

Program Commentary

Importance of Beans

Beans (*Phaseolus vulgaris* L.) are a principal food crop for small farmers in many countries in tropical America, Africa, and the Middle East, and constitute a major source of protein in those countries, especially for the low income segments of their populations. Bean production is the main activity supporting an estimated 5 million people living on small farms in Latin America and Africa; and for a far greater number of such farmers, beans are an important part of their cropping systems, and of their diet.

Beans provide 11% of total protein consumption in tropical Latin America, and in many countries it is the cheapest form of high quality protein. In Eastern/Central Africa per capita bean consumption reaches up to 50 kg/person/year, the highest in the world. Here people derive more protein from beans than from all animal products combined. Because of their low price, beans play an especially critical role in the nutrition of the poor. For example, in urban Colombia, the share of beans in total protein in the diet of the poor is twice that of high income people. Beans are of greatest importance in diets in rural areas. In rural Brazil, beans provide from one-quarter to one-third of total protein consumption, as well as 10-15% of total calories.

Bean production in the tropics is principally concentrated in Latin America (the center of the crop's origin) where 4.1 million tons are produced annually. In Eastern Africa some 1.4 million tons are produced annually. In Latin America, Brazil is the largest producer, followed by Mexico. In Africa, Burundi, Kenya, Rwanda, Tanzania, and Uganda are the leading producers. Because small farmers in Africa and Latin America produce beans with low levels of inputs, on poor hillside soils, with the bean crop subject to considerable disease and drought stress, and in low plant populations in associated cropping systems, yields average little more than 500 kg/ha in tropical Latin America and Africa.

Due to the high stress conditions under which they are produced, beans are a risky crop with highly variable output. For example, in Latin America, production fluctuates as much as one million tons from year to year. Moreover, in most bean producing countries there has been no productivity growth in the period 1966-81, and often yields have been falling during this period. Due primarily to area expansion, production increases have been lagging behind population growth in most countries. As a result, for the first time in the history, Latin America and Africa have become net importers of beans.

Problems of the Crop

Potential yields of current commercial varieties used in Latin America range from 2-3 t/ha. One of the principal reasons why actual yields are low is the heavy disease pressure on the crop. Disease incidence varies from region to region. Nevertheless, some diseases are prevalent in virtually all production regions (e.g., 60 percent of bean production in Latin America is subjected to risk of anthracnose attack). Disease transmission via the seed has undoubtedly contributed to the wide distribution of many bean diseases. Disease pressure is further increased by the poor plant type of bush beans. Plants commonly lodge at maturity, and with pods in contact with the soil, disease accumulation in seed occurs. Farmers traditionally save their seed for subsequent plantings, and thus are further contributing to disease incidence. Climbing beans that are excessively vigorous have podloads well above the ground, but are subject to seed loss when the maize lodges. Farmers have reacted to the strong disease pressure by planting towards the end of the wet season, which increases drought stress.

In addition to diseases, insects can cause severe reductions in bean production, particularly under the dryer conditions referred to above. With beans increasingly being displaced to marginal lands, soil acidity and phosphorus fixation are becoming important. A further

important problem is that beans do not fix much nitrogen under most production conditions.

The Bean Program is reasonably confident that the above summary of production problems reflects production reality. Nevertheless, additional information on production methods, production systems and specific production constraints in given countries is continually being gathered and is used in the adjustment process to which the Program's research priorities are continually exposed.

Program Objectives

The Bean Program's objective is to develop, in collaboration with national programs, improved technology that permits increased bean production and yields. The following primary activities support this objective.

1. Genetic improvement of bean germplasm that meets the agronomic requirements of farmers as well as consumer preferences.
2. Development of agronomic practices compatible with improved genotypes.
3. Training to strengthen the research and technology transfer and validation activities of collaborating national programs.
4. International cooperation at all levels for the further development of an active bean research network throughout the action area of the Program.

Program Strategies

Genetic improvement to overcome production problems—rather than the use of purchased inputs—is the principal strategy of the Bean Program to increase yields. Genetic improvement activities are based on the large genetic variability encountered in beans and are facilitated by the availability of more than 35,000 bean accessions (including their wild ancestors and related species) in the CIAT germplasm bank. The Bean Program performs several thousand hybridizations per year. The resulting progenies pass through uniform successive nurseries. The best selections are tested in international uniform nurseries from which the national programs select materials for direct use in regional or on-farm testing, or, alternatively, for use in their own breeding programs. At the beginning of this decade, and following several years of systematic training of national programs personnel, the program started an intensive effort to decentralize selection. Today national program scientists are increasingly selecting locally adapted materials mostly of CIAT-generated populations.

The bean breeding activities strive to combine the following desired variability.

1. **Resistance to priority diseases and insects**, including bean common mosaic virus (BCMV), rust, anthracnose, angular leaf spot, common bacterial blight, and leafhoppers. In addition, the Bean Program, through its decentralized breeding strategy, attempts to incorporate into improved varieties resistance to important location-specific diseases (such as bean golden mosaic virus in Central America, or the beanfly in Africa). Of major importance in selecting improved varieties is the need to meet local color and seed size requirements. These requirements vary from country to country and from region to region.
2. **Yield potential**. Increasing yield potential of a legume crop like beans is a long-term objective. In order to be able to increase yields of beans when disease resistances have been incorporated, the Program has recently started to place great emphasis on genetic improvement for increasing yield potential, first under no-stress conditions, to be followed later under diverse stress conditions.
3. **Improvement of drought resistance**. Over large areas in Africa and Latin America beans suffer from drought stress. The germplasm collection and breeding will provide lines better able to withstand drought stress.
4. **Decreased dependence of fertilizer requirements**. While all lines are being developed and evaluated under low fertilizer (and plant protection) regimes, a genetically improved bean/*Rhizobium* interaction is sought to increase the nitrogen fixation ability of beans. Also, the Bean Programs strives to enhance the genetic variability for adaptation to low soil phosphorus conditions which is of principal importance in Brazil and large areas in Africa.

While genetic improvement for protein content, cooking time or digestibility are not actively being pursued, the Program does monitor these factors in newly developed materials to ensure that no deterioration occurs.

Since agronomic practices are largely site-specific, the Bean Program conducts little research in this area. There are indications, however, that improved varieties perform differently on the experiment station than on farmers' fields. Given that on-farm research and regional variety trials still are inadequately developed in most countries, the Program has found it necessary to devote considerable resources to validation trials. The Bean Program has therefore developed an active on-farm research and training program with national programs to provide

feedback to research and link research and extension. This program is being developed in close collaboration with other international centers, especially with CIMMYT as beans are mostly grown in association with maize.

Status of the Program

(See Bean section under SUMMARY OF ACHIEVEMENTS, pp. 5-6.)

Special Projects

Bean Improvement for Eastern Africa

The objective of this project is to increase bean production in Kenya, Uganda, Ethiopia and Somalia, thereby increasing human protein intake and nutritional status of local populations, mainly small farmers, through propagation of improved bean varieties and production technologies. Major activities are (a) developing national program research capacity by training of bean breeders and agronomists; (b) introducing new germplasm and, through national breeding programs, developing highly productive varieties adapted to local conditions and consumer preferences; and (c) improving cropping systems. Germplasm improvement emphasizes the development and distribution of multiple disease- and pest-resistant lines. The Program emphasizes regional collaboration on research and networking activities to improve communication among national programs. The project is financed by CIDA and USAID through the CDA (Cooperation for Development in Africa) mechanism.

	Budget (US'85$'000)	
	1985	1986
Personnel (4 Senior staff)	289	434
Honoraria, Stipends and Allowances	65	137
Supplies & Services	51	82
Travel	24	42
Equipment Replacement & Capital	66	71
Indirect Costs	64	104
Contingencies	43	69
TOTAL	602	939

Bean Improvement for Francophone Eastern Africa

This regional bean project is to strengthen national research in Great Lakes region of Africa (Rwanda, Burundi and Kivu Region of Zaire). Strategies include (a) incorporation of disease resistance and tolerance to climatic and edaphic constraints; (b) on-farm cropping systems research, evaluating small farmers' production constraints and testing new bean technology components, with emphasis on dynamics of genetic mixtures in traditional cropping systems; and (c) training through regional and in-country courses and development of training materials in order to develop national programs' self-reliance in bean research. The project is financed by the Swiss Development Cooperation. Funding is assured through 1985 and is assumed to continue in 1986 at the level indicated below.

	Budget (US'85$'000)	
	1985	1986
Personnel (3 Senior Staff)	289	289
Honoraria, Stipends & Allowances	59	54
Supplies & Services	47	47
Travel	85	85
Equipment Replacement & Capital	93	93
Indirect Costs	48	48
Contingencies	24	24
TOTAL	645	640

Bean Improvement for Southern Africa (SADCC Countries)

This project, expected to be funded starting in 1986, is designed to increase bean productivity, production and consumption, and to strengthen national agricultural research in *Phaseolus* beans in the SADCC countries of Africa. This regional networking project will develop, in collaboration with national programs in the region, new bean production technology for both traditional and innovative cropping systems, and will strengthen national research capacity so as to increase national bean production to keep pace with expected demand from rapidly growing populations in the region. The project is likely to be funded by CIDA within the CDA (Cooperation for Development in Africa) mechanism.

	Budget (US'85$'000)	
	1985	1986
Personnel (4 Senior Staff)	—	339
Honoraria, Stipends & Allowances	—	68
Supplies & Services	—	56
Travel	—	44
Equipment Replacement & Capital	—	184
Indirect Costs	—	76
Contingencies	—	51
TOTAL	—	818

Interspecific Hybridization

This project, carried out in collaboration with the University of Gembloux (Belgium), includes research on interspecific hybridization of *Phaseolus vulgaris* and *P. coccineus*, including a complete evaluation and characterization of the latter; (b) characterization of the existing *P. lunatus* collection then drawing up recommendations re further germplasm collection activities in species; and (c) consultation by Belgian expert with CIAT staff on taxonomic problems related to forage legume species collection at CIAT. It is financed by the Government of Belgium. Funding is assured through 1985 and is expected to continue in 1986 at the levels indicated below.

	Budget (US'85$'000)	
	1985	1986
Personnel	29	29
Honoraria, Stipends & Allowances	—	—
Supplies & Services	12	12
Travel	13	13
Equipment Replacement & Capital	6	6
Other Expenses	2	2
Contingencies	9	9
TOTAL	71	71

Beans & Rice Research, Peru

This is a bilateral project with financing from the World Bank. It entails collaboration with INIPA on bean and rice research through the outposting of two research advisers who provide technical backstopping and assist national program coordinators. They also play an active role in varietal selection trials, in-service training, and the selection of candidates for training at CIAT. They also assist in the formulation of medium- and long-term research plans. Funding is assured for 1985 and is expected to continue in 1986 at the levels indicated below.

	Budget (US'85$'000)	
	1985	1986
Personnel (2 Senior Staff)	117	117
Honoraria, Stipends & Allowances	—	—
Supplies & Services	40	40
Travel	9	9
Equipment Replacement & Capital	—	—
Indirect Costs	13	13
Contingencies	—	—
TOTAL	179	179

Germplasm Collection Beans & Cassava

This special project, financed by IBPGR, includes analysis of available plant genetic resources data for *Phaseolus vulgaris* cultivated and wild forms; and (b) transformation of existing cassava collections in Brazil, Guatemala, Mexico and Paraguay into *in vitro* cultures for transportation to CIAT to be stored in cassava germplasm collection and to be utilized in crop improvement. Funding is approved through 1985 and is expected to continue in 1986 at the levels indicated.

	Budget (US'85$'000)	
	1985	1986
Personnel (1 Senior Staff)	24	22
Honoraria, Stipends & Allowances	2	2
Supplies & Services	5	5
Travel	2	2
Equipment Replacement & Capital	1	1
Other Expenses	1	1
Contingencies	—	—
TOTAL	35	33

Biological Nitrogen Fixation, Beans and Pastures

(See under Special Projects in Tropical Pastures section, p. 34).

CASSAVA PROGRAM

CASSAVA PROGRAM CORE RESOURCES

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
RESEARCH															
Utilization			1	1	1	3	4	4	4	4	6	8	8	8	8
Physiology	1	1			1	2	1			2	12	7			11
Germplasm Develop.	1	1	1	1	1	2	2	2	2	2	27	27	27	27	27
Pathology	1	1	1	1	1	1	2	2	2	2	13	11	11	11	11
Entomology	1	1	1	1	1	3	3	3	3	3	12	12	12	12	12
Plant Nutrition	1	1	1	1	1	2	2	2	2	2	11	12	12	12	12
Cultural Practices	1	1	1	1	1	2	2	2	2	2	12	9	9	9	9
Economics	1	1	1	1	1	3	3	3	3	3	3	4	4	4	4
Genetic Resources											2				
Media Luna						1	1	1	1	1		1	1	1	1
Carimagua						1	1	1	1	1	11	11	11	11	11
Virology						1	2	2	2	2	5	4	4	4	4
Breeding				1	1				2	2				11	11
Program Leader		1	1	1	1		2	2	2	2	4	2	2	2	2
TOTAL	7	8	8	9	10	21	25	24	26	28	118	108	101	112	123
REGIONAL COOPERATION															
S. E. Asia	1	1	1	1	1						3	3	3	3	3
Africa				1	1									2	2
TOTAL	1	1	1	2	2						3	3	3	5	5

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	1,586	1,645	1,632
Supplies & Services	182	141	129
Travel	189	188	181
Replacement Equipment	15	1	1
	1,972	1,975	1,943

Budget Changes

Increases in personnel costs in 1985 are due to the addition of a full-time Program Leader position. Reductions in supplies, services, and replacement equipment are in accordance with global reductions in these items due to budgetary restrictions. In 1986, slight reductions in expenses are due to the elimination of the Physiology Section and its replacement with the incorporation into core of the Utilization Section.

Program Commentary

Importance of Cassava

In 1984 world cassava production was estimated at approximately 125 million tons, produced on some 14 million hectares. The production is roughly divided as follows: 40% in Africa, 35% in Asia and 25% in the Americas. More than 60 percent of the total production is destined for use as human food, half as fresh cassava, and half after some form of processing. Fourteen percent is used as animal feed within the developing countries, and an increasing amount is being exported as dried pellets for animal feed in the developed countries. Estimates vary for the amount of cassava lost as waste after harvest. However, the figure is somewhere between 13-25 percent, highlighting the importance of post harvest handling. In terms of direct human consumption, cassava provides from 200-1000 calories per day for more than 700 million people in the developing countries.

Cassava is especially important for the poor because it is among the most inexpensive of foods available. In

many countries dried cassava is by far the cheapest form of obtaining calories while fresh cassava usually costs about the same as other major calorie sources, such as corn or rice. Since the crucial nutritional deficiency in low income countries is calories, cassava may be particularly important both because it is inexpensive and also because it is consumed primarily by the poor who are most vulnerable to calorie shortages.

Most cassava is produced by small farmers cultivating marginal soils, making it an important component of the diet among a major segment of the rural poor. Cassava consumption is lower in cities than in the countryside. This is the result of a complex interaction of a variety of factors, including: the perishability of cassava, poor transportation systems, relatively higher prices for cassava due either to subsidies for other foods or the heretofore rather slower pace of technological innovation caused by the historical neglect of the crop in terms of research and development. New technologies which raise the yields of cassava and reduce problems of storage may be expected to reverse current trends and, when coupled with elimination of subsidies for other foods and improvements in marketing and transportation systems, induce an increase in urban consumption of cassava.

Although cassava is relatively low in protein, it can also contribute to augmenting protein availability when used as an animal feed. Because of the availability of unused marginal land which cannot support other crops but could produce cassava, the use of cassava as an animal feed could vastly reduce the competition between feed grains for the concentrate industry and the human food sector for calorie and protein sources. Moreover, domestic production of feed grains often has been unable to meet demand, leading both to imports of feed grains by many countries than can ill afford it, and also to upward pressure on the price of animal feeds that tends to push up the cost of meat, putting it out of reach of the very poor. Production of cassava with underutilized domestic resources could promote employment, alleviate the burden of costly imports, and contribute to maintaining a supply of inexpensive animal protein.

In the developing world imports of wheat are increasing dramatically. In those countries with cooler climates good possibilities exist for increasing wheat production. However, in the lowland tropical areas this possibility seems remote. Cassava flour, mixed with a protein source such as soya bean meal, can readily substitute for part of the wheat flour in products such as bread, pastas and biscuits. The advantages of replacing imports with locally produced products with a high labor requirement are obvious.

Problems of the Crop

The problems facing the cassava crop differ depending on the desired end use. The major problem confronting the fresh cassava market is the perishability of the crop. In many areas the producer only receives a very small percentage of the final price paid by the urban consumer. It is often thought that this is due to inefficient marketing systems; this is probably not true. The high marketing margin is merely a reflection of the extreme perishability and bulkiness of the crop. Recent research results suggest that major improvements in the shelf life can be achieved through improved post harvest technology. This could result in reduced prices for the consumer, increased demand and reduced wastage, without reducing the farm gate price.

The problems facing cassava as a dried product, either for animal feed or human food, are very different. The major part of the cost of production of dried cassava is the cost of the fresh roots, which can be reduced by high yield, low input technology. Present average yields of 10 t/ha are well below the potential due to: a) poor agronomic practices; b) lack of varieties responsive to low input, improved management; and c) diseases and insects.

A further problem in the production of dried cassava products is the dehydration process. Fresh cassava contains about 60-65% water which must be reduced to 12-14%. In areas with long dry periods natural drying techniques are now well developed. However, good natural drying technology does not exist for the wetter periods in those areas of the tropics where humidity is rarely low.

The market potential for dried cassava products appears very large if a supply of cheap roots can be obtained and if they can be effectively dried. This potential may not always be realized as government policies often favor competing products, mainly wheat, through heavy subsidies. It is suggested that the availability of new production and processing technology can be used as a powerful argument to force changes in those government policies that militate against cassava.

Program Objectives

The overall goal of the cassava network is to increase small farmers' income and food supply, and to improve food availability to the overall population. This goal is to be achieved by converting cassava from being mainly a traditional rural staple, to a major, multiuse carbohydrate source.

The Cassava Program has two main components or functions: firstly, that of an international center; and secondly, that of a regional center in Asia and Latin America and the Caribbean. In Asia the regional activities are closely interwoven with the Regional Coordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in Humid Tropics of Asia and the Pacific (CGPRT) which has comparative advantage in the socioeconomic aspects specific to Asian Agriculture. In Africa, IITA has a regional responsibility to serve the important needs of cassava in that country.

The CIAT program, in its global capacity, provides the following major inputs into the overall research and development efforts of the network:

(a) Maintenance of the world cassava germplasm collection; and from this base the provision of elite gene pools with known characteristics to regional and national programs. Coupled with this effort is the development of improved breeding methodology.

(b) Development of the basic principles for establishing improved production and utilization systems, and the research methodology required to adapt such systems to local conditions.

(c) Basic research directed to better understanding the crop and its interaction with environmental stresses.

(d) Analysis of the future potential role of cassava in the economy of the developing world.

(e) Operation of the world's cassava documentation and information center.

(f) Organization of training opportunities and meetings for cassava workers from national and regional programs.

In its function as a regional center for Latin America and the Caribbean, CIAT has set up a group to investigate integration of production, utilization and marketing of cassava. This section works closely with national programs in setting up small scale integrated cassava pilot projects. The overall activities of the group concentrate on: (a) macro-economic analysis of cassava potential in given countries/projects; (b) planning and organization of project structure; (c) establishment of projects and development of local adaptive research; (d) economic analysis of the pilot projects, and (e) policy recommendations on commercialization when solicited by governments.

In order to satisfy the specific requirements of germplasm for Asia, to develop agronomic practices more appropriate to the intensive cropping systems, and also to assist in strengthening Asian national programs, a CIAT regional program is now established in Asia.

Program Status

(See cassava section under SUMMARY OF ACHIEVEMENTS, pp. 6-7.)

Expected Benefits

The combination of new varieties and improved agronomic practices have been shown to greatly increase cassava productivity and reduce costs. In Latin America benefits can only be reaped from this new technology by closely linking cassava with processing and marketing. The establishment of pilot projects in various countries will accelerate the diffusion process, and large increases in the use of the new storage technology for fresh cassava and the entry of large quantities of dried cassava into the animal feed market. Both these aspects of cassava will bring benefits to both the small scale producer and the consumer. The former will benefit from increased demand for his product, thus allowing him to reap the benefits of improved production technology; and the latter, in the case of fresh cassava, from a cheaper, higher quality product. In the case of dried cassava for animal feed, savings will be made in foreign exchange, which is so scarce in the regions at present.

In Asia the major benefits will come from the new varieties that will increase production with little or no change in production costs.

At present in Africa production of cassava is declining due to the effects of mealybugs and mites. The use of biological control, developed by cooperative activities of CIAT, IITA and CIBC in a truly international effort, should reverse this trend and alleviate, at least partially, the serious food deficits in that continent.

Special Projects

Cassava Improvement for Asia

This special project, initially financed by the Government of Japan, is designed to increase cassava productivity and production and improve utilization technologies for both human food and animal feed by establishing a network among Southeast Asian countries. Priority areas include work on germplasm development, agronomy and cropping systems, postharvest handling and economics (this last area to be done by CGPRT-ESCAP in Bogor, Indonesia). Specific activities include (a) assessment of region-wide constraints to increased

production and productivity; (b) organization of regional workshops and conferences to coordinate research, improve communications and prevent wasteful duplication of efforts; (c) coordinate training programs; (d) develop agronomic practices suitable for local cropping systems, particularly those based on perennial crops.

	Budget (US'85$'000)	
	1985	1986
Personnel (1 Senior Staff)	29	62
Honoraria, Stipends & Allowances	—	—
Supplies & Services	4	12
Travel	5	11
Equipment Replacement & Capital	5	—
Indirect Costs	6	12
Contingencies	—	—
TOTAL	49	97

Cassava Development, Colombia

This project is financed by the Ford Foundation. It is to develop means for planning and propagating integrated cassava development projects in tropical Latin America through (a) development of a generalized procedure for institutional assessment, coordination and division of responsibilities in integrated cassava projects; (b) research to develop a macro planning framework for integrated cassava projects; and (c) motivation of policy support by holding a conference with key policymakers on the potential of cassava within their individual countries.

	Budget (US'85$'000)	
	1985	1986
Personnel	64	80
Honoraria, Stipends & Allowances	11	—
Supplies & Services	4	3
Travel	16	22
Equipment Replacement & Capital	—	—
Other Expenses	—	—
Contingencies	—	—
TOTAL	95	105

Cassava Utilization, Colombia

This IDRC-financed project is (a) to investigate economic conditions in farm production, milling, baking, and consumer sectors to identify constraints to the design and operation of a cassava flour industry; (b) develop/adapt equipment for small-scale rural processing of cassava into flour; (c) determine influence of cassava varieties on flour quality and bakery product characteristics; (d) develop/modify baking procedures that optimize the incorporation of cassava flour and that ensure acceptability by bakers and consumers; (e) recommend and disseminate results to farmers, food processors and government agencies; and (f) encourage integrated production and post-production research in Colombia through coordinated activities at CIAT and the participating national institutions (the Instituto de Investigaciones Tecnológicas [IIT] and the Universidad del Valle).

	Budget (US'85$'000)	
	1985	1986
Personnel	23	11
Honoraria, Stipends & Allowances	—	—
Supplies & Services	4	2
Travel	8	3
Equipment Replacement & Capital	21	10
Other Expenses	—	—
Contingencies	9	4
TOTAL	65	30

Cassava Genotyping

This project is carried out in collaboration with the University of Manitoba, and is to develop electrophoretic methodologies for the routine characterization of genotypes of *Manihot, Phaseolus, Stylosanthes, Centrosema, Zornia* and *Desmodium*. Specifically, the objectives are to (a) select the most useful electrophoretic technologies for characterizing germplasm in CIAT's collections and specify operating parameters; (b) determine the most suitable genetic markers, whether total/storage proteins or isozyme patterns, for each genus; (c) assess the effects of plant tissue source, as well as agronomic and storage histories on electrophoretic profiles; and (d) convert analogue electrophoretic data into digital form for computer storage and analysis. The project is financed by IDRC.

	Budget (US'85$'000)	
	1985	1986
Personnel	14	23
Honoraria, Stipends & Allowances	—	—
Supplies & Services	4	8
Travel	2	3
Equipment Replacement & Capital	5	10
Indirect Costs	4	7
Contingencies	—	—
TOTAL	29	51

Mycorrhiza

This special project is to maintain and evaluate CIAT's mycorrhizal collection (300 strains); conduct field evaluation trials with highly effective mycorrhizal fungi under different edapho-climatic conditions using cassava as test crop; define influence of agricultural management practices on native mycorrhizal symbiosis; and assist in the development of mycorrhizal research in national programs to ensure transfer of research results to farmers. It is financed by GTZ (W. Germany).

	Budget (US'85$'000)	
	1985	1986
Personnel	79	45
Honoraria, Stipends & Allowances	—	—
Supplies & Services	7	4
Travel	6	3
Equipment Replacement & Capital	5	3
Other Expenses	—	—
Contingencies	—	—
TOTAL	97	55

Fresh Storage

CIAT is seeking funding for this project which would be executed in collaboration with the Integrated Development Program of Colombia. This project would (a) demonstrate the viability of the new fresh cassava storage technology developed at CIAT on a commercial scale; and (b) describe quantitatively the impact of the new technology on total demand for fresh cassava, and farm-level and consumer prices. As of June 1985 funding for this project had not been assured.

	Budget (US'85$'000)	
	1985	1986
Personnel	24	51
Honoraria, Stipends & Allowances	4	—
Supplies & Services	2	4
Travel	4	9
Equipment Replacement & Capital	3	5
Indirect Costs	7	14
Contingencies	1	1
TOTAL	45	84

Cassava and Rice Research in Panama

(See Special Projects in Rice section pp. 29-30.)

Germplasm Collection Beans and Cassava

(See Special Projects in Bean section p. 19.)

RICE PROGRAM

RICE PROGRAM CORE RESOURCES

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
RESEARCH															
Agronomy (Prod. Systems)	1	1	1	1	1	1	2	2	2	2	5	8	8	8	8
Breeding (Upland)	1	1	1	1	1	2	2	2	2	2	13	12	12	12	12
Breeding (Irrig.)	1	1	1	1	1	3	2	2	2	2	23	23	23	23	23
Pathology (Irrig./ Upland)	1	1	1	1	1	2	3	3	3	3	11	11	11	11	11
Economics			1	1	1			2	2	2			6	6	6
Physiology	1	1	1	1	1	2	2	2	2	2	11	6	6	6	6
Program Leader		1	1	1	1		1	1	1	1		1	1	1	1
TOTAL	5	6	7	7	7	10	12	14	14	14	63	61	67	67	67

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	715	928	1,097
Supplies & Services	166	77	90
Travel	41	59	74
Replacement Equipment		5	5
	922	1,069	1,266

Budget Changes

Increases in personnel (and travel) in 1985 are due to the filling of previously vacant senior staff positions and the addition of a fulltime position for the Leader of the Rice Program. The 1986 budget includes the addition of an agricultural economist (see p. 11). Supplies and services in 1984 were exceptionally high due to the required build-up of the research facilities at the Santa Rosa Station near Villavicencio. Costs for supplies and services in 1985 and 1986 are returning to the normal pattern of expenditures.

Program Commentary

Annual growth rates for rice in Latin America during the past two decades have averaged 3.3, 2.3 and 1.0% for production, area, and yield, respectively. Per capita consumption of rice has been rising and is currently about 35 kilograms of milled rice annually. Rice provides, on average, around 9% of total calories in the Latin American diet. Countries with the highest rice contribution to total caloric intake are Panama, Dominican Republic, Cuba, Brazil, Costa Rica, Colombia, and Peru.

During 1980-82 net imports of milled rice were 220,000 tons, or 2% of apparent consumption. The largest exporters were Uruguay, Surinam, Argentina, and Guyana with the major importers being Cuba, Brazil, and Peru.

If demand increases continue at the annual rate of about 3.5% observed during the past 20 years, production must nearly double by the year 2000 to satisfy internal demand at current relative price levels. This indicates an increase from the current 17 million tons to over 30 million tons by the end of the century. Land and water resources are more than ample to permit this growth. The task ahead is to identify the ecologies and areas where growth will predominate, and to orient and intensify research and training toward the physical and biological constraints characteristic of these areas.

The CIAT Rice Program focuses on the Western Hemisphere including Mexico, Central America, the Caribbean and South America. It collaborates closely with IRRI's efforts in global rice research and with IITA in areas of mutual interest. Research on major regional constraints is encouraged through an active network of rice specialists cooperating in the International Rice Testing Program (IRTP) coordinated by an IRRI scientist located at CIAT.

Program Accomplishments

The excellent early collaboration between the CIAT Rice Program and ICA provided a rapid impact, both in and outside of Colombia. In addition, the strength of the IRRI program is an important component of the successes achieved. From its cooperative program with CIAT, ICA has released several dwarf varieties with high yield potential. All of these varieties are now grown internationally. CIAT breeding lines have resulted in more than thirty other dwarf varieties released by national programs in the region. A recent impact study[1] has shown that these varieties are now grown on about 2.5 million hectares annually in irrigated, highly favored and moderately favored upland systems in the Western Hemisphere. These new varieties, together with improved cultural practices, annually produce an additional 3 million tons of rice with a value of over 800 million US$. The surge in production in countries with these farming systems has equalled or exceeded population growth, and most of these countries have reached effective self-sufficiency.

Rice consumption has continued to increase as rice has become cheaper in relation to alternative foods. A detailed analysis of the impact of new rice technology in Colombia showed that low-income consumers have received most of the economic benefits resulting from the large production gains.

CIAT has provided professional training in production agronomy, breeding and pathology to about 300 rice researchers from twenty-three countries. Consequently, an effective regional network of cooperators for exchanging information and evaluating technology is fully operational. The Program's regional activities include IRTP nurseries, monitoring tours, production courses within countries, and biennial conferences at CIAT for research workers organized jointly by CIAT and IRRI under the auspices of IRTP.

Production Systems and Constraints

Trends in rice production, area planted and yield vary widely among countries and over time. The major contribution to production during 1965/75 came from increase in area, particularly in Brazil. This was reversed in the more recent period of 1976/82 when essentially all regional growth came from yield increases. The unfavored upland area in Brazil began to decline, but was offset by increased productivity from irrigated areas in Rio Grande do Sul and Santa Catalina.

Fourteen of the 23 more important rice producing countries now have average yields of over 3 t/ha. The Latin American average of 2 t/ha reflects the massive impact of the national average of 1.5 t/ha in Brazil. The basic causes for this variability are found in the predominant production system in each country.

Several distinct production systems exist in the region. Often rice production is divided, somewhat misleadingly, into two main systems, irrigated and upland. In 1981/82 irrigated rice covered 2.1 million hectares (24% of the area), averaged 4 t/ha and contributed 52% of regional production. Essentially all of the remainder came from the upland sector covering 6.2 million ha with an average yield of 1.1 t/ha. This simplistic division obscures the actual productivity of distinct upland farming systems and the potential productivity achievable with research on specific constraints.

CIAT work in agroecosystem analysis is identifying and classifying current Latin American rice production systems. Several fairly distinct upland ecologies are apparent, despite forming a continuum from highly favored to unfavored in terms of productivity. In general terms, upland productivity is highest when soils are fertile and rainfall is heavy and well distributed. Unfavored upland rice suffers severe water stress and is normally grown on relatively infertile soils.

Irrigated Rice

This system receives high CIAT priority because of its major contribution to regional production and its comparative advantage in maintaining and further increasing productivity and stability of supply. It is found in all countries and predominates in southern Brazil, Colombia, the Caribbean area, Guyana, Nicaragua, Peru, Surinam, Venezuela, and the Southern Cone countries. Average national yields range from 3 to over 5 t/ha. Important constraints include increasing production costs, weeds, water control, rice blast and other diseases, lodging and, in some countries, the availability of suitable grain quality for export markets.

Highly Favored Upland Rice

This system is generally confined to flat areas receiving over 2000 mm of rainfall in eight or nine months of the year. Normally, there are no marked dry periods during the rainy season. The alluvial soils are slightly to moderately acid and well drained. This system uses modern dwarf varieties and improved agronomic practices. Yields average 2.5 t/ha, but better farms consistently produce 4-5 t/ha. The system is found in parts of Brazil, Central America and Colombia and is expected to expand in tropical Central and South America. Major constraints are grassy weeds and diseases. CIAT assigns high priority to this system.

[1] Muchnick de Rubinstein, E. 1984. **The diffusion and economic impact of high-yielding semi-dwarf rice varieties in Latin America.** CIAT, Cali, Colombia.

Moderately Favored Upland Rice

Most of Central America, Venezuela and part of Brazil employ this system. It differs from the preceding one in having a shorter wet season with less overall rainfall, and with a dry period during the growing season. Dwarf varieties used in Central America yield about 2 t/ha. Brazil grows tall varieties yielding an average 1.5 t/ha. Irregular rainfall causes high yield variances. Constraints include weeds, mild to moderate droughts, mineral stresses and diseases. CIAT includes this system within its priorities.

Unfavored Upland Rice

This system —found in areas having irregular and low total rainfall— has low planting densities and utilizes tall varieties producing an average yield of less than 1 t/ha. Yield variance is extremely high. Much of Brazil's rice is produced with this system on relatively infertile, moderately acid soils.

The main system constraint is dry periods occurring during the growing season. This stress is compounded by poor root development associated with aluminum toxicity in the subsoil. The degree of drought enhances the severity of fungal diseases, particularly blast, in this system. Phosphorus and other deficiencies are a serious overall constraint. CIAT does not conduct research directly on unfavored upland rice since the system is mainly utilized in Brazil and at the present time the Program has no comparative advantage for work in this area.

The main unfavored upland rice system areas in the region have two main environmental constraints, i.e., low and/or unreliable rainfall and infertile acid soils. In the tropical lowlands of the Americas there are vast areas of well watered savanna lands which have not been opened up for arable agriculture. In these areas rice does have a future potential provided the problems of adaptation to low soil fertility conditions and soil acidity can be successfully resolved. CIAT has commenced research on these problems.

Rainfed Lowland Rice

This system is a transition between irrigated and upland and utilizes rainwater trapped and held by field levees. Nevertheless, water deficits and/or deep flooding are common. Dwarf varieties can be grown when water control is provided, but tall varieties predominate. Average yields are 2.0-2.2 t/ha. The crop many be transplanted or directly seeded and few purchased inputs are used. Rainfed rice is important only in coastal Ecuador, Colombia's northern coast and in the Dominican Republic. The main problem in this system is inadequate water control, which forces farmers to use tall varieties and, because of the risks involved, low levels of purchased inputs. CIAT does not directly research this system.

Program Objectives

Specific objectives for Rice Program activities in collaboration with national institutions in the Western Hemisphere include:

1. Continuing to develop germplasm-based technology designed to overcome the principal constraints to increased production of irrigated rice and the more favored upland production systems.

2. Developing widely applicable production technology, including the introduction and evaluation of appropriate farm machinery, oriented toward weed control and other related cultural practices to reduce costs and increase stability of supply.

3. Strengthening of national rice research programs in the region through training, conferences and technical collaboration activities and through these mechanisms to further stimulate the highly effective regional rice research network which is now in place.

General Research Strategy

Since its beginning in 1967, the Rice Program's basic strategy was to improve yields and production of irrigated rice in the region. This strategy was adopted because: (a) irrigated rice offered the greatest opportunity for rapid gains, (b) irrigated rice technology was more easily generated and transferred than that for other production systems; and (c) limited core resources did not permit simultaneous work on all production systems.

Varietal improvement has been the key element in CIAT's irrigated rice research strategy. Tall varieties were used throughout the area before 1968, when IR8 was introduced. An immediate increase in productivity of 2 t/ha confirmed the decision to work exclusively on dwarf materials for this system. The research has sought varieties combining dwarfism, strong stems, insensitivity to photoperiod, long grain with clear endosperm, resistance to the *Sogatodes* leafhopper and blast resistance. Earliness and improved adaptability to acid soils are more recent varietal objectives.

In recent years a number of fungal diseases, apart from rice blast (dirty panicles, brown spot, leaf scald, eye spot,

narrow brown leaf spot and sheath blight) have increased in severity and now constitute yield constraints, partially as a consequence of increase in fertilizer use and expansion of upland rice and irrigated rice on infertile soils. These problems, along with the resurgence of the hoja blanca virus, have intensified the need for resistance breeding for all ecologies.

Once improved dwarf lines and varieties were produced, research was extended to developing appropriate cultural practices for the high yielding varieties. Seeding rates and methods, fertilizer practices and timing of weed control were emphasized. Farmers learned to manage modern varieties, but severe cultural practice deficiencies remain. These include red rice and weed infestations, seed quality, land preparation and water control, and lack of simple, appropriate equipment for small farm operations.

The unexpected adoption of the newer dwarf varieties in recent years in the highly and moderately favored upland systems allowed the Program to modify its original strategy. Entries for nurseries and regional yield trials, especially for the more favored upland systems, were selected from the advanced irrigated breeding lines and distributed to national programs for continued local selection and evaluation. Thus, CIAT contributed directly to upland systems while focusing on irrigated varieties. In 1981, CIAT began to intensify its activities in upland rice. Allocation of program resources and general research emphasis for the irrigated and upland sectors will be approximately equal during the coming decade.

In the irrigated sector the number of crosses has increased substantially in response to new disease problems, need for iron toxicity tolerance, and the specific requirements for the temperate Southern Cone. This latter activity is expanding rapidly now that dwarfs are known to be well adapted throughout the temperate production areas, and the anther culture technology permits large volume production of fixed lines for these conditions.

Breeding for the more favored upland ecologies and high rainfall-acid soil savanna upland has increased dramatically. Crossing is currently focused on disease tolerance, grain and plant type, earliness and general adaptability to upland soils. Work must be undertaken on the multiple mineral nutrition stresses of upland soils with specific breeding attention to tolerances to zinc, phosphorus, iron, and manganese deficiencies along with aluminum and manganese toxicities in acid soils. It seems clear that one way to reduce fungal disease pressure in upland rice is through breeding for tolerance to mineral nutrition imbalances.

Specific research strategies for the remainder of the decade of the eighties and beyond have been developed for the various production systems identified for priority attention.

Research Strategy for Irrigated Rice

This system will continue to receive major attention. Enhanced disease tolerance to blast, other fungal diseases, hoja blanca and soils problems including iron toxicity and the straighthead disease would increase yields, lower production costs and increase production stability. The approach will combine breeding directly for disease resistance with breeding for tolerance to soil stresses as well as emphasis on weed control and lower seeding and fertilizer rates. Lowered inputs should result in decreased fungal disease severity. Additionally, breeding will focus on better lodging resistance and, simultaneously, seek modest gain in yield capacity.

Improvement in farm cultural practices is indispensable to narrow the gap between varietal yield potential and farm productivity. Research on cultural practices has lagged behind varietal development. New technology in tractor wheels will be linked to recent advances in low volume sprayers with the goal of increasing terrestrial farm operations: seeding, fertilizer, herbicide and pesticide applications. This should reduce costs, increase weed control efficiency, permit reduction in seeding rates, and lessen dependence on the inefficient airplane.

Many new irrigated rice areas are coming into production, principally by small producers. They lack appropriate small machinery to facilitate the transition from transplanting to direct seeding where labor is scarce. Such machines (hand seeders, boom sprayers, harvesters and threshers) are commercially available. The Rice Program will emphasize introduction of appropriate machinery through national programs.

Research Strategy for the More Favored Upland Systems

Selected lines from the irrigated breeding program can contribute to the varietal component for expanding this system in the region. Nevertheless, a breeding program is designed to address the peculiar stresses of upland soils, particularly moisture and mineral nutrition, and their interaction with fungal diseases, in several sites reflecting a range of ecologies from moderately to highly favored upland. Vigorous, dwarf varieties tolerant to problem soils, diseases and short dry periods should increase and stabilize yields at an average of 3 t/ha, one ton higher than existing average productivity.

Weed infestations are a massive yield constraint in upland rice and are more difficult to control than in irrigated rice. Since available herbicides are relatively effective, research will focus on appropriate terrestrial delivery systems to improve timing and reduce dosages.

New Production Systems Research Strategy

The vast savanna regions of Colombia, Venezuela, and Brazil and are favored by abundant, well distributed rainfall, but the soils are extremely acid and infertile. Although little upland rice is produced on these soils there is a clear need for a crop component in the pasture system being developed by the Tropical Pastures Program to facilitate and finance land preparation for pasture establishment. Upland rice could become a pioneer crop thus encouraging the economically sound development of acid, high rainfall savannas.

A minimum-input, upland rice system using cultivars having tolerance to acid soil and diseases appears attainable. Initial research with soil-adapted cultivars consistently gives plot yields of 3.5 to 4.5 t/ha without soil amendments or chemical protection. Thus, a 3 ton commercial yield seems reasonable and economically viable. A high volume crossing program is underway with upland materials from Africa, Brazil, Japan and other sources. Specific breeding objectives are identified and parental sources are available. Although typical, high yielding, irrigated germplasm is not useful for this ecology, many rices are well adapted to infertile, acid soils having over 80 percent aluminum saturation. Breeding will stress tolerance to Mn and Al toxicities and P, Zn, and other deficiencies. The ideal plant type remains unclear but intermediate grain quality, multiple fungal tolerances, hoja blanca, sogata, and sugar cane borer resistance are requirements.

Research on cultural practices will concentrate on weed control, methods of seeding and applying fertilizer, and conversion into pastures after one or two rice crops.

Research Sites

The research program has largely decentralized its activities from the Palmira CIAT headquarters, with the crossing program, quality laboratory, germplasm storage, sogata and hoja blanca screening, and IRTP remaining in Palmira.

Three locations in Panama were made available by IDIAP, within a collaborative program, for selection of segregating generations of upland and irrigated materials. In 1983, CIAT acquired the Santa Rosa experiment station near Villavicencio, in the Colombian Llanos which now is the central breeding location for favored upland and irrigated rice. Also in 1983, ICA provided long-term use of 16 ha of acid savanna on its La Libertad station adjacent to Santa Rosa. Irrigated and upland selection and evaluation work continues in Peru under a cooperative project with INIPA. Implementation of the Caribbean Regional Network will add the Juma Experiment Station in the Dominican Republic as an additional research site.

Special Projects

Caribbean Cooperative Rice Research Network

This special project—not yet funded as of June 1985—is designed to strengthen national research and development programs through the creation of an active rice research network that will allow for horizontal transfer of production and seed technology and strengthen CIAT/IRRI collaboration with national programs in the region. Network activities will comprise (a) coordination of research on common problems, dividing responsibilities among national programs; (b) testing of germplasm for relevant production constraints; (c) reinforcement of national research and extension capabilities through in-country courses and in-service training; (d) training in seed technology; (e) regional workshops and monitoring tours to improve communications and cooperation in the area. One senior staff position will be provided by IRRI through the IRTP.

	Budget (US'85$'000)	
	1985	1986
Personnel	20	26
Honoraria, Stipends & Allowances	73	75
Supplies & Services	42	44
Travel	16	17
Equipment Replacement & Capital	51	24
Indirect Costs	24	27
Contingencies	—	—
TOTAL	226	213

Cassava & Rice Research in Panama

This project is based on bilateral agreement, whereby (a) CIAT's Rice Program helps IDIAP evaluate segregating populations to obtain advanced lines and varieties under conditions in Panama and the rest of Central America; and carry out observation, yield and regional

trials of promising lines and selections; and (b) CIAT's Cassava Program assists in baseline study of socio-economic and physical biological conditions of cassava production in Panama; development of appropriate production and processing technology; and development at the experimental level, of cassava processing and drying technology for a future national-level project. The project is financed by USAID. Funding is assured through 1985 and is assumed to continue in 1986 at the levels indicated below.

	Budget (US'85$'000)	
	1985	1986
Personnel	11	11
Honoraria, Stipends & Allowances	—	—
Supplies & Services	11	11
Travel	—	—
Equipment Replacement & Capital	—	—
Other Expenses	2	2
Contingencies	—	—
TOTAL	24	24

Bean and Rice Research, Peru

(See under Special Projects in Bean section p. 19.)

TROPICAL PASTURES PROGRAM

TROPICAL PASTURES PROGRAM CORE RESOURCES

	Senior Staff					Scientific & Supervisory					Clerical & Other				
Personnel (Positions)	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Program Leader	1	1	1	1	1	2	1	1	1	1	3	3	3	3	3
GERMPLASM EVALUATION															
Germplasm Evaluation	1	1	1	1	1	3	3	3	3	3	12	15	15	15	15
Agron. (CMG)*	1	1	1	1		2	2	2	2	2	12	12	12	12	12
Forage Agr. (Br.)**	1	1	1	1	1										
Regional Trials	1	1	1			2	2	2	2	2	4	4	4	2	2
Plant Pathol.	1	1	1	1	1	2	2	2	2	2	10	10	10	10	10
Plant Entomol.	1	1	1	1	1	3	3	3	3	3	9	9	9	9	9
Soil Microbiol.	1	1	1	1	1	3	3	3	3	3	10	11	11	11	11
Forage Agron./Breed.	1	1	1	1	1	3	3	3	3	3	13	11	11	11	11
PASTURE EVALUATION															
Seed Product.	1	1	1	1	1	2	2	2	2	2	18	18	18	18	18
Soil Plant/Nutrition	1	1	1	1	1	2	2	2	2	2	13	13	13	13	13
Pasture Dev.(CMG)	1	1	1	1	1	2	2	2	2	2	9	9	9	9	7
Pasture Dev.(Br.)**					1										2
Past.Quality & Nutrit.	1	1	1	1	1	2	2	2	2	2	15	15	15	15	15
Pasture Dev./Ecophysiol.	1	1	1	1	1	1	2	2	2	2	8	12	12	12	12
PASTURE EVALUATION IN FARM SYSTEMS															
Past.Eval. (H.T.)***		1	1	1	1		1	1	1	1		6	6	6	6
Past.Renov./Maint.(H.T.)			1	1	1								4	4	4
Cattle Production	1	1	1	1	1	3	3	3	3	3	11	11	11	11	11
Economics	1	1	1	1	1	3	3	3	3	3	2	2	2	2	2
Collab. Oper.						1	1	1	1	1	8	3	3	3	3
TOTAL	16	17	18	17	17	36	37	37	37	37	157	164	168	166	166
REGIONAL COOP.															
Central Amer. & Carib.				1	1									2	2
TOTAL				1	1									2	2

* CMG Carimagua - Llanos Orientales
** Br. Brazil - Cerrado
*** HT Humid Tropics

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	2,561	2,639	2,825
Supplies & Services	392	304	311
Travel	325	314	327
Replacement Equipment	68	27	27
	3,346	3,284	3,490

Budget Changes

Increases in personnel costs in 1985 are due to the addition of the senior staff position in Agronomy/Pasture Evaluation for the humid tropics. Additional costs in 1986 reflect the full-year costs of this position in 1986, and the addition of a Pastures Reclamation Specialist that will complete the team in the humid tropics (see p. 11). Per-senior staff reductions shown in supplies and services, travel and replacement are in accordance with overall budget reductions made to adjust to reduced availability of funds.

Program Commentary

Importance of the Program's Products

The Tropical Pastures Program has four major products: beef, milk, conservation of tropical ecosystems, and resource base expansion. A short summary of the importance of these products follows.

Beef. Beef is one of the staple foods for people in Latin America, including the urban and rural poor. The availability of beef is one of the principal reasons why protein malnutrition is less acute in tropical America than in Africa or Asia. However, during the last 15 years the annual growth in demand for beef in tropical America (5.6 percent) has exceeded increases in production (3.6 percent). This gap is resulting in real price increases which will cause a decrease in beef consumption by families of the lower 25 percent income strata which presently use from 8 to 16 percent of their total budget to buy beef. The high price and income elasticities of demand for beef also suggest that increase in beef production leading to lower real prices would have a larger impact on consumption and quality of diet than production increases of most other major staple food crops consumed by the Latin American poor. In order to accomplish this, production costs, particularly social costs, must be reduced, and this is more likely possible in the underutilized, acid infertile soil areas because of their present low opportunity costs.

Milk. The situation with milk production trends in tropical America is similar to that of beef with low per capita production (one-quarter that of the U.S.), and imports of milk and dairy products tripling in the last 10 years. The Program's target area survey has shown that milk production from dual-purpose cattle farms is an important source of income in many areas and that its importance increases as farm size decreases.

Conserving Tropical Ecosystems

The Oxisol/Ultisol savanna and *Cerrado* regions of tropical Latin America, covering almost 300 million hectares, are no longer only "potential" areas of expansion. As new roads are built, development is taking place at an ever-increasing rate. Much of this development occurs without appropriate soil management technology, resulting in land abandonment, soil erosion, and the conversion of the land into unproductive pastures. Extensive, pasture-based beef production is the most widespread land use in the region, and, if properly managed, one of the most ecologically sound ones. Well-managed, productive and persistent grass/legume pastures not only provide excellent protection against soil erosion but improve soil fertility because of nitrogen fixation and nutrient recycling by plants and the grazing animal. On the other hand, poorly managed pastures can be disastrous, especially on more sloping sites.

Expanding the Land Resource Base

In addition to its ecological implications, pasture-based beef production can serve as a catalyst for settling the Oxisol/Ultisol regions, primarily because the initial infrastructure investment is much lower than for crop production. The development of well-managed pastures increases the value of the land. When roads provide improved access to market, it becomes more profitable to intensify the farm operation by devoting part of the land to crop production. Well-managed legume-based pastures that increase nitrogen and organic matter levels in the soils by reducing the fertilizer requirements for crops in rotation with pastures, provide for a more productive and socially efficient land use alternative. Intercropping annual or perennial crops with pastures is also a feasible and efficient alternative. Therefore, beef operations can serve as a wedge to develop this important resource base and open the way for integrated agricultural development. Furthermore, increases in beef production in Oxisol/Ultisol regions permit alternative uses of better soils located closer to markets which should be used for more intensive crop production.

Program Objectives

The objective of the Tropical Pastures Program is to develop and transfer, together with national institutions, improved, low-input pasture technology in the acid, infertile soil lowlands of the humid and subhumid tropics, with principal responsibility for tropical America, in order to increase beef and milk production, conserve and improve soil resources of tropical ecosystems, and provide a basis for an economically and ecologically sound utilization of underexploited land resources.

Program Strategies

The Program's research team is organized into three functional groups: (a) Germplasm evaluation (including the sections of germplasm, agronomy, plant pathology, entomology, and breeding); (b) Pasture evaluation (including the sections of soil plant nutrition and microbiology, ecophysiology, pasture development, pasture quality and production); and (c) Pasture evaluation in production systems (including the sections on seed production, farming systems, and economics). These

three units assure a dynamic flow of germplasm in which characterization of germplasm screening by ecosystems, assembly of appropriate pasture production technology, and economic evaluation of new pasture technology in farm systems, constitute major research steps. While thousands of germplasm entries are worked with during the initial phases of the flow of germplasm though the Program activities, only very few highly promising germplasm materials succeed in being selected for the assembly of pasture technologies and further evaluations.

The Program exploits the natural variability of germplasm to identify grass and legume species adapted to the various ecosystems in the region. Accordingly, germplasm is assembled from a wide range of conditions throughout the acid, infertile soil regions of tropical America as well as Southeast Asia and Africa. Presently, the CIAT germplasm bank contains some 14,000 accessions. This germplasm is screened for tolerance to high soil aluminum and acidity, low phosphorus availability, and tolerance to diseases and insects. Ecotypes which pass this first screening are characterized in terms of tolerance to drought, flooding, burning, grazing, minimum nutrient requirements, nutritive value, and compatibility in grass/legume mixtures. Subsequently, pastures based on highly promising ecotypes are assembled, relevant establishment technology is developed, and cattle liveweight gains are measured. The most promising pasture combinations are subjected to a long-term productivity and economic evaluation, and the respective technological packages are further adapted to the requirements of the predominant farm system in the area. Finally, the improved technology is evaluated in economic terms. This entire research process is carried out in close collaboration with national institutions throughout the area of interest.

To date, the principal emphasis has been placed on the two savanna ecosystems known as "Llanos" and "Cerrados". Research for the Llanos ecosystem is carried out in the Carimagua Station which is jointly administered with the Colombian National Research Institute (ICA). Research for the Cerrados ecosystem is carried out in collaboration with the Brazilian Agricultural Research Center for the Cerrados region (CPAC), a station of EMBRAPA. Also, a regional trial network has been assembled in cooperation with national institutions, to evaluate promising germplasm in sites which represent sub-ecosystems both in the Llanos and the Cerrados region. The network also encompasses additional ecosystems, including the poorly drained savannas, humid tropics and moderately acid soils. This allows the Program, in collaboration with national organizations, to test germplasm throughout the area of interest and to evaluate the adaptation and productivity of promising germplasm to the different ecosystems and sub-ecosystems in the lowlands of tropical America. The information obtained through this evaluation network is recorded in computerized data banks which allows for effective analyses of germplasm performance across locations. In addition, participants of the network are brought together in workshops to discuss alternative methodologies for germplasm evaluation and to exchange data recorded in different regional trials. These network activities allow for a high degree of feedback which assists in moving germplasm significantly faster to more advanced stages of evaluation under grazing for eventual release by national institutions.

Status of the Program

(See Tropical Pastures section under SUMMARY OF ACHIEVEMENTS, p. 7.)

Expected Achievements

The Tropical Pastures Program is well on its way to developing, in collaboration with national institutions, low input, pasture production technology that has the potential to intensify the pioneer animal production system in the vast frontier of tropical Latin America. Available research results reconfirm the soundness of the Program's strategy to develop legume-based pasture technology that rests on germplasm adapted to specific ecosystems.

With the potential contribution of available germplasm already having been demonstrated, the Program will expand research into the humid tropical ecosystems starting in 1985, as projected in the Long-Range Plan. The main objective of this research thrust is to develop a low input pasture technology based on adapted germplasm and pasture reclamation techniques to establish in already degraded areas economically and ecologically sound, persistent pastures.

The availability of alternative viable techniques is expected to contribute to the gradual recovery of several million hectares that are at present in different stages of degradation throughout the humid tropics of Latin America and the Caribbean. The Program is planning to further decentralize its research strategy to cover important areas of Central America and the Caribbean where moderately acid soils predominate. The activity is planned to be initiated in 1987.

As germplasm moves into more advanced stages of evaluation under grazing in the different countries, more frequent and intensive visits are required to assist national programs in designing, analyzing and interpreting trial

results, as well as in coordinating the required backstopping from Program specialists. This is more efficiently and cost effectively done by outposted personnel in charge of regional network activities than by scientists stationed at headquarters. This implies further decentralization of the network activities of the Program. The plan is to gradually develop four parallel networks in Central America and the Caribbean; the Llanos ecosystem in Colombia, Venezuela and Northern Brazil; the humid tropics ecosystem in Colombia, Ecuador, Brazil and Peru; and the Cerrados ecosystem in Brazil, Paraguay and Bolivia. It is envisaged that the agronomists initially responsible for screening in the respective ecosystems will assume these regional network responsibilities.

This will enable the Program to significantly accelerate technology transfer and to foster the achievements of national programs in the mandate area. These regional networks are critical for horizontal transfer of technology among national programs operating in the respective regions and to bring about economies of scale through networking of formerly isolated efforts.

Special Projects

Biological Nitrogen Fixation, Beans & Pastures

This UNDP-financed project is to stimulate research for maximization of crop production through BNF by (a) training national program personnel in BNF; (b) conducting limited research in Latin America on pertinent aspects of BNF technology; (c) holding a workshop to present results to national programs. The project also constitutes the first phase of a longer-term plan to establish small-scale inoculation plants at national institutes.

	Budget (US'85$'000)	
	1985	1986
Personnel (1 Senior Staff)	51	53
Honoraria, Stipends & Allowances	27	—
Supplies & Services	18	8
Travel	28	8
Equipment Replacement & Capital	—	70
Indirect Costs	12	12
Contingencies	—	—
TOTAL	136	151

RESEARCH SUPPORT

VISITING SCIENTISTS AND POSTDOCTORAL FELLOWS

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Stipends & Allowances	423	694	694
	423	694	694

Budget Changes

The increase in 1985 funds allocated to the Visiting Scientists/Postdoctoral Fellow fund is to allow for the execution of the EPR-recommended socioeconomic studies of actual and potential cassava use, with particular emphasis on Latin America.

Program Commentary

This section includes all funds for visiting scientists and postdoctoral fellows.

Visiting Scientists

The Center seeks to attract outstanding scientists working in research institutions in developed and developing countries to spend short (six to twelve months) periods at CIAT to contribute in their areas of specialization to the objectives of CIAT's research or research support programs. In a large number of cases, visiting scientists spend time at CIAT as part of a sabbatical leave arrangement whereby CIAT provides additional support as necessary.

Postdoctoral Fellows

Most postdoctoral fellows are contracted in support of research activities. Contracts are for one year, extendable to a maximum of two years. A small portion of postdoctoral fellowships is reserved for postdoctoral fellows from cooperating countries who stay at CIAT for short periods before returning to institutions in their home country.

Visiting scientist funds provide for about 6 man-years. Postdoctoral funds provide for 16 man-years.

GENETIC RESOURCES UNIT

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Germplasm Processing						4	3	3	3	3	16	16	16	16	16
Seed Health							1	1	1	1	2	2	2	2	2
Head, Germplasm Unit		1	1	1	1							5	5	5	5
Tissue Culture	1					4					5				
TOTAL	1	1	1	1	1	8	4	4	4	4	23	23	23	23	23

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	346	268	285
Supplies & Services	114	32	32
Travel	13	8	8
Replacement Equipment	4	1	1
	477	309	326

Budget Changes

Reductions in 1985 reflect the transfer of the position of cell physiologist to the newly created Biotechnology Research Unit. Increased personnel costs in 1986 are due to the full-year effect of filling the position of the head of that unit.

Program Commentary

The objectives of the Genetic Resources Unit are to collect, evaluate, maintain, document and distribute the germplasm of *Phaseolus* beans, tropical pastures and cassava in support of the crop improvement programs. These activities are designed to allow for the full utilization of the valuable genetic resources and at the same time to make provisions for their conservation. The above germplasm management activities cover 34,000 accessions of *Phaseolus* beans (of which 30,000 belong to *P. vulgaris*), 3,700 accessions of cassava, and 16,000 accessions of tropical pasture species.

Both the *Phaseolus* beans and the tropical pasture germplasm are maintained in the form of true seeds. The Genetic Resources building provides facilities for seed storage conditions with three cold rooms. One cold room of 180 m^3 is maintained at 10^0C for short-term storage of beans and tropical pasture germplasm, while the other two (40m^3 and 33m^3, respectively) are maintained at -5 to -6^0C for long-term storage. A glasshouse was added to the Genetic Resources Unit in 1979. A replicate of the field cassava germplasm collection is presently being transferred into meristem tissue culture form for storage. The new Biotechnology Research Unit is currently responsible for the maintenance and multiplication of cassava in tissue culture.

In addition, collaborative research at Saskatoon, Canada, has shown the feasibility of storage in liquid nitrogen.

Field collection activities have been arranged with the national programs in Mexico, Brazil, Colombia, Argentina, Peru and Guatemala to obtain *Phaseolus* materials which are poorly represented in the germplasm bank. With the support of the IBPGR, cultivated and wild *Manihot* germplasm has been collected in Paraguay and Brazil, and plans are in hand for collection in Panama and Nicaragua. CIAT maintains the world collection of *Phaseolus* germplasm which includes *P. lunatus P. coccineous, P. acutifolius* and the wild *Phaseolus* species. These materials are being evaluated for 32 standard descriptors plus data on collection sites, disease resistance, environmental adaptation, and the like. The information collected is fed into a system of computerized data management which permits efficient filing and rapid retrieval, at the same time that it lends itself to statistical analyses. Clustering techniques are being carried out as a means to identify similar germplasm. From 1978 to 1984 a total of 113,000 germplasm samples have been distributed internationally and within CIAT. To assist in the distribution and utilization of these genetic materials

catalogues are published at regular intervals. In addition, a seed testing laboratory has been established within the GRU. In future a CIAT statement on seed health will accompany all outgoing germplasm and trials material. In this way the risk of transmitting seed-borne pests and diseases will be substantially reduced.

The GRU is also responsible for the CIAT tropical pastures germplasm, currently 15,000 samples, of which 3,000 samples were distributed in 1984.

The increasing age of the present cold stores, which were not originally intended for germplasm storage, and the rapid build-up in stored material, indicates the need for new, enlarged facilities. Improvements in storage technology and increase in experience means that newly designed cold stores could be run at lower cost, and be more convenient to use. Mobile shelving would dramatically increase capacity, and humidity control would increase the storage life of seeds with no extra handling cost. An associated large-scale seed drying room would speed-up the current slow process of placing seed in long-term storage.

The IBPGR recommended long-term storage temperature of -20°C can only be reached by installing new equipment. Planned long-term storage capacity should be ample, to allow CIAT to reciprocate the duplicate storage of CIAT germplasm by other institutions.

The needs for duplication of base collections, at least of *Phaseolus* spp., and for third country quarantine for material from outside Latin America for introduction into Colombia should be solved by the end of 1985. Considering the ever-increasing costs in electricity plus the large space needed in refrigerated storage facilities, the alternative use of liquid nitrogen storage is being studied.

Evaluation procedures and data management systems similar to those for beans have been developed for CIAT's collection of cassava and tropical pastures germplasm in close collaboration with the respective programs. It is hoped that through this expansion of the Unit's activities, the needs for the research programs for a well characterized germplasm can be met. For the present, the seed increase and distribution of tropical pasture germplasm and the collection and characterization of *Phaseolus* germplasm (including wild species) form the main ongoing activities in the respective commodities.

In addition, a collaborative project with a Canadian institution is being arranged to use electrophoretic finger printing techniques to characterize germplasm

The location at CIAT of a IBPGR liaison officer for Latin America has permitted strengthening collaboration with IBPGR, especially in collection activities of *Phaseolus*, cassava and tropical pastures germplasm.

For *Phaseolus*, an IBPGR researcher/collector is stationed at CIAT on a postdoctoral fellowship. This position is regarded as essential to widening of the utilization of *Phaseolus*, but is only funded on a year-to-year basis. A Belgian associate expert attached to the GRU is responsible for investigating interspecific crossing in *Phaseolus* (in cooperation with the University of Gembloux, Belgium).

BIOTECHNOLOGY RESEARCH UNIT

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Head, Biotechnology Research Unit		1	1	1	1		4	4	4	4		8	8	8	8
Virology			1	2	2			3	6	6			7	14	14
TOTAL		1	2	3	3		4	7	10	10		8	15	22	22

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	—	170	296
Supplies & Services	—	29	39
Travel	—	11	17
Replacement Equipment	—	1	1
	—	211	353

Budget Changes

The Biotechnology Research Unit was created partly in response to a recommendation by the EPR. Initially, the only senior staff position in this Unit is that of a cell physiologist transferred from the Genetic Resources Unit. In 1986, the virology position currently in the Bean Program will also be transferred to the Biotechnology Research Unit.

Program Commentary

The involvement of CIAT in monitoring and applying some of the most promising biotechnologies was anticipated in the plans outlined in the document "CIAT in the 1980's". The Second External Review recommended that CIAT establish an interdisciplinary research structure comprising those disciplines that interface with all commodity programs. CIAT, in its response to the EPR recommendation, agreed to the establishment of a small cross-commodity effort in the form of a research unit initially devoted to the emerging field of biotechnology.

Objectives

To act as an interface between advanced research institutions where new methodologies are becoming available, and CIAT and national programs where the new technologies will be tested. The Unit will deal primarily with those biotechnologies that can significantly increase the efficiency of traditional plant breeding methods or make possible certain otherwise intractable processes.

Highlights

The major current activity in the BRU involves research in cell and tissue culture for clonal propagation and for generation of useful variability.

Cassava. (a) Nearly 60% of the CIAT cassava germplasm collection is stored in vitro using slow shoot-tip cultures. Facilities have been adapted to hold up to 6000 accessions. Plants of 7 cultivars grown from shoot-tips retrieved from liquid nitrogen storage have been transplanted to the field for testing; (b) Over 600 accessions from Brazil, Paraguay, and Peru have been transferred to CIAT using *in vitro* techniques, and nearly 200 pathogen-tested clones were distributed to 12 countries in the last two years; (c) Complete plants have been regenerated from 10 cultivars through somatic embryogenesis using isolated foliar segments. The isolation and culture of leaf mesophyll protoplasts has been standardized. These developments should allow new genetic manipulation with cassava in the future.

Rice. (a) Anther culture methods have been developed that permit the production of homozygous diploid plants from F_1 hybrids in a period of 7-8 months, as compared to 3-4 years with traditional techniques; (b) In collaboration with the Rice Program, techniques for the massive production of homozygous rice lines by anther culture was initiated with the purpose to accelerate the generation and selection of new breeding lines for the savanna and Southern Cone ecosystems of Latin America; (c) First results to select tolerance to Al toxicity and cold

using anther callus cultures show apparent correlation between plant genotype and cell cultures.

Stylosanthes **spp.** (a) Techniques to regenerate plants from cell cultures have been standardized; (b) Large numbers of plants of two cultivars have been regenerated. In collaboration with the Tropical Pastures Program, the occurrence of variability, especially in reaction to anthracnose attack and seed production, will be evaluated in the field.

Phaseolus **beans.** In collaboration with the Genetic Resources Unit, work to scale up the recovery of interspecific hybrid plants has been initiated.

A project to develop electrophoretic finger printing techniques to characterize cassava, bean and legume forage germplasm is underway in collaboration with the University of Winnipeg, Canada.

Future Developments

As a discipline closely related to biotechnology, virological research at CIAT will become integrated with the BRU in 1986. This association will allow the sharing of specialized facilities such as the electron microscope, ultracentrifuges, autoradiography, and others. Interaction of virologists with the commodity programs will take place through professional support staff.

The BRU is expected to generate special projects to advance knowledge in emerging biotechnologies and their application to CIAT crops. The potential of recombinant DNA for pathogen and gene detection, mapping, and gene transfer techniques for transformation of cassava and beans is being evaluated at this time for collaborative projects.

RESEARCH SERVICES

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Food Qual.& Nutr.						1	1	1	1	1					
Laboratories						1	1	1	1	1	11	13	13	13	13
Greenhouses						1	1	1	1	1	3	3	3	3	3
Maintenance						1	1	1	1	1	3	2	2	2	2
TOTAL						4	4	4	4	4	17	18	18	18	18

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	215	220	220
Supplies & Services	55	83	83
Travel	2	1	1
Replacement Equipment	40	20	20
	312	324	324

Program Commentary

The Laboratory Services Unit is under the control and supervision of the Research Services Committee and 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. Maintenance and repair of all CIAT laboratory instruments and equipment, and coordination of the use of laboratory facilities.
4. Control, washing, and sterilization of glassware used by pathology and microbiology programs.
5. Management and maintenance of CIAT's greenhouses, screenhouses and growth rooms, including soil storage and sterilization facilities.
6. Maintenance of colonies of small animals (rabbits, mice, etc.).

These activities are supervised on a part-time basis by various senior staff members which are part of the Research Services Committee. Day-to-day management is provided by four research associates/assistants in charge of the various sections.

The excellent greenhouse facilities are presently in full use. It is foreseen that in the next few years glasshouse space will become insufficient due to the further developments of core programs and expansion of special projects. For this reason capital requirements for an additional glasshouse are included on the Forward List for 1986.

STATION OPERATIONS

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Station Operations	1	1	1	1	1	1	1	1	1	1	28	28	28	28	28
Popayan						1	1	1	1	1	5	5	5	5	5
Quilichao						1	2	2	2	2	21	20	20	20	20
Sta. Rosa (Meta)						1	1	1	1	1	4	4	4	4	4
Tractor Pool											3	3	3	4	4
Labor Pool											23	23	23	23	24
TOTAL	1	1	1	1	1	4	5	5	5	5	84	83	83	84	85

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	671	626	626
Supplies & Services	248	162	162
Travel	10	6	6
Replacement Equipment	64	56	56
	993	850	850

Budget Changes

In 1985, the budget for support personnel and supplies and services is reduced as part of the global reductions to adjust to reduced availability of funds. The same expense pattern will be maintained in 1986.

Program Commentary

The Stations Operations Unit provides logistics support for the land use of the research programs. The Unit is in charge of agricultural machinery, land preparation, planting, irrigation, field work, and harvesting at headquarters in Palmira, and at the two sub-stations in Quilichao and Popayan. The Unit is also in overall charge of the general upkeep and maintenance of the experimental fields, and of the continuous upgrading of the experimental sites in the three locations. In addition, the Unit is in charge of commercial seed production (rice, beans, tropical pastures) and commercial crop production (sorghum, maize, beans, and cassava) on experiment station land that is temporarily not utilized for research purposes.

CARIMAGUA STATION

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Support Unit						2					2	2	2	2	2
Administration						1	3	3	3	3	5	4	4	4	4
TOTAL						3	3	3	3	3	7	6	6	6	6

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	269	228	228
Supplies & Services	266	215	215
Travel	63	52	52
Replacement Equipment	92	11	11
	690	506	506

Budget Changes

In 1984 expenses for supplies and services were higher due to the need for the installation of a new sewage system. In 1985, reductions in personnel, supplies and services, travel, and replacement equipment were introduced as part of the overall economies to adjust to reduced availability of funds. Expenditures in 1986 will follow the 1985 pattern.

Program Commentary

The Carimagua Research Station is located 350 kilometers east of Villavicencio, near the Meta-Vichada border, at 4°30'N latitude, 71°30'W longitude in the Eastern Plains of Colombia. Carimagua's climate, soil, vegetation and topographic conditions are typical of one of the greatest land resources in the world that is just beginning to be exploited—the tropical American savannas, which comprise 300 million hectares.

In 1969, ICA purchased 22,000 hectares of land, and field work was initiated in early 1970. In February 1977, an agreement was signed between ICA and CIAT for the development of a cooperative research program in the Eastern Plains. Under the terms of the agreement, an advisory committee composed of three ICA managers and three CIAT senior staff members is responsible for coordinating and directing operations of the station.

Costs of this research station are shared equally by the Colombian Institute for Agriculture (ICA) and CIAT. The budget shown is for CIAT's share of the cost of personnel, supplies and services, and travel costs.

DATA SERVICES

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Statistical & Comp. Services	1	1	1	1	1	8	8	8	8	8	11	10	10	11	11
TOTAL	1	1	1	1	1	8	8	8	8	8	11	10	10	11	11

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	373	356	356
Supplies & Services	104	161	161
Travel	9	5	5
Replacement Equipment	—	8	8
	486	530	530

Budget Changes

The 1985 budget for supplies and services is increased due to the expansion of computer hardware, including the upgrade of the mainframe IBM computer.

Program Commentary

Statistical and Computing Services

The Data Services Unit provides advice, training and assistance in all mathematical, statistical and computational aspects of the work of the scientific programs of CIAT. The Unit has two sections, Biometrics and Computing, whose functions and responsibilities are detailed below.

Biometrics Section

- To provide statistical advice on all aspects of the work of CIAT, including planning, data collection, analysis and interpretation;
- To keep abreast with current developments in statistical methodology by internal and external education, and utilize and develop such techniques for the betterment of agricultural research at CIAT;
- To provide a statistical computing service;
- To carry out collaborative research with other workers with the aim of producing joint scientific publications;
- To provide advice and assistance and engage in collaborative research work on operational research topics, such as simulation mathematical programming and decision theory;
- To provide training in statistical methods both for staff within CIAT and for CIAT program courses.

Computing Section

- To provide and maintain appropriate computer hardware for the scientific and associated programs at CIAT;
- To provide and maintain appropriate computer software for the scientific and associated programs at CIAT;
- To provide adequate documentation of all software and hardware;
- To investigate all aspects of work at CIAT which might benefit from computerization;
- To keep abreast with current developments in computing;
- To carry out collaborative research;
- To write suites of programs of general applicability;
- To ensure sufficient training is obtained within and outside the section;
- To provide the hardware and software to build and

maintain scientific data bases and ensure that these are accessible to the appropriate range of personnel within a security network.

An IBM 4331 Group 1 computer with one megabyte of real memory was installed at the end of 1981. During 1983 the machine was upgraded to a Group 2 and a further megabyte of memory was added. Early in 1984 the real memory was increased to the maximum for the machine, namely four megabytes. Administrative work was moved to an *IBM System 36 purchased* in 1983. The present configuration of the 4331 machine is as follows:

1	4331 Group 2 CPU with 4 megabytes real memory
3	3370 Fixed Disk Units each of 570 megabytes capacity
1	3262 Line Printer rated at 650 lines per minute
1	Communication Adaptor with 6 lines
1	Calcomp Model 965 Plotter and 907 Controller
2	Model 8809 Magnetic Tape units
2	Operator 3278 Consoles
3	Cluster Controllers type 3276
19	Displays type 3278
2	IBM PC's connected as 3278's

Delivery from IBM of items to upgrade the present mainframe to a Model 4361 with six megabytes of real memory is imminent. Until now the machine has been running both the VM/CMS and DOS/VSE operating systems but the movement of the administrative work and the availability of more software running directly under VM/CMS will permit the dropping of DOS/VSE. Installed database software includes the products IDMS/R (Cullinet Software, Inc., Westwood, Mass., USA), ISIS (IDRC Canada), and STAIRS (IBM). Statistical packages include SAS (SAS Institute, Raleigh, N. Carolina, USA), GENSTAT and GLIM (Numerical Algorithms Group, Oxford, England).

There are now some 64 registered users of the 4331 computer and almost 50 hours of CPU have been utilized during peak weekly periods. During the last three years IDMS systems have been written for the Rice and Tropical Pastures Programs; and Fortran and SAS based systems for the Bean, Cassava, Tropical Pastures programs, the Library and the Genetic Resources Unit. Statistical data processing mainly done by the Biometrics Section currently takes some 50 percent of computing resources.

To facilitate the interchange of information the Computing Section publishes a newsletter and there is a Users Group made up of representatives of the programs and staff of the Data Services Unit.

AGROECOLOGICAL STUDIES

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Agrometeorology	1	1	1	1	1	2	2	2	2	2	3	4	4	4	4
Land Systems				1	1				2	2				3	3
TOTAL	1	1	1	2	2	2	2	2	4	4	3	4	4	7	7

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	128	128	128
Supplies & Services	8	11	11
Travel	6	12	12
Replacement Equipment	—	1	1
	142	152	152

One of the most important underlying reasons for agroecological analysis is that crop and pasture improvement for less-favored areas and their wider diversity of production constraints impose severe problems on new technology design, development and transfer. Less-favored production zones - i.e., most nonirrigated areas in the tropics with a wide range of soil constraints and insect and disease pressures - are the main targets of CIAT research. The rate of progress in genetic improvement of any species is generally inversely proportional to the number of constraints to be overcome through new genetic variability. It is clear that accurate information on the relevant constraints in each zone is essential at all stages of increasing production and productivity of basic food commodities in the tropics. This need is even more critical in the small farm situation since the environmental conditions on farms in this sector - particularly those in Latin America - are generally more severe, and constraints are more varied than in the case of the large farm sector. Given the great diversity of prevailing climates, soils, cropping systems and socioeconomic conditions, the need for an inventory of production conditions in the small farm sector is pressing.

Objectives for Agroecosystems Analysis

Some general areas have been identified that represent common needs across CIAT programs with respect to agroecosystem information for the areas of interest in each commodity. These needs are reflected in the following objectives:

a. To develop a system for environmental and socioeconomic assessment of introduction constraints in the production areas of present or future importance in each CIAT commodity. Such assessment will allow for a more **accurate definition of research priorities**, and thus the allocation of research resources among the wide range of alternatives available for action.

b. To develop an agroecological information system which can be integrated with the germplasm development process. This improved process would provide for a more **cost effective and efficient operation of the cooperative germplasm transfer and evaluation** programs with collaborating national institutions. The objective is essentially to reduce the burden on national institutions imposed by testing all germplasm in all locations.

c. 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. One example would be crop/weather relations in international nurseries and in other experiments.

d. To develop a data system which will provide a firm base for **comparative socioeconomic studies** on the wide diversity of production zones. This system will enable both **ex-ante** and **ex-post** assessments of the **impact of new technology, in particular within the small farm sector**, so that the research process can be further focused on real needs. In addition, the data system would provide a medium in which to

assess economically the development priorities for underutilized frontier lands, and to analyze marketing and associated economic constraints to increased production and productivity.

Research Strategy

A computer-based information system designed for the needs of four quite ecologically divergent commodity programs must be flexible in order that the degree of detail and scale provided is appropriate in each case. In addition, the collection of data, and its storage, retrieval and analysis, must be at a level of definition appropriate to the resources available. In other words, CIAT could not implement a massive new survey involving a great deal of field work. Accordingly, a methodology has been developed which relies on prior surveys, census information, and local knowledge of the situation in each zone. Information is gained on an opportunistic basis by CIAT personnel during duty travel and from the large number of visiting scientists and trainees from the region who visit CIAT. In this way, a cost effective collection system has been developed which appears sufficiently accurate. Any attempt at a more detailed approach would probably be frustrated by lack of accurate local data.

Progress of Agroecosystem Analysis in Commodity Programs

The following examples illustrate some of the work completed and planned in the various programs.

Tropical Pastures. The study on the South American lowlands[1] has enabled a classification of the major ecosystems making up the Program's area of interest. Aggregation of the land system units within each major ecosystem has permitted a quantitative assessment of the natural resources available in each ecosystem. The basic philosophy of the Program outlined in this plan revolves around this classification.

In technology evaluation and transfer, the study has provided direction for defining sites for regional experiments within the germplasm evaluation scheme of the Program. In the future, an accurate definition of the environmental constraints in each land system will provide a means for defining new technology specifications, particularly with respect to germplasm characteristics for each zone. Economic studies on the relative advantages of different zones with respect to future development will facilitate national policy making. The studies are already in use at CIAT and in Brazil and are in the form of computer files in EMBRAPA.

Beans. The Program has been considerably aided by early studies in defining research priorities and strategies and in the location of its primary sites for the first two stages of the germplasm evaluation program. A climatic analysis of the 110 bean microregions permitted an assessment of crop/temperature conditions. It also verified that growing season temperature conditions at CIAT-Palmira and CIAT-Popayan are clearly representative of, and bracket, the major proportion of production zones (with respect to temperature) in Latin America.

With the increasing interest of the Bean Program in Eastern Africa, the unit's work has been extended. Crop distribution, soils and climate data are being compiled. In the meantime a preliminary agroecological zonation of African bean regions has been produced to aid the new efforts in the region.

Rice. Initial studies have begun to define, locate and classify the microregions of production of upland rice in South and Central America. Census data have defined municipal level information on which to aggregate data into definable and relatively homogenous microregions. This information is vitally needed to help define more closely the research strategy for the upland sector.

Cassava. The cassava production zone or ecosystem classification provided in this plan is a preliminary one.Detailed analysis of cassava distribution is now under way. An inventory of Latin American cassava production at a scale of 1:5,000,000 has been produced and has given valuable insight into the range of environments encountered. Present projects are microregion definition and database design. As these projects are completed and the database becomes operational, a re-evaluation of a cassava agroecozone classification will be feasible.

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[1] T.T. Cochrane et al. **Land in Tropical America.** Vol. III. **Computer Summary and Soil Profile Descriptions of the Land Systems** (in press).

SEED UNIT

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Seed Unit	2	2	2	2	2	5	6	6	6	6	7	8	8	8	8
TOTAL	2	2	2	2	2	5	6	6	6	6	7	8	8	8	8

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	231	330	330
Supplies & Services	68	69	70
Travel	47	35	30
Replacement Equipment	31	43	23
	377	477	453

Budget Changes

Personnel expenses in 1984 were lower because one senior staff position was kept vacant throughout the year (this position has now been filled).

Program Commentary

The need for a Seed Unit at CIAT grew out of two different problem contexts. First, the CIAT commodity programs—beans, rice, tropical pastures, and cassava—have reached a stage of development where a centralized support service for the production, processing, and distribution of breeder and basic seed represented the most rational and obvious route for the streamlining of seed-related activities at the Center. Second, the flow of new materials emanating from CIAT's research programs was hampered by the fact that in many Latin American and Caribbean countries there was only an incipient seed industry at the national level that needed determined and systematic assistance from the international level to accelerate development. Regarding the latter point, CIAT was an obvious choice for the location of an international input in the development of national seed programs. In addition CIAT was concerned about a need for a stronger seed sector in Latin America and the Caribbean capable of delivering seed of improved materials to the producer level. The Center has had available the necessary factors for hosting a successful seed effort: physical facilities for seed production, an extensive training infrastructure, expertise on seed-related aspects, and an international mode of operation.

The first phase of the Seed Unit special project, financed by the Swiss Development Cooperation (SDC), was for the three-year period January 1979-December 1981; the second phase was for the period January 1982-December 1983. The third phase, 1984-86, continues the Unit as a restricted core activity with SDC support.

The objectives of the Seed Unit at CIAT are:

1. To train personnel in government and private institutions, primarily from Latin American and Caribbean countries, in various aspects of seed industry and seed program development.

2. To 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.

3. To conduct specific research in seed technology which is relevant to CIAT commodity interests and relevant to problems that collaborators at the national levels are faced with.

4. To provide CIAT with a single unit to cooperate with commodity programs in multiplying, processing, storing and distributing advanced experimental materials, or breeder and basic seed, to collaborating countries for further multiplication.

5. To disseminate information on seed activities, advances in seed technology and the availability of promising materials in the region.

The project includes two internationally recruited scientists with a full complement of support services, resources for consultants and visiting scientists, plus scholarship monies for postgraduate interns. Also included in the initial project were resources for the remodelling of existing buildings and for the construction of additional facilities for the operation of seed-related activities (seed processing, storage, laboratory spaces for training purposes, as well as office/working spaces for staff of the Seed Unit).

During the period 1979-1984, the Unit has mainly concentrated its efforts on:

Training. A combination of intensive seed production and seed technology courses, advanced short-courses, individualized in-service training, and M.S. thesis research opportunities are offered. In the period 1979-1984, some 399 professionals have received CIAT-based training by the Seed Unit. In addition, the Seed Unit is supporting in-country training courses in the areas of seed production and seed technology.

Workshops. The Seed Unit organizes and conducts an average of one workshop per year to provide a forum for professionals with similar interests to exchange experiences, and to work together in developing plans, recommendations, and fresh approaches to help seed activities advance more rapidly.

Technical Collaboration. Assistance to seed programs, industries and associations, contribute to developments at the national level. Sub-regional activities in Central America and the Andean Zone have re-inforced seed network developments.

Seed Production and Supply. The Seed Unit has supported the CIAT commodity research program—especially rice, beans, and tropical pastures—with the production, drying, conditioning and supply of basic seed of promising materials and already released varieties.

Research. A limited research input in the area of seeds is provided by the Seed Unit primarily through M.Sc. thesis programs. The preparation and dissemination of technical publications, workshop proceedings and audio-tutorial units have spread seed technology and production information in the region. In addition a quarterly newsletter improves communications on developments in the region and contributes to the strengthening of the seed network.

Status of the Seed Unit

The three intensive short courses organized in 1984 added 91 professionals to a growing list of seed technologists trained at CIAT and illustrates the Seed Unit's emphasis on training. The development and successful completion of the first course in Seed Enterprise Management and Marketing as well as one in Tropical Pastures Seed Production were new initiatives. The latter course was planned and conducted cooperatively with the Tropical Pastures Program. Both courses initiated specialized training of special interest to people from seed enterprises and contributed to the development of the local commercial seed industry. In addition to region-wide training, the Unit assisted eight courses at the in-country level plus an Andean region course. These courses, together with in-service training and thesis research, develop professionals at various levels to operate and lead seed activities that can be more effective in getting seed to farmers. A systematic evaluation of course participants from 1979-82 showed very positive results. To build upon the interest and motivation presently generated, increased efforts are needed through specialized, advanced courses at CIAT, sub-regional training and encouragement to in-country training.

A workshop on Seed Testing of Tropical Pastures Species combined the capabilities of the International Seed Testing Association, the Tropical Pastures Program and the Seed Unit to improve understanding and international seed quality evaluation guidelines. This activity was the sixth of a series of workshops designed to concentrate on topics of high priority for the region.

The development of the Regional Association of Seed Technologists for Central America, Panama and the Caribbean (ARTES), assisted by the Seed Unit, provides an additional mechanism to strengthen the seed network. The association has sponsored two courses and is starting to develop other program activities. An agreement between the Junta del Acuerdo de Cartagena and CIAT provides a mechanism to assist seed development in the Andean sub-region. A similar agreement with the Centro de Estudos a Treinamento em Tecnologia de Sementes e Mudas (CETREISEM) in Brazil provides the means to cooperate in various training and staff sharing arrangements with special emphasis on the Southern Cone.

Increased effort was placed on helping national programs improve, clarify and implement plans and strategies to accelerate production of improved varieties. The formation of a region-wide association, the Latin American Association of Seed Experts (ALES) opens opportunities to jointly achieve many seed network development objectives. Technical collaboration has included activities with CIMMYT and CIP, especially in training and workshops.

Over 100 tons of basic seed of rice, beans and tropical pastures were produced in cooperation with the Station

Operations Unit, the CIAT commodity programs and others and sold to national programs in 1984. Improved basic seed production within national programs, an ultimate objective, is gradually emerging; but the pace needs to be accelerated.

Although seed technology and production research is not a major objective of the Seed Unit, limited research, such as the work to improve variety description methodology, has resulted in more complete descriptions for eight major rice varieties used in the region; similar investigations are underway on bean varieties. A workshop planned for July 1985 is designed to help link isolated researchers in the region and more clearly identify needs and priorities.

Communications and information are closely linked to training and are an integral part of the Seed Unit. Audiotutorials on seed production, conditioning and quality are now available in both English and Spanish. Proceedings of workshops are published—the most recent one on **Improved Seed for the Small Farmers** was completed in both English and Spanish. The circulation of the quarterly newsletter has risen to 1,500.

The impact of the Unit is felt initially through the improved technical capability and motivation of course participants. The network of universities with seed technology and production courses, trained seed technologists in public and private programs, and seed associations is growing. Sub-regional activities and networks are developing. Simultaneously, many national program goals are being clarified. The quantities of seed of improved varieties are increasing. National programs have given the Unit strong support. This most positive response has resulted in the Seed Unit becoming a restricted core activity of CIAT with a clear long-range role to play.

Special Projects

Seed Training

This project is financed by the Pact of Andean Countries (JUNAC). It entails training in seed technology for the Andean members of the Cartagena Pact. Courses offered are on seed-quality control, and on seed enterprise management and marketing. The project also funds participants (one per country) to attend the basic seed production course and one advanced course at CIAT during these two years, as well as in-service training. Funding for 1986 is not yet assured but is expected to be at same level as in 1985.

	Budget (US'85$'000)	
	1985	1986
Personnel	—	—
Honoraria, Stipends & Allowances	17	17
Supplies & Services	—	—
Travel	6	6
Equipment Replacement & Capital	—	—
Indirect Costs	12	12
Contingencies	—	—
TOTAL	35	35

INTERNATIONAL COOPERATION

TRAINING AND CONFERENCES

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Training	1	1	1	1	1	9	9	9	9	9	8	8	8	8	8
Conferences						1	1	1	1	1	2	2	2	2	2
TOTAL	1	1	1	1	1	10	10	10	10	10	10	10	10	10	10

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	508	600	597
Stipend & Allowances	701	498	631
Supplies & Services	176	118	114
Travel	217	100	93
Replacement Equipment	43	32	26
	1,645	1,348	1,461

Budget Changes

Increases in personnel in 1985 are due to the filling of vacant support staff positions. Reductions in stipends and allowances, and travel are part of the overall reductions which CIAT needed to implement to adjust to reduced levels of funding. These reductions are compensated for by concomitant increases in special project funding of training scholarships. The budget request for 1986 shows a restoration in core funds allocated for stipends and allowances for training participants.

Program Commentary

After a period of emphasis on short-course training in all four commodities, CIAT has increasingly moved towards in-country training courses conducted in cooperation with national research programs. At the same time, continued heavy emphasis is placed on individualized specialization training at CIAT of national research program personnel to help strengthen cooperating national research teams and regional commodity research networks. Doctoral and M.S. thesis training continues to be given high priority, although this type of training is hampered by a lack of sufficient funds for academic study in agriculture in the overall international donor community available to national programs.

Status of Training and Conference Activities

To date, CIAT has provided training to some three thousand professionals. Throughout the years, CIAT has emphasized training in research methodology and production technology as related to the commodities in the Center's mandate. Recent survey data show that 60% of former CIAT training participants are actively working with the commodities on which they received training; an additional 15% continue to be active in agricultural research, albeit not directly related to CIAT's commodities. Nevertheless, the continued growth of national programs and the shift of their personnel to other institutions, including the private sector, continuously renews the demand for training of new personnel.

CIAT training has helped national programs of numerous countries in Latin America, Asia, and Africa to become stronger and to increase their capacity to engage in applied, adaptive, and validative research. CIAT-trained scientists increasingly are playing major roles in the selection and release of new varieties and attendant technologies. Training has also been a key contributing factor in the establishment and development of international and regional research networks on beans, rice, tropical pastures and cassava. These networks facilitate exchange of germplasm and technical information, and play an important role in the organization and conduct of cooperative research with CIAT and among participative countries. Conferences are the principal tool for the exchange of information and the coordination and development of concerted research strategies in the networks.

In the last two years the training and conference activities at CIAT have streamlined operation to focus more clearly than ever on concerted collaboration with national research programs and private industry to interlink the various research efforts, and to get newly available technology moving towards the producers' fields. Three sets of action programs have been put into practice:

1) A progressive shifting of emphasis from courses at Palmira headquarters to in-country courses conducted by national institutions with the assistance of CIAT. Such courses are frequently coordinated with the release of new varieties and/or agronomic and plant protection practices.

2) The development of training plans based on expressed medium- and long-term interests of national programs and their scientific manpower needs with regard to CIAT's commodities.

3) The regionalization of courses to increasingly focus on the circumstances of specific regions.

Degree-related training continues to receive high priority but actual increases in this type of training are difficult to realize due to scarcity of funds for academic study.

After many years of predominantly focusing attention on training in Latin America, CIAT's increasing role in Asia (cassava) and Africa (beans) have caused the Center to receive for training an increasing number of professionals from developing countries outside of Latin America and to organize relevant training opportunities in the respective regions.

Through the Seed Unit, CIAT has assumed a lead role in Latin America in providing training on seed technology and to contribute to the development of seed programs in the region through an active conference/-workshop program.

Future Plans

The table below shows the projections of training activities in terms of number of participants and man-months for each main type of training for the period 1986-1987. The growth in man-months is due to the relative increase in longer-term training internships (average of 4 months), post-M.S. training (average of 9 months) and thesis training (average of 12 months). Multidisciplinary short courses at headquarters will continuously decrease as short-term training is shifted to CIAT-assisted in-country courses. Funding for in-country short courses is expected to come mostly from interested country institutions. Regional courses will increase substantially, particularly in Africa and Asia.

Number of Participants and Man-months of Training Planned for 1986-1987.

Type of Training	1986		1987	
INDIVIDUAL TRAINING	No	MM	No	MM
Thesis Research (M.S. and Ph.D.)	34	408	38	456
Specialized Internships	103	618	98	588
SUBTOTAL	137	1026	136	1044
GROUP TRAINING				
Multidisciplinary Courses	96	144	48	72
Specialized Courses	120	180	160	240
Regional Courses	48	48	72	72
SUBTOTAL	264	372	280	384
TOTAL	401	1398	416	1428
IN-COUNTRY COURSES	480	240	540	270

The Table below shows core-funded and special project-funded conferences planned for CIAT in 1986-87

CIAT Conferences Projected for the Period 1986-1987

PROGRAM	1986	NP	1987	NP
Beans				
Network Events:	Bean Research, Central America	25	International Trials, Global	80
	Bean Research, Central Africa	25		
Special Topics:	Bean Breeders Workshop, L. Amer. (2)	24	Bean Breeders Workshop, E. Afr.	12
			Bean Breeders Workshop, Latin America	12
	N. Fixation	50		
	Physiological Potential	50	Plant Protection	80
SUBTOTAL		174		184
Cassava				
Network Events:			Germplasm Exchange and Quarantine (3)	120
	Methodology of Pilot Projects for Drying	35		
Special Topics:	Integrated Pest Management	50	Diseases of Cassava	60
SUBTOTAL		85		180
Rice				
Network Events:			IRTP-L. America	80
Special Topics:	Breeders Workshop, Central America	12	Breeders Workshop (Upland) Central America	12
	Breeders Workshop Upland Rice	40		
SUBTOTAL		52		112
Tropical Pastures				
Network Events:	Int. Trials, IV RIEPT Meeting	120		
	Adv. Com. RIEPT	24	Adv. Com. RIEPT	26
	Workshop on Methodology	80		
	Workshop on Pasture Seed Production	120		
SUBTOTAL		344		26

(Continues)

CIAT Conferences (Continued).

Seeds				
Special Topics:	Seeds for Small Farms II	120	Seed Certification and Legislation	120
Across Programs				
BRU			Biotechnology Research	60
CISU	Strategies in Communication	80		
OTHERS	Consultation Seminar with National Inst.	60	Agricultural Systems in Acid Soils	120
SUBTOTAL		140		180
TOTAL		915		802

COMMUNICATION AND INFORMATION SUPPORT UNIT

Core Resources

Personnel (Positions)	Senior Staff Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Scientific & Supervisory Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Clerical & Other Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Editor/Writing	1	1	1	1	1	3	2	2	2	2	1	1	1	1	1
Editor/Publications	1	1	1	1	1	3	4	4	4	4	1	1	1	1	1
Training Mats.						1	1	3	3	3			2	2	2
Distribut. & Marketing												3	3	3	3
Graphic Arts Prod.						4	4	4	4	4	29	28	28	29	29
Unit Head	1	1	1	1	1	9	9	9	9	9	22	20	20	20	20
TOTAL	3	3	3	3	3	20	20	22	22	22	53	53	55	56	56

Direct Costs (85$Thousands)

	Current Budget Actual 1984	Current Budget Revised 1985	Proposed Budget 1986
Personnel	1,162	1,020	1,112
Supplies & Services	336	386	390
Travel	27	28	28
Replacement Equipment	5	5	5
	1,530	1,439	1,535

Budget Changes

Reductions in personnel in 1985 were due to the phase-out of a training materials project which was classified as a transferred special core project. Supplies and services are increasing in 1985 to help CIAT respond to the greatly increased need to support regional projects with communication and information services.

Program Commentary

Unit Activities

CIAT's information strategy is to manage agricultural information in a way that makes it most accessible to CIAT staff and the other members of CIAT's commodity research networks. This is done through an integrated set of information products and services.

Technical Publications

Research monographs, studies of the impact of new technology, field manuals, scientific articles for publication in international journals, and other such publications are designed to provide tropical agricultural scientists with the results of continuing research at CIAT.

Training Support Materials

Training support materials emphasize the mastery of concepts related to specific training objectives. Depending on the objectives and course design, key topics may be presented in manuals, as handouts, or in the form of "audiotutorial units." These materials teach research methodology, develop practical skills, and foster attitudes that facilitate technology transfer.

Network Publications

Annual Program Reports, produced within the commodity programs, provide an in-depth, yearly progress report on every area of CIAT research. The reports are working documents, written in technical language.

Network Research Data are made available to all the members of the commodity research networks through a series of working reports, such as the results of the International Network for Evaluation of Tropical Pastures (RIEPT), the International Bean Yield and Adaptation Nursery (IBYAN), or the International Rice Testing Program (IRTP).

Commodity-specific newsletters contain information on developments within the programs, new research and production technology—whether from CIAT or from other research institutions, and commodity related news from regional and national collaborators. The purpose of

these newsletters is to provide workers in existing networks with regular information on developments in that commodity area.

Conference proceedings are often generated when the members of the networks convene, whether the group is commodity or discipline oriented. These proceedings compile the research developments of an entire group of collaborators under one publication.

Reporting the Center's Activities

CIAT Report is a full-color publication that highlights CIAT research of the previous year and communicates the Center's activities and achievements in a popular style. This report is published in Spanish and English.

CIAT International, a trimestral newsletter, is specifically devoted to keeping decision makers and other CIAT contacts informed on program developments at CIAT, new production and research methodology resulting from CIAT's efforts, and utilization of CIAT-developed germplasm. Written in a non-technical style, it is published in both Spanish and English.

Other kinds of information products are also routinely needed by the Center in order that its research be made available to the widest number of interested persons at an international level. These include press releases, articles on the Center and its research efforts, catalogs, brochures, flyers, and others.

Library Services

A specialized library with a collection of 29,000 books, 2500 microfiche, and over 2000 serials provides references and bibliographic research service to the staff of CIAT and to its network collaborators. The **Content Pages**, a current awareness service, is published monthly and distributed to CIAT staff and subscribers throughout the tropics. Tables of contents of over 800 journals are listed, and interested scientists can order copies of articles in their field.

Specialized Information Centers

In line with its global and global/restricted mandate for field beans, cassava, and tropical pastures, CIAT has built up three specialized information centers (SIC's) in support of each of these three commodities. Each SIC seeks to collect, abstract, and systematically file scientific documents on the respective commodities, and to use this databank to provide scientific information to researchers in these commodities. Services include retrospective searches, reference and referral, current awareness service, and document delivery.

Volumes of abstracts of the scientific literature are published three times per year and distributed to CIAT staff and to subscribers in the research institutions in the tropics.

Specialized Information Centers Project

A special project to reinforce the operations of the specialized information centers was funded by the International Development Research Centre (IDRC) in 1984. Specific objectives are:

1. To achieve a high level of expertise among the information-handling personnel of the SIC's at CIAT, through advanced training and through recruiting new personnel.

2. To improve linking mechanisms between the SIC's and information providers and/or users, through computerization of the data base, through the participation of visiting scientists at CIAT, and through contracting individuals for specific acquisitions tasks.

3. To increase the output of products of analysis and synthesis of information, such as monographs, manuals, articles for journal or newsletter publications, and mini-bibliographies.

Status of Program

To support the concept of integrated information, some changes were made during 1984 in the structure of CISU. The new organization is comprised of five subsections, each headed by one of a multi-disciplinary team of specialists. The principal staff team includes a science writer, a publications manager, an educational materials specialist, an information specialist, and a production manager. Professional support staff have degrees in a wide range of specializations including biology, agronomy, economics, agricultural engineering, food science, languages, librarianship, and computer programming. All work together to provide CIAT and collaborating scientists with top-quality communication and information support.

Measurable Productivity

During 1984, CISU produced 65 publications, including four manuals, three conference proceedings, six research data reports, four progress reports, a research

monograph, a reference guide, a technical bulletin, 23 newsletters, nine bibliographic volumes, 12 sets of contents pages and one directory. A total of 109,972 publications and 6283 audiotutorial units were distributed. Almost 20,000 documents were loaned and 2700 reference questions answered. In all, CIAT's information products reached 131 different countries.

Productivity has been enhanced by increasing sophistication in equipment for all phases of information management. Word processing and computerized photocomposition have significantly speeded up the publication process. Computerized systems that are presently in the implementation phase are expected to similarly streamline bibliographic database management and acquisition of library materials.

Targeting CIAT's Audiences

As the commodity programs decentralize, and their breeding and technology development strategies grow more complex, it has become increasingly important to develop highly specific communication strategies that define both audience and purpose for each product. These strategies result from close collaboration between the commodity programs and CISU.

Additionally, a number of studies have been implemented to determine the needs of specific audiences, their disciplinary specialization, their media preferences and their information-seeking habits. Two studies that sought the users' evaluation of specific CIAT products received very positive responses and provided valuable user insights.

Areas with new research efforts, for example, East Africa, Indonesia, Malaysia, and the Philippines, receive particular attention. A consultant is conducting an in-depth study of bean research communication in East Africa, where special data collection efforts have also been instigated.

Marketing and Distribution

Increasing attention is also being given to delivery systems in order to assure that information generated in CIAT's research programs reaches the end user. A publications catalog, an audiotutorials catalog, and a complete bibliography make all of CIAT's publications available by mail or through the CIAT bookstore. A multi-level, computerized mailing list is being upgraded to serve as a database of collaborators as well as a listing of information users. Computerized inventory control enables CISU staff to study seasonal and geographical fluctuations in demand.

Copies of new publications are sent to selected book reviewers, to agricultural databases, to libraries of almost 500 key institutions. CIAT is an active participant in agricultural information networks, including AGRINTER, AGLINET, and SNICA. Distribution agents in the U.S. and Europe see that interested audiences in their areas know about CIAT's work through direct mail, displays at professional societies, and major book fairs worldwide.

Special Projects

Information Services

This project, financed by IDRC, is to reinforce operations of the specialized information analysis centers on cassava, beans and tropical pastures. Specific objectives (a) for cassava, include strengthening the scientific component in staffing of the Center, increasing outreach activities in Asia and Africa, and producing state-of-the-art reviews or manuals; (b) for beans, improving capacity to collect and organize relevant documents and producing state-of-the-art reviews or manuals; (c) for pastures, upgrading the information bulletin **Pasturas Tropicales** to become a medium of publication for brief research reports and to produce a state-of-the-art review; and (d) for all three centers, strengthening the common services available by computerizing their data bases, improving acquisition facilities in Asia and Africa, duplicating microfiche sets, producing mini-bibliographies, and improving promotion.

	Budget (US'85$'000)	
	1985	1986
Personnel	84	55
Honoraria, Stipends & Allowances	41	46
Supplies & Services	39	36
Travel	—	—
Equipment Replacement & Capital	12	1
Indirect Costs	15	14
Contingencies	—	—
TOTAL	191	152

Training Support Materials

CIAT is seeking funding for this special project to support technology transfer and the development of research capacity in countries where collaborative projects exist between CIAT and national programs.

Through a systematic integration of training support materials with training activities such as field, greenhouse and laboratory practice, and classroom lectures, it is possible to build human capital for the national institutions. Specific objectives are to (a) increase CIAT's capacity to produce a full range of training support materials (e.g., audiotutorials, course materials, field guides) that allow direct audiences to acquire competencies associated with the use of improved technologies emanating from CIAT's research; and (b) make the utilization phase of training support materials for indirect audiences more effective through the strengthening and expansion of a network of centers for utilizing and producing training materials. As of June 1985 funding was not assured.

	Budget (US'85$'000)	
	1985	1986
Personnel	64	129
Honoraria, Stipends & Allowances	6	26
Supplies & Services	13	25
Travel	2	8
Equipment Replacement & Capital	45	56
Indirect Costs	17	38
Contingencies	—	—
TOTAL	147	282

ADMINISTRATION

BOARD OF TRUSTEES

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Honoraria	53	49	49
Supplies & Services	7	20	20
Travel	100	67	68
	160	136	137

Budget Changes

In 1985, a slightly reduced meetings schedule accounts for the reduction in funds budgeted to support the activities of the Board of Trustees.

Program Commentary

The CIAT Board of Trustees has 17 members. Normally the Board holds one annual meeting. Its executive committee, program committee, audit committee, and nominations committee meet at the time of the annual meeting, plus at various intervals throughout the year. Budgeted here are costs for international and national travel, honoraria, per diems, and other expenses directly associated with the meeting of the Board and its committees.

OFFICE OF THE DIRECTOR GENERAL

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Director General	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
Assistant Director	1	1	1	1	1						1	1	1	1	1
Internal Auditor						3	3	3	3	3	1	1	1	1	1
Visitors Office						3	3	3	3	3	2	2	2	2	2
Deputy Director General	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Director of Finance and Administration	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL	5	5	5	5	5	10	10	10	10	10	9	9	9	9	9

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	878	880	880
Supplies & Services	41	33	33
Travel	99	91	91
Replacement Equipment	6	—	
Other Expenses	24	28	30
	1,048	1,032	1,034

Program Commentary

Three Division Heads, the Assistant to the Director General, and the Internal Auditor report to the Director General. The following three divisions make up the organization of CIAT.

Research Division I: it consists of the Bean Program, the Cassava Program, plus the following research support units: Genetic Resources, Biotechnology Research, Station Operations, and Research Services (except Data Services). This division is headed by a Deputy Director General.

Research Division II: it is comprised of the Tropical Pastures Program, the Rice Program, the Data Services Unit, the Agroecological Studies Unit, the Seed Unit, and the Coordinating Office for Training and Conferences. The division is headed by a Deputy Director General.

Finance and Administration: this division, responsible for the general services and financial administration, is headed by the Director of Finance and Administration.

The Assistant to the Director General, in addition to staff responsibilities to the Director General and the Board of Trustees, has line responsibilities for the Communication and Information Services Unit and the Visitors Office. Also, the projects officer is attached to the office of the Assistant to the Director General.

The Office of the Internal Auditor is headed by a General Administrative Staff (GAS) member who also reports to the Director General.

Budgeted in the Office of the Director General are special resources for international travel of directing staff of collaborating national institutions. These resources are used to make possible selected trips of such staff to CIAT for consultation purposes.

ADMINISTRATIVE SUPPORT

Core Resources

	Senior Staff					Scientific & Supervisory					Clerical & Other				
Personnel (Positions)	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Controller						8	8	8	8	8	20	18	18	20	20
Executive Officer	1	1	1	1	1	4	4	4	4	4	8	10	10	10	10
Human Resources						2	2	2	2	2	13	13	13	13	13
Supplies						5	5	5	5	5	23	23	23	23	23
Systems & Procedures						4	5	5	5	5	3	5	5	5	5
TOTAL	1	1	1	1	1	23	24	24	24	24	67	69	69	71	71

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	1,465	1,207	1,207
Supplies & Services	243	198	198
Travel	102	23	23
Replacement Equipment	65	5	5
Other Expenses	41	45	46
	1,916	1,478	1,479

Budget Changes

The reduction in personnel in 1985 reflects the phase-out of additional personnel needed in 1984 in the change-over from a manual to a computerized system in accounting and budgeting. In "actual expenses" for 1984 are included US$228,000 for the External Program Review.

Program Commentary

This section includes the office of the Executive Officer, the Controller, the human resources administration, the systems and procedures department, the purchasing/supplies section, the travel office, and the CIAT offices in Bogota and Cali.

GENERAL OPERATING EXPENSES

Core Resources

Personnel (Positions)	Senior Staff					Scientific & Supervisory					Clerical & Other				
	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88	Act. 84	Bud. 85	Bud. 86	Bud. 87	Bud. 88
Physical Plant Maintenance						4	4	4	4	4	52	53	53	53	53
Physical Plant Security											40	40	40	40	40
Physical Plant Gardens											11	11	11	11	11
Physical Plant Cleaning											52	52	52	52	52
Motor Pool						1	1	1	1	1	51	51	51	51	51
TOTAL						5	5	5	5	5	206	207	207	207	207

Direct Costs (85$Thousands)

	Current Budget		Proposed Budget
	Actual 1984	Revised 1985	1986
Personnel	1,378	1,352	1,352
Supplies & Services	1,199	964	964
Travel	19	27	27
Replacement Equipment	347	419	419
Other Expenses	438	353	344
Gain Exchange Rate	(519)	(300)	(300)
	2,862	2,815	2,806

Budget Changes

Reductions in the budget for supplies and services in 1985 were announced in the Mid-Term Report (1984) as a means to help finance the conversion of part-time program coordinators to full-time positions. These reductions are made up by the introduction of cost-saving measures.

Program Commentary

The Palmira installations consist of about 20 buildings or complexes of buildings including two laboratory buildings, three office buildings, two field laboratory buildings, seed processing and storage facilities, communications and library buildings, conference facilities, food, housing and recreational facilities, six glasshouses, warehouse, a germplasm store and service building for machinery and vehicle maintenance, laundry facilities, water treatment, etc. The gross area of buildings is 42,000 m^2 of which about 50% is airconditioned. The entire complex is served by about 26,000 m^2 of roads and parking areas and is surrounded by about 10,000 m^2 of gardens.

Other than electricity, for which only standby and emergency capacity is maintained, CIAT provides all its own services. The Physical Plant includes resources to run these services, maintain all buildings and grounds and provide security.

CIAT operates a fleet of about 250 vehicles which includes buses, trucks, vans, pickups, jeeps and passenger cars from various manufacturers. The Motor Pool is responsible for servicing, repairing and maintaining these vehicles and for providing bus services to transport personnel to and from work and regular services during the day and night to Cali and Palmira for employees, training participants, and visitors.

SELF-SUPPORTING AND INCOME GENERATING ACTIVITIES

CIAT has several self-supporting activities, which are meant to break even, and several other activities which generate income in excess of the extra costs incurred. Activities falling under the two groupings are as follows:

Self Supporting	Income Generating
Food and Housing	Farm Production
Aircraft Operation	Cattle Herds
Publications Fund	Seed Marketing
Seed Processing & Conditioning	Special Project Support
"PROCIAT" Health Service	

None of these activities appear separately in this budget document although in some cases significant amounts are charged to the core budget. Examples of this are: the food operation, which is partly supported by a subsidy which is charged as a personnel cost; and the aircraft operation, which is funded by charges to individual program's travel budgets. Personnel in each of these activities are shown in the table of positions and manpower (Table II).

CAPITAL REQUIREMENTS

The proposed capital budget amounts to C$1,022,000 for 1986. Of this amount, C$392,000 are for equipment (including capital equipment required for three new senior staff positions in rice (economics), tropical pastures (agronomy, humid tropics), and beans (Africa-wide coordinator). The remaining C$630,000 are for construction projects (genetic resources storage facilities, one glasshouse, one quarantine glasshouse, one field laboratory). Justifications for these construction items are given in the discussion of the Forward List.

Summary of Capital Requirements

	Budget 1986	Projections 1987
Category I Projects (Construction)	630,000	
Category II Expenditures (Equipment)	392,000	680,000
TOTAL	1,022,000	680,000

TABLES

TABLE I

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL

SUMMARY OF MAN-YEARS AND COSTS BY PROGRAM AND ACTIVITY

	ACTUAL				1985 BUDGET						PROPOSED BUDGET		PROJECTION			
	1983		1984		Bottom Brkt.		Top Brkt.		Current Estimate		1986		1987		1988	
	M-Y	83$000	M-Y	84$000	M-Y	85$000	M-Y	85$000	M-Y	85$000	M-Y	85$000	M-Y	85$000	M-Y	85$000
RESEARCH PROGRAMS																
Beans	12.0	2,458	14.0	2,775	16.0	2,905	16.0	2,970	16.0	2,953	16.0	2,983	16.0	2,966	16.0	2,966
Cassava	8.9	1,897	7.6	1,905	9.0	1,925	9.0	1,968	9.0	1,975	9.0	1,943	11.0	2,307	12.0	2,527
Rice	4.5	868	3.1	891	6.0	1,191	6.0	1,217	5.8	1,069	7.0	1,266	7.0	1,266	7.0	1,266
Tropical Pastures	15.9	2,959	14.9	3,233	16.0	3,226	17.0	3,459	16.0	3,284	18.0	3,490	18.0	3,432	18.0	3,402
SUB-TOTAL	41.3	8,182	39.6	8,804	47.0	9,247	48.0	9,614	46.8	9,281	50.0	9,682	52.0	9,971	53.0	10,161
RESEARCH SUPPORT																
Visiting Scient. & Post.Doc.	-	253	-	409	-	446	-	446	-	694	-	694	-	694	-	694
Germplasm Resources	1.0	356	1.0	461	1.0	411	2.0	520	0.7	309	1.0	326	1.0	326	1.0	326
Biotechnology Research	-	-	-	-	-	-	-	-	1.0	211	2.0	353	3.0	495	3.0	495
Research Services	-	269	-	301	-	335	-	335	-	324	-	324	-	329	-	334
Station Operations	1.0	828	1.0	959	1.0	962	1.0	962	1.0	850	1.0	850	1.0	864	1.0	878
Carimagua Station	-	488	-	667	-	524	-	524	-	506	-	506	-	506	-	506
Data Services	1.0	556	1.0	469	1.0	555	1.0	555	1.0	530	1.0	530	1.0	552	1.0	556
Agroecological Studies	1.0	119	1.0	138	1.0	152	2.0	343	1.0	152	1.0	152	2.0	338	2.0	338
Seeds	2.0	667	1.0	364	2.0	477	2.0	477	1.8	477	2.0	453	2.0	453	2.0	453
SUB-TOTAL	6.0	3,536	5.0	3,768	6.0	3,862	8.0	4,162	6.5	4,053	8.0	4,188	10.0	4,557	10.0	4,580
TOTAL RESEARCH	47.3	11,718	44.6	12,572	53.0	13,109	56.0	13,776	53.3	13,334	58.0	13,870	62.0	14,528	63.0	14,741
INTERNATIONAL COOPERATIONS																
Training & Conferences	1.0	1,035	1.0	1,589	1.0	1,374	1.0	1,694	1.0	1,348	1.0	1,461	1.0	1,313	1.0	1,313
Communication & Inf. Supp.	3.0	1,392	2.6	1,478	3.0	1,413	3.0	1,413	3.0	1,439	3.0	1,535	3.0	1,548	3.0	1,552
TOTAL INTERN. COOP.	4.0	2,427	3.6	3,067	4.0	2,787	4.0	3,107	4.0	2,787	4.0	2,996	4.0	2,861	4.0	2,865
ADMINISTRATION																
Board of Trustees	-	107	-	155	-	104	-	104	-	136	-	137	-	134	-	134
Director General	2.0	464	2.0	520	2.0	526	2.0	526	2.0	512	2.0	513	2.0	500	2.0	500
Directors	3.0	430	3.0	493	3.0	527	3.0	527	3.0	520	3.0	521	3.0	508	3.0	508
Administrative Support	1.0	1,580	1.0	1,851[a/]	1.0	1,574	1.0	1,574	1.0	1,478	1.0	1,479	1.0	1,453	1.0	1,456
TOTAL ADMINISTRATION	6.0	2,581	6.0	3,019	6.0	2,731	6.0	2,731	6.0	2,646	6.0	2,650	6.0	2,595	6.0	2,598
GENERAL OPERATING EXPENSES																
Physical Plant	-	1.537	-	1,564	-	1,490	-	1,490	-	1,349	-	1.344	-	1,314	-	1,314
Motor Pool	-	609	-	701	-	975	-	975	-	915	-	907	-	902	-	905
General Expenses	-	1,899	-	500	-	906	-	906	-	551	-	555	-	538	-	542
TOTAL GENERAL OPER.EXP.	-	4,045	-	2,765	-	3,371	-	3,371	-	2,815	-	2,806	-	2,754	-	2,761
OTHER																
Contingency						224		224		216		133		228		230
Provision for Price Changes												783		2,705		4,807
TOTAL CORE	57.3	20,771	54.2	21,423	63.0	22,222	66.0	23,209	63.3	21,798	68.0	23,238	72.0	25,671	73.0	28,002
TOTAL SPECIAL PROJECTS		1,168		1,250		1,169		1,169		2,131		3,183		3,000		3,000
CATEGORIES OF EXPENSES																
Personnel Costs		13,090		13,955		14,197		14,736		14,768		15,372		15,862		16,060
Honoraria, Stipends & Allow.		647		1,180		1,083		1,402		1,275		1,377		1,417		1,417
Supplies & Services		3,358		3,522		3,535		3,625		3,193		3,192		3,267		3,304
Travel		1,441		1,492		1,344		1,383		1,303		1,323		1,350		1,345
Equipment		1,375		848		849		849		656		643		605		602
Other		860		426		954		954		351		381		237		237
Contingency						260		260		252		167		228		230
SUBTOTAL		20,771		21,423		22,222		23,209		21,798		22,455		22,966		23,195
Provision for Price Changes												783		2,705[b/]		4,807[b/]
TOTAL CORE		83$20,771		84$21,423		85$22,222		85$23,209		85$21,798		86$23,238		87$25,671		88$28,002

24/ 07/ 85

a/ Included US$220 for External Program Review

b/ Inflation between budget years 1986 and 1987, and between 1987 and 1988, are calculated at 8.0 percent.

CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL
SUMMARY OF SOURCES AND APPLICATION OF FUNDS
(C US$ Thousands)

	ACTUAL		1985 BUDGET			PROPOSED BUDGET	PROJECTIONS	
	1983	1984	BOTTOM BRACKET	TOP BRACKET	CURRENT ESTIMATE	1986	1987	1988
SOURCES OF FUNDS								
Core Operations								
Australia	404	505			545			
Belgium	121	106			110			
Brazil		400			400			
Canada	1,300	1,239			1,240			
China		33			33			
European Economic Community	1,351	1,225			1,285			
Ford Foundation	100	100			100			
France	46	31			50			
Germany (Federal Republic)	1,041	814			732			
Interamerican Development Bank	4,043	4,043			4,040			
International Fund for Agricultural Development	1,150	1,000			1,000			
Italy	293	289			628			
Japan	1,303	1,329			1,330			
Mexico		397						
Netherlands	285	244			235			
Norway	295	274			245			
OPEC Fund for International Development	300	300						
Rockefeller Foundation	100				54			
Spain	50	50			30			
Sweden	79	98			130			
Switzerland	453	452			477			
United Kingdom	458	447			420			
United States of America	5,400	5,600			5,600			
World Bank	410	921						
Unidentified Sources			19,606	20,593	512	20,672	24,800	27,364
Balance (deficit) from previous year	165	-15			-39			
Income applied in year	69		575	575	600	621	621	621
TOTAL CORE OPERATING FUNDS	19,216	19,882	20,181	21,168	19,757	21,293	25,421	27,985
Capital								
Others	605	115						
World Bank		409						
Unidentified Sources			394	602	302	1,142	883	682
Income applied in year	794	375						
Balance of working funds	1,500	1,577	1,800	1,800	1,577	1,577	1,697	1,900
TOTAL CAPITAL FUNDS	2,899	2,476	2,194	2,402	1,879	2,719	2,580	2,582
Special Core Projects								
Ford Foundation	35	10			84			
International Development Research Centre (IDRC)	57	75			154			
Kellogg Foundation	569	266						
Switzerland	952	2,065			762			
U.N. Development Programme (UNDP)	110	249			391			
Unconfirmed Sources			1,858	1,858		1,430	250	17
Balance from previous period	372	519	183	183	1,220	515		
TOTAL SPECIAL CORE PROJECT	2,095	3,184	2,041	2,041	2,611	1,945	250	17
Special Projects								
Belgium	29	33			106			
Board of the Andean Pact		24						
Canada (CIDA)					359			
Ford Foundation	25	30			95			
FAO	42	2						
German Agency for Technical Cooperation (GTZ)	91	55			97			
German Foundation for International Development	41	-4						
IBPGR	19	92			35			
International Development Research Centre (IDRC)		240			271			
Japan		200						
Switzerland	434	485						
U.N. Development Programme					136			
U.S. Agency for International Development (AID)	44	68			305			
World Bank	204				179			
Others	10	2			44			
Unidentified Sources			1,169	1,169		3,141	3,000	3,000
Balance from previous year	314	525	500	500	908	442	400	400
TOTAL SPECIAL PROJECTS	1,253	1,752	1,669	1,669	2,535	3,583	3,400	3,400
Projects at CIAT by Sister Institutes								
International Fertilizer Development Center (IFDC)	85	109			76			
International Maize and Wheat Improvement Center	17	88						
International Rice Research Institute	70	237			188			
Intsormil	105	65						
Intsoy	10	10						
Unconfirmed Sources					38			
Balance from previous year	12	-141			-38			
TOTAL PROJECTS BY SISTER INST.	299	368			264			
TOTAL FUNDS	25,762	27,662	26,085	27,280	27,046	29,540	31,651	33,984
APPLICATION OF FUNDS								
Core Operation	20,771	21,203	22,222	23,209	21,798	23,238	25,671	28,002
External Review		220						
Capital	1,358	1,361	302	427	357	1,022	680	488
Special Projects	728	844	1,169	1,169	2,093	3,183	3,000	3,000
Projects at CIAT by Sister Institutes	440	406			264			
Unexpended Balances								
Unrestricted Core (deficit)	-15	-39						
Working Funds	1,577	1,577	1,892	1,975	1,577	1,697	1,900	2,094
Special Core Projects	519	1,220			515			
Special Projects	525	908	500	500	442	400	400	400
Projects at CIAT by Sister Institutes	-141	-38						
SUB-TOTAL	2,465	3,628	2,392	2,475	2,534	2,097	2,300	2,494
TOTAL APPLICATIONS	25,762	27,662	26,085	27,280	27,046	29,540	31,651	33,984
Memo :								
1. Total Core Operating Funds Required	20,771	21,423	22,222	23,209	21,798	23,238	25,671	28,002
Less unexpended balance previous year	-165	-253	-183	-183	-1,126	-515		
Less earned income applied	-69		-575	-575	-600	-621	-621	-621
Net Core Operating Funds Required	20,537	21,170	21,464	22,451	20,072	22,102	25,067	27,398
2. Total Capital Funds Required	2,330	2,823	2,194	2,402	1,934	2,719	2,580	2,582
Less unexpended balance previous year		-251			-55			
Less balance working funds	-1,500	-1,577	-1,800	-1,800	-1,577	-1,577	-1,697	-1,900
Less earned income applied	-794	-375						
Net Capital Funds Required	36	620	394	602	302	1,142	883	682
3. Total Funds Required from Donors	20,573	21,790	21,858	23,053	20,374	23,244	25,933	28,063
4. Total Earned Income	863	375	575	575	600	621	621	621
Applied to Core Operation	-69		-575	-575	-600	-621	-621	-621
Applied to Capital	-794	-375						
Balance	-	-	-	-	-	-	-	-

CENTRO INTERNACIONAL DE AGRICULTURAL TROPICAL

TABLE III

SUMMARY FINANCIAL DATA 1983 - 1986

	Actual 1983	Actual 1984	1985 Budget Bottom Bracket	1985 Budget Top Bracket	1985 Budget Current Est.	Budget 1986
Current Assets						
Cash and Banks	3,698	2,841	3,400	3,400	3,400	3,500
Receivable from Donors	1,177	834	900	900	900	900
Receivable from Employees	210	168	220	220	220	300
Receivable from Others	1,276	1,975	2,000	2,000	2,000	2,120
Inventories	1,492	1,678	1,000	1,000	1,000	500
Prepaid Expenses	47	72	80	80	80	80
Properties for Sale	58	201	200	200	200	200
Total Current Assets	7,958	7,769	7,800	7,800	7,800	7,600
Long-Term Accounts Receivable and Other Assets	823	1,019	1,187	1,187	1,187	1,215
Fixed Assets						
Research Equipment	5,300	5,787				
Aeroplane	1,271	1,299				
Vehicles	2,655	2,796				
Furnishings & Office Equipment	1,458	2,154				
Buildings, Lands & Construction in Progress	7,268	7,766				
Total Fixed Assets	17,952	19,802	20,104	20,229	20,159	21,181
TOTAL ASSETS	26,733	28,590	29,091	29,216	29,146	29,996
Liabilities						
Bank Overdrafts		125	100	100	100	100
Accounts Payable	3,439	3,851	4,127	4,044	3,985	4,183
Employees' Social Benefits	1,840	1,516	1,668	1,668	1,668	1,835
Grants Received in Advance	1,052		700	700	700	600
Total Liabilities	6,331	5,492	6,595	6,512	6,453	6,718
Fund Balances						
Invested in Fixed Assets	17,952	19,802	20,104	20,229	20,159	21,181
Unexpended Funds (deficit)						
Core Unrestricted	(15)	(39)				
Working Fund Grants	1,562	1,245	1,892	1,975	1,577	1,697
Special Core Projects	519	1,220			515	
Other Special Projects	384	870	500	500	442	400
Total Fund Balances	20,402	23,098	22,496	22,704	22,693	23,278
TOTAL LIABILITIES AND FUND BALANCES	26,733	28,590	29,091	29,216	29,146	29,996

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