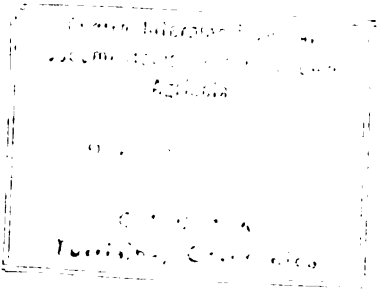
FACING THE CHALLENGE

A ten-year strategic plan for 1988 to 1997



CENTRO AGRONOMICO TROPICAL DE INVESTIGACION Y ENSEÑANZA

CATIE

Turrialba, Costa Rica

1988

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PREFACE

This document lays out the objectives of CATIE over the next ten years and explains how it intends to reach them. It is based on the agricultural development needs of Central America and the Dominican Republic and the attributes of CATIE that make it capable of addressing those needs. The plan covers the following:

- What CATIE is.
- What CATIE has accomplished over the past 45 years.
- What other related institutions operating in the area are doing.
- What yet needs to be done in Central America -- the major challenges.
- CATIE's comparative advantages in responding to the challenges.
- CATIE's research and educational priorities.
- CATIE's organization to mobilize these priority activities to contribute to the challenge.
- Alternative staffing patterns and activity levels to correspond to projected funding levels.
- CATIE's proposed graduate program.
- Other considerations, including governance.

However, this document is more than just an institutional plan. It encompasses a strategy of horizontal cooperation and of integration among the different agricultural research, education and development institutions and programs operating in the region. Such integration is a vital element in the development of the institutional strategy. It is the only way to work towards obtaining the technological innovations that are necessary for the modernization of the region's agriculture and for producing an impact on agricultural development. It is also the only way to link production and productivity with conservation of natural resources aimed at a sustainable agricultural development. And it is, undoubtedly, the only way to link research and educational activities with efforts oriented towards agricultural growth and development.

As in any document of this kind, indications are given about the financial requirements to implement the strategy over the next ten years. It is important to note, however, that because of a clear definition of research priorities that imply a concentration of efforts in selected critical areas, and because of a rather conservative projected institutional growth, the financial requirements, particularly in terms of number of staff, are not much

different from today's existing figures. What is required is a change in the present financial structure (25% core budget : 75% special projects) because a medium-term strategic plan cannot be implemented with a short-term special projects' funding structure. This is the key to a successful implementation of CATIE's strategic plan for 1988 to 1997.

Rodrigo Tarté
Director General

EXECUTIVE SUMMARY

As a development-oriented research and education institution, CATIE has defined a medium-term strategy that will allow the Center to meet the challenge towards increasing and sustaining agricultural productivity and development in conjunction with the national institutions. CATIE's actions will strive at strengthening such institutions as well as at collaborating and complementing efforts with other international, regional or national research, education and development organizations or programs. It is believed that an effective institutional horizontal cooperation mechanism can be put into work through the establishment of a Regional Agricultural Research and Education System in which each participating institution would play a carefully planned, active and complementary role. CATIE hopes to play an important role in the organization of this system.

In order to perform its task, CATIE has identified research and educational priorities which have been incorporated into three interactive research and development programs, described as follows:

1. PROGRAM I - Tropical Crops Improvement. This Program is oriented towards a) improvement of coffee, cacao and plantain aimed at obtaining more productive and disease resistant genetic material, b) collection, maintenance, evaluation and distribution of promising tropical plant genetic resources, and c) technology development through emphasizing research on critical components limiting production of coffee, cacao, plantain and promising tropical crops.

2. PROGRAM II - Sustainable Agricultural Production and Development. This program is oriented towards a) technology development through emphasizing research on critical components limiting production of annual food crops (rice, corn, beans and sorghum), livestock (meat and dairy bovine cattle), and forestry, b) development of improved economic and sustainable production systems aimed at an integrated regional development, and c) development of improved methods for agro-technology transfer and utilization of new technologies by farmers.

3. PROGRAM III - Integrated Natural Resources Management. This program is oriented towards a) providing general biophysical and socio-economic information aimed at integrated regional resources management, b) conducting appropriate planning of regional natural resources utilization as a basis for the development of sustainable production systems, c) providing information and assistance on conservation of regional natural

resources (soil, water, natural forests, biological diversity), and d) conducting research on resources management.

All three Research and Development Programs will work in coordination among themselves and integrate their activities with a perspective of integrated regional development. While Program III has the responsibility of providing information and assistance on management of natural resources and its integration with the production and development-oriented research and education activities of Programs I and II, these two programs have in common the development of technological components or new technologies that would, in a complementary way with National Agricultural Research Systems (NARS's) and International Agricultural Research Centers (IARC's), be used to assemble improved production systems under the responsibility of the Production Systems Area of Program II. Joint and complementary actions with national programs will be conducted in a few pilot areas where a multi-disciplinary concentration of efforts will be achieved. It is expected that in these pilot areas located in different geographical regions of CATIE's member countries, the efficiency of the integrated action will be improved and the impact of the expected results will be more meaningful.

It is hoped that after five years, improved economic and sustainable production systems in which innovative technologies have been tested and put into operation will be used by the majority of farmers in at least one pilot area per country. Attempts will be made so that by the end of ten years, the majority of farmers of the main producing areas in each country will use the advanced technologies. Significant production increases and improvements in the standard of living of rural families should occur, providing the pieces of the R&D regional system are carefully and adequately coordinated and appropriate political decisions are taken. By the same token, the present trends in deforestation rate will have to be stopped by the end of ten years, in favor of a rational utilization of forests and other natural resources of the region.

The educational programs constitute the second pillar of CATIE's activities. While CATIE focuses its research, and hence its development impact, on the people of Central America and the Dominican Republic, it has a Latin American mandate in education (graduate degree and continuing education levels). On the other hand, CATIE does not limit its activities in the formation of human resources to the programmatic areas of research already mentioned. Although these areas constitute one of the bases of its educational activities, it is also involved in other areas needed to articulate its multi-disciplinary and integrated approach and to develop the human resources needed in the fields of agricultural sciences, natural resources and related fields.

CATIE approaches the development of human resources through an institutional strategy of horizontal cooperation. By means of a networking mechanism, CATIE focuses its educational activities within the context of a research-education-development system involving its seven member nations (Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama). The "Regional Cooperative Network for Education in Agriculture and Renewable Natural Resources (REDCA)", involving more than 60 institutions of higher education, ministries of agriculture, research institutes and national councils on higher education of the seven member countries represents the main mechanism or strategy of action. Through the operation of this network, CATIE seeks to strengthen the national research and educational institutions, and contribute to the strategically vital formation of human resources needed in accelerating and sustaining development in the region.

It is hoped that after five years, some 460 students will have received their M.Sc. degree from CATIE, and a total of 935 will have done it after ten years. They will constitute a critical mass which will add to the inputs required to attain the desired goals of agricultural growth and development in the region.

A summary of the costs required to implement the above mentioned programs can be seen in Tables 11, 12 and 13. It is obvious that an institutional strengthening that could guarantee a sound and sustained growth is vital to the implementation of the strategy. This would imply to somewhat reverse the present financial structure (75% special projects, 25% core) and be able to expand the core budget (including restricted core funding) operations. Such re-dimensioning of the financial position of CATIE is being taken into consideration as some new fund raising activities as well as productive operations are being put into practice. Also, a major step has been taken towards more institutional stability by improving the management of finances and administration and giving more responsibility and stability to CATIE's Governance.

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BACKGROUND

1. CATIE: A REGIONAL CENTER FOR AGRICULTURAL RESEARCH AND EDUCATION

1.1 MANDATE

CATIE is a regional institution whose efforts are devoted to research and education for agricultural development and the integrated management of natural resources.

CATIE had its beginnings in 1942 with the foundation of the Inter-American Institute of Agricultural Sciences (now IICA). In 1973, CATIE became an autonomous body at the signing of a contract between the Government of Costa Rica and IICA. Since then, seven countries have become members of CATIE: Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panamá.

CATIE's mandate includes: scientific research in agriculture and natural resources in the American Tropics, particularly Central America and the Caribbean; and education in agricultural sciences and natural resources through graduate studies leading to a master's degree, and diverse forms of training. While CATIE has a Latin American mandate in training, it strives to focus its research, and hence its development impact, on the people of Central America and the Dominican Republic.

To fulfil its mandate CATIE maintains a highly-qualified professional staff at its headquarters in Turrialba, Costa Rica (located in a valley 650 meters above sea level, 64 kms from San Jose, the capital city) as well as scientific personnel for operations in its seven member countries.

CATIE strives to:

- Measure its impact in terms of development--improving the people's standard of living, particularly the poor rural families--rather than in terms of the number of varieties released or the number of people trained.

- Develop agricultural technologies (improved varieties and practices) aimed at increasing and sustaining productivity and, hence, improving nutrition, health, and income.

- Increase through training and technical assistance, the supply of skilled and experienced scientists and technicians to carry out much-needed research, make the research findings available to farmers and other rural dwellers, and promote a policy environment to support and encourage the adoption of improved technologies and practices.

In addition to its unique blend of research and training (both at the graduate and the continuing education levels), CATIE also seeks to balance its efforts between production and conservation for agricultural growth and development.

A comprehensive review that has been conducted since 1984 highlighted the need to define priorities under a medium-term institutional strategy in order to better meet the challenge of low and unsustainable agricultural productivity and development so characteristic of the region. For that reason a ten-year strategic development plan was approved by CATIE's Board of Directors in November 1987.

Elaboration of the plan involved numerous internal and external consultations, and especially constant consultation with the member countries. This innovative mechanism enacted during the pre-change phase made it possible for the institution to involve itself more with the national research and education programs and, consequently, with the agricultural development process of the countries.

1.2 FUNDING STRUCTURE

Since its creation as an autonomous organization in 1973, CATIE has experienced remarkable growth in its activities, programs and infrastructure, thanks to financing and special projects offered by many agencies and governments.

While the execution of special projects through cooperative agreements with donor institutions and Governments has increased from US$5.9 millions in 1984, to 6.6 in 1985, 7.6 in 1986 and 12.2 in 1987, this situation has led to an imbalance between the core* and special projects budget. In 1987,

* CATIE's core budget is formed by members' contribution (IICA and member countries) on an annual basis, special projects' overhead charges, and some productive commercial activities.

special projects represented 78.7% of CATIE's total budget. This situation has obviously worked against sound and sustained growth and has diminished CATIE's capacity for development, as it has been impossible to both maintain the diversity of actions that have characterized the institution and, at the same time, provide for the necessary counterpart contributions needed for the development of new projects.

To implement the new strategic development plan, CATIE urgently needs to be strengthened both scientifically and academically. This, of course, calls for sound financial management and an effective administrative structure to effect the projected changes with maximum efficiency. This task would be impossible without a bigger core budget, without which core activities would have to be restricted, thus limiting the projected medium and long-term programs. However, CATIE's financial structure is being reconsidered and new fund-raising activities as well as productive operations are being put into practice.

1.3 MAJOR ACHIEVEMENTS

Following on the footsteps of its predecessor organization in Turrialba, Costa Rica, CATIE has singularly combined research and educational activities, thus providing a solid foundation and decisive projection for agricultural development in the region of its mandate, and other countries of the American tropics.

Under the auspices of IICA, and then as an independent center, CATIE has worked consistently and effectively to strengthen the national research programs.

One of the most important achievements in its research programs has been the development of an orientation toward benefitting the small farmers, since they are the most numerous producers in the agricultural systems of CATIE's geographic domain and are responsible for a large share of their countries' production.

CATIE has contributed to develop a viable methodology for farming systems research, the results of which have been applied in specific areas. CATIE has also greatly raised the capacity of the national institutions to manage these methodologies. They have, in fact, been adopted by the ministries of agriculture and research institutions of four countries of the region: Panama, Honduras, Guatemala and El Salvador.

Moreover, CATIE, because of its vast experience in research, has assumed a leadership role in diverse areas, including silviculture, agroforestry and the management of renewable natural resources.

Currently CATIE is the only international institution of its kind that is seriously addressing the problem of natural resources management in the Central American and Caribbean region. Because of this emphasis and the interest it has created in different donor groups all over the world, CATIE has been making notable progress toward balancing conservation of resources and increased production.

The Center has also succeeded in developing technologies that have led to the growth of agricultural production in the region, particularly in the selection and development of high-yield disease resistant varieties of coffee and cacao--extremely important traditional export crops.

The results of CATIE's research in integrated pest management, as well as in milk production systems for small farmers, have been widely disseminated. Equally important has been its action with regard to developing the protected wildlands of Costa Rica, Panama, Honduras, Belize, Nicaragua, El Salvador, Guatemala and the Dominican Republic.

In other areas of work CATIE maintains and distributes improved animal and plant germplasm. The plant genetic resources collection maintains around 5,000 introductions in seed form (seed bank), around 5,000 as live collections, and 150 in tissue cultures.

CATIE has developed tissue culture propagation techniques for coffee, plantains and other crops, making it possible to mass produce disease-free materials and distribute them to national researchers for use in their own research programs.

Another one of CATIE's vital technical resources is its library, with over 80,000 volumes and 11,000 periodicals, which probably constitute the most complete collection of books on tropical agriculture in Latin America today.

The Center's related bibliographical services, pest and disease inventories and its capacity to process data are unparalleled in the region, and they are widely used.

CATIE being the first institution in the region to offer a graduate program in agricultural sciences, is now a leader in graduate education, with a highly competitive program. Around 1,000 students have earned a Master's degree since 1944. Now these professionals fulfil vital roles (many of them in decision-making positions) in their own countries. A recent study revealed

that approximately a third of the graduates work in the academic field, a third are in government and business administrative positions, and the rest are working in research and development organizations.

From 1974 to the present some 5,500 participants have attended short courses and seminars offered by CATIE (over 10,000 since 1944).

Further, with the recent expansion of CATIE's graduate program, a network of national universities and research institutions (REDCA) was established for the purpose of strengthening the scientific and technological base required by the region's agricultural development.

1.4 INSTITUTIONAL STRENGTHS

CATIE has developed over the years a very special capacity for regional research and educational activities that qualifies it as a solid institution with numerous comparative advantages:

1) Its experience in the fields of production (agriculture, livestock, forestry) and conservation of the region's natural resources: CATIE's programs in agriculture, animal production and agroforestry are aimed at increasing the productivity of the small farm, while at the same time, its activities in watershed management, land use planning and wildlands management seek to protect our ecosystems from permanent damage and make the best use of our basic natural resources. In both domains CATIE has developed areas of excellence. Unlike other international research centers and many other rural development agencies, CATIE is able to integrate its actions--a clear advantage for a region, where the majority of the land is unfit for farming and where a massive process of deforestation is constantly taking place.

2) CATIE's research emphasis in areas not covered by other institutions: in spite of the importance of coffee and cacao to the economies of Central America, at present no international agricultural research center is providing the support required by the national research agencies in those perennial crops. CATIE's programs concentrate on filling this void, both through its research programs and the development of strong ties with national universities and programs all over the world. Its educational programs and its direct technical assistance are mechanisms for extending the advances in research to those national entities. For these reasons CATIE is justifiably known as a center of excellence in coffee and cacao.

In annual crops, the international centers conduct much of the basic research required by the national agencies. Nonetheless, improved technologies are useful only when they are adapted to the specific circumstances of their potential clients. In this respect, CATIE's recent policy has been to avoid duplicating the research work of other international centers and concentrate on the integration of technologies in an appropriate way for the small farmers of the region. Hence, a multi-disciplinary approach has been followed, conceiving production as an integrated system and regarding technologies from not only a technical but also a socio-economic perspective. Further, CATIE has incorporated agroforestry into this integrated approach, offering new alternatives to the small farmer.

Of great significance to regional development is the progress CATIE is making in the conservation of Middle America's genetic resources and the utilization of promising genetic material of food crops, forest species, medicinal plants and spices, among others. CATIE's live collections constitute an invaluable material with a great economic potential.

3) CATIE possesses several special qualities as a regional research organization: because of its regional mandate, CATIE can maintain very close relations with the national programs (both research and education).

CATIE's representatives in each country adequately follow up on the needs, priorities and potentials of these institutions.

The research and educational programs can be adjusted to respond to the specific problems of each country. Also by bringing together students from all of its member countries, CATIE takes on a somewhat informal, but no less important role, as a liaison for discussion between countries, as a debate forum and a very distinctive collaborator in seminars, short courses and other activities. Finally, CATIE establishes ties among research scientists working on common problems in different parts of the region.

What is more, the regional nature of CATIE's mandate and the close contact CATIE maintains with the national institutions allows it to magnify the potential, through its activities, of the multi-lateral resources it obtains. Thus, we can accurately speak of "economies of scale" for a region with a group of countries totalling 32 million inhabitants.

4) CATIE is recognized by the national institutions as a source of regional stability. Its relative independence from the national political vicissitudes, put it in a position to undertake long-range research programs.

Moreover, this relative independence gives CATIE direct access to the international community, with whom it has continued to expand its formal ties, especially during the last two years. Likewise, this makes it possible to recruit international staff, whose magnitude and diversity of specialized knowledge, enables the Center to act as a source of technical cooperation.

CATIE's prestige, firmly rooted in the region, place it in an advantageous position to promote activities of horizontal cooperation through research and educational networks.

5) As an educational and training center, CATIE can provide a unique, rich experience. In part, this is so because its scientific staff is involved in both research and teaching. In general, in most of the universities of the region the faculty is not heavily involved in research due to time limitations, inadequate physical facilities and insufficient financing. By contrast, CATIE's staff devotes a large share of its time to researching the key problems of the region. Its teaching reflects that experience. Students and professors alike benefit from this dual role.

2. AGRICULTURAL RESEARCH AND EDUCATION IN THE REGION: OTHER INSTITUTIONS

Every country in the region has some national organization devoted to agricultural research whose work is crucial to agricultural development. Certainly, they have made a significant contribution. Their effectiveness is hindered, however, by such problems as low and fluctuating budgets; not enough qualified researchers; scant resources that must be distributed among many programs; austere economic situations in the countries making it necessary to reduce public spending, particularly affecting the budget for operating costs; relatively low salaries, making it difficult to retain the most qualified personnel. All of these hamper the possibility of maintaining stable long-term research programs.

The national research centers, however, have succeeded in carrying out relatively effective applied on-farm research activities (in this, CATIE has played an important role). Their research has been conducted mainly with

staple and annual food crops, although recently there has been some interest in investigating non-traditional crops. Research in the area of livestock has been very limited, while virtually non-existent in forestry.

The international agricultural research centers have conducted research on most of the important food crops of the area: CIMMYT, with headquarters in Mexico works with wheat and corn. CIAT, in Colombia, is researching beans, cassava, rice and tropical pastures. CIP, in Peru, works with potatoes and sweet potatoes, and ICRISAT, in India with sorghum. The most important contributions of these international centers have been made in the production of germplasm, the development and distribution of research methodologies and the offering of training and information to the national systems. CIMMYT, CIAT and CIP all have a regional program in Central America which links them directly with the national institutions.

The private sector, is also beginning to participate in two ways which could prove to be significant in the future: 1) through farmers associations, especially producers of export crops who conduct applied research on their own products of interest and 2) through companies that produce and distribute supplies such as fertilizers, pesticides and seeds, who carry on some adaptive research at the regional level in their specific areas of interest, particularly in plant protection, in which they have been increasing their cooperation with the national research institutions.

Several centers of higher education in the region offer programs in agriculture. Generally, however, these programs are oriented toward undergraduates. Moreover, the university research programs of those countries, are very limited by budgetary restrictions and are usually quite modest.

There are many possibilities for improving the academic capacity of the higher education centers through cooperation and complementation. This is where CATIE aims to play a key role by seeking, among other things, to improve technology transfer, an area of great weakness in the region.

3. CHALLENGES THE REGION FACES

Agriculture has historically been the backbone of the economy of the 32 million people living in the seven countries of Central America and the Dominican Republic. In 1980, agriculture accounted for over one quarter of Central America's GNP, it directly employed over half of the labor force, and traditional exports generated over 60 % of the region's export earnings. A large portion of industrial employment, such as food processing and textiles, depends on the agricultural sector.

The World Bank estimates that over 70 % of the rural families in Central America and the Dominican Republic could be classified as poor. These people derive most of their income from agriculture. In spite of the international research efforts to produce improved germplasm, except for beans, the yields of the main staples (rice, corn, plantain, sorghum, roots and tubers) is way below the world average. Diseases and pests as well as the lack of an adequate system of technology transfer greatly limit the production of these food items. Low agricultural productivity and decreasing per capita food production (Fig.1) are the chief causes of rural poverty and the sluggish growth of the agricultural sector.

Likewise, livestock production is experiencing difficult times due to the poor existing genetic base and the low carrying capacity per area unit. Although the region does possess comparative advantages for producing some export crops such as coffee, bananas and cacao, the emergence of new deadly diseases (coffee rust, black sigatoka in bananas, moniliasis in cacao) pose a constant threat to their production. The importance of other traditional export products such as cane sugar has diminished to the point where huge areas once devoted to their production are being replaced or new alternatives are being sought.

The possibility of diversifying production for export markets with non-traditional crops is limited by the unavailability of information about their cultivation and of high quality germplasm, as well as by the lack of knowledge about the actual potential and limitations of the markets.

Population expansion in the region (2.8 % annually) has put a tremendous strain on natural resources. High population densities combined with inequitable access to good lands have resulted in attempts to intensively farm steep hillsides and other vulnerable lands, threatening to degrade permanently the very resource base upon which the livelihood for most of the rural population depends. In Central America, forests disappear at a rate of 400,000 hectares per year, equivalent to 3.5% of the actual remaining forest. This is one of the highest deforestation rates in the tropical world. Many of these vulnerable lands are being farmed in total disregard of cultivation practices and conservation measures which would avoid erosion.

Obviously an enormous effort must be put forth in order to raise substantially the standard of living and income for rural families while ending the destruction of natural resources. Even though numerous complex factors come into play in the search for solutions to these problems, the modernization of agriculture is, doubtless, one of the most crucial elements to activating rural development.

To modernize agriculture, we must come up with new management options for the tropics that will make sustained agricultural development possible, placing equal emphasis on new production technologies designed to raise yields and make more efficient use of the land, and on the conservation of the resources that sustain agricultural production.

Unless progress is made to improve agricultural productivity and conserve the natural resource base of the region, the agricultural sector will never be the needed "engine of growth" to the economies of Central America and the Dominican Republic, and sustainable agricultural development will be impossible. As a complement to this technical challenge, however, there must be an integrated planning for rural development that will assign a primary role to technology generation and transfer and its integration into the rest of the productive process. This is the biggest challenge to agricultural science and technology in the region.

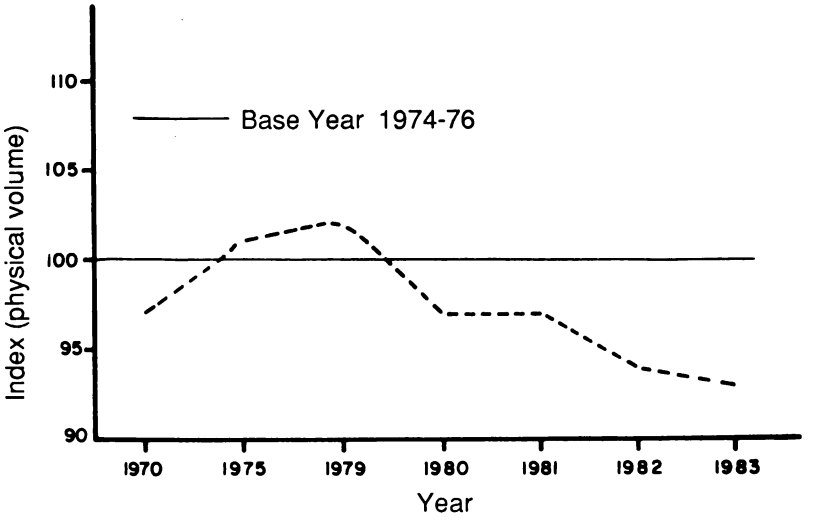


Fig. 1. PER CAPITA FOOD PRODUCTION IN CENTRAL AMERICA

Taken from Gallardo María Eugenia and J. R. López: "Centroamérica, la crisis en cifras". IICA, FLACSO. 1986.

THE PLAN

4. RESEARCH AND EDUCATION FOR AGRICULTURAL DEVELOPMENT: A NEW DIMENSION

There is an obvious and urgent need to accelerate and sustain agricultural growth and development in the region. The situation described previously makes it easy to realize the need for an institutional strategy that would allow CATIE to respond efficiently and effectively to the challenges that are faced. This calls for adjustments and changes in agricultural research and education, as they both are the two columns which should support our agricultural development efforts.

Agricultural research has today a more challenging role than in the past. There is an increasing awareness of the need to generate technological innovations as a pre-requisite to the modernization of agriculture needed to spur agricultural and rural development.

This makes us consider the need to make our efforts devoted to higher education in agriculture more appropriate to guarantee the training of the scientifically qualified human resources required to produce the urgently needed technological innovations, and perhaps the need to produce a new breed of specialized professionals with a greater degree of knowledge and awareness about our problematic agricultural development situation, so that they can face the challenge of today's agriculture with dedication, competence and commitment.

4.1 THE STRATEGY

CATIE's strategic plan is mainly the outcome of continuous consultation with the member countries. CATIE works with the national institutions to meet the challenge, seeking at the same time to strengthen those institutions. This joint action in research and education will provide mechanisms that will make technology generation more efficient and improve technology transfer substantially.

CATIE is involved in several activities that should be continued and enhanced, but its efforts in the next few years must capitalize on its present areas of strength and accurately focus its limited available resources on

high priority activities aimed at solving the principal problems that hinders the region's progress. Thus, CATIE will concentrate its efforts on a few priority areas that require the shaping of a stable critical mass.

This strategy will require at least three guiding elements to facilitate its implementation:

1) Develop and transfer technological innovations that will contribute to modernize the region's agriculture. Research should be oriented, therefore, to increase and sustain productivity through appropriate integrated natural resources management, to find ways of reducing production costs, to find and develop more efficient ways to utilize the natural resource base (i.e. through appropriate biotechnology) instead of trying to use external imported resources, and to develop new methods for increasing the efficiency of agrotechnology transfer. Further, CATIE's educational programs should seek to train the scientifically qualified human resources required to spur on the modernization of the region's agriculture.

2) Maximize the use of a systems' approach to agricultural growth and development. Emphasis will be given to research on the critical components of farm production systems and their integration into highly-productive technological packages or options, to the use of a regional perspective for an integrated management of the resources and the development of improved production systems, and to the establishment of ties with other institutions in order to integrate planning, research, education, and development.

3) Strengthen horizontal cooperation mechanisms among institutions with an eye to establishing a Regional Agricultural Research and Education System. This would give a new and challenging dimension to agricultural research and education in the region by integrating CATIE's activities with those of national, regional and international institutions operating in the region. While this approach might seen difficult to implement, CATIE has already taken some very successful steps in this direction with the establishment of the REGIONAL COOPERATIVE NETWORK FOR EDUCATION IN AGRICULTURE AND RENEWABLE NATURAL RESOURCES. Established in June 1986, with the participation of more than 25 Universities, Ministries of Agriculture, and Agricultural Research Institutions, this network constitutes, as will be explained later, the essence of the new dimension of CATIE's higher educational programs*.

* By May 1988, over sixty institutions had become members of REDCA.

Within the context of horizontal cooperation, universities outside the region would play a very important role. So far, a few selected universities from the United States (University of Missouri, Iowa State University, Colorado State University, University of Wisconsin, etc.) and Europe (University of Wageningen) have begun or are planning collaboration activities in some of CATIE's priority areas. They could participate and coordinate activities within the above-mentioned network, thus strengthening the Regional Agricultural Research and Education System.

4.2 RESEARCH PRIORITIES

CATIE has approached the task of identifying research priorities in four steps:

First, it identified the activity areas in which it is currently engaged, including staff allocation to each activity area (Annex 1).

Second, it evaluated each activity area in terms of five criteria:

1) actual productivity,
2) potential productivity,
3) comparative advantages,
4) regional importance,
5) regional shortcomings.

The results were grouped into three categories: high, medium and low priority (Annex 2).

Third, it lowered several of the "high priority" categories based on additional considerations, such as the need to emphasize those critical disciplinary areas which are inadequately covered in national or regional programs, as well as CATIE's responsibility to assist NARS' in carrying out site-specific adaptive research and testing. Seven priority program areas were identified (Table 1).

Fourth, it surveyed professional staff to identify staffing needs in each of the high priority areas at two levels:

1) the minimum critical mass needed to produce the required results; and

2) the desirable staffing pattern to effect those results more rapidly. Staffing needs will be treated in Section 4.5 of this chapter.

TABLE 1: IDENTIFICATION OF RESEARCH PRIORITIES

DISCIPLINARY AREAS(1) / PROGRAM AREAS	1 BIOLOGY AND GENETICS	2 ENVIRON-MENTAL RESOURCES	3 CROP PROTECTION	4 SOCIO-ECONOMICS	5 CROP, SILVI-CULTURE AND LIVESTOCK MANAGEMENT
A PERENNIAL CROPS	X	X	X	X	
B ANNUAL FOOD CROPS	X	X	X	X	
C PROMISING TROPICAL CROPS	X				
D TROPICAL LIVESTOCK	X			X	X (2)
E FORESTRY AND AGROFORESTRY	X	X		X	X (2)
F PRODUCTION SYSTEMS DEVELOPMENT	X	X		X	X
G INTEGRATED MANAG. OF WATERSHEDS AND REGIONAL NATURAL RESOURCES		X		X	

X = High priority

(1) Main disciplines

1- Biology and genetics: physiology, genetics, microbiology, biostatistics, animal health.
2- Environmental resources: engineering, soil science, agroclimatology, ecology, wildlife management, hidrology, land use planning.
3- Crop protection: plant pathology, virology, entomology, nematology, weed control.
4- Socio-economics: sociology, economics, anthropology.
5- Crop and livestock management: agronomy, silviculture, agroforestry, livestock management, production systems.

(2) Priority should diminish with time

The research priorities of each of the seven program areas identified (Table 1) are outlined below:

1) Perennial Crops.

This area covers coffee, cacao and plantains and is already one of CATIE's areas of excellence. The following critical disciplinary areas will be stressed in research:

a) Biology and Genetics, with the purpose of developing improved germplasm, resistant to the major crop diseases,
b) Soil Science and Agroclimatology,
c) Plant Protection, emphasizing biological control methods,
d) Socio-Economics.

2) Annual Food Crops.

Rice, corn, beans and sorghum are the chief staple crops in the region's production systems. Since several international centers are already researching these crops, we have not planned to do any genetic research in them. Instead we will be complementing the research endeavors of those centers in order to support more effectively the national programs in the following critical disciplinary areas:

a) Soil Science and Agroclimatology, with emphasis on plant nutrition,
b) Plant Protection,
c) Socio-Economics.

Research in this program area shall be conducted in coordination with research activities in tropical livestock, agroforestry and perennial crops as part of the efforts directed at integrated regional development.

3) Promising Tropical Crops.

Looking into the future and based on CATIE's existing collection of plant genetic resources, we will be stressing the conservation of germplasm from promising species in Middle America, as well as biology and genetics, with emphasis in biotechnological and horticultural research in some crops selected for their economic potential in the region. The purpose, in addition to conservation of a valuable resource, is to produce high-quality genetic material, along with minimum technological packages needed for conducting production activities, and make them available to the countries.

4) Tropical Livestock.

There is a need to improve genetically the livestock herds in the region, as well as bolster production for small and medium-sized farmers. To this end, we will be promoting research of tropical, mainly dual-purpose cattle, in the area of biology and genetics with an emphasis on breeding and animal nutrition, including pastures and forages. In the latter we will complement the work of CIAT's Tropical Pastures Program in the region. We will also be working in Socio-Economics and Livestock Management. In the area of Livestock Management our endeavors will gradually diminish assuming that the national programs will be getting progressively stronger. To a lesser degree we will be working in goat raising management in order to enhance national programs, at least on a temporary basis. Coordination of activities with those in Annual Food Crops, Agroforestry and Perennial Crops shall be conducted as part of the efforts directed at integrated regional development.

5) Forestry and Agroforestry.

Research in this area will be in the following critical disciplinary areas:

a) Biology and Genetics, particularly in biological Nitrogen fixation, mycorrhiza, etc. and the improvement of tree species,
b) Soil Science,
c) Socio-Economics, and
d) Crop Management.

Agroforestry, a new agricultural alternative, requires both basic research to design more productive systems and applied research in crop management. In the early years we will concentrate on crop management because of the present weaknesses in national programs, but we expect that this need will gradually decrease. This activity will interact with those in annual food crops, perennial crops and tropical livestock.

6) Production Systems Development.

This area originated out of a need to integrate production-oriented research activities (crops, tropical livestock, forestry and agroforestry), commensurate with CATIE's strategy and its systems approach to agriculture. Through actions in crop and livestock management, socio-economics and technology transfer research (development of extrapolation methods and simulation models), we seek to coordinate institutional action within an integrated framework: RESEARCH-EDUCATION-DEVELOPMENT.

The purpose of this area is not to develop farm production systems based on the integrated management of farm resources, but rather to find sustainable regional production systems based on the integrated planning and management of a region's biophysical and socio-economic resources.

7) Integrated Management of Watersheds and Regional Natural Resources.

This area involves the integrated management of regional natural resources, taking the watershed as the basic planning unit, and the management of wildlands. Water, soil and vegetation conservation, as well as the development of agro-climatological and geographical data bases are some of the main emphases. The activities in land use planning will serve as a basis for developing sustainable production systems in the above mentioned areas. Socio-economic aspects will also be given due consideration.

It is important to remark that in the above-mentioned seven program areas, great emphasis is placed on bio-ecological disciplinary areas such as Biology and Genetics (including biotechnology as a support and/or alternative to conventional genetic improvement), environmental resources and crop protection. These are considered critical areas that will complement the national programs through long-range research. Depending on the circumstances, the specialists in these disciplinary areas could devote attention to more than one program area when required. The priority given to crop and livestock management will gradually diminish as national institutions progressively become stronger in those areas. The emphasis in socio-economics is necessary to the development of the institutional strategy. The program areas, Integrated Management of Watersheds and Regional Natural Resources, and Production Systems Development play a complementary and integrating role in CATIE's strategy.

4.3 EDUCATIONAL PRIORITIES

CATIE will implement and strengthen its educational activities through two areas:

1) Graduate studies, leading to a master's degree and
2) Continuing education (short courses or in-service training).

These undertakings will be targeted to all Latin America, according to CATIE's new mandate.

Graduate education will be conducted in collaboration with the universities of the region through bilateral or regional cooperative programs. We expect to strengthen the university programs by training some professors and agricultural professionals, with a clear orientation toward development. Specializations will be offered in the above-mentioned priority programs or disciplinary research areas, or in one of the following additional priority areas: Socio-Economics for Rural Development, Agricultural Research Management, and Agricultural Extension and Communication.

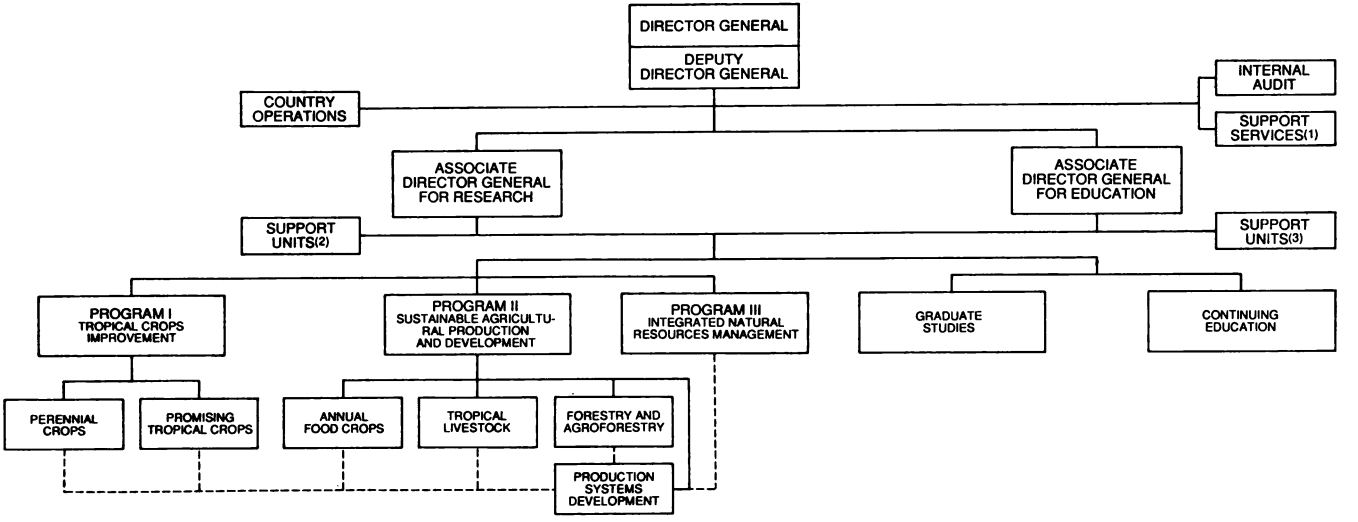
Continuing education will be offered in CATIE's areas of strength, to both agricultural professionals (researchers, extensionists, policy makers) and farmers. Training for the latter will be provided through national institutions and programs. We expect, in addition to the training offered in specific areas, to strengthen the national institutions through the training of instructors and improvement of training management. We also expect to make a positive contribution to small and medium-sized farmers' organizations, especially cooperatives.

4.4 ORGANIZATION

Developing an institutional strategy calls for effective integration, both internally and externally. Although much is said about integration today, the fact is most institutions are not equipped for integrated programs. Hence, if CATIE is to strengthen national programs and institutions through the integration of efforts and have an impact on agricultural development, it will need a new internal structure.

Each of the seven program areas identified emphasizes research into currently unsolved critical problems in national or regional programs, in addition to CATIE's responsibility to assist the National Agricultural Research Systems (NARS') in conducting site-specific adaptive research and testing. As explained below, each program area identifies staffing needs (minimum and desirable critical mass) to produce the expected results.

A new organizational structure (Fig. 2) groups the seven priority areas into three programs: Program I - Tropical Crops Improvement; Program II - Sustainable Agricultural Production and Development; and Program III - Integrated Natural Resources Management. These programs are clearly oriented toward development, and to the strengthening of the national institutions. The new structure also creates two Associate General Directorates to cover the two major activities of the Center: RESEARCH and EDUCATION. Both Associate General Directorates will see to it that the



(1) Administration and Finances; Human Resources; Development Office
(2) Computer Center; Biometrics and Statistical Analysis
(3) Communications; Library

Fig. 2. CATIE's ORGANIZATIONAL STRUCTURE

quality and productivity of the research and educational activities is maintained at all times.

This structure should encourage interdisciplinary activities and projects, help identify areas of strength, opportunity and need, and facilitate the process of technology generation and transfer, and, above all, allow for the integration of biological, physical and socio-economic perspectives in its programs on behalf of agricultural and rural development.

The new structure must also be flexible enough to ensure, not only the interaction between disciplinary areas, but also between program areas whenever the circumstances warrant. In short, it must give coherence to the institutional strategy.

4.5 STAFFING REQUIREMENTS

The structure described herein defines realistic dimensions for the institution. This is important since we have tried to design an institution commensurate with the actual possibilities of financing that will also be able to respond to the expectations of its strategic plan.

The estimated principal staff requirements by discipline area for a ten-year period is indicated in Annex 3. For practical purposes, the minimum critical mass is the total staff requirement at Year 1 while the desirable critical mass is the total number at Year 10. Since most of the principal staff is located at the CATIE headquarters, in Turrialba, no indications are given of outposted staffing needs. Nevertheless, it should be noted, that outposted staff will be required as outreach activities increase. However, such outposted staff is expected to be financed by mechanisms other than core budget (i.e. special projects). Country representatives, though important for the implementation of the institution's strategy, are not included in the critical mass as such. This is so because they are appointed on the basis of a country membership to CATIE, and the collected annual dues as well as other indirect contributions from member countries will guarantee their appointment.

Table 2 summarizes what we have estimated as the desirable critical mass and the minimum critical mass to implement the priority activities within the strategic plan for 1988-1997. The figures correspond to the budgetary units represented by the number of principal staff members. Each budgetary unit (including support staff and operational costs) is estimated at US$150,000; thus, if the total minimum critical mass comes to

TABLE 2. DESIRABLE / MINIMUM CRITICAL MASS

DISCIPLINARY AREAS / PROGRAM AREAS	1 BIOLOGY AND GENETICS	2 ENVIRON-MENTAL RESOURCES	3 CROP PROTECTION	4 SOCIO-ECONOMICS	5 CROP, SILVI-CULTURE AND LIVESTOCK MANAGEMENT	TOTAL
A PERENNIAL CROPS	8/5	2/1	7/3	1/1		18/10
B ANNUAL FOOD CROPS	3/2	5/3	7/5	1/1		16/11
C PROMISING TROPICAL CROPS	3/2					3/2
D TROPICAL LIVESTOCK	10/8			1/1	3/2	14/11
E FORESTRY AND AGROFORESTRY	3/3	2/2		2/2	5/4	12/11
F PRODUCTION SYSTEMS DEVELOPMENT	2/1	1/1		2/2	3/3	8/7
G INTEGRATED MANAGEMENT OF WATERSHEDS AND REGIONAL NATURAL RESOURCES		13/8		1/1		14/9
TOTAL	29/21	23/15	14/8	8/8	11/9	85/61
MANAGEMENT, ADM. & EDUCATIONAL PROGRAMS						9/9
CENTRAL SUPPORT UNITS						5/3
TOTAL CATIE						99/73

73, it represents a total budget of US$10,950,000; with a desirable critical mass of 99, the total annual budget would amount to US$14,850,000.

Certainly, CATIE's current core budget (US$2,700,000 in 1988) would be inadequate to cover the total staff requirements, which, in terms of the number of principal staff members is not much greater than the present size, but is significantly different as to the orientation of activities to be carried out. Although a large portion of the proposed dimensions can be financed by funds from special projects, obviously, the best approach would be to try to raise additional funds for the specific purpose of supporting the activities financed by the core budget.

At present, there is a USAID/ROCAP funded project that is providing long-term principal staff, and therefore it is considered as a restricted core support. Such support represents an important contribution to our staffing requirements. The actual staffing and financial needs will be indicated with more detail in Chapters 5 to 8 for each of CATIE's programs and activities.

The participation of the core budget (including restricted core budget) in the financing of programmed priority activities is estimated to be approximately 60% of the total budget (US$6,570,000 for the minimum critical mass) (Table 3). We estimate that this goal can be reached in a relatively short time and that by the end of the ten-year period our fund raising efforts will allow us to reach the desirable critical mass.

4.6 GOVERNMENT

The process of providing CATIE with the necessary instruments to implement its strategic plan during the next decade has been conducted with a constant concern by the Board of Directors that the institution's governing bodies be restructured accordingly so as to make future actions more effective and increasingly more stable, and insure the achievement of the proposed goals.

Hence, the Inter-American Board of Agriculture in its Fourth Ordinary Meeting held in Ottawa, August 30th to September the 4th, 1987 approved, through Resolution IICA/JIA/Res 135 (IV-0/87), the final version of the proposal for modifying CATIE's Constitutive Contract, previously approved by the Board of Directors, and in effect since January 1st, 1988.

TABLE 3. ESTIMATED CORE BUDGET PARTICIPATION IN MINIMUM CRITICAL MASS FINANCING[1]

DISCIPLINARY AREAS / MINIMUM CRITICAL-MASS	1 BIOLOGY AND GENETICS	2 ENVIRON-MENTAL RESOURCES	3 CROP PROTECTION	4 SOCIO-ECONOMICS	5 CROP, SILVI-CULTURE AND LIVESTOCK MANAGEMENT	OTHER[2]	TOTAL
TOTAL	21	15	8	8	9	12	73
NUMBER TO BE FINANCED WITH CB[3]	16.8	7.5	4	1.6	1.8	12	43.7
% TO BE FINANCED WITH CB[4]	80	50	50	20	20	100	59.8
OBSERVATIONS	LONG TERM ACTIVITIES	DEVELOPED TECHNOLOGY AVAILABLE IN THE MEDIUM TERM		SHORT TERM APPLICATION		FINANCED SOLELY WITH CORE BUDGET	

(1) Includes long term funding for specific activities.
(2) Includes general directorate, administration, educational programs and central support units.
(3) Number of principal staff.
(4) Percentage of principal staff.

The governing bodies referred to are the following (Fig. 3):

1) The Inter-American Board of Agriculture.
2) The Board of Directors.
3) The General Directorate.
4) The Executive Committee.
5) The Technical Committee.
6) The Academic Committee.
7) The Administrative Committee.

1) The Inter-American Board of Agriculture

It is the superior governing body of CATIE, responsible for studying the biannual technical, financial and administrative report on matters submitted by the Director General of CATIE. This body would also have the final say concerning the dissolution of the institution, should the case arise.

2) The Board of Directors

It is the administrative body. It has the permanent responsibility of the supervision and control of CATIE. The new integration includes a representative from each regular member country of the Central American Isthmus and the Dominican Republic, a representative from the Inter-American Board of Agriculture and two representatives from the Inter-American Institute of Cooperation on Agriculture. Moreover--and this is probably one of the most significant changes--it incorporates into its ranks three independent agricultural scientists of recognized prestige.

3) The General Directorate

Responsible for directing and administering CATIE, in conformity with the guidelines and policies set by the Board of Directors.

4) The Executive Committee

An advisory body to the Board of Directors. It carries out the functions assigned by the Board of Directors and does the preparatory work for the Board of Directors' meetings. It is constituted by members of the Board of Directors.

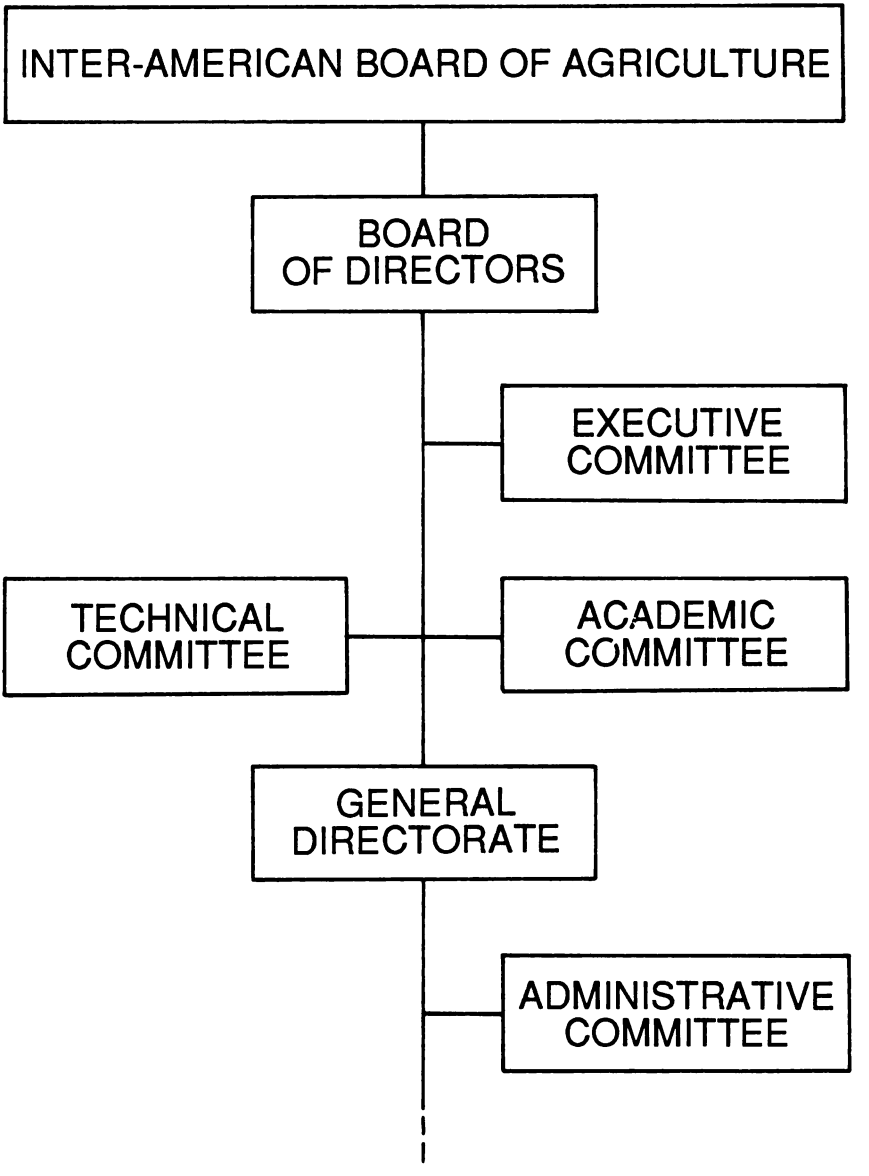


Fig. 3. CATIE's GOVERNING BODIES

5) The Technical Committee

An advisory body to the Board of Directors. It fulfills the functions assigned to it by the Board of Directors and sees to it that the policies and strategies set by the Board of Directors with respect to research and technology are carried out. It is comprised of members of the Board of Directors.

6) The Academic Committee

Advises the Board of Directors in matters relating to educational policies and strategies. It is partially constituted by members of the Board of Directors.

7) The Administrative Committee

Advises and supports CATIE's Director's Office in technical, administrative and financial matters. It is constituted by members of CATIE's professional staff.

PROGRAMS AND PROJECTIONS

5. THE RESEARCH AND DEVELOPMENT PROGRAMS AND THEIR INTEGRATION

There is a need to link research to the development process if that process is to achieve its goals. CATIE's strategic plan does indeed approach agricultural development in that way and is designed for impacting on it. However, for it to work properly, efforts among the institutions of the region must be coordinated.

As explained above, CATIE plans to act by participating within the context of a Regional Agricultural Research and Education System. Therefore, CATIE's programs must assume cooperation and/or integration with other participating entities, such as national research, extension and education programs, international centers and regional institutions (IICA, CIAT, CIMMYT, etc.) and universities outside the region (U.S., Europe, etc.). A Regional Agricultural Research and Education System in which each participating institution plays a carefully planned, active and complementary role will be an effective mechanism of horizontal cooperation for the region.

Being a development-oriented research and education institution, CATIE must also maintain strong ties with development institutions and organizations so that the whole RESEARCH-EDUCATION-DEVELOPMENT process is integrated. CATIE's participation, as well as the whole system's, and its interaction among the different institutions and programs is aimed at strengthening national programs. (See Fig. 4).

This system's approach serves as a guide for each of the three Research and Development Programs--the core of CATIE's research activities under the new structure. In order to achieve the institutional objectives and goals, the three programs are integrated.

In the simplest way, based on information related to integrated natural resources management provided by Program III, Programs I and II will conduct research to develop new technologies or technological components focusing on both productivity and sustainability of agricultural production. Those technologies, with the active collaboration of national programs, will

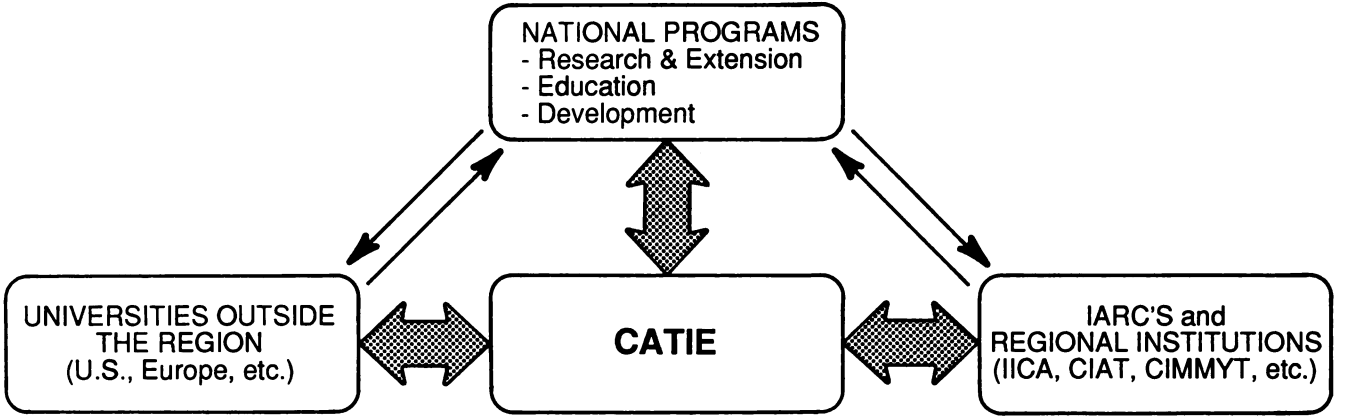


Fig. 4. A REGIONAL AGRICULTURAL RESEARCH AND EDUCATION SYSTEM

be integrated into technological packages or options to be transferred to farmers. This integration is accomplished under the leadership of the Production Systems Development Area, which is dependent on Program II (Sustainable Agricultural Production and Development). The Heads of the three programs will ensure that the required interactions and interdisciplinary work among them are done according to the strategic plan. The interrelationships among the programs activities and outcomes are indicated in Fig. 5.

The efficiency of the integrated action can be improved and the impact of the expected results made more meaningful if areas of multi-disciplinary concentration of efforts are established. A few pilot areas, based on research and educational activities, located in different geographical and ecological sites of CATIE's member countries will be selected in which to integrate planning with the development and use of technological packages to improve agricultural production and/or development. These areas of concentration of multi-disciplinary efforts in which all three programs would participate, will help meet the objectives of raising and sustaining agricultural productivity through appropriate management of resources and coordination of research and development activities aimed at an integrated regional development. They are also essential for developing improved, reliable methods for agrotechnology transfer, particularly the development of decision support systems and simulation models.

These pilot areas will not only be helpful in developing and transferring technological innovations, and in maximizing the system's approach to agricultural growth and development, but are essential to strengthening horizontal cooperation mechanisms among different institutions involved in research, education and development. Because CATIE's strategy is designed to strengthen national institutions, their active participation in the establishment of such pilot areas is crucial to the success of this approach. Hence, CATIE's pilot area approach to integration is not only multi-disciplinary but pluri-institutional as well.

The three Research and Development Programs are described below, emphasizing the following items: Program Direction and Focus, Existing Facilities, Objectives and Strategy, Program Staffing (in terms of minimum and desirable critical mass), Cooperating Institutions (including donors and technical institutions), and Funding Requirements.

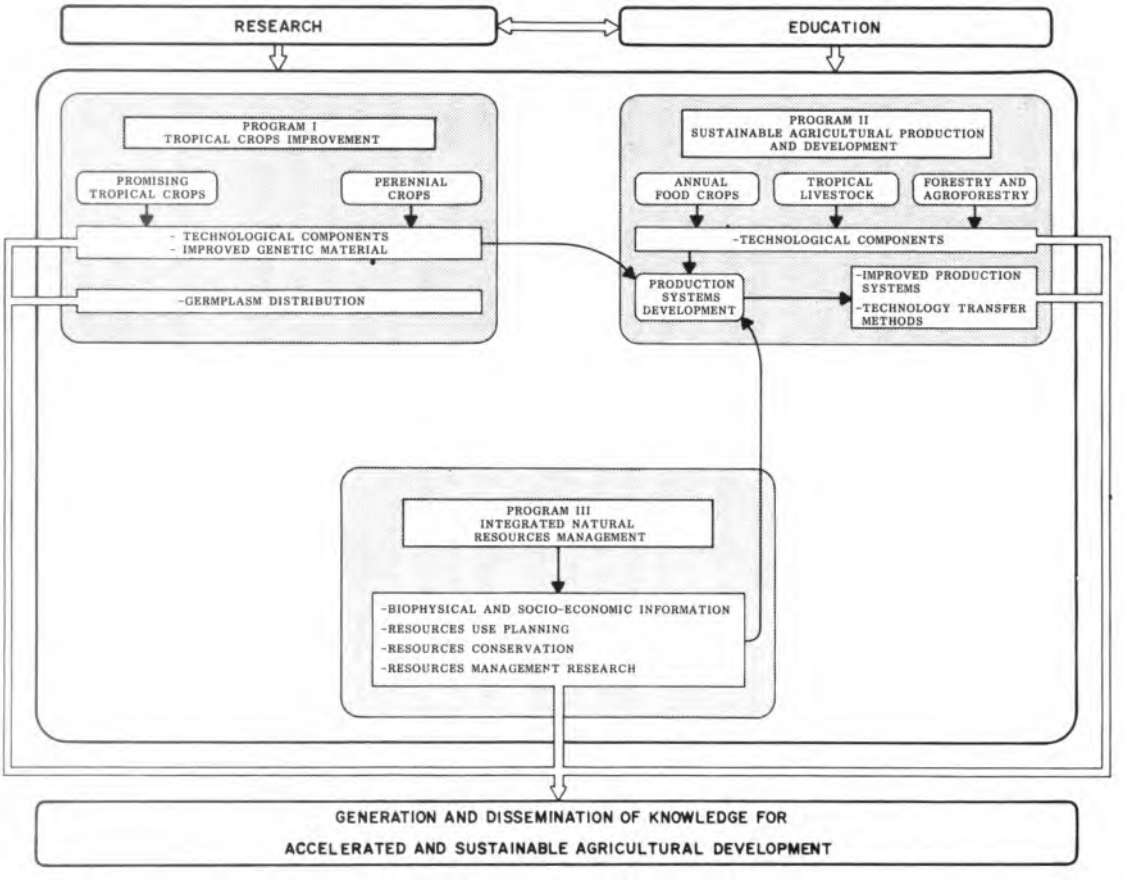


Fig. 5. INTERRELATIONSHIPS AMONG PROGRAM ACTIVITIES AND PRODUCTS

5.1 PROGRAM I. TROPICAL CROPS IMPROVEMENT

5.1.1 General remarks

This program addresses the improvement of three perennial crops of major importance to the region, and explores the potential of promising new tropical crops.

CATIE has gained a reputation over the years for its outstanding work in cacao and coffee, two major export crops of the region. Plantain (cooking banana), an important food staple in Central America, has been added recently to the priority list. At present, no other institution in the region plays such an important role in the conservation and improvement of these crops, each of which is faced with severe disease and other production problems.

Cacao (*Theobroma cacao*) is produced throughout the region and is a traditional export crop in Guatemala, Costa Rica and Panamá. There are 160,000 hectares under cultivation in Central America and the Dominican Republic for a total production of approximately 50,000 t. Productivity, however, is only around 225 to 300 kg/Ha/yr compared to potential yields of 800-1,200 kg/Ha/yr using existing technology, and up to 2,000-2,500 kg/Ha/yr with improved varieties and cultural practices.

The primary diseases affecting cacao production in the region are *Moniliophthora* rot, *Phytophthora* pod rot, and *Ceratocystis* wilt. In some cases, severe incidence of these diseases can cause production losses exceeding 50% of the yield.

In addition, farmers are limited by unselected cultivars, poor cultural practices, and low technology levels.

Coffee is the chief export crop in the region, but the emergence of new destructive pests and diseases, such as the coffee rust and the coffee berry borer, has reduced yield and increased the cost of production. Thus disease control and evaluation of resistant germplasm have to be considered along with other alternatives like biological control.

Likewise, Black Sigatoka is rapidly killing plantains throughout the region. Black Sigatoka has replaced Yellow Sigatoka wherever it has spread. In fact, the disease has become so rampant that, without some means of control, plantain could cease to be a major economic crop in the region. Chemical control is expensive and restricts harvesting by small and medium-sized farmers.

Scientists and researchers worldwide recognize that the tropics have a tremendous potential for food production. The possibility of year-round production and availability of greater biological diversity are only two of the comparative advantages. Nevertheless, the lack of research in tropical crops is an obstacle to realizing this potential, since agricultural research worldwide has concentrated on less than 20 edible plant species out of some 3,000 that have been used as food throughout the history of mankind. The development of new crops will depend on preserving the biological diversity of the tropics.

Therefore, in addition to perennial crops, CATIE, gives high priority to promising tropical crops through existing collections of valuable plant genetic resources. The germplasm from promising species should be evaluated and preserved. Then the most promising crops can be improved and propagated, thereby diversifying production activities.

5.1.2 Program Direction and Focus

- Improvement of coffee, cacao and plantain aimed at obtaining more productive and disease-resistant genetic material.

- Collection, maintenance, evaluation and distribution of promising tropical-plant genetic resources.

- Technology development through research into critical components limiting the production of perennial and promising tropical crops.

A combination of conventional improvement methods with biotechnological techniques would allow CATIE to accomplish these objectives in a shorter period of time, during which technology development and experimentation will be crucial. This program, represents an area of excellence for CATIE and a unique opportunity to make a lasting, positive impact on agricultural production in the region.

5.1.3 Existing facilities

The program currently has the following facilities: two tissue culture laboratories; one plant physiology and one plant pathology laboratory, a seed processing and storage unit with more than 5,000 accessions including two low temperature rooms (5º and -17ºC); greenhouses; live collections of more than 5,000 accessions of plant genetic resources; coffee and cacao collections; one experimental farm with 100 Ha. dedicated mainly to cacao research; and other facilities.

The two basic components of the program are outlined below.

5.1.4 PERENNIAL CROPS: Objectives and strategy

5.1.4.1 Objectives

Cacao, coffee and plantain have been three of the most important crops in the region from a social and economical standpoint. However, several diseases have dramatically reduced the production of these perennial crops. Even though chemical control has been used to fight such diseases, it has generally been expensive, particularly for small and medium sized farmers. New alternatives for controlling such diseases are urgently needed, particularly those related to genetic resistance and biological control. Hence, the Tropical Crops Improvement Program will concentrate its efforts on the production of disease-resistant genotypes of these three crops, along with the development of technological alternatives aimed at obtaining significant increases in productivity.

Objectives for the next five and ten years are:

Cacao: Cacao research will focus on disease and pest management with emphasis on biological control, testing for high-yield, disease-resistant germplasm, and improved crop management technologies.

Five years

- Evaluate clones and hybrids for resistance to moniliasis and other major cacao diseases.

- Set up at least one model farm, using selected resistant material to the major cacao diseases, in each country of the region. Whenever possible, this will be done in the pilot areas where multi-disciplinary field work will be carried out.

- Develop a protocol for *in vitro* cacao micropropagation.

- Study the epidemiology of the major cacao diseases in order to determine the best control practices.

- Develop and implement, throughout the region, an integrated pest management system stressing biological control.

- Whenever possible, develop improved cacao production systems, in at least one pilot area of concentrated action per country.

- Train an estimate of 500 researchers, extension workers, technicians, and farm leaders in the latest technology and management practices in cacao production.

Ten years

- Develop a technology for *in vitro* micropropagation of superior genotypes.

- Provide national programs with highly-productive germplasm, resistant to the major cacao diseases, to be distributed to the region's farmers.

- Disseminate to the majority of the farmers, through the national programs, improved technological packages and recommendations on cacao management.

- Train an estimate of 1,000 researchers, extension workers, technicians, and farmers in the latest technology and management practices in cacao production.

Coffee: Coffee research will focus on pest and disease assessment and control, and testing of resistant germplasm derived through conventional and biotechnological methods.

Five years

- Evaluate CATIE's germplasm collection for resistance to coffee rust, nematodes and other major pests and diseases, and begin breeding and testing clones for varietal resistance. Evaluation of germplasm collection will involve techniques ranging from field evaluation (descriptors) to biochemical methods (electrophoresis).

- Establish model plots using the best selected genotypes, based on the germplasm evaluation studies. These plots will be located in the pilot areas whenever possible.

- Release selected coffee clones using a microcutting propagation technique (*in vitro*).

- Train at least 200 researchers, extension workers, technicians, and farm leaders in the latest technological innovations and management practices in coffee production.

Ten years

- Systematically release superior resistant germplasm which could be widely adopted by farmers to increase and stabilize production.

- Establish lines of research in physiology and genetics related to coffee quality, germplasm conservation and *in vitro* screening.

- Train at least 400 researchers, extension workers, technicians, and farm leaders in the latest technology and management practices in coffee production.

Plantains: Research on plantains will feature the production of disease tolerant or resistant clones, as well as seeking biological control methods for Black Sigatoka and other important pests and diseases. Improved production systems in which plantains would play a substantial role will be developed.

Five years

- Develop a protocol for *in vitro* micropropagation and conservation of selected genotypes.

- Begin distributing plantain clones, inside and outside the region, to test resistance to Black Sigatoka and other major pests.

- Develop a method of biological control of Black Sigatoka.

- Whenever possible, develop improved production systems, using plantains, in at least one pilot area of concentrated action per country.

- Train an estimate of 125 researchers, extension workers, technicians, and farm leaders in the latest technology and management practices in plantain production.

Ten years

- Develop *in vitro* techniques for screening Black Sigatoka and other diseases.

- Release clones of plantain resistant to Black Sigatoka and/or other major pests to most of the farmers of the region through the national programs.

- Release improved technologies and recommendations for plantain management to most of the plantain farms, through the national programs.

- Train an estimate of 250 researchers, extension workers, technicians, and farm leaders in the latest technology and management practices in plantain production.

5.1.4.2 Strategy

Cacao: CATIE has one of the most complete genetic collections of *Theobroma* in the world. Its breeding material has potential for disease resistance and high yields. Unfortunately, many of the clones are self-incompatible (i.e., cannot pollinate within the clone), thus making their use in plantations undesirably complex. Moreover, the selection and use of superior hybrids is considerably more difficult due to a substantial lack of uniformity in the offspring when propagated by sexual means.

Basic studies are required in physiology, cytogenetics, and biochemistry to increase efficiency in selecting superior individuals for characteristics, such as pollination compatibility. Another important component of this strategy consist of continuing studies in biological control of moniliasis. CATIE's expertise in these areas could swiftly reap benefits through interdisciplinary actions. Therefore, through research, CATIE will:

- Conduct basic genetic studies to determine levels of ploidy, incompatibility, and physiological effects in order to maintain the superiority of the selected genotypes.

- Classify the cacao collection, with respect to resistance to the principal diseases in order to identify resistant genotypes that could be incorporated into the *in vitro* cloning system, and conventional breeding methods.

- Breed improved clones emphasizing resistance to moniliasis using conventional and biotechnological methods.

- Develop *in vitro* technology for multiplying superior cacao genotypes by means of micropropagation.

- Identify antagonistic and beneficial microorganisms, predators, and parasites of major pests and develop methods for mass propagation and distribution.

- Develop management strategies for moniliasis, including biological control.

Coffee: Chemical treatment of coffee rust is expensive, and micro-grafting of resistant clones to vigorous stocks of other clones is only a temporary solution (currently resistant clones have underdeveloped root structure and limited production). Therefore, genetic improvement is needed.

Although CATIE's coffee germplasm collection is one of the largest in the world, no systematic research has been conducted to characterize this

collection. Since biotechnology introduces powerful new techniques promising faster and more effective results, research will be conducted to:

- Characterize systematically the germplasm collection, to obtain data for future breeding research stressing disease resistance.

- Screen breeding clones/varieties seeking resistance to important diseases and pests using conventional and biotechnological methods.

- Study major insect pests and nematodes and strategies for control, including biological methods.

- Develop management strategies for coffee rust, including biological methods.

Plantain: Conventional breeding of *Musa* spp. (plantain and bananas) is extremely difficult. Tissue culture appears to show the most promise for developing plantain clones resistant to black Sigatoka. Sources of resistance to yellow Sigatoka, black Sigatoka/black leaf streak have been identified. However, currently resistance has to be inserted into varieties with other desirable traits. *In vitro* techniques are being widely used to multiply elite genotypes, micropropagate disease-free individuals, and preserve and exchange germplasm. Using in vitro techniques variability can also be enhanced through the incidence of "off-types" in micropropagated material. The taxonomy of *Musa* is still somewhat confusing. Therefore, research will focus on:

- Micropropagation of plantain from different introductions for testing resistance to Black Sigatoka under field conditions.

- Evaluating the genetic stability of individuals produced by micropropagation techniques.

- Induction of variability and assessment of variants for resistance to Black Sigatoka and other major pests.

- Study of antagonistic organisms to biologically control Black Sigatoka.

5.1.5 PROMISING TROPICAL CROPS: Objectives and strategy

A number of promising crops that could bolster the region's economy can be classified as: 1. Roots and tubers, having a great potential as human food source. 2. Fruits and vegetables. 3. Spices and dyes.

5.1.5.1 Objectives

With a minimum technology input, some of these species could become very important food or income sources for the region's farmers. Some of these species could even be potential export crops. Thus, the overall objective in this area will be to determine the promising species best adapted to each of the pilot areas in order to make the greatest possible contribution and economic impact.

Five years

- Evaluate genotypes of selected (on the basis of biological, agricultural and economical aspects) tropical species for potential as food or income crops. Promising material will be chosen for evaluation under each pilot area on the basis of its ecological adaptability to that area.

- Establish demonstration plots using the most promising germplasm, for each selected pilot area in each participating country.

- Provide the national programs with selected genotypes of promising crops of short reproductive cycle, for distribution to farmers.

- Generate a minimum set of crop management recommendations for efficient production of selected genotypes of promising crops of short reproductive cycle.

- Train an estimate of 125 researchers, extension workers, technicians and farm leaders in the latest technology and management practices for producing the promising tropical crops.

Ten years:

- Develop a technology for *in vitro* micropropagation of selected genotypes of promising crops.

- Provide the region's national programs with selected genotypes of promising perennial crops for distribution to the farmers.

- Generate a minimum set of crop management recommendations for efficient production of the selected genotypes.

- Train an estimate of 250 researchers, extension workers, technicians and farmers in the latest technology and management practices in the production of promising tropical crops.

5.1.5.2 Strategy

The research emphasis in promising tropical crops will focus on the selection and evaluation, in each pilot area, of promising species in CATIE's germplasm collections. Complementary research will be conducted to:

- Collect and field evaluate new introductions with potential in each pilot area.

- Develop appropriate technology for germplasm preservation.

- Develop appropriate technology for conventional clonal propagation of selected superior genotypes.

- Develop tissue culture techniques for *in vitro* micropropagation and improvement of promising tropical species.

5.1.6 Program staffing

Minimum critical-mass staffing calls for 12 principal professionals: two plant breeders, one plant physiologist, one biotechnologist (tissue culture specialist), two plant physiologist-horticulturists, one soil microbiologist, one soil scientist, two plant pathologists, one entomologist, and one economist. The desirable critical mass for perennial crops during the ten-year period, however, would be 21, including two more plant breeders, one plant physiologist, one plant physiologist horticulturist, three plant pathologists, one soil scientist, and one entomologist (Table 4).

5.1.7 Cooperating institutions

Financial Support

US AID	United States Agency for International Development
IDRC	International Development Research Center
IBPGR	International Board for Plant Genetic Resources
BMZ/GTZ	Ministry of Cooperation of the Federal Republic of Germany

TABLE 4. PROGRAM I - TROPICAL CROPS IMPROVEMENT

CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

DISCIPLINE	CRITICAL - MASS			CRITICAL - MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)(2)	
	DESIRABLE	MINIMUM	EXISTING(1)	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
PLANT BREEDING	4	2	1	3	1	450	150
PLANT PHYSIOLOGY	2	1	1	1	0	150	0
PLANT PHYSIOLOGY/HORT.	3	2	0	3	2	450	300
SOIL MICROBIOLOGY	1	1	0	1	1	150	150
SOIL SCIENCE	2	1	0	2	1	300	150
PLANT PATHOLOGY	5	2	1	4	1	600	150
BIOTECHNOLOGY	1	1	1	0	0	0	0
ENTOMOLOGY	2	1	0	2	1	300	150
ECONOMICS	1	1	0	1	1	150	150
TOTALS	21	12	4	17	8	2,550	1,200

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (Includes salaries, benefits, support personnel, operational costs).

Human Resources

IRCC/CIRAD	French Coffee and Cocoa Research Institute
IICA	Inter-American Institute for Cooperation on Agriculture
ACRI	American Cocoa Research Institute

Reciprocal Technical Cooperation

FHIA	Honduran Agricultural Research Foundation
CIAT	International Center for Tropical Agriculture
CIP	International Potato Center

National Programs: National research institutes, ministries of agriculture, universities and other institutions dealing with some of the commodities involved in the program (i.e. coffee growers' associations).

Networks

INIBAP International Network for the Improvement of Banana and Plantain.

5.1.8 Funding requirements

Critical mass requirements and relationship to existing core-funded principal staff are indicated in Table 4:

Only four of the twelve minimum critical mass are presently funded, through unrestricted core (1) and restricted core financing (3). At present, one position (Plant Pathology) corresponding to the minimum critical mass, is provided by IRCC/CIRAD.

Training costs are estimated at US$190,000.00 per year.

5.1.9 Summary of funding requirements. Program I

	Annual Requirements (in US$1000's)		
	By Year 1	By Year 5	By Year 10
Critical mass 1/	1,800	2,550	3,150
Training 2/	190	190	190

1/ Does not consider the existing core-funded principal staff.

2/ Annual cost, excluding international travel

5.2 PROGRAM II. SUSTAINABLE AGRICULTURAL PRODUCTION AND DEVELOPMENT

5.2.1 General Remarks

This program comprises four priority program areas: Annual Food Crops, Tropical Livestock, Forestry and Agroforestry, and Production System Development.

Just as with Program I, technological components to insure productivity and sustainability of agricultural production and development will be generated. These technological components as well as those produced by Program I will be integrated into improved production systems. New methods to improve technology transfer and adoption of new technologies by farmers will also be developed.

Sustainable agricultural production is considered here within a perspective of integrated regional development. Within the context of integrated regional resources management, the livestock, crop and tree components cannot be taken in isolation but rather as part of a coordinated system, if sustainability as well as productivity are to be achieved.

The program will work toward:

1) Creating a solid support base for the national research and development programs.

2) Integrating institutional efforts with a systems approach seeking technological options that will substantially contribute to the modernization and sustainability of the region's agriculture.

3) Carrying out these RESEARCH-EDUCATION-DEVELOPMENT efforts within the framework and perspective of integrated regional development.

CATIE's mandate region is faced with problems of increasing population with a limited resource base, resulting in increased deforestation, the use of marginal lands for food production, and a decline in production per unit area.

The chief staple food crops of the region, (rice, corn, beans and sorghum) comprised in CATIE's Annual Food Crops Area, is not keeping pace with population growth. Per capita production has decreased by 7% in the past ten years in Central America. Imported foodstuffs during this period has ranged from 19,000 to 263,000 metric tons annually. While some progress

has been made with rice, beans and sorghum in some member countries, the situation of corn is critical, as the need to import has been steadily rising each year.

Yields per unit area remain low since more profitable export activities dominate the most productive lands, leaving less suitable lands for food crops. It is imperative to decrease the cost of production in order to overcome the frequent situation of domestic prices higher than those of the world market.

Although the improvement of these crops is the main task of the Intternational Agricultural Research Centers in cooperation with national programs, the Annual Food Crops area of this program will be working in physiology and simulation modeling, soil microbiology, soil management, and integrated pest management to improve the performance of the genetic material próduced and selected and thus augment and streamline production. This of course requires strong collaborative efforts among the institutions involved.

Farming enterprises frequently combine livestock, food grain, export crop, and wood production. Increased production of food grains will require working in this context as well as shifting this activity from marginal areas to those better suited to intensive agriculture. Efficiency of food crop production will have to be improved to make it competitive with export crop production on better lands.

Most countries of the region have deficits in animal protein consumption while conditions would permit higher productivity of tropical livestock. Efforts to increase cattle productivity must, however, take into account the high temperatures, humidity, and precipitation of the lowland tropics, that make this ecosystem fragile and subject to degradation if not properly managed. Hence, the Tropical Livestock Area should develop and introduce effective technologies for increasing and sustaining cattle productivity while preserving a stable ecosystem.

Criollo genotypes available at CATIE, such as the Romosinuano (beef criollo) and Reyna cattle (Central American dairy criollo), represent valuable adapted sources of tropical livestock germplasm that can be used in bio-economically efficient crossbreeding programs to improve the efficiency of dairy and beef production systems. These criollo genotypes, conserved and utilized at CATIE for the last 35 years under tropical conditions, are the largest herds in a foot-and-mouth disease-free country. But since these genotypes have only been observed under Turrialba's conditions and for specialized beef and dairy production systems, more research needs to be

conducted to see how crossbreeding could improve dual purpose production systems. Also, where environmental conditions are difficult for cattle production, adequately managed goat production systems are a viable option for providing milk and meat to a small farmer, and should therefore be studied.

Research in the Forestry and Agroforestry Area seeks first to determine which multi-purpose trees, many of them leguminous, can best enrich the total soil nutrients while elevating the farm economy. It will also seek better methods of managing tree-crop-pasture combinations, within existing farm systems.

Forty percent of the region is still forest land of different types, but deforestation is so rapid (about 400,000 Has. annually) that in a relatively short time, the remaining native forests could be completely obliterated. The recorded contribution of forestry to the gross national product (GNP) is quite low (about 2%) but when all actual goods and services are figured in, it reaches 6%. The developed nations are considering increasing their support to agroforestry, silviculture, and forest management of plantations and native forests through the Tropical Forestry Action Plan (TFAP). Countries of the region urgently support the plan to create the capacity to implement agroforestry and silvicultural systems and techniques based on species behavior research.

Agriculture, with respect to productivity and sustainability, must be considered on a regional basis integrating resource planning and management with the development of improved production systems, if we are ever to achieve lasting results. The Production Systems Development Area, in close collaboration with the national programs will be responsible for coordinating research conducted on system's components by other program areas and integrating them into improved production systems designed to enhance integrated regional development. Research conducted in pilot areas of multi-disciplinary efforts will provide the basis for developing such production systems and designing improved methods for agrotechnology transfer.

5.2.2 Program direction and focus

- Development of technology by emphasizing research on critical components that limit the production of annual food crops, livestock and forestry.

- Development of improved and economically sustainable production systems that will advance integrated regional development.

Development of improved methods of agrotechnology transfer and utilization of new technologies by farmers.

5.2.3 Existing facilities

One soils laboratory, one plant protection laboratory (entomology, nematology), a 20 Ha. annual crop experimental farm, a 100 Ha. experimental forestry farm (saw mill and production equipment), a 300 Ha. livestock farm (including dairy facilities), one embryo transfer laboratory, one animal nutrition laboratory and the largest forestry data base in tropical America soon to be interconnected with a network of national forestry programs of the region.

5.2.4 ANNUAL FOOD CROPS

5.2.4.1 Objectives

Five years

- Develop the best strain-cultivar-site combinations for maximum N-fixation and yield in beans, and identify soil-limiting factors and ways to overcome them. Effective methods of inoculation should be developed and high quality inoculants should be employed in at least one pilot area per country.

- Soil fertility levels and the dynamics of soil nutrients will be determined in each pilot area in order to develop and implement improved soil management practices for staples leading to a more efficient use of fertilizers and, therefore, lower production costs and environmental contamination.

Information on water flow in the soil will be integrated into crop simulation models and validated in each pilot area.

- Determine and identify the major pests (weeds, plant pathogens and insects) that limit production of staple crops in each of the pilot areas, quantifying crop losses associated with major pests and their economic importance. The existence of native beneficial organisms will be determined and identified for their potential in reducing the populations of major pests and sustaining these reductions. Alternative methods of control to the costly and ecologically detrimental use of pesticides will be identified, including promising resistant varieties (developed by the international centers and other programs), crop rotations, cultural practices, and management of natural enemies.

- After five years, the annual food crops area is expected to have trained an estimate of 1,010 persons. The training program will include crop simulation modeling, soil microbiology, soil management, and integrated pest management.

Ten years

- Superior strains and inoculants of *Rhizobium* for bean cultivars and soils should be available to all production areas in each country. Fine-tuned management techniques for maximum N-fixation and bean yields should be available for application in each country.

- High-quality inoculants for other food legumes will be available and used in at least one major region in each country.

- Soil management practices packages, based on greater knowledge of macronutrient dynamics in the soil and micronutrient dynamics and water flow (crop model), should be employed in major crops production areas of each country. An important outcome will be more efficient use of fertilizers, and, hence, higher crop yields with lower production costs.

- During the ten-year period, economically-efficient and ecologically-sound integrated pest-control strategies will be developed for staples in each of the regions under study by integrating the alternative control methods identified during the earlier period. Promising beneficial organisms (native or imported) will be cultivated in CATIE's facilities for release in the pilot areas. At the end of the 10 year period, alternative integrated pest management strategies will be validated under farm conditions within each pilot study area.

- Integrated pest management practices within each pilot area will have a multiple impact. Pest populations will be reduced and kept low through better management of the environment. Crop productivity will be increased while reliance on imported and costly technology (pesticides) declines. The overall outcome will be a net increase in social benefits through reduced social costs (pollution and effects on human health) and the outflow of capital to purchase pesticides.

- At the end of the ten years period we expect to have trained at least 3,120 persons in the area of Annual Food Crops, in programs dealing with crop simulation modeling, soil microbiology, soil management and integrated pest management.

5.2.4.2 Strategy

Genetic improvement of food crops such as corn, beans, rice, and sorghum is presently being studied by international agricultural research centers, many of which maintain outreach personnel with national programs in the region. CATIE will complement their work by researching critical components of production systems such as crop protection, soil microbiology, environmental resources and socio-economics. Also, CATIE's support of national research programs will be an important part of its research strategy. Cooperative agreements with other Latin American, European, and North American Universities can provide specialized assistance for specific studies as well as enhancing the effectiveness of training programs.

In the field of soil microbiology and legume inoculation, we want to improve the existing laboratory facilities at CATIE by establishing a strain bank of *rhizobia* as well as a strategy for storing, distributing, and promoting the use of inoculants in the region. We also plan to construct a pilot production center for legume inoculants.

Soil management research will include macro and micronutrient dynamics and water-flows in order to find more effective and cost-efficient fertilization techniques.

Regarding integrated pest management, identifying and determining the economic impact of major pests on food crops will be a priority, so that integrated pest-management technologies can be established for the most harmful weed, pathogen and insect pests of the major food crops. Socioeconomic constraints to the adoption of pest management practices will also be identified and studied in order to promote acceptance and transfer of the technologies developed.

5.2.4.3 Staffing

Minimum critical-mass staffing: four soil scientists (soil physics, soil chemistry, soil microbiology and soil management), five crop protection specialists (pathology, entomology, virology, nematology, and weed management), one economist, and one crop physiologist.

A more desirable level of staffing would include the following additional scientists: soil physicist, soil chemist, plant pathologist, entomologist and crop physiologist (Table 5).

TABLE 5. PROGRAM II - AREA: ANNUAL FOOD CROPS

CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

DISCIPLINE	CRITICAL - MASS			CRITICAL - MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)(2)	
	DESIRABLE	MINIMUM	EXISTING(1)	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
SOIL PHYSICS	2	1	1	1	0	150	0
SOIL MICROBIOLOGY	1	1	1	0	0	0	0
SOIL MANAGEMENT	1	1	1	0	0	0	0
SOIL CHEMISTRY	2	1	1	1	0	150	0
PLANT PATHOLOGY	2	1	0	2	1	300	150
ENTOMOLOGY	2	1	1	1	0	150	0
VIROLOGY	1	1	0	1	1	150	150
WEED MANAGEMENT	1	1	0	1	1	150	150
ECONOMICS	1	1	0	1	1	150	150
CROP PHYSIOLOGY	2	1	0	2	1	300	150
NEMATOLOGY	1	1	0	1	1	150	150
TOTALS	16	11	5	11	6	1,650	900

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (Includes salaries, benefits, support personnel, operational costs).

5.2.4.4 Cooperating institutions

Financial Support

The Annual Food Crops Area, has one restricted core contributor, the United States Agency for International Development, through the Regional Office for Central American Programs (USAID/ROCAP). A regional integrated pest management project whose scientific personnel also cover other program areas (in Programs I and II) is funded by USAID/ROCAP.

Human Resources

The Overseas Development Agency of the United Kingdom (ODA) assists in activities related to Integrated Pest Management with one (1) Entomologist.

Reciprocal Technical Cooperation

Through the Integrated Pest Management project (funded by ROCAP/AID); and the Project on Phosphorus Retention in Tropical Soils (funded by AID), CATIE has established links with institutions in six countries. Costa Rica: Ministry of Agriculture and Livestock (MAG). El Salvador: National Center of Agricultural Technology (CENTA). Guatemala: Agricultural Science and Technology Institute (ICTA), University of San Carlos (USC) and University of El Valle. Honduras: Ministry of Natural Resources, Regional University Center of the Atlantic (CURLA), Pan-American Agricultural School (EAP). Nicaragua: Ministry of Agricultural Development and Agrarian Reform. Panama: Institute of Agricultural Research of Panama (IDIAP), Ministry of Agricultural Development (MIDA).

Networks

Networking activities in the Annual Food Crops Area are carried out within the context of the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT), a USAID funded project, and the Food Security Program for Central America sponsored by the European Communities Commission.

5.2.4.5 Funding requirements

Critical mass requirements and relationship to existing core-funded principal staff:

Five out of eleven scientists required in the minimum critical mass are presently working in this area (Table 5). Two of them are funded by

unrestricted core budget and the remaining three by the restricted core funds.

Critical mass staff funded via short term projects:

At present, one USAID/ROCAP funded project in Integrated Pest Management (IPM) in assisting the Annual Food Crops Area with 11 principal staff. Five of those positions are related to the minimum critical mass (one Nematologist, one Plant Pathologist, one Virologist, one Weed Management Specialist and one Economist). Considering the desirable critical mass seven positions are presently funded by the above-mentioned short-term project (one additional plant pathologist and one entomologist).

Cost of training:

The total cost of training 1,010 persons in a five year period amounts to US$1,575,000 and US$4,725,000 for 3,120 persons in ten years. The estimate costs per man/week is US$500. Annual costs of training is US$315,000 for the first five years and US$472,000 in the second five years.

5.2.5 TROPICAL LIVESTOCK

5.2.5.1 Objectives

Five years

- Develop forage-based ruminant feeding strategies (cattle and small ruminants) aimed at increasing productivity of small and medium-size farms in two pilot areas representing humid and wet-dry tropical environments. As much as possible, a silvo-pastoral approach will be considered.

- Identify and characterize biologically and genetically valuable cattle germplasm within the region to be used in crossbreeding programs for the purpose of increasing milk and beef production on small and medium-size farms.

- Strengthen and promote the conservation, multiplication and distribution of genetically superior germplasm of local cattle for milk yield and growth under certain grazing conditions, in at least one ecologically defined area in three countries.

- Train an estimate of 1,000 persons: 50 decision-makers, 500 professionals, 350 technicians and 100 farmers.

Ten years

- Implement efficient ruminant production systems (cattle and small ruminants) developed by CATIE that will increase milk and beef production in a sustainable manner, in at least one pilot area in each country of the region.

- Identify and disseminate bio-economically efficient cross-bred genotypes involving dairy and beef criollo, zebu and European dairy breeds. This will contribute to a sustainable increment in productivity per unit area, thus lessening the deficit of milk and beef in the region.

- Train an estimate of 2,500 persons: 125 decision-makers, 1,250 professionals, 875 technicians and 250 farmers.

5.2.5.2 Strategies

Several studies have contemplated ways to improve milk and beef production and quality under a dual-purpose production system. They have consistently met with biological limitations imposed by inadequate use of the genetic resources available. For example, although criollo genotypes are well-adapted to the tropics, they have not been widely utilized, and their numbers continue to decrease. This germplasm urgently needs to be conserved, multiplied and distributed. Criollo genotypes could offer an important alternative to overcoming biological limitations through controlled and well-defined crossbreeding of zebu with European dairy breeds. In order to achieve the short and long-term objectives proposed, detailed studies should be conducted in genetics, reproductive and environmental physiology, animal health, economics and physiology of lactation.

Ruminant nutrition must be substantially improved through better production and utilization of grasses, herbaceous legumes, Nitrogen-fixing trees, and other woody perennials. In addition, conservation of crop residues and forages should be improved for use as feeding sources during the critical seasons in some ecological regions of Central America and the Caribbean.

Multi-disciplinary work (incorporating activities in other program areas) aimed at integrated regional development will be carried out in a few selected pilot areas in different geographical locations.

Thus, through research conducted in the Tropical Livestock Area, CATIE will:

1) Utilize leguminous trees and other woody perennials to improve cattle and goat feeding systems, and maintain soil fertility and ecological balance in humid and wet-dry tropical environments.

2) Conduct experiments on pasture production and utilization of germplasm generated by CIAT and other sources.

3) Identify potential criollo cattle genotypes (in addition to those at CATIE) in the region for their possible use in livestock production systems. This will make necessary a bio-genetic characterization of those identified genotypes.

4) Conserve, multiply, and use more effectively the dairy and beef criollo cattle available at CATIE for use in crossbreeding programs.

5) Evaluate the biological and economical performance of the resulting crossbreeds with respect to livestock production systems in humid and wet-dry tropical environments.

To accomplish the objectives described, it will be necessary to implement a solid training program for technical staff of the national institutions, since they will be assuming ever increasing responsibility for research management within their own countries. The program will offer in-service training and short courses in breeding and genetics, reproductive and environmental physiology, animal health, nutrition, forage production and utilization, and goat and cattle production systems.

5.2.5.3 Staffing

Minimum critical-mass staffing: two animal geneticists, one reproductive physiologist, one animal health specialist, one animal nutritionist, two forage utilization specialist, one pasture management specialist, one meat and muscle biologist, one economist, and one small ruminant production specialist.

Desirable staffing would add one environmental physiologist, one lactation physiologist, and one pasture agronomist (Table 6).

TABLE 6. PROGRAM II - AREA: TROPICAL LIVESTOCK

CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

DISCIPLINE	CRITICAL-MASS			CRITICAL-MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)(2)	
	DESIRABLE	MINIMUM	EXISTING(1)	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
ANIMAL GENETICS	2	2	2	0	0	0	0
REPRODUCTIVE PHYSIOLOGY	1	1	1	0	0	0	0
ANIMAL HEALTH	1	1	1	0	0	0	0
ANIMAL NUTRITION	1	1	1	0	0	0	0
FORAGE UTILIZATION	2	2	1	1	1	150	150
PASTURE MANAGEMENT	1	1	1	0	0	0	0
MEAT AND MUSCLE BIOLOGY	1	1	1	0	0	0	0
GOAT PRODUCTION	1	1	1	0	0	0	0
ENVIRONMENTAL PHYSIOLOGY	1	0	0	1	0	150	0
LACTATION PHYSIOLOGY	1	0	0	1	0	150	0
ECONOMICS	1	1	0	1	1	150	150
PASTURE AGRONOMY	1	0	0	1	0	150	0
TOTALS	14	11	9	5	2	750	300

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (Includes salaries, benefits, support personnel, operational costs).

5.2.5.4 Cooperating institutions

Financial Support

Two contributors provide funds to short-term projects in the Tropical Livestock Area: the International Development Research Center of Canada (IDRC) and the United States Agency for International Development, Regional Office for Central American Programs (USAID/ROCAP).

Reciprocal Technical Cooperation

The Tropical Livestock Area cooperates in activities with the national institutions of the region, as well as with universities outside the region (University of Missouri, University of Wisconsin, Ohio State University and Wageningen Agricultural University), the US National Research Council and the International Center for Tropical Agriculture (CIAT).

Networks

CATIE is part of the Latin American Animal Production Systems Research Network (RISPAL) funded by IDRC, and is working with the International Network for Tropical Pastures Evaluation (CIAT-RIEPT).

5.2.5.5 Funding Requirements

Critical mass requirements and relationship to existing core-funded principal staff:

Nine out of eleven scientists required in the minimum critical mass are presently working in this area. Three of them are funded by unrestricted core budget and the remaining six by restricted core funds (Table 6).

Critical mass staff funded via short term projects:

At the moment there is only one critical-mass position (forage utilization specialist) funded by IDRC through a short-term project in silvo-pastoral systems. No other staff members are funded by any other short-term projects.

Cost of Training:

For the training activities proposed, US$500 per man week has been estimated; hence, a total of US$500,000 is required, to train the proposed 1,000 persons during the first five years. By the tenth year, the training of 2,500 persons will have an approximate cost of US$1,250,000.

5.2.6 FORESTRY AND AGRO-FORESTRY

5.2.6.1 Objectives

Five years

- Develop highly productive and sustainable agroforestry systems for at least two ecologically different pilot areas, including the introduction and utilization of woody perennials, in association with perennial or annual crops and pastures.

- Select clones from the genus *Erythrina* (a Nitrogen-fixing tree), based on superior biomass production and propagation ability, and distribute to cooperating farmers, especially in pilot areas.

- Improve microbiological management of at least one NFT (Nitrogen Fixing Tree) species.

- Select from high quality genotypes at least four multi-purpose and three timber tree species and distribute to cooperating farmers, especially in the pilot areas.

- Develop improved silvicultural technology for 14 multi-purpose tree species available to farmers, and disseminate the new technology in the pilot areas.

- Establish and operate a forestry data base connected with the national programs through CATIENET (CATIE's computerized regional network).

- Develop and operate demonstrative management plans for natural forest units in two different zones (as much as possible, in the pilot areas).

- Contribute to the effective operation and institutional strengthening of forestry and agroforestry national programs.

- Train at least 1,200 persons in different aspects of forestry and agroforestry production, of which 300 will be decision-makers, 400 professionals, and 500 technicians.

Ten years

- Select clones of NFT's (*Erythrina*, *Gliricidia* and *Inga*)* based on forage quality, high association ability with annual crops, and efficient propagation

* *Erythrina*, *Gliricidia* and *Inga* are, besides *Leucaena*, the three most common legume tree species in Central America.

and biomass production; and distribute to cooperating farmers in at least one pilot area per country.

- Elaborate and disseminate vegetative propagation methods for NFT's, and other economically important species.

- Select high quality germplasm from 14 priority multi-purpose and 10 timber tree species, and distribute to cooperating farmers, especially in pilot areas.

- Establish a simulation model to guide decision-making on species choice, associations, and management of different ecosystems in the region.

- Develop a system for adequate management of natural forests that can be transferred to development projects in four of the principal ecosystems in the region.

- Stimulate the adoption by farmers of highly productive forestry and agroforestry practices, with measurable effect on land use and sustainability in at least one pilot area per country.

- Collaborate with national programs in stimulating the implementation by farmers of improved management techniques of natural forests, as a productive activity, and promoting the active participation of communities and small farmers in forestry and agroforestry development projects, in pilot areas, in each of the participating countries.

- Train in the various aspects of forestry and agroforestry at least 2,700 persons, of which 800 will be decision-makers, 900 professionals, and 100 technicians.

5.2.6.2 Strategy

The adoption of improved forestry and agroforestry practices by farmers and entrepreneurs to achieve the desired long-term productivity, depends on many factors:

- Availability of superior germplasm (both trees and crops) to be included into the production systems.

- Availability of suitable management practices for improved productivity, propagation, nutrient cycling, Nitrogen-fixation, etc.

- Convincing demonstration of the biological and economical superiority of forestry and agroforestry practices, and insight into how they work.

- Availability of resulting information to the extension and research staff.

- Understanding of the economic and cultural motivation of farmers in order to design appropriate diffusion techniques that take into account the long-term commitment required for tree management.

- Willingness of the institutions that promote forestry and agroforestry to undertake the necessary tasks.

If any of these ingredients is missing, the chances for success will be reduced.

This program area will therefore include activities in three main lines of action:

1) Training and technical assistance. Improvement of the institutions capacity will be attained by motivating decision-makers, training staff at all levels, promoting the formation of agroforestry teams, strengthening existing forestry units within key institutions, and providing documentary support. Graduate teaching, specific training, and technical support are the main components of this line of action.

2) Research is another line of action, the success of which depends greatly on systematic methodology. Within the general framework, supporting research plays a vital role in generating the technologies that provide the kind of solutions that can easily be transferred and adopted. The main aspects of research are: genetics, tree physiology, plantation and natural forest silviculture, soil microbiology, agroforestry, ecology, modeling, economics, sociology, and forest management.

3) The third line of action relates to the preparation and distribution of technical information for extension staff and the general public in the form of technical bulletins, data bases on available technologies, bibliographies, and other communication media. These materials will be produced and distributed by CATIE's Tropical American Forestry Information and Documentation Service (INFORAT) and through CATIE's representative offices, where small documentation units will be set up.

This area will closely interact with the other areas in Program II. For example, there will be support to the Tropical Livestock Area in assessing the nutritional value of tree species for livestock feeding. The interaction with the Production Systems Development Area will consist of the evaluation of improved farming systems and collaboration in modeling

aspects. Finally, this area will interact with the Annual Food Crops Area in the design and evaluation of agroforestry systems involving annual crops.

Interactions with Program III (Integrated Natural Resources Management) will be primarily in land-use planning, to determine suitable sites and incorporate appropriate management of agroforestry systems, plantations and natural forests into rational watershed management.

With Program I (Tropical Crops Improvement), interactions will consist of the design and evaluation of appropriate systems for perennial crops (coffee, cacao) in association with trees, as well as dissemination and use of superior fruit and woody plant germplasm.

It is important to point out that there is no international center responsible for forestry and agroforestry research, except for IITA and ICRAF, both in Africa, neither of which conduct research within CATIE's mandate region.

5.2.6.3 Staffing

Minimum critical-mass staffing: two silviculture specialists, one forest geneticist, one agroforestry specialist, one forest physiologist, one tree physiologist (expert in modelling), one ecologist, one sociologist, one economist, one soil scientist and one specialist in forest management (Table 7).

A more desirable level of staffing would add one silviculture specialist.

5.2.6.4 Cooperating institutions

Financial Support

The program has a number of contributors through short-term projects.

The main contributor, USAID/ROCAP, is funding the Tree Crop Production Project, a regional effort in the research and utilization of multiple-use trees. The Kellogg Foundation contributes to the Data Base component, in a joint effort between CATIE and the University of Minnesota. The Swiss Cooperation for Development supports the genetic research component as well as silviculture and management of native tropical forests research.

In agroforestry, the United Nations University is funding research in silvo-pastoral systems and supports in-service training activities. The German Government, through the German Cooperation Agency (GTZ), is contributing significantly to basic and applied agroforestry research,

TABLE 7. PROGRAM II - AREA: FORESTRY AND AGROFORESTRY

CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

DISCIPLINE	CRITICAL-MASS			CRITICAL-MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)(2)	
	DESIRABLE	MINIMUM	EXISTING(1)	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
GENETICS	1	1	0	1	1	150	150
TREE PHYSIOLOGY	1	1	0	1	1	150	150
SILVICULTURE	3	2	1	2	1	300	150
AGROFORESTRY	1	1	1	0	0	0	0
SOIL SCIENCE	1	1	0	1	1	150	150
ECOLOGY	1	1	0	1	1	150	150
MODELLING (PLANT PHYS.)	1	1	0	1	1	150	150
SOCIOLOGY	1	1	0	1	1	150	150
ECONOMICS	1	1	1	0	0	0	0
FOREST MANAGEMENT	1	1	0	1	1	150	150
TOTALS	12	11	3	9	8	1,350	1,200

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (Includes salaries, benefits, support personnel, operational costs).

technical meetings and training; Canada's IDRC supports research in *Erythrina* and *Gliricidia* spp. germplasm conservation and selection, as well as silvo-pastoral systems in the humid lowlands. The Government of Japan, through the Japanese International Cooperation Agency (JICA), assists in agroforestry training courses.

Human Resources

The British Government (ODA) and JICA provide two geneticists. The Swiss Government provides one specialist in natural forests management. Specialists in agroforestry are provided via the Intergovernmental Migration Committee (CIM) (1) and by Germany's GTZ (2). The Government of Holland has contributed with one specialist in silviculture.

Reciprocal Technical Cooperation

The program area cooperates with many national institutions, such as national forest services (INAFOR in Guatemala, CENREN in El Salvador, COHDEFOR in Honduras, DGF in Costa Rica, INRENARE in Panama and IRENA in Nicaragua), Universities, particularly ITCR and UNA in Costa Rica, ESNACIFOR in Honduras, USC in Guatemala and UP in Panama, as well as private organizations like ANAI in Costa Rica and PEMASKY in Panama. The area also works with USAID - COSUDE - and CARE- funded projects in the region. In addition, there are work agreements with the Universities of Minnesota, Missouri, Ohio State, Yale, Toronto, Gottingen and Oxford for the joint implementation of doctoral research and dissertations.

In agroforestry, close contacts are maintained with ICRAF and with the Nitrogen Fixing Tree Association (NFTA) for research methodologies, data banks on multi-purpose tree species, joint scientific meetings, training and economic models for agroforestry systems evaluation.

Networks

CATIE is a member of IUFRO, the International Union of Forestry Research Organization, as well as of CAMCORE, a Cooperative for the Preservation of Conifer Resources of Central America and Mexico, and actively participates with the Regional Energy and Agroforestry FAO Networks.

5.2.6.5 Funding requirements:

- Critical mass requirements and relationship to existing core-funded principal staff:

As can be observed in Table 7, only three of the eleven minimum-critical mass requirements of the program area are presently being funded, two of them through unrestricted core and one through restricted core funds.

- Critical mass staff funded via short term projects:

At present, there are eight critical mass staff members funded by short-term projects in the following disciplines: Genetics (1), Physiology (1), Silviculture (2), Agroforestry (1), Ecology (1) and Modelling (1).

- Cost of Training:

The proposed training activities of the Forestry and Agroforestry Area would consider the training of 240 persons per year during the first five years. The annual cost of this training program is US$336,0000, given US$500 per person/week. At the end of the ten-year period 2,400 persons will have been trained.

5.2.7 PRODUCTION SYSTEMS DEVELOPMENT

5.2.7.1 Objectives

Five years

- Validate promising technological components generated by CATIE and/or national programs and facilitate their transfer and adoption by most farmers in one pilot area of each country.

- Coordinate the design of improved production systems under the concept of integrated regional development and have them ready to be validated in one pilot area per country.

- Increase utilization of research results through development of improved methods for agrotechnology transfer (simulation models that would allow extrapolation and utilization of research results to other areas).

- Train an estimate of 20 decision-makers, 150 extensionists and 100 researchers in different aspects of the research and development process aimed at integrated regional development.

Ten years

- Validate improved production systems in several cultivated areas per country. Attempts will be made in conjunction with national programs to stimulate adoption by farmers.

- Stimulate the use of promising, validated simulation models for agrotechnology transfer.

- Increase the number of trainees to an estimated ten-year total of 50 decision-makers, 400 extensionists, and 100 researchers from participating countries.

5.2.7.2 Strategy

More productive and sustainable regional production systems can be developed by integrating the various activities of CATIE's many areas and programs. Only a well-coordinated multi-disciplinary action will successfully integrate the perspective of planning, research, and development at a regional level.

The basic information provided by Program III, together with the technological components provided by Programs I and II, will be integrated to spur the development of the priority pilot areas indicated above. This effort will be carried out in close collaboration with the national programs throughout all phases of the process.

The phases to be coordinated and implemented by the Production Systems Development Area are:

- Characterization of regional sites for research and development (pilot areas) in collaboration with Program III.

- Orientation and coordination of multi-disciplinary research work (all three programs) according to the socio-economic and bio-physical characteristics of the sites, and based on adequate planning of the use of land and other natural resources at the regional level, and on a careful analysis of the economic feasibility of the ecologically suitable potential commodities to be developed.

- Integration of technological components into sound technological packages.

- Verification under the pilot area field conditions of the technological packages leading to improved production systems.

- Utilization of the new technologies to develop simulation models and design new methods for agrotechnology transfer.

- Promotion and transfer of the new technologies among farmers through proper mechanisms of interaction with the national programs.

- Impact studies of the new technologies and production systems developed, using the results to improve the research and development process.

5.2.7.3 Staffing

Minimum critical-mass staffing: one ecologist, one economist, one sociologist-anthropologist, one crop management specialist, one production systems specialist, one agrotechnology transfer specialist, and one specialist in crop simulation modeling (Table 8).

A more desirable level of staffing would add a second specialist in crop simulation modeling.

5.2.7.4 Cooperating institutions and networks

CATIE will cooperate in this area with the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) sponsored by USAID and with the Food Security Program for Central America, sponsored by the European Communities Commission. The participation of national research and technology transfer institutions as well as the agricultural sector planning offices of the Ministries of Agriculture of the participating countries is considered essential to the implementation of the strategy of this program area.

5.2.7.5 Funding requirements

- Critical-mass requirements and relationship to existing core-funded principal staff:

Critical-mass requirements, cost and relationship to existing core-funded principal staff are illustrated in Table 8. As observed, only two of the seven minimum critical mass staff members of the program area are currently being funded, through restricted core (one crop simulation modelling specialist and one production and one production systems specialist), and no short-term project is providing staff to it.

- Cost of training:

The cost of the proposed training program (estimated at US$500 per man/week) for 270 persons in five years is US$270,000 and for 550 persons in 10 years is US$550,000

TABLE 8. PROGRAM II - AREA: PRODUCTION SYSTEMS DEVELOPMENT

CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

DISCIPLINE	CRITICAL-MASS			CRITICAL-MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)(2)	
	DESIRABLE	MINIMUM	EXISTING(1)	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
ECOLOGY	1	1	0	1	1	150	150
ECONOMICS	1	1	0	1	1	150	150
SOCIOLOGY/ANTHROPOLOGY	1	1	0	1	1	150	150
CROP MANAGEMENT	1	1	0	1	1	150	150
AGROTECHNOLOGY TRANSFER	1	1	0	1	1	150	150
CROP SIMULATION MODELLING	2	1	1	1	0	150	0
PRODUCTION SYSTEMS	1	1	1	0	0	0	0
TOTALS	8	7	2	6	5	900	750

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (Includes salaries, benefits, support personnel, operational costs).

5.2.8 Summary of critical-mass requirements - Program II

See Table 9 for a summary of critical-mass requirements in relationship to existing core-funded principal staff, for the Sustainable Agricultural Production and Development Program.

5.2.9 Summary of funding requirements - Program II

	Annual Requirements (in US$1000's)		
	By Year 1	By Year 5	By Year 10
Critical mass 1/	6,000	7,200	7,500
Training 2/	805	805	1,014

1/ Does not consider the existing core-funded principal staff.

2/ Annual cost, excluding international travel.

TABLE 9. SUMMARY PROGRAM II - SUSTAINABLE AGRICULTURAL PRODUCTION AND DEVELOPMENT CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

DISCIPLINE	CRITICAL-MASS			CRITICAL-MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)(2)	
	DESIRABLE	MINIMUM	EXISTING(1)	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
ANNUAL FOOD CROPS	16	11	5	11	6	1,650	900
TROPICAL LIVESTOCK	14	11	9	5	2	750	300
FORESTRY AND AGROFORESTRY	12	11	3	9	8	1,350	1,200
PRODUCTION SYSTEMS DEVELOP.	8	7	2	6	5	900	750
TOTALS	50	40	19	31	21	4,650	3,150

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (Includes salaries, benefits, support personnel, operational costs).

5.3 PROGRAM III. INTEGRATED NATURAL RESOURCES MANAGEMENT

5.3.1 General remarks

> *"Degradation and destruction of environmental systems and natural resources are now assuming massive proportions in some developing countries, threatening continued, sustainable development. It is now generally recognized that economic development itself can be an important contributing factor to growing environmental problems in the absence of appropriate safeguards. A greatly improved understanding of the natural resource base and environmental systems that support national economies is needed if patterns of development that are sustainable can be determined and recommended to governments."*
>
> *World Bank Annual Report, 1985.*

From the above statement, one can surmise that it is increasingly recognized that:

1) Sustainable development greatly relies on the natural resource systems that ultimately support most economic activity.

2) In developing countries, natural resource systems are being depleted at accelerated rates--soil is being eroded, forests are being eliminated, grasslands are being over-grazed, etc. to a degree that is adversely affecting the prospects for sustainable development.

3) Policy-makers urgently need an analytic and institutional framework to tackle the problem, systematically evaluating trade-offs and determining optimal points for policy intervention and project formulation and implementation.

These considerations especially apply to tropical developing countries, insofar as they are generally primary producers, with large subsistence sectors that depend on their natural resource systems, thus creating an urgent need for appropriate methods of managing the tropics.

In fact, proper appropriate management of natural resources, including the maintenance of biological diversity in the tropics, especially in the Central American and Caribbean Region, is of such magnitude that it merits a separate, visible program. CATIE is the only institution in the region that

directly addresses the problem through its integrated natural resources management programs, taking the watershed or biophysical entity as the basic planning unit.

This program provides the basis for developing the sustainable production activities outlined in the previous programs. It seeks, within a regional perspective, to shape a multi-disciplinary decision-making process for the planning, management and conservation of natural resources, in order to improve production and sustainable development.

5.3.2 Program direction and focus

- Provide general biophysical and socio-economic information on integrated regional resources management.

- Plan for the appropriate utilization of regional resources as a basis for developing sustainable production systems.

- Provide information and assistance related to regional resources conservation (soil, water, natural forests, biological diversity).

- Conduct research on resources management

5.3.3 Existing facilities

The Program, thus far, has at its disposal the following facilities and equipment:

Quantity	Description
1	Geographic information system that uses the Earth Resource Data Acquisition System (ERDAS).
1	Data bases with the following hardware: Eclipse Data General MV-7800 computer, and several computers and other supporting hardware.
1	An experimental watershed (Tuis River, near Turrialba) with the following infrastructure: 13.5 Ha. experimental farm; 1 continuous rain gauging station; 6 daily rain gauging stations; 2 continuous stream-flow recording stations.
1	Fully equipped meteorological station. Audiovisual and other supporting equipment.
1	Documentation center with more than 2,500 users.

5.3.4 Objectives

Five years

- Consolidate national institutional frameworks for watershed and wildlands management in each participating country enabling the implementation of integrated natural resources management techniques.

- Establish one demonstration watershed in each selected pilot area of each participating country, employing applied watershed and wildlands management practices, integrating resource conservation into agricultural and forestry production systems.

- Promote, cooperate with, and actively participate in: 1) the preparation and implementation of management plans for watershed and wildlands systems and subsystems; 2) the planning and implementation of high-priority conservation-for-development strategies and projects in the selected pilot areas in each participating country.

- Validate soil and water conservation technologies to be transferred to and adopted by the majority of farmers in at least one selected pilot area per participating country.

- Develop and apply standard information-gathering formats, and set up data bases in national institutions of the participating countries.

- Establish a geographic information center, for watershed and wildland planning, with validated methodologies for agro-meteorological zoning and land-use management.

- Develop methodologies to optimize the use of water and the yields of selected annual crops in the participating countries.

- Develop, in close collaboration with Programs I and II, modeling techniques and alert systems, for the purposes of prediction of situations and management of selected crops.

- Train an estimate of 2,230 persons, in the aspects of agro-meteorology and watershed and wildlands management: 300 decision-markers, 1,130 professionals, and 800 technicians.

Ten years

- Establish several demonstration watersheds with ongoing development projects in each participating country, applying validated integrated natural resource management practices in agricultural and forestry production systems.

- Develop and improve policies and strategies for the sustainable development of natural and cultural resources, to bring about long-lasting socio-economic benefits at the local, national, and regional levels.

- Consolidate the regional wildlands and watershed management systems by promoting the exchange of information, horizontal cooperation, and management of international wildlands and watersheds, maximizing long-term conservation of biological diversity, thus providing for a sustainable framework for integrated natural resource management in the region.

- Significantly diminish or stop present trends of deforestation in favor of integrated natural resources management practices, provided participating countries support these activities at the decision-making level.

- Transfer validated soil and water conservation technologies to the majority of farmers in the main producing areas in each participating country.

- Manage, use, and consolidate a general biophysical and socio-economic data base network, through CATIENET (CATIE's computerized network), on a regional basis.

- Generate and validate water and land-use management technologies for the humid tropical areas in the participating countries.

- Consolidate the agro-meteorological capabilities of national institutions in the participating countries enabling them to: a) optimize the use of water and expected crop yields; and b) develop modeling techniques for the purposes of prediction and of alert systems for crop planning.

- Train an estimate of 5,680 persons in the aspects of integrated natural resources management: 2,750 decision-makers, 2,655 professionals, and 2,275 technicians.

5.3.5 Strategy

This program entails two main areas: watershed management and wildlands management. The underlying concept is based on the fact that

within a watershed there exists a system of natural resources that supports agricultural production and development in the fertile soils downstream. The sustainability of that development depends on appropriate, integrated natural resources management.

A watershed is defined as the land or geographic area that collects and discharges its surface stream flow through one common outlet. It serves as an appropriate unit of integrated natural resources planning and management because it consists of a well-defined topographical boundary, a drainage area, and a water course, i.e., a river or a stream. It includes all of the natural resources in the basin, especially water, soil, and vegetation.

Watershed management is a multi-disciplinary activity; the technical fields it integrates depend on the physical, biological, and socioeconomic characteristics of the particular watershed being treated. This integrated approach is especially appropriate for the Central American region, where the topography and climatic conditions contribute to very pronounced watershed, and where watersheds, resources play a critical role in economic development. This particular program lays stress on two disciplinary areas: environmental resources and socio-economics, but other disciplines from other programs will take part when required.

The tasks of watershed planning and management involve assessing the natural resources of the watersheds and the various demands, which may be in conflict, and deciding upon a priority use or optimum mix of uses. Based on these assessments, appropriate integrated natural resource management practices will be determined.

CATIE's research, in cooperation with national institutions, seeks to enable the region to adapt and develop techniques for the analysis, planning and monitoring of sustained development--measured in terms of increased incomes combined with resource conservation and enhancement--in demonstration watersheds, within a selected pilot area in each participating country. The research conducted in these demonstration watersheds will lead to integrated natural resource management practices to be incorporated into the production systems.

Likewise, sustainable economic development in tropical forest areas is a global concern. Most efforts, however, have confirmed one objective reality: if use exceeds what the natural resource base can sustain, degradation will set in and eventually may affect essential ecological processes and diminish genetic diversity. An alternative approach is being worked out by the sponsors of the World Conservation Strategy (IUCN, UNEP, WWF, 1980),

whose major goal is to help sustain development through conservation of living resources.

In Central America, as in any other part of the world, sustainable development is closely related to conservation. Conservation can be achieved to promote sustainability through proper use and management. Therefore conservation is an essential part of CATIE's strategy for production and sustained development. In this field, CATIE has played an important role as a strategist, catalyzer, and adviser in the establishment, planning, and management of a regional system of protected wildlands in the Central American region, constituted by more than 300 individual areas that cover more than 40,000 km^2.

Therefore, CATIE goes beyond research to:

1) Provide technical cooperation in: the application of planning and monitoring techniques to specific priority watersheds; the establishment and management of wildland areas to promote the conservation of biological diversity.

2) Train national system scientists, decision-makers, and technicians who will increasingly take responsibility for national watershed and wildland management programs.

In addition, this program is in charge of generating, storing, and supplying information on integrated natural resources management to the other two programs.

5.3.6 Staffing

Minimum critical-mass staffing: one natural resource economist, one agrometeorologist, one hydrologist, one soil conservation specialist, one data-base management specialist, one land-use planner, one watershed management specialist, and two wildlands management specialists (Table 10).

A more desirable level of staffing would add a second agrometeorologist, one land-use planner, one data-base management specialist, and two wildlands management specialists.

TABLE 10. PROGRAM III - INTEGRATED NATURAL RESOURCES MANAGEMENT CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

DISCIPLINE	CRITICAL-MASS			CRITICAL-MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)[2]	
	DESIRABLE	MINIMUM	EXISTING[1]	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
ECONOMICS	1	1	1	0	0	0	0
AGRO-METEOROLOGY	2	1	0	2	1	300	150
HYDROLOGY	1	1	0	1	1	150	150
LAND USE PLANNING	2	1	0	2	1	300	150
SOIL CONSERVATION	1	1	0	1	1	150	150
DATA BASE MANAGEMENT	2	1	0	2	1	300	150
WATERSHED MANAGEMENT	1	1	1	0	0	0	0
WILDLANDS MANAGEMENT	4	2	1	3	1	450	150
TOTALS	14	9	3	11	6	1,650	900

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (includes salaries, benefits, support personnel, operational costs).

5.3.7 Cooperating institutions

5.3.7.1 Financial Support

The program has a number of contributors through short-term projects.

In the watershed management area, there are two contributors: the United States Agency for International Development through its Regional Office for Central America and Panama (USAID/ROCAP), and the Government of France, through ORSTOM and CIRAD.

In the wildlands area, there are numerous cooperating institutions, including donors such as the Swedish International Development Authority, the World Wildlife Fund for Nature--Switzerland and the United States--the National Audubon Society, the Nature Conservancy, the United Nations Environmental Program, the International Union for the Conservation of Nature and Natural Resources, the Ministry of Development Cooperation of Norway, UNESCO, IIED, Conservation International, the Inter-American Fund, the National Park Service and Fish and Wildlife Service of the United States.

5.3.7.2 Human Resources

The institutions that provide human resources for the wildlands area are: the World Wildlife Fund for Nature--Switzerland (0.5) and the United States (1.5)--and the International Union for the Conservation of Nature and Natural Resources (1).

In the watershed management area, the Government of France, through ORSTOM (1) and CIRAD (1), and the Government of the Netherlands (1) also contribute human resources to the Program.

5.3.7.3 Reciprocal Technical Cooperation

Its involvement in watershed management in the Central American Region has led CATIE to promote inter-institutional coordination, in an effort to overcome one of the main obstacles to this activity. Thus, through the implementation of the Tropical Watershed Management Project CATIE is associated with the following national inter-institutional committees:

COSTA RICA

The National Meteorological Institute, (IMN)
The National Service of Subterranean Water, Irrigation and Drainage, (SENARA)
The Costa Rican Electricity Institute, (ICE)
The National Electricity Service, (SNE)
The National Council of University Rectors, (CONARE)
The Ministry of National Planning, (MIDEPLAN)
The Forestry General Directorate, (DGF)
The National Institute of Water and Sewage Systems, (A y A)

GUATEMALA

The National Forestry Institute, (INAFOR)
The National Directorate for Irrigation, (DIRYA)
The National Institute of Seismology, Volcanology, Hydrology and Meteorology,(INSIVUMEH)
The Potable Water Company of Guatemala, (EMPAGUA)
The University of San Carlos, (USAC)
The Ministry of Urban and Rural Development
The National Electricity Institute, (INDE)

HONDURAS

The Honduran Forestry Corporation, (COHDEFOR)
The National Autonomous Service of Water and Sewage Systems, (SANAA)
The National Electric Energy Company, (ENEE)
The Ministry of Planning, Budget and Coordination, (SECPLAN)
The Ministry of Natural Resources

PANAMA

The Ministry of Agricultural Development, (MIDA)
The Ministry of Planning and Economic Policy, (MIPPE)
The National Institute of Renewable Natural Resources, (INRENARE)
The Institute of Hydraulic and Electrical Resources, (IRHE)
The National Institute of Water and Sewage Systems, (IDAAN)
The Technological University of Panama (UT)
The University of Panama (UP)
The Ministry of Public Works (MOP)

Other reciprocal technical cooperation activities are conducted with the following programs and institutions in the areas of watershed management and planning: the Tennessee Valley Authority, the University of Wisconsin,

the University of Minnesota, Colorado State University, the National University of Costa Rica, the National University of Honduras, and the Pan American Agricultural School of El Zamorano in Honduras.

Reciprocal technical-cooperation institutions in the wildlands area are even more numerous: one in Belize, one in Guatemala, three in El Salvador, four in Honduras, two in Nicaragua, three in Costa Rica, one in Panama, three in Dominican Republic, one in Mexico, seven in South America and the Caribbean, two in the United States and two in Europe. The non-governmental cooperating organizations include: two in Belize, one in Guatemala, two in El Salvador, two in Honduras, one in Nicaragua, four in Costa Rica, four in Panama, four in Mexico, six in South America, seven in the United States, and two in Europe. This makes a total of 30 governmental organizations and 35 non-governmental organizations that are cooperating with the wildlands area alone.

5.3.8 Funding requirements

- Critical-mass requirements and relationship to existing core-funded principal staff:

As seen in Table 10, only three of the nine minimum critical-mass scientists of the Program are presently being funded, through core budget (unrestricted).

- Critical-mass staff funded via short-term projects:

At present, there are seven critical mass staff members funded by short-term projects or agreements with ROCAP/AID, WWF and CIRAD. These are: Wildlands management (2), Agrometeorology (1), Hydrology (1), Land Use Planning (1), Soil Conservation (1) and Data Base Management (1).

The critical-mass funding via the Regional Tropical Watershed Management Project (USAID/ROCAP) extends until the end of 1989. The critical mass, sponsored by WWF and CIRAD, is funded on an annual basis.

- Cost of training:

The training requirements, as indicated in Section 5.3.4, are estimated in 3,345 man-weeks for 5 years, and 8,520 man-weeks for 10 years. The cost per man/week is estimated at US$500.00 giving the total annual requirement shown in the table below.

5.3.9 Summary of Funding Requirements - Program III

	Annual Requirements (in US$1000's)		
	By Year 1	By Year 5	By Year 10
Critical mass 1/	1,350	1,800	2,100
Training 2/	296	335	426

1/ Does not consider the existing core-funded principal staff.

2/ Annual cost, excluding international travel.

6. EDUCATIONAL PROGRAMS

6.1 GENERAL REMARKS

Today CATIE is considered to be the most important human resource training center at the graduate level (Magister Scientiae) in agricultural sciences and renewable natural resources in Latin America and the Caribbean region.

This Center has gained a wealth of experience in its more than forty years of existence, with nearly a thousand MS graduates from all over the hemisphere. Each year, CATIE receives between 250 and 300 admission applications for its graduate program from all countries of Latin America and the Caribbean, and even from the United States, Canada and Europe.

Starting in 1984, CATIE began a process of institutional strengthening of certain scientific and academic aspects by increasing its technical staff, renovating its laboratories, library, computer center and experimental stations; and expanding its infrastructure in order to substantially augment its capacity to develop human resources.

CATIE's activities aimed at the formation of human resources are strategically vital in accelerating and sustaining agricultural growth and development in the region. In fact, to attain such development, raising productivity and sustaining it through the integrated management of resources, and the generation of technological innovations, we must increase our capacity to conduct research and establish better means of transferring and disseminating knowledge.

CATIE does not limit its generation of human resources to the programmatic areas of research already mentioned. Although these areas constitute one of the bases of its educational activity, it is also involved in other areas necessary to its multidisciplinary and integrated approach and to the development of human resources in the fields of agricultural sciences, natural resources and related fields.

In this section we refer only to graduate-level education, as other types of educational activities (training, short courses, in service training, etc.) are dealt within the sections having to do with the three research and development programs.

6.2 PROGRAM DIRECTION AND FOCUS

CATIE's Graduate Program in Agricultural Sciences and Renewable Natural Resources provides qualified training at the Master's degree level in the areas of Improvement of Tropical Crops (Tissue Culture, Plant Breeding), Sustained Agricultural Development and Production (Animal Breeding, Ruminant Nutrition, Animal Production, Integrated Pest Management, Tropical Soils, Agricultural Production Systems, Silviculture, Agroforestry), and Integrated Management of Natural Resources (Watershed Management, Wildlands Management). Furthermore, it is expected that in 1988 CATIE will initiate a Graduate Program in Socio-Economics applied to Agricultural Development. This Program will be headquartered in the Dominican Republic. It will cover the following areas: Rural Development, Agricultural Research Management, and Cooperatives Management.

All students participating in CATIE's Master's degree program are qualified professionals and technicians working in the agricultural sectors of their respective countries. After graduation, these professionals return to the national, public, or private institutions in their countries where they worked before joining CATIE's Graduate Program.

We approach the training of human resources through an institutional strategy of horizontal cooperation. By means of a networking mechanism, CATIE focuses its educational activities within the context of a research-education-development system involving its seven member nations (Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador and the Dominican Republic). But, as already pointed out, CATIE's educational activity extends beyond these countries to nearly all of Latin America and the Caribbean region. Moreover, the Center's cooperative agreements with numerous universities and research institutions of the United States and

Europe and other international organizations represent important channels of scientific and academic support.

The "Regional Cooperative Network for Education in Agriculture and Renewable Natural Resources" (REDCA), involving more than 60 institutions of higher education, ministries of agriculture, research institutes, and higher education councils of the seven member countries is the main mechanism for CATIE's educational action (Annex 4). Through this network, CATIE seeks to strengthen the national research and educational institutions. CATIE's programs also receive support from those institutions, while promoting exchange and cooperation among all of them. In this way the network enables us to integrate diverse scientific, academic, and development projects, both on the national and regional levels. This modus operandi has received broad support and recognition from its member countries and their institutions.

6.3 FACILITIES

To meet the needs of the graduate students, CATIE employs an academic staff of more than 100 researchers-professors most of them belonging to the three research and development programs. They devote around 40% of their time to teaching and theses tutoring. Further, CATIE, with the financial support of USAID/ROCAP, has expanded its infrastructure (residence halls and housing for staff and students, academic buildings, etc.) to accommodate a greater number of graduate students. Nonetheless, as we explain in the paragraphs that follow, this number also depends on available scholarship funds.

As mentioned above, CATIE receives around 300 applications for admission to the Graduate School annually. Of these applicants, usually a little over one-third pass the entrance examination. Only a few of these, however, can actually enroll, due to the scarcity of scholarships. From 1973 to 1983 the annual enrollment averaged 27 students. In 1985, the enrollment was 33 students; in 1986, 46; and in 1987, the number of students enrolled rose to 59.

6.4 STAFFING

CATIE strives to keep its academic administration to the minimum needed to manage its educational programs. The current academic administrative staff is listed below:

1) Associate Director General for Education

2) Dean of the Graduate Program in Agricultural Sciences and Renewable Natural Resources

3) Director of the Continuing Education Program

Starting in mid 1988, when the new program in Socio-Economics applied to Agricultural Development is to be launched, a person will be appointed as program coordinator in the Dominican Republic. The scientific staff working in CATIE's various technical Programs are in charge of the actual academic activities (teaching, counselling and thesis guidance).

6.5 FUNDING REQUIREMENTS (SCHOLARSHIPS)

During the last four years the demand for CATIE's Graduate Program in all Latin American and Caribbean countries has been on the rise, as evidenced by the increasing number of applications for admission. Some 60% of these applications come from the seven member countries (Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador and the Dominican Republic); most of the others are from other countries in the hemisphere.

Nonetheless, 75% of the students enrolled in the graduate program are from the member countries. Since CATIE is primarily committed to them, they receive most of the available scholarships.

CATIE has a limited and uncertain number of scholarships available each year for graduate students entering its two-year master's degree program. The scholarships are provided by entities such as ROCAP (USAID), and agencies from the British Government (ODA), the Netherlands, West Germany (GTZ, DSE,DAAD), the Swedish Government (SIDA) and Canada (IDRC). In addition, a smaller number of students receive scholarships from institutions in their home countries.

Additional funding for scholarships will be needed to derive maximum benefit from CATIE's increasing capacity and provide greater opportunities to member and non-member countries.

Before presenting the scholarship funding needs for the next 10 years, it is important to note out how the annual enrollment (for 2-year study periods) in recent years has been growing.

PERIOD	NO. OF STUDENTS	COSTS (SCHOLARSHIPS)
1984-1986	27	US$567,000.00 (1)
1985-1987	33	695,000.00 (1)
1986-1988	46	1,104,000.00 (2)
1987-1989	59	1,534,000.00 (3)

(1) Unit cost per scholarship, US$21,000.00

(2) Unit cost per scholarship, US$24,000.00

(3) Unit cost per scholarship, adjusted to new needs, including the need for additional resources for research and thesis work in the country of origin, US$26,000.00

The first of the two-year program is devoted to formal courses; the second is spent on the thesis research project.

The total cost per student, as of January 1988, amounts to US$26,000.00, including a monthly stipend and all student expenses.

In order to maximize CATIE's resources, including its expanded facilities and graduate staff, we estimate that an annual enrollment of approximately 60 students per year must be maintained. However, the institution will be able to accommodate a maximum of 75 graduate students per year (for two-year study periods) by the end of 1988 when its present physical expansion program will be completed.

As for the new Dominican Republic based Regional Program in Socio-Economics for Rural Development, an ideal yearly enrollment would be around 20 students (also for two-year study periods).

The primary limiting factor in attaining these goals is the number of available scholarships. CATIE is presently guaranteed approximately 30 scholarships per year, provided by traditional sources (The Netherlands, ODA, DAAD, DSE, GTZ, SIDA, etc.). The projects conducted by the Center have been another important source of scholarships for students of the region. These scholarships cannot be counted on in the future, however, due to the limited duration of the projects, whose main source of funding has been AID/ROCAP.

Our main goal for the next ten years is to train 935 new specialists--almost as many as graduated from CATIE in its first forty-years of its existence. Of these, 735 students will earn M.Sc. degrees in Agricultural Sciences and in Renewable Natural Resources and 200 in socio-economics applied to agricultural development.

The total scholarship funding needs for the next ten years, itemized in the following table, are based on a per-scholarship cost of $26,000.00.

COST OF SCHOLARSHIPS (for two year periods)

YEAR 1	YEAR 2	YEAR 3
Students: 85	Students: 90	Students: 95
Cost:	Cost:	Cost:
US$2,210,000.00	US$2,340,000.00	US$2,470,000.00

For the following years up to year 10, CATIE will maintain an admission of 95 students per year. The cost of each two-year period will be the same as for year 3, i.e., US$2,470,000.00.

7. SUPPORT SERVICES, MANAGEMENT AND GENERAL ADMINISTRATIVE SERVICES

7.1 SUPPORT SERVICES

Basic services needed by CATIE's programs are provided by its support units and library.

Three of CATIE's support Units (the computer center, the biometrics unit and the communications unit) and the library are in need of special help in addition to financial support from core budget.

7.1.1 Computer Center

Computerized data processing is essential to CATIE's research, teaching, and management activities.

For the next five years the following projects have been proposed:

1) Installation of a regional computer network, CATIENET, to offer the following services: electronic mail, file transfer, remote processing and access to CATIE's databases.

2) Creation of a regional training program on the use of microcomputers for agricultural research and technology transfer.

3) Installation of a Management Information System in collaboration with the Division of Finances and Administration.

4) Development of instructional techniques based on and assisted by computers in collaboration with the Communications Unit.

7.1.1.1 Existing facilities

The computer center has recently replaced its IBM 4331 computer system used for statistical and management processing by an IBM 9370, donated by IBM.

A new building for the computer center is currently under construction with funds from the Higher Education Project (USAID/ROCAP).

CATIE has recently installed a geographic information system for processing satellite images and geographic information of all kind. This equipment is under the operation of Program III.

CATIE also has around 80 microcomputers in different programs.

Computers are currently used at CATIE for statistical analysis, modeling, data storage and organization, prioritization decision support, retrieval of bibliographic references, word processing and all aspects of accounting.

7.1.1.2 Funding requirements

Needed facilities

The equipment necessary to carry out the proposed activities includes: US$77,000 in hardware and US$79,000 in software.

Needed staffing

The computer center includes one principal staff scientist as well as support personnel.

7.1.2 Biometrics and Statistical Analysis Unit

The Biometrics and Statistical Analysis Unit provides general statistical support for CATIE's research and educational programs. Statistical consulting, which involves experimental design, sample surveys, statistical analysis and computer programming for data processing, is one of the main activities of this unit. The unit also offers graduate courses in statistics, (general statistics, experimental design, etc.) and participates in short training activities.

The objectives for the next five years are to develop a small group of biometricians to assist in statistical planning and analysis of experiments and sample surveys, and in simulation and modeling activities, to broaden the scope of subjects offered in CATIE's graduate and training activities, and to develop, jointly with the Computer Center's staff, instructional techniques based on and assisted by computers.

Additional objectives during the next ten years include the creation of a small regional training program in agricultural statistics to support the staff of national institutions providing continuing educational opportunities. The 10-year strategic development plan also features multidisciplinary work in the systems' approach, stressing modeling and simulation techniques.

7.1.2.1 Funding requirements

Needed staffing

Minimum critical-mass staffing includes one statistician (presently funded through restricted core). A desirable critical mass would add a second statistician, perhaps an expert in simulation modelling.

7.1.3 Communications Unit

The chain of research, education and development requires a well designed, planned and systematized communication strategy to achieve the results in a target population of small and medium scale farmers, whose major characteristics are:

- Illiteracy rates that exceed 35% in some countries;

- Great dispersion and difficulties in accessibility;

- Insufficient allocation of resources for rural extension services.

- Such communications strategy for development must include three fundamental aspects:

- Close coordination among entities of research, education agricultural planning and extension in the region.

- Use of systematized teaching-learning methods accompanied by an intensive use of techniques, media and materials to facilitate the communication process.

- Use of two-way communication schemes interlocutor <--> medium <--> receiver, rather than the traditional transmitter --> receiver.

7.1.3.1 Existing facilities

CATIE has a Central Media Production Unit that specializes in producing graphic materials. It includes a medium capacity offset printing machine and a low capacity computer.

Facilities also include photographic equipment with developers and enlargers, audiovisual projectors, and equipment for the production of short audiovisuals. The Unit lacks video cassette production equipment.

A training program with the necessary equipment is being designed in preparation for installation of a small recording, edition and distribution center for educational video programs and for strengthening the capacity of the printing and photographic services.

A building to house the Communications Unit is also being designed. These activities will be financed under the ROCAP/AID Higher Education Project.

7.1.3.2 Staffing

A communications specialist and an editor cover the minimum critical mass requirements. Support staff includes nine full-time technical members.

7.1.3.3 Proposed activities

The following activities are proposed for the next five years:

- Design of a strategic plan and development of a pilot project for the establishment of a Communications Network called "ECO-DEVELOPMENT", which will be based on REDCA and will offer the following services:

1) Education-Extension Programs and Information on Agriculture and Renewable Natural Resources for the purpose of following up and providing feedback on CATIE's Training and Graduate Studies.

2) Audiovisual Teaching packages in CATIE's areas of competence to be used with closed circuit TV in formal and informal educational processes.

- Preparation of the Regional Training Program for Audiovisual Teaching (design, production and use of better communications methods, techniques and materials) to support the formal and informal teaching-learning processes in agriculture and renewable natural resources required in the region.

- Installation of a Communications System for Development at CATIE.

- Strengthening of the infrastructure and equipment of REDCA's media production and distribution units.

At the end of the first five years we hope to begin the integrated development of the ECO-DEVELOPMENT network in support of CATIE's Strategic Plan and more thorough regional coverage.

7.1.3.4 Funding requirements

In order to carry out the five-year Plan of Activities, CATIE's present Media Unit must make both a qualitative and a quantitative leap as to its human resources, infrastructure and equipment if it is indeed to become a communication system better adapted to actual regional requirements. The total cost of this effort will be US$2,749,412, summarized as follows:

ECO-DEVELOPMENT NETWORK US$649,412
includes:

- Design of the Preliminary Plan US$216,000
- Design, implementation and evaluation of the Pilot Project US$433,412

REGIONAL AUDIOVISUAL TEACHING PROGRAM US$910,000
includes:

- US$120,000 for each of the seven member countries of REDCA.

COMMUNICATION SYSTEM FOR DEVELOPMENT AT CATIE US$350,000
includes:

- Printer and peripheral equipment US$150,000
- Complementary equipment for video recording, editing and distribution (close circuit) US$200,000

STRENGTHENING OF REDCA'S MEDIA PRODUCTION AND DISTRIBUTION UNITS US$840,000
includes:

- US$120,000 for each of REDCA's seven (7) member countries

7.1.4 Library

The Orton Memorial Library, founded in 1946, centrally holds almost all of CATIE's available scientific and educational references. This conservation and updating of its collections is both crucial for the successful execution of CATIE's research and educational activities and vital as a fundamental source of information for the national institutions.

The library's budget is provided jointly by IICA and CATIE, according to an agreement between the two institutions. IICA is presently funding all library personnel.

The library building, inaugurated in 1982, was donated by the British Government through O.D.A. It has complete reference facilities as well as study rooms, offices, classrooms and a conference room. It currently has some 80,000 books and pamphlets and 11,000 periodicals.

In addition to regular loan services and circulation of documents, the library offers four other main services: a) inter-library loans, b) compilation of reference lists c) acquisition of documents and d) reproduction of documents.

Short training courses for non-professional librarians of the agricultural sector are offered. The Kellogg Foundation has helped to fund this activity in the past years.

The objectives for the next five years are a) conserve and update the collections and procure funds for personnel and b) automate the catalog files, setting up a bibliographic database to serve CATIE and the national institutions of the region. CATIENET, our proposed regional computer network, will provide access to these databases.

One ten-year objective is to inter-connect the main libraries in the region with CATIENET, thus forming an integrated source of agricultural information and documentation. Selective dissemination of information to national institutions and automated generation of specialized bibliographies and catalogs will be offered.

7.1.4.1 Funding requirements

Staffing

Desirable staffing required for automation of services would include one additional professional librarian with experience in data processing, as well as support personnel.

Needed facilities

-Peripheral computer equipment	US$33,000.00
-Bibliographic software	20,000.00
-Acquisition of publications	20,000.00
TOTAL	US$73,000.00

7.2 MANAGEMENT AND GENERAL ADMINISTRATIVE SERVICES

CATIE's planning process, with the re-structuring of its programs and organization, has been accompanied by a strengthening of the Finance and Administration area, which will significantly contribute to the short, medium and long-term stability of the institution.

For the fiscal year 1988, the estimated operating costs of CATIE's Management and General Administrative Services, by budgetary area, is as follows:

AREA	COST-1988
Board of Directors	US$30,000.00
General Management	232,600.00
Finance and Administration	718,510.00
Other administrative services (including operations in member countries)	347,370.00
TOTAL	US$1,328,480.00

The above includes four principal staff members: the Director General, Deputy Director General, Head of Administration and Finances, and Head of Human Resources. It also includes the Representatives in each of the member countries.

The main achievements of the past 12-month period are summarized below:

7.2.1 Improvement of management reports

Great strides have already been taken, in order to install an integrated financial accounting and information system which will improve our decision-making capacity by providing more meaningful and precise reports.

7.2.2 Parallel efforts to improve reporting and control by means of micro-computer based systems of:

1) Inventory Control

2) Purchase Order Recording and Payment Updates

3) Cash and Banks

7.2.3 Finance and Administration Systems Study

This USAID/ROCAP funded study, conducted in 1987-1988 by Price Waterhouse, is intended to review present procedures and systems in order to recommend an integrated mini computer-based system to meet CATIE's reporting and control needs, while providing a full audit trail for CATIE's activities.

7.2.4 Internal Audit

An Internal Audit unit was created at the end of 1986 (in close collaboration with IICA) as a measure to strengthen internal control.

7.2.5 Operating efficiency

Budgeting Process

Improvement of the budgeting process using a microcomputer-based standard budget form.

Restructuring of the Division of Finances and Administration

During 1987, finances and administration were placed under a single head in order to facilitate collaboration and cooperation and make both operations more efficient.

In the financial area some restructuring was done in 1987 with the establishment of controller and treasurer sections for the purpose of better

distributing responsibilities and strengthening middle management levels, which were either non-existent or heavily overloaded.

7.2.6 Training of personnel

This activity will become a priority task in 1988, as existing staff must be trained in applications of new technology, and an entirely new reporting system.

7.2.7 Systems and Methods-Efficiency Studies

A systems and methods section has been set up to analyze existing procedures with an eye toward improving the efficiency of cumbersome methods, working with internal auditing to maximize limited resources, and ensure that applications fit coherently into the organizational whole.

7.2.8 Procedures Manual

In addition to the manuals being revised prepared as a result of the Price Waterhouse financial revision, a Purchasing Procedures Manual is being elaborated as a guide for the daily operations of the purchasing unit.

7.2.9 Overhead Study

Price Waterhouse has also been contracted to perform a study, to determine the level of overhead CATIE should be charging to cover additional costs incurred in special projects. This study should greatly support CATIE in establishing a standard, easy-to-understand, and justifiable position as it negotiates this normally sensitive issue.

7.2.10 Improved financial position

In the last 24 months, CATIE has much improved its financial position through necessary, but painful employee reductions: a large number of international staff amounting to almost US$750,000 a year and 60 local employees for approximately US$100,000.

Institutional cash flow, critical two years ago, has become manageable due to the cost reductions effected in 1987, collections of past-due receivables, and the enactment of a new policy to create and manage separate donor bank accounts.

7.2.11 Human Resources systems

The National Association of Schools of Public Affairs and Administration (NASPAA) together with the Central American Institute of Public Administration (ICAP), with the financial assistance of USAID/ROCAP developed an adequate system for administering CATIE's human resources. This system includes proposals for the classification of positions, a salary plan and a benefit package. They also produced a manual on human resources management, including personnel regulations, and strategies for organizing the human resources area. This program was established in June 1987.

SUMMARY OF FINANCIAL REQUIREMENTS

A summary of the institutional financial requirements for staffing as related to critical-mass is indicated in Table 11. As can be seen, the cost of the minimum critical mass (by year 1) is estimated at US$10,950,000,00. However, since core budget (unrestricted and restricted) is presently (1988) funding about half of the minimum critical-mass (38 out of 73) the real funding needs would be US$5,250,000.00 (Table 12). By Year 10, the funding needs in relationship to the existing core-funded critical mass staff would amount to US$9,150,000.00.

TABLE 11. SUMMARY OF INSTITUTIONAL CRITICAL-MASS FINANCIAL REQUIREMENTS

	ANNUAL COSTS (IN US$1,000's)		
PROGRAM	BY YEAR 1	BY YEAR 5	BY YEAR 10
PROGRAM I	1,800	2,550	3,150
PROGRAM II	6,000	7,200	7,500
PROGRAM III	1,350	1,800	2,100
EDUC. PROGRAMS	450	450	450
SUPPORT SERVICES	450	600	750
MANAGEMENT	900	900	900
TOTAL	10,950	13,500	14,850

TABLE 12. SUMMARY OF INSTITUTIONAL CRITICAL-MASS REQUIREMENTS AND RELATIONSHIP TO EXISTING CORE-FUNDED PRINCIPAL STAFF

PROGRAM AREA	CRITICAL-MASS			CRITICAL-MASS NEEDS			
				AMOUNT		ANNUAL COSTS (000's US$)(2)	
	DESIRABLE	MINIMUM	EXISTING(1)	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM
PROGRAM I	21	12	4	17	8	2,550	1,200
PROGRAM II	50	40	19	31	21	4,650	3,150
PROGRAM III	14	9	3	11	6	1,650	900
EDUCAT. PROGRAMS	3	3	3	0	0	0	0
SUPPORT SERVICES	5	3	3	2	0	300	0
MANAGEMENT	6	6	6	0	0	0	0
TOTALS	99	73	38	61	35	9,150	5,250

(1) Numbers represent existing principal staff funded through restricted and unrestricted core budget.
(2) Cost is estimated at US$150,000 per principal staff per year (Includes salaries, benefits, support personnel, operational costs).

TABLE 13. SUMMARY OF INSTITUTIONAL FINANCIAL REQUIREMENTS FOR TRAINING ACTIVITIES

PROGRAM	ANNUAL COSTS (IN US$1,000's) BY YEAR 1	BY YEAR 5	BY YEAR 10
PROGRAM I	190	190	190
PROGRAM II	805	805	1,014
PROGRAM III	296	335	426
TOTAL	1,291	1,330	1,630

TABLE 14. SUMMARY OF INSTITUTIONAL FINANCIAL REQUIREMENTS FORSTAFFING AND EDUCATIONAL ACTIVITIES

PROGRAM	ANNUAL COSTS (IN US$1,000's) BY YEAR 1	BY YEAR 5	BY YEAR 10
CRITICAL-MASS STAFF	10,950	13,500	14,850
TRAINING ACTIVITIES	1,291	1,330	1,630
SCHOLARSHIPS (GRADUATE PROGRAM)	2,210	2,340	2,470
TOTAL	14,451	17,170	18,950

Table 13 shows the annual cost of the training activities proposed. They vary from US$1,291,000.00 by Year 1 to US$1,630,000.00 by Year 10. A summary of financial requirements for staffing and educational activities (including scholarships for the graduate studies program) is indicated in Table 14. No financial estimates have been made in this plan for activities pertaining to maintenance of CATIE's facilities and other related costs. Financial requirements for investments in equipment (computer center, communication unit, etc.) are not included in Table 14 either, but can be seen in the corresponding sections of this plan.

Summary of costs, for Year 1, indicated in Table 14 are not much different from the present institutional budget. As stated before, what is required is a change in the existing financial structure, (25% core budget: 75% special projects) since a medium-term strategic plan like this cannot be implemented with a short-term, special projects funding structure as it now exists.

ANNEXES

ANNEX 1: DISTRIBUTION OF PRINCIPAL STAFF ACCORDING TO WORK AREA (as of 1986)

	DISCIPLINARY AREAS																							
	1		2		3		4		5		6		7		8		9		10		11		12		13
PROGRAM AREAS	BIOLOGY AND GENETICS		SOILS AND NUTRITION		ANIMAL NUTRITION		CROP & LIVESTOCK MANAGE-MENT		ANIMAL & PLANT HEALTH		CLIMA-TOLOGY		SOCIO-ECONOMICS		TECH. TRANSFER RESEARCH		LAND USE PLANNING		WATER SOIL & VEG. CON-SERVATION		FARMS RESEARCH		OTHER DISC.		TOTAL
	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	N	M/Y	M/Y
PERENNIAL CROPS	8	3.61	2	0.50			4	1.30	8	2.72	1	0.10	1	0.10							4	1.10			9.43
ANNUAL CROPS	3	1.27	4	1.80			4	0.65	9	6.33	1	0.15	3	1.75							6	0.82			12.77
PROMISING TROP. CROPS	3	0.84	2	0.15			2	0.80	2	0.53															2.32
BOVINE PRODUCTION	4	2.75			3	0.80			1	0.40					1	0.10					7	1.50			5.55
PASTURES AND FORAGES			4	0.40	5	1.75	3	0.65													4	0.70			3.50
SMALL RUMINANTS	1	0.20			2	0.40			1	0.20											2	0.20			1.00
AGROFORESTRY AND MULTI-USE TREES	4	0.66	6	1.23			15	4.54					4	1.35	8	1.70	1	0.05			12	2.75			12.28
SILVICULTURE	3	1.60	2	0.20			11	4.70			1	0.20	6	1.00	6	0.90			2	0.50	7	0.70			9.80
WATERSHED MANAGEMENT											4	1.25	3	0.30	4	1.30	5	1.85	7	2.45					7.15
WILDLANDS MANAGEMENT	1	0.80					1	0.10			1	0.05	2	0.30	1	0.20	3	1.55	5	3.00	1	0.05			6.05
PRODUCTION SYSTEMS DEV.			1	0.50			1	0.30					1	0.60	3	0.70	1	0.25	1	0.25	4	2.55			5.15
ADMINISTRATIVE SUPPORT																							5	5.00	5.00
INFORMATION AND PUBLIC RELATIONS																							1	1.00	1.00
DOCUMENTATION AND EDITING																							2	2.00	2.00
BIOSTATISTICS & DATA PROCESSING																							3	3.00	3.00
MEMBER COUNTRIES REPRESENTATION																							4	4.00	4.00
EDUCATION MANAGEMENT																							2	2.00	2.00
TECHNICAL SUPPORT																							1	1.00	1.00
TOTAL	27	11.73	21	4.78	10	2.95	41	13.04	21	10.18	8	1.75	20	5.40	23	4.90	12	3.70	15	6.20	47	10.37	18	18.00	93.00

N = Number
M/Y = Man/Year

ANNEX 2: CLASSIFICATION OF CATIE'S ACTIVITIES BY ORDER OF PRIORITY

	DISCIPLINARY AREAS									
	1	2	3	4	5	6	7	8	9	10
PROGRAM AREAS	BIOLOGY AND GENETICS	SOILS & PLANT NUTRITION	ANIMAL NUTRITION	CROP & LIVESTOCK MANAGEM.	PLANT & ANIMAL HEALTH	AGROCLIMA-TOLOGY	SOCIO-ECONOMICS	TECHNOLOGY TRANSFER RESEARCH	LAND USE PLANNING	WATER, SOIL & VEGETATION CONSERVATION
A PERENNIAL CROPS	H	H	-	L	H	-	M	M	-	-
B ANNUAL FOOD CROPS	L	H	-	L	H	-	H	H	-	-
C PROMISING TROPICAL CROPS	H	L	-	L	M	-	M	L	-	-
D BOVINE PRODUCTION	H	-	H	H	L	-	M	M	-	-
E PASTURES AND FORAGES	L	M	-	H	L	-	M	M	-	-
F SMALL RUMINANTS	L	-	M	H	L	-	M	L	-	-
G AGROFORESTRY AND MULTI-USE TREES	H	H	-	H	L	-	H	M	-	-
H SILVICULTURE	H	L	-	H	L	-	H	M	-	-
I WATERSHED MANAGEMENT	-	M	-	-	-	H	M	H	H	H
J WILDLIFE MANAGEMENT	L	-	-	-	L	-	M	L	H	H
K PRODUCTION SYSTEMS DEVELOPMENT		-	-	H	-	-	H	H	-	-

H: High priority M: Medium priority L: Low priority

ANNEX 4

REDCA'S REGULAR MEMBERS (NATIONAL INSTITUTIONS)

Costa Rica

Minister of Science and Technology
(Ministerio de Ciencia y Tecnología)

National Council for Scientific and Technological Research
(Consejo Nacional de Investigaciones Científicas y Tecnológicas, CONICIT)

National University
(Universidad Nacional, UNA)

By-tutory State University
(Universidad Estatal a Distancia, UNED)

Technological Institute of Costa Rica
(Instituto Tecnológico de Costa Rica, ITCR)

Minister of Agriculture and Livestock
(Ministerio de Agricultura y Ganadería, MAG)

El Salvador

Minister of Agriculture and Livestock
(Ministerio de Agricultura y Ganadería, MAG)

University of El Salvador
(Universidad de El Salvador)

Central American University Jose Simeon Cañas
(Universidad Centroamericana José Simeón Cañas)

Politechnic University of El Salvador
(Universidad Politécnica de El Salvador)

Agricultural Technology Center
(Centro de Tecnología Agrícola, CENTA)

Agricultural Training Center
(Centro de Capacitación Agropecuaria, CENCAP)

Guatemala

Minister of Agriculture and Livestock
(Ministerio de Agricultura y Ganadería, MAG)

Institute of Science and Agricultural Technology
(Instituto de Ciencia y Tecnología Agrícola, ICTA)

University of San Carlos
(Universidad de San Carlos)

Rafael Landivar University
(Universidad Rafael Landivar)

Del Valle University
(Universidad del Valle)

Honduras

Minister of Natural Resources
(Ministerio de Recursos Naturales)

National Autonomous University of Honduras
(Universidad Nacional Autónoma de Honduras)

Pan American School of Agriculture
(Escuela Agrícola Panamericana, EAP ("El Zamorano")

National School of Agriculture
(Escuela Nacional de Agricultura, ENA)

National School of Forestry Sciences
(Escuela Nacional de Ciencias Forestales, ESNACIFOR)

Nicaragua

Minister of Agricultural Development and Land Reform
(Ministerio de Desarrollo Agropecuario y Reforma Agraria, MIDINRA)

National Council of Higher Education
(Consejo Nacional de Educación Superior, CNES)

Autonomous University of Nicaragua
(Universidad Autónoma de Nicaragua)

National Autonomous University of Nicaragua
(Universidad Nacional Autónoma de Nicaragua)

Central American University
(Universidad Centroamericana, UCA)

Institute of Agricultural Sciences
(Instituto Superior de Ciencias Agrícolas, ISCA)

International School for Agriculture and Livestock
(Escuela Internacional de Agricultura y Ganadería)

Politechnic University of Nicaragua
(Universidad Politécnica de Nicaragua)

Popular Center of Higher Education
(Centro Popular de Educación Superior, CEPES)

Panamá

Minister of Agricultural Development
(Ministerio de Desarrollo Agropecuario, MIDA)

Institute of Agricultural Research
(Instituto de Investigación Agropecuaria, IDIAP)

University of Panama
Universidad de Panamá, UP

Santa Maria la Antigua University
(Universidad Santa María la Antigua, USMA)

Technological University of Panamá
(Universidad Tecnológica de Panamá)

National Institute of Renewable Natural Resources
(Instituto Nacional de Recursos Naturales Renovables, INRENARE)

Institute for Development and Utilization of Human Resources
(Instituto para la Formación y Aprovechamiento de Recursos Humanos, IFARHU)

República Dominicana

State Secretariat for Agriculture
(Secretaría de Estado de Agricultura, SEA)

National Council for Higher Education
(Consejo Nacional de Educación Superior, CONES)

Autonomous University of Santo Domingo
(Universidad Autónoma de Santo Domingo, UASD)

Dominican Republic Association of University Rectors
(Asociación Dominicana de Rectores de Universidades, ADRU)

Pedro Henriquez Ureña National University
(Universidad Nacional Pedro Henriquez Ureña, UNPHU)
Mother and Master Catholic University
(Universidad Católica Madre y Maestra, UCMM)

Technological Institute of Santo Domingo, INTEC
(Instituto Tecnológico de Santo Domingo, INTC)

Central University of the East
(Universidad Central del Este)

APEC University
(Universidad APEC)

Northeastern University
(Universidad Nordestana)

Iberoamerican University
(Universidad Iberoamericana)

Technological University of Cibao
(Universidad Tecnológica del Cibao, UTECI)

Technological Institute of Eastern Cibao
(Instituto Tecnológico del Cibao Oriental, ITECO)

Agricultural Higher Education Institute
(Instituto Superior Agropecuario, ISA)

Salesian Agronomic Institute
(Instituto Agronómico Salesiano)

Agronomic Institute S. Ignacio de Loyola
(Instituto Agronómico S. Ignacio de Loyola)

Loyola Politechnic Institute
(Instituto Politécnico Loyola)

REDCA MEMBERS OF THE SUB-NETWORK OF AMERICAN UNIVERSITIES

University of Wisconsin
Cornell University
Iowa State University
University of Florida
Colorado State University
University of Missouri

INAFOR	National Forestry Institute
INFORAT	Tropical American Forestry Information and Documentation Service
INRENARE	Institute of Renewable Natural Resources
IPM	Integrated Pest Management
IRCC/CIRAD	French Coffee and Cocoa Research Institute
IRENA	Institute of Natural Resources
ITCR	Technological Institute of Costa Rica
IUCN	International Union for the Conservation of Nature
IUFRO	International Union of Forestry Research Organizations
JIA	Inter American Board of Agriculture
JICA	Japanese International Cooperation Agency
MAG	Ministry of Agriculture and Livestock, Costa Rica
MIDA	Ministry of Agricultural Development, Panama
NASPAA	National Association of Schools of Public Affairs and Administration
NARS's	National Agricultural Research Systems
NFTA	Nitrogen Fixing Tree Association
ODA	Overseas Development Agency of the United Kingdom
ORSTOM	French Institute of Scientific Research for Development Cooperation
PEMASKY	Project of Studies for the Management of Natural Areas Kuna Yala
R&D	Research and Development
REDCA	Regional Cooperative Network for Education in Agriculture and Renewable Natural Resources
RIEPT	International Network for Tropical Pastures Evaluation
RISPAL	Latin American Animal Production Systems Research Network
SIDA	Swedish International Development Authority
TFAP	Tropical Forestry Action Plan
UNA	National University of Costa Rica
UNEP	United Nations Environmental Program
UP	University of Panama
USC	University of San Carlos, Guatemala
US AID	United States Agency for International Development
USAID/ROCAP	United States Agency for International Development, Regional Office for Central American Programs
WWF	World Wildlife Fund

GLOSSARY

ACRI	American Cocoa Research Institute
ANAI	International Association of New Alchemists
BMZ	Ministry of Cooperation of the Federal Republic of Germany
CAMCORE	Cooperative for the Preservation of Conifer Resources of Central America and Mexico
CARE	Cooperative for American Relief Everywhere
CATIE	Centro Agronomico Tropical de Investigacion y Enseñanza
CATIENET	CATIE's Computerized Regional Network
CENREN	National Center for Natural Resources
CENTA	National Center of Agricultural Technology, El Salvador
CIAT	International Center for Tropical Agriculture
CIM	Intergovernmental Migration Committee
CIMMYT	International Center for the Improvement of Maize and Whea
CIP	International Potato Center
COHDEFOR	Honduran Corporation for Forestry Development
COSUDE	Swiss Cooperation for Development
CURLA	Atlantic Regional University Center, Honduras
DAAD	German Academic Exchange Service
DGF	Forestry Directorate General
DSE	German Foundation for International Development
EAP	Pan-American Agricultural School, Honduras
ESNACIFOR	National School of Forestry Sciences
FAO	Food and Agricultural Organization
FHIA	Honduran Agricultural Research Foundation
GNP	Gross National Product
GTZ	German Agency for Technical Cooperation
IARC's	International Agricultural Research Centers
IBM	International Business Machines
IBPGR	International Board for Plant Genetic Resources
IBSNAT	International Benchmark Sites Network for Agrotechnology Transfer
ICTA	Agricultural Science and Technology Institute, Guatemala
ICRAF	International Council for Research in Agroforestry
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IDIAP	Institute of Agricultural Research of Panama
IDRC	International Development Research Center of Canada
IICA	Inter-American Institute for Cooperation on Agriculture
IIED	International Institute for Environment and Development
IITA	International Institute of Tropical Agriculture