CORECA

REGIONAL COUNCIL FOR
AGRICULTURAL COOPERATION

GISA

INTER-INSTITUTIONAL GROUP
OF THE AGRICULTURAL SECTOR

FIRST AGRICULTURAL SECTOR MEETING OF THE CENTRAL AMERICAN GOVERNMENTS WITH COOPERATING GOVERNMENTS AND INSTITUTIONS

5 REGIONAL PROGRAM ON THE DEVELOPMENT OF BIOTECHNOLOGY

PEC/AS/91/5
PROJECT CAM/90/002
SPECIAL PLAN OF ECONOMIC COOPERATION
FOR CENTRAL AMERICA

The technical information for the First Agricultural Sector Meeting is presented in ten documents to facilitate reading by cooperating governments and institutions. The documents are:

PEC/AS/91/1: Executive Summary

PEC/AS/91/2: Importance of the Agricultural Sector. Technical and Financial Assistance. Summary of Project Profiles.

Documents 3 to 10 describe the eight regional programs on topics selected as being of priority by the Central American governments. The Programs are:

PEC/AS/91/3: Regional Agro-alimentary Program.

PEC/AS/91/4: Program on Irrigation, Drainage and Land Leveling.

PEC/AS/91/5: Program on the Development of Biotechnology.

PEC/AS/91/6: Program on Intra-regional Trade and Exports to Third Countries.

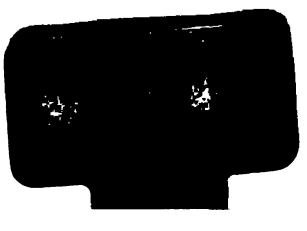
PEC/AS/91/7: Program on Agroindustrial Development.

PEC/AS/91/8: Program to Strengthen Plant and Animal Health Services.

PEC/AS/91/9: Program on the Development of Border Areas.

PEC/AS/91/10: Program to Strengthen Rural Enterprises.

Each Program consists of two components: one of regional scope and the other of national scope. The regional component involves cooperative projects and actions among the countries of the isthmus, while the national component is made up of the investment projects to be carried out in individual countries.



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REGIONAL PROGRAM ON THE DEVELOPMENT OF BIOTECHNOLOGY

1991

PROJECT CAM-90-002 UNDP/PAHO/PEC

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INTRODUCTION

The principal objectives of this Regional Program are to transfer micropropagation technology to the six countries of the Central American isthmus and to begin harmonizing technological policy in the region. This region-wide effort, which began as an experiment by the Tropical Agriculture Research and Training Center (CATIE), will make it possible to test and validate micropropagation techniques on a commercial scale, which is seen as a permanent solution to limited availability of high-quality seed -- a major limitation to modernization and expansion of certain priority crops in the countries of the region.

Micropropagation technology for plants will be transferred to the six countries.

The efforts of scientists to apply biotechnology to commercial production led to a series of technological processes to generate plants from tissue cultures. It is felt that the Central American countries should not be excluded from progress being made in applying biotechnology to agriculture.

The Regional Program will be carried out on two levels. The first will be executed individually in the countries, while the second will serve the region as a whole, and includes technical cooperation and pre-investment projects. The Regional Program contains a proposal for establishing an integration mechanism to facilitate and promote technology transfer; encourage private and public-sector investments and joint ventures aimed at producing high-quality seed of asexual plants; increase trade of such seed among the six countries of the Central American isthmus; and establish a service for eradicating viruses from food crops.

Technical cooperation and pre-investment will aim to integrate national efforts.

This integration mechanism will take the form of a Technology Transfer and Investment Promotion Network, in which private institutions and enterprises will participate. This Network will facilitate investments in infrastructure for the commercial production of seed; establish uniform standards and technological procedures for obtaining superior-quality seed in each of the countries; facilitate and promote the intra-regional trade of the seed produced; and reduce the costs of training to update the skills of technical personnel and entrepreneurs.

The institutions and enterprises making up the Network will set the criteria for efficient technology transfer; determine the economic resources needed for investments; establish the levels of profitability

The Network will establish efficiency criteria for technology transfer and investment promotion at the national level.

of the companies; and produce information on seed prices, as relates to their performance on national and regional markets.

The countries will be able to engage in less expensive, more efficient and sustained technology transfer if the tasks of basic and applied research, on the one hand, are clearly divided from commercial-scale seed production activities, on the other. Organizing the transfer process in this way, on the basis of the efforts of a regional scientific center (CATIE) and to consolidate joint public and private-sector efforts at the country level, will result in more efficient use of national resources. Also, unnecessary expenditures will be avoided by avoiding a duplication of efforts and repeated mistakes.

The Regional Program contains national investment projects and region-wide technical cooperation and pre-investment projects.

The Regional Program is basically a model for transferring technology from a regional scientific center (CATIE) to national institutions and private seed companies in the countries. It will also work to harmonize technology policies, among the member countries and includes investment projects for each of the countries, as well as technical cooperation and pre-investment projects administered at the regional level. This proposal is the result of the scientific and technological work begun by a regional agency on behalf of farmers in its member countries, and is sufficiently broad in scope to contribute substantially to modernizing production in the region. Its aims are to reactivate agriculture and boost trade with third countries.

I. FRAME OF REFERENCE

1. Macroeconomic Setting and Its Impact on the Regional Program

The problem of seed shortages for asexual reproduction will be solved.

The governments of the Central American isthmus, aware of the advantages offered by biotechnology, and of the fact that technological development is the best way to modernize agriculture, agree on the need to accelerate the application and commercial development of biotechnology as a means of producing seed for asexual plants, currently in short supply.

The potential of agriculture in the isthmus is high, and amounts to approximately 20 percent of the GDP. Agriculture also supplies a large portion of Central American exports to third countries. The demand for large amounts of high-quality products on international

markets is such, that the economic situation of the countries of Central America and Panama can stand to improve considerably.

Bananas provide an excellent example; demand for this fruit could double in coming years. The situation is similar for pineapple. Other important foods consumed in the region are potatoes, cassava, plantain, sweet potato and yam, quality seed for which -- as in the case of bananas and pineapples -- are in short supply. Consequently, all the countries support policies aimed at expanding and renewing plantations.

The Regional Program would ensure the application of biotechnology in each country, in an effort to resolve the shortage of seed for the priority crops covered by the national projects. Production modules that can be managed jointly by private enterprises and the state will be installed in each country.

Transfer will be accomplished through production modules managed by private enterprises, with state support.

After three years of Regional Program activity, the countries will be producing between 15 percent and 20 percent of total seed demand in the region for the crops mentioned above.

2. Analysis of Production Options and of the Technical Environment

All the plants mentioned above are of great importance for the region, but all are affected by problems related to propagation. First, the supply of propagation material is very limited (such is the case with bananas and plantains). All six countries of the isthmus have insufficient propagation material for these crops. Of equal importance is the shortage of basic seed for roots and tubers. Another problem to consider is that when vegetative propagules are used, diseases are transmitted to the following generation, which has the effect of steadily reducing yields.

The only real way to control the quality of such propagules is to "clean" them through tip cultivation. At CATIE, this technique has been successfully used on tiquisque (*Xantho soma spp.*) and other plants. It has been demonstrated that yields can be increased by as much as 400 percent through tissue culture. The technology for micropropagation of these species has been developed and adapted at CATIE, and will be made available to the countries of the region through the installation of production modules designed to micropropagate seed on a commercial scale.

The use of the techniques proposed will boost yields by up to 400 percent.

At CATIE, tissue-culture studies have been conducted to solve problems concerning some of the most important crops in Central America. However, transfer of findings to its member countries, national technological institutions and private seed companies, has been very limited. Because a serious obstacle to developing these

CATIE provides training in biotechnology to some 100 technical personnel per year

techniques is the lack of qualified personnel in the countries, CATIE has put into operation one of the most complete biotechnology training programs in Latin America, reaching an average of 100 technical personnel per year. A majority of those who study at CATIE come from Central America.

Another serious limitation on the adoption of these techniques is the shortage of economic resources for establishing tissue-culture laboratories that would continue studies under way and apply findings to the solution of priority problems. This situation is discouraging to trained personnel and prevents them from making effective use of in vitro techniques. CATIE's Biotechnology Unit has the facilities and infrastructure needed to serve as a coordinating body, and, at the same time, will provide training and advisory services in appropriate biotechnology, in consonance with its institutional mandate.

3. Socioeconomic Situation of Potential Beneficiaries

Small- and medium-scale producers of roots, tubers and plantain will benefit most

Principal beneficiaries of this initiative will be small- and medium-scale farmers in the countries of the Central American isthmus, especially those growing roots, tubers and plantains. These crops have traditionally been produced for the farmers' own consumption or for small surpluses.

The high-quality seed produced through the Regional Program, will enable farmers to plant more land in these crops and obtain greater yields and production volumes, resulting in increased exports and more foreign-exchange earnings. All of this will translate into higher income for farmers.

The supply of food to subregional markets will also improve as diversification makes better-quality and less-expensive products available to consumers.

4. Institutional Conditions

CATIE's role in the Regional Program is key.

CATIE is a regional institute dedicated to research and education. Its principal beneficiaries are small- and medium-scale farmers in the countries of Central America, Panama and the Dominican Republic. Included in its mandate are research into sustainable agriculture and the development of biotechnology.

The Inter-American Institute for Cooperation on Agriculture (IICA) is a regional cooperation agency with considerable experience in efforts to harmonize technological policies for the agricultural sector.

Actions of this type require the collaboration of other regional and international institutions. Officials of AID-ROCAP, which is providing substantial support to the region through its RENARM project, have expressed interest in this type of initiative.

5. Legal Framework

Inasmuch as the biotechnological tools to be applied in the Regional Program do not require the use of recombinant DNA, it will not be necessary to create new legal instruments or biosafety regulations. The handling of germ plasm will be carried out under the supervision of plant protection authorities in each country.

6. The Program in the Context of Regional Integration

Isolated biotechnology projects have been undertaken in Central America. Nevertheless, there is no mechanism to facilitate investment in micropropagation infrastructure and seed trade among the six countries of the isthmus, which has led to a repetition of errors, duplication of efforts and unnecessary expenditure of resources. The Biotechnology Network will operate at the regional level to promote investment in national technological institutions and private enterprises in a position to produce seed using micropropagation techniques and, subsequently, to market the seed throughout the region.

The Biotechnology Network will facilitate micropropagation and the trade of seed throughout the region.

Facilities and incentives for new investments in the countries that make up the Regional Technology and Investment Promotion Network, which encourages joint ventures among countries, will reduce the cost of installing laboratories, providing equipment, training technical personnel, exchanging information and experience and updating biotechnological know-how for commercial-scale operations.

The Network will make it possible to make more efficient use of investment and genetic resources, installations, equipment, technical personnel and organizational structure of institutions and enterprises already in existence in the countries. Furthermore, it will forge closer ties between the private and public sectors within a given country and among the countries of the region, in the joint effort to promote balanced development of biotechnology aimed at modernizing agriculture through the production of more and better seed.

The new mechanism will lead to a more efficient use of resources.

II. REGIONAL PROGRAM DESCRIPTION

1. Justification

Plants obtained through tissue culture are superior to those obtained through conventional methods.

The Regional Program is justified on the grounds that it will:

- promote the use of biotechnology as a way of overcoming the problem of limited availability of high-quality seed, and supply farmers in the region with plants obtained through tissue culture, which have proven to be superior to those obtained through conventional means;
- provide access to the know-how generated by CATIE, IICA and other institutions, to advisory services provided by their technical personnel, to laboratory services they offer and to the germ plasm they possess, all of which will contribute to upgrading the skills of technical personnel and entrepreneurs with modern, technological training at a lower cost;
- facilitate and foster public and private investment in biotechnology for the commercial production of seed in the six countries of the Central American isthmus;

Intra-regional trade will be enhanced.

- facilitate and promote intra-regional trade by harmonizing technological policies. The institutions and enterprises making up the Network will set the criteria for determining the economic efficiency of investments, establish the levels of profitability and produce information on seed prices in terms of their performance on the regional market; and
- promote a process of technology transfer and adoption that will be less costly to the countries, but which will last long enough to ensure sustained plant production. This transfer process will be based on an effort to create a subregional technological center like CATIE. At the same time, the consolidation of joint efforts between the private and public sectors, at the country level, will result in more efficient use of national resources by eliminating unnecessary expenditures, avoiding a duplication of efforts and preventing a repetition of mistakes.

2. Objectives

General

- To make high-quality plants available in the short term in the countries of the isthmus, especially those considered to be most important economically and which are difficult to multiply

- To establish a Network for technology transfer and promotion of investments which will facilitate the commercial production of germ plasm, the harmonization of national technology policies and the establishment of private companies to multiply plants using micropropagation techniques
- To facilitate the intra-regional trade of seed from asexual plants
- To promote the formation of private seed companies throughout the region which use micropropagation techniques

The private sector will assume greater responsibilities in the commercial generation of germ plasm.

Specific

- To increase availability of new genotypes at lower costs
- To offer support in designing, installing and adjusting equipment, starting up the laboratories and providing technical supervision of the national institutions and private enterprises
- To offer training courses for technical and middle-level management personnel
- To assist the technological institutions and private enterprises in all stages of the process
- To facilitate the countries' access to the phytosanitary diagnoses of the Network
- To provide services to control the quality of micropropagated plants
- To produce and distribute diagnostic tests using specific antibodies to detect the presence of viruses
- To offer a technological service for removing viruses in food crops
- To assist technological institutions and national policy-making institutions to develop and harmonize the technological policies required
- To promote the use of common standards in the countries with a view to facilitating the intra-regional trade of seed
- To promote the formation of private seed companies

Training will be an important component at all levels of the Regional Program.

3. Strategy*

The Regional Program strategy has two main elements. The first deals with investments in the countries for the installation of the micropropagation laboratories described in each profile. The second involves the administration and execution of the technical cooperation and pre-investment projects.

The second level consists of five stages:

Stage 1. To organize and administer the Network and to identify and select priority crops and counterpart institutions

Actions included are:

Priority crops will be identified and selected.

- Technical missions to the countries in the short and medium term, in order to determine what they consider to be priority crops, to survey existing national institutions and to study policies, rules and regulations currently in effect
- Technical proposal for the operation of the transfer network with the private sector
- Technical meeting to analyze the proposal for private-sector participation

Stage 2. To establish and put laboratory and greenhouse facilities into operation in each country

Actions included are:

Laboratories and modules will be outfitted with the latest equipment.

- To offer intensive training program at CATIE
- To provide advice in installing laboratories and modules
- To put laboratories and commercial micropropagation modules into operation in each of the countries
- To design and apply technical standards for the design and construction of the laboratories
- To evaluate the results of laboratory and greenhouse operations
- To bring laboratory output up to field-level conditions
- To design and operate a cost accounting system for each commercial micropropagation module

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*The strategy is spelled out in the document entitled "Development of Programs and Projects in Biotechnology for Central America," prepared by a GISA committee made up of CORECA, FAO, CATIE and CADESCA. This document describes additional needs in Central America for cooperation in biotechnology-related subjects; nonreimbursable requirements amount to US$573,000.

Stage 3. To increase region-wide access to technology and to upgrade the operations and output of the transfer network

The diagnostic laboratory will play a key role in the Network.

In order to ensure that the plant material produced through tip culture is free of pathogens, proper detection methods must be employed. Therefore, a diagnostic laboratory is an essential part of a comprehensive process of plant material propagation. For optimal operation of the Network, there should be a central diagnostic laboratory to produce antibodies and which has the facilities needed to diagnose the most important diseases of the crops included in this proposal. Main actions included in this stage are:

- Technical missions to collect new genotypes
- Expansion of the collections of the germ plasm bank
- Assistance to the countries in obtaining superior genotypes from the germ plasm bank. This includes improving facilities, packing equipment and containers, shipping, delivery routes, transportation, reception in the countries and preparation in the laboratories.
- Improvements in installations at the central phytosanitary diagnostic laboratory
- Equipment to produce specific antibodies to be used in detecting diseases caused by viruses present in the countries of Central America

Specific antibodies will be produced for viruses prevailing in the region.

- Design and operation of the service, at the central laboratory, to "clean" food crops of viruses
- Support in formulating and applying national regulations governing the exchange and regional trade of seed and joint research

Stage 4. Promotion and organization of private-sector producers of asexual seed in the member countries of the Network

Actions included are:

- Incentives for the formation of seed companies
- Facilities for the importation of equipment not produced in the countries of Central America
- Promotion of national associations of private seed companies

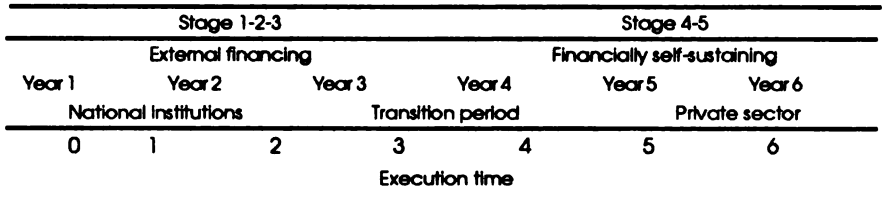
Stage 5. Organization of private-sector companies in the region for intra-regional trade of seed, within the framework of the Network

The private sector will also play a key role in intra-regional trade of seed.

- Protocols and quality standards for the marketing of asexual seed on the intra-regional market
- Trade information system on seeds in the Central American market

— Commercial incentives for the export of seed to third countries
— Promotion of a region-wide organization of private seed companies

The following diagram illustrates this strategy:



4. Projects and Components

Project 1

Technology Transfer and Investment Promotion Network for the production of plants using micropropagation techniques

Key tasks of the Network:
—Administration
—Germ plasm bank
—Tissue culture
—Agricultural health diagnostic service

Subproject 1. Administration of the Network

Components are:

— Design of proposal
— Organization and implementation
— Follow-up and evaluation

Subproject 2. Germ plasm bank

Components are:

— Technical missions to collect new genotypes
— Expansion of the collections of the germ plasm bank
— Assistance to the countries in obtaining superior genotypes from the germ plasm bank. This includes improving facilities, packing equipment and containers, shipping, delivery routes, transportation, reception in the countries (preparation in the laboratories).

New and better genotypes will be used.

Subproject 3. Central tissue-culture laboratory

Components are:

— To provide advice on the installation of laboratories and modules
— To apply technical standards in the design and construction of the laboratories
— To bring laboratory output up to field-level conditions

— To design and operate a cost accounting system for each commercial micropropagation module

Subproject 4. Central diagnostic laboratory

Components are:

— Improvements in installations at the central phytosanitary diagnostic laboratory
— Equipment to produce specific antibodies to be used in detecting diseases caused by viruses
— Design and operation of the service, at the central laboratory, to "clean" food crops of viruses

Project 2

Region-wide norms for the production and trade of plants

Components are:

— Design of technical standards for the model and construction of laboratories
— Protocols and quality standards for the marketing of asexual plants on the intra-regional market

New techniques, protocols and quality standards will be established at the international level.

Project 3

Reciprocal technical cooperation

Components are:

— Fund for training at specialized centers
— Scholarships for advanced studies
— Short refresher courses
— Meetings between entrepreneurs and technical personnel

Project 4

Harmonization of investment policies

Components are:

— Incentives for the formation of plant-multiplication companies
— Facilities for the importation of equipment not manufactured in the countries of Central America
— Establishment of lines of credit for producers to purchase the micropropagated plants
— Registration of patents of the seed companies
— Support to national agencies responsible for monitoring and registering seed, in order to develop and enforce standards

Private seed companies will be established.

Project 5

Private national enterprises and regional organizations

Components are:

National associations of private seed companies will be promoted, as will a regional association of producers of biotechnological products.

- Promotion of national associations of private seed companies
- Promotion of a regional association of private seed companies

5. Goals

The goals of the Regional Program are illustrated below:

Goals of the technical cooperation projects

The goals of the Regional Program are based on the five technical cooperation and pre-investment projects

Activities include congresses of entrepreneurs and a journal produced by the regional association.

Description	Indicators	Goals
Technology Transfer Network		
Administration of Network	Proposal	1
Preparation of germ plasm bank	Study by teams	1
Expansion tissue lab	Study by teams	1
Expansion central diagnostic lab	Study by teams	1
Reciprocal Technical Cooperation		
Training fund	Scholarships	1
	Doctorate	2
	Master's degree	6
Short courses and apprenticeships	National courses	6
	Apprenticeships	12
Meetings of entrepreneurs	Meetings	3
Regional Norms		
Technical standards for design and construction of laboratories	Proposal	1
Protocols and quality standards	Proposal	1
Marketing of seed		
Harmonization of Investment Policies		
Incentives for formation of enterprises	Proposal	1
Facilitation of imports of equipment	Proposal	1
Establishment of line of credit	Proposal	1
Registration of patents	Proposal	1
Support to national monitoring agencies	Technical assistance	6
National and Regional Organizations		
Promotion national associations	Proposal	1
Organization of associations	Proposal	1
National seminars	Seminars	6
Promotion Regional Association and Organization of Association		
Regional congress of entrepreneurs	Proposal	1
Institutional journal of association	Congress	1
National and regional goals	Proposal	1

National and region-wide operative goals

Countries	Central tissue lab No. Institution	Commercial modules No. Species	Private enterprises No. Enterprises	National association of enterprises	National monitoring agencies
Costa Rica	1 CORBANA	2 Plantain and pineapple	3	1	1 CORBANA
El Salvador	1 CENTA	2 Plantain and potato	3	1	1 CENTA
Guatemala	1 ICTA	2 Banana and potato	3	1	1 ICTA
Honduras	1 FHIA	2 Banana and pineapple	3	1	1 FHIA
Nicaragua	1 CENAPROVE	2 Banana and plantain	3	1	1 CENAPROVE
Panama	1 IDIAP	2 Banana and cassava	3	1	1 IDIAP
Regional Program	6	12	18	6	6

In each country, there will be a central laboratory, three private enterprises and a national association of enterprises.

National and region-wide plant production goals

Banana (Thousands of plants)

Country/Year	1	2	3	4	5
Guatemala	65	250	1 000	1 000	1 000
Honduras	100	500	1 000	1 000	1 000
Nicaragua	50	200	500	500	500
Panama	40	160	1 000	1 000	1 000
Regional Program	**255**	**1 110**	**3 500**	**3 500**	**3 500**

Bananas head the list of goals of the region, with production to reach 3.5 million plants by the third year.

Plantain (Thousands of plants)

Country/Year	1	2	3	4	5
Costa Rica	100	300	1 000	1 000	1 000
El Salvador	100	300	1 000	1 000	1 000
Nicaragua	100	500	1 000	1 000	1 000
Regional Program	**300**	**1 100**	**3 000**	**3 000**	**3 000**

Pineapple (Thousand of plants)

Country/Year	1	2	3	4	5
Costa Rica	20	80	200	200	200
Honduras	50	150	500	500	500
Regional Program	**80**	**230**	**700**	**700**	**700**

Potato (Thousands of plants)

Country/Year	1	2	3	4	5
El Salvador	100	400	1 000	1 000	1 000
Guatemala	100	400	1 000	1 000	1 000
Regional Program	**200**	**800**	**2 000**	**2 000**	**2 000**

Cassava (Thousands of plants)

Country/Year	1	2	3	4	5
Panama	50	150	400	400	400
Regional Program	50	150	400	400	400

6. Regional Program Beneficiaries

Direct beneficiaries in the region: 4,150 farmers (direct) and 12,450 farmers (indirect)

Direct and indirect Regional Program beneficiaries are:

Country	Farmers (direct)	Farmers (indirect)	Totals
Costa Rica	950	2 850	3 900
El Salvador	600	1 800	2 400
Guatemala	1 000	3 000	4 000
Honduras	500	1 500	2 000
Nicaragua	600	1 800	2 400
Panama	500	1 500	2 000
Regional Program	**4 150**	**12 450**	**16 600**

Other beneficiaries include 60 national technical personnel who will participate directly in the Regional Program, and 90 technical staff from private enterprises.

Some 150 technical personnel participating in the Regional Program will also benefit.

Country	Beneficiaries			
	Institutions	No. of technicians	Private enterprises	No. of technicians
Costa Rica	CORBANA	10	3	15
El Salvador	CENTA	10	3	15
Guatemala	ICTA	10	3	15
Honduras	FHIA	10	3	15
Nicaragua	CENAPROVE	10	3	15
Panama	IDIAP	10	3	15
Regional Program		**60**	**18**	**90**

7. Support Services for Production

CATIE and IICA, and their offices in the countries, will provide support to Regional Program execution.

Country	CATIE office	IICA office
Costa Rica	Headquarters	Headquarters
El Salvador	Country office	Country office
Guatemala	Country office	Country office
Honduras	Country office	Country office
Nicaragua	Country office	Country office
Panama	Country office	Country office

Also, research and training will be channeled through REDCA, which is made up of more than 70 institutions of the region. Support will also be provided by the ministries of agriculture, as well as national and regional research centers. The Network will be coordinated by the Biotechnology Unit at CATIE.

The Network will be coordinated by the Biotechnology Unit at CATIE.

Coordination of the Regional Program will require the participation of the private sector. The facilities at each laboratory and their ties with the central diagnostic laboratory, which will be located in the Biotechnology Unit at CATIE, will make it possible to diagnose the phytosanitary status of the plantations. Technical recommendations for the integrated management of pests and diseases will be made through CATIE and national plant protection programs.

III. ORGANIZATIONAL STRUCTURE

1. Executing Unit

The Regional Program will be coordinated by the Tropical Agriculture Research and Training Center (CATIE) and IICA. The unit for coordination and follow-up at CATIE will work to link the different public and private agents of the Network. This proposal also includes, as additional elements of support, CATIE's communications facilities and documentary information, its greenhouse and fields, germ plasm, training courses, computer facilities, data bases and access to specialists in biotechnology and agricultural sciences. IICA will contribute its experience in harmonizing policies, available through the corresponding units at its headquarters and in its offices in the countries.

The Network will bring the private and public sectors closer together.

CATIE will ensure direct communication with the member laboratories of the Network and with regional and international institutions operating in the region.

The regional coordinating unit will serve as a mechanism for integrating the Network and will promote the communication and transfer of CATIE's experience to the countries, and among the countries, at different levels. It will also facilitate communication with the private sector and with donors.

Priority crops selected for the culture of meristematic tips in the short term, and the national institutions making up the Network are:

Priorities for the culture of meristematic tips in the short term have been established in each country.

Country	Crop	Technological Institution	
Costa Rica	Pineapple, plantain	National Banana Corporation	CORBANA
El Salvador	Plantain, potato	Center for Agricultural Technology	CENTA
Guatemala	Banana, potato	Agricultural Science and Technology Institute	ICTA
Honduras	Banana, pineapple	Honduran Agricultural Research Foundation	FHIA
Nicaragua	Banana, plantain	National Plant Protection Center	CENAPROVE
Panama	Banana, cassava	Panamanian Agricultural Research Institute	IDIAP

Basic grains, citrus and tubers will be given priority attention for virus "cleaning."

The priority crops to be "cleaned" of viruses in the short term are: basic grains, citrus and tubers.

2. Plan of Action

The plan of action includes different activities which can be carried out in sequence or simultaneously. Listed below are the most important:

Activities will be carried out at CATIE and in the six countries.

Description of activity	Place of execution	Year of execution		
		1	2	3
-Advice on construction of multiplication units in the countries	All 6 countries	■		
-Construction of diagnostic laboratory	CATIE	■		
-Training of personnel	CATIE	■		
-Preparation of biological material for the 6 countries	Country labs/CATIE	■	■	
-Advice on installation of production modulesC	ountries		■	■
-Diagnosis and management of diseases	Countries		■	■
-Advice on establishing plants in the field	Countries		■	■
-Establishment of plants in the field	Countries			■
-Evaluation of Regional Program	CATIE/IICA/ Countries			■

3. Resources

Listed below are the most important resources that will be needed:

— Human resources: two professionals with Master's degrees (one to assist in the administration of the Regional Program); a secretary; two laboratory technicians; and a field assistant

- Equipment: one vehicle; two microcomputers; a photocopier; air conditioning equipment; audiovisual equipment; and a facsimile machine
- Laboratory and office equipment
- Reagents and glassware
- Construction for expanding the diagnostic laboratory
- Bibliographic materials, publications and printed material

4. Participating Institutions

The Network will require the participation of one institution per country, in order to make it possible to gradually transfer the modules to the private sector after year three of the Regional Program. In selecting the counterpart institution that will serve as the executing unit in each country, consideration was given to the technical advantages and other benefits offered that will ensure the success of the corresponding national project.

The modules will be transferred gradually to the private sector at the end of the third year.

In order to facilitate the exchange of knowledge and germ plasm, the ministries of agriculture will play a major role in the execution of the national project and follow-up at the farm level.

There will be an active exchange of germ plasm in the region. Information, as well as scientific and technological know-how, will also be transferred.

Certain physical infrastructure and human resources are already available for initiating the Regional Program. In the case of the national projects, it will be necessary to specify clearly the corresponding technical cooperation and other requirements.

The nature of the work to be carried out in each country depends on the crops selected as priorities, and on the facilities that will have to be provided for each case.

IV. COSTS AND FINANCING

1. Costs

Total cost of the Regional Program: US$7 803 million

The cost of the proposed Regional Program is US$7.803 million.

Level	Amount (US$)
1. Country projects	**4 745.2**
Costa Rica	860.5
El Salvador	698.6
Guatemala	698.6
Honduras	828.9
Nicaragua	822.1
Panama	836.5
2. Technical cooperation and pre-investment projects	**3 057.8**
Regional Program (1+2)	**7 803.0**

The cost of the technical cooperation and pre-investment projects and subprojects is US$3,057,800. This sum is broken down by objective in the following table:

Projects and subprojects	Amount (US$ X 000)
Project 1. Technology Transfer and Investment Promotion Network for the production of plants through micropropagation	**1 928.9**
Subproject 1. Administration of the Network	1 165.2
Subproject 2. Equipping and maintenance of germ plasm banks	200.0
Subproject 3. Central laboratory for tissue culture of meristematic tips	200.0
Subproject 4. Expansion/equipping of central diagnostic laboratory	363.7
Project 2. Region-wide Norms for the Technology Transfer and Investment Promotion Network	**52.8**
Subproject 1. Design of technical standards for construction of laboratories	26.4
Subproject 2. Protocols and quality standards for the marketing of plants on the intra-regional market	26.4
Project 3. Reciprocal Technical Cooperation	**586.2**
Subproject 1. Fund for training at specialized centers	26.4
Subproject 2. Scholarships for advanced studies	284.0
Subproject 3. Short refresher courses and apprenticeships	192.0
Subproject 4. Meetings between entrepreneurs and technical personnel	**83.9**
Project 4. Harmonization of Investment Policies	**155.5**
Subproject 1. Incentives for the formation of seed companies	26.4
Subproject 2. Facilities for the importation of equipment not manufactured in the countries of Central America	26.4
Subproject 3. Establishment of lines of credit for producers to purchase the micropropagated plants	26.4
Subproject 4. Registration of patents of seed companies	26.3
Subproject 5. Support for harmonizing national monitoring standards	50.0
Project 5. Private National Enterprises and Regional Organizations	**334.4**
Subproject 1. Promotion of national associations of private-sector seed companies	179.4
Subproject 2. Promotion of a regional association of private-sector seed companies	155.0
Total	**3 057.8**

The cost of the technical co-operation and pre-investment projects is US$3,057,800.

The sum of US$334,400 will be earmarked for organizing the private sector.

Investments will be maae over a period of three years.

The schedule of investments for the Regional Program is as follows:

Levels	Year 1	2	3	Amount (US$ X 000)
1. Country projects	**2 751.7**	**913.9**	**1 079.6**	**4 745.2**
Costa Rica	528.0	152.7	179.8	860.5
El Salvador	357.3	154.8	186.5	698.6
Guatemala	357.3	154.8	186.5	698.6
Honduras	496.9	154.5	177.5	828.9
Nicaragua	515.1	143.5	163.5	822.1
Panama	497.1	153.6	185.8	836.5
2. Technical cooperation and pre-investment projects	**1 773.4**	**638.6**	**645.8**	**3 057.8**
Regional Program (1+2)	**4 525.1**	**1 552.5**	**1 725.4**	**7 803.0**

The schedule of investments for the technical cooperation and pre-investment projects is as follows:

During the first year, US$1,027,100 will be invested in organizing the Network.

Projects	Years 1	2	3	Amount (US$ X 000)
Project 1. Technology Transfer Network	1 027.1	448.4	453.4	1 928.9
Project 2. Region-wide Norms for Network	52.8			52.8
Project 3. Reciprocal Technical Cooperation	434.2	124.0	28.0	586.2
Project 4. Harmonization of Investment Policies	155.5			155.5
Project 5. Regional Private-Sector Organizations	103.8	66.2	164.4	334.4
Totals	**1 773.4**	**638.6**	**645.8**	**3 057.8**

2. Financing

The Regional Program is financed as follows:

External support for the Regional Program is US$6 533 million.

Level	External	Country	Other contributions	Total (US$ X 000)
1. Country projects	**4 255.2**	**490.0**		**4 745.2**
Costa Rica	781.5	79.0		860.5
El Salvador	626.1	72.5		698.6
Guatemala	626.1	72.5		698.6
Honduras	737.4	91.5		828.9
Nicaragua	739.6	82.5		822.1
Panama	744.5	92.0		836.5
2. Technical cooperation and pre-investment projects	**2 277.8**	**180.0**	**600.0**	**3 057.8**
Regional Program (1+2)	**6 533.0**	**670.0**	**600.0**	**7 803.0**

The technical cooperation and pre-investment projects are financed as follows:

External support for the technical cooperation and pre-investment projects will amount to US$2,277,800.

Project	External	Country	Other	Total (US$ X 000)
Project 1. Technology Transfer Network	1 328.9	0	600.0	1 928.9
Project 2. Region-wide Norms for Network	40.8	12.0	0	52.8
Project 3. Reciprocal Technical Cooperation	562.2	24.0	0	586.2
Project 4. Harmonization of Investment Policies	131.5	24.0	0	155.5
Project 5. Regional Private-Sector Organizations	214.4	120.0	0	334.4
Totals	**2 277.8**	**180.0**	**600.0**	**3 057.8**

V. ANALYSIS

1. Technical Analysis

It has been widely demonstrated that the culture of meristematic tips is the best means of obtaining disease-free plants, including disease caused by viruses. At the present time, micropropagation is the most effective tool for multiplying healthy asexual plants. The Biotechnology Unit at CATIE has conducted research which shows that these techniques can be applied to tropical plants in Central America, and has earned international prestige for its research and

training. All of this guarantees that this Regional Program is technically sound.

2. Institutional Analysis

CATIE's work in science and teaching have earned it international recognition.

CATIE's research in tropical agriculture has earned it international recognition for its capabilities related to the management of genetic and natural resources. It also has a long tradition of education, offering advanced studies culminating in a Master's degree. Since its founding, more than 1,000 professionals have earned their degrees at CATIE. Furthermore, more than 1,500 people per year receive training at its headquarters in Turrialba, Costa Rica.

Over the last three years, an average of 100 people have been trained annually in biotechnology alone. These activities ensure the sustainability of its institutional action. CATIE will contribute salaries, facilities, installations and equipment equal to 65 percent of the total cost of the Regional Program.

IICA, through its Technology Generation and Transfer Program, is carrying out numerous activities in the area of harmonization of policies, especially as regards biotechnology.

3. Legal Analysis

The Regional Program fits in with the legal framework of all six countries.

The Regional Program fits in with the existing legal framework of each country. Therefore, no obstacles are envisaged to implementation. Similar proposals, with other objectives, are under way in the region and are coordinated by CATIE, in response to the mandate of its member countries and in association with regional institutions and national programs.

4. Financial and Economic Feasibility

In order to analyze the financial and economic feasibility of the entire Regional Program, the results of the investment projects in each country are shown, as is the present profile of the technical cooperation and pre-investment program.

Level	NPV (US$ X 000)	IRR %	B/C
Country Projects			
Costa Rica	1 039.0	44.3	1.9
El Salvador	1 543.8	> 100	2.8
Guatemala	1 508.2	> 100	2.8
Honduras	1 662.2	> 100	2.5
Nicaragua	1 522.5	> 100	2.2
Panama	1 385.5	> 100	2.3

The feasibility analysis of this proposal shows that it will have a high rate of return. The results of the variations studied are:

The financial analyses reveal that the Regional Program is profitable.

Variation 1. Increased costs +10%

Level	NPV (US$ X 000)	IRR %	B/C
Country Projects			
Costa Rica	893.5	35.6	1.8
El Salvador	1 447.5	> 100	2.6
Guatemala	1 411.9	> 100	2.6
Honduras	1 520.2	> 100	2.3
Nicaragua	1 387.6	> 100	2.1
Panama	1 247.9	> 100	2.1

Variation 2. Reduced revenues +10% and increased costs +10%

Level	NPV (US$ X 000)	IRR %	B/C
Country projects			
Costa Rica	644.1	26.4	1.6
El Salvador	1 196.8	> 100	2.3
Guatemala	1 164.9	> 100	2.3
Honduras	1 212.1	> 100	2.0
Nicaragua	1 100.4	> 100	2.0
Panama	971.8	> 100	1.9

5. Regional Program Impact

The results expected from implementation of the Regional Program are:

- Support of government policies to modernize agriculture
- Decreased expenditure of foreign exchange on imports of propagules of nontraditional crops
- Involvement of the private sector in micropropagation of priority crops
- Increased exports of higher-quality products
- Increased production of crops covered by the Network
- Improvement in the quality of products intended for local consumption and for export
- Development and application of appropriate technology because technical personnel will have the opportunity to learn about, innovate and apply advances in biotechnology
- Better use of genetic resources

The private sector will become more involved in the use of biotechnology.

5. Project Impact

In addition to modernizing agriculture and increasing production, the Project will provide the country with the opportunity to learn about and use new technologies and upgrade the skills of its technical personnel.

The principal effects of the Project will be:

- Modernization of agriculture
- Increased production of banana and plantain
- Increased exports of higher-quality products
- Development of appropriate biotechnology for Nicaragua, which can be made available for application to other crops

HONDURAS

MICROPROPAGATION FOR COMMERCIAL PRODUCTION OF BANANAS AND PINEAPPLE

(Project)

1991

PROJECT CAM-90-002 UNDP/PAHO/PEC

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INTRODUCTION

The Project contained herein is a proposal for using biotechnology to produce high-quality banana and cassava plants on a commercial scale in Panama, in response to growing domestic demand for both crops.

Micropropagation of plants, as a biotechnological technique, is a technically- and economically-feasible option for the commercial production of seeds of asexual plants.

Panama, like the other countries of Central America, is promoting the production of nontraditional crops in order to create additional sources of foodstuffs and boost foreign exchange earnings in the short term. Musaceae, roots and tubers are the key crops considered in the government's plan.

Panama's efforts to promote nontraditional crops are hindered by the fact that high-quality seed is not produced locally.

A factor which seriously limits the expansion of these crops in the short term is the lack of high-quality seed. At the present time, these seeds are imported at very high prices, ranging from US$0.60 to US$1.40, depending on the supplier.

In order to produce high-quality banana and cassava seed, the Project will install two experimental commercial-scale modules for micropropagation of cultures of meristematic tips. These modules are designed to produce one million banana and 400,000 cassava plants annually, at prices between US$0.25 and US$0.35 each.

1. FRAME OF REFERENCE

1. Macroeconomic Setting and Its Impact on the Project

The agricultural sector in Panama accounts for 10 percent of GDP. The sector is working hard to increase its role in the economy of the country. Panama must solve its food shortage problems and promote exports as a means of earning foreign exchange and improving its balance of payments situation.

This trend is reflected in the 1989 boom in banana production. The area planted in banana covers 14,000 hectares, much of which will have to rehabilitated in the short term. More than 14 million plants will be needed over the next five years to renew the plantations. At

The two commercial micropropagation modules will make it possible to produce sufficient seed, which will result in foreign exchange savings and increased production.

the lowest price currently charged for imported seed (US$0.60), such rehabilitation would cost US$8.4 million.

In Panama, there are 100,000 cassava producers farming less than five hectares each. It is estimated that 95 percent of these farmers grow both cassava and banana for human consumption. The area planted in both adds up to between 16,000 and 18,000 hectares, reflecting a demand for high-quality seed for 25 million plants.

The Project is intended to meet approximately eight percent of the demand for banana, without taking into consideration new plantations. In the case of cassava, the Project will meet 3.2 percent of domestic demand.

2. Analysis of Production Options and of the Technical Environment

Sanitary conditions can be controlled when germ plasm is produced by cultivating meristematic tips.

The decision to undertake the commercial production of seed for many nontraditional crops is based on the fact that they are propagated by asexual means. Because of this, there is a propensity to spread disease, because the offspring replicate the diseases of the parent plant. There being no way to effectively screen out sick plants when propagation is done at the farm level, a direct impact is produced on production. Disease is present to some degree or other in over 90 percent of the plantations, due to the origin of the planting material. This produces a steady decline in yield and quality over time.

The technical proposal for solving this problem involves the cultivation of meristematic tips, which will produce healthier, higher-quality seed. The two experimental modules proposed will produce disease-free banana and cassava plants in adequate numbers in the short term to provide real support to the country's agricultural policy.

Micropropagation is a technically-sound alternative for producing the quantity and quality of banana and cassava seed demanded by the producers.

3. Socioeconomic Situation of Potential Beneficiaries

By years two and three of the Project, farmers will have access to better-quality seed.

Musaceae and cassava producers will benefit from the Project. The propagules they receive during the second and third year of Project life, will be superior to material they themselves select from their plantations and equal in quality to that imported in recent years.

Banana production has increased by approximately 20 percent in recent years. Indications are that this trend will continue, which means that projects such as this can make a significant contribution

to the national economy and will benefit farmers directly, by providing high-quality seed in the short term.

4. Institutional Conditions

Some institutions have attempted unsuccessfully to develop these micropropagation techniques for the same purposes. It is considered that the institution selected to carry out this Project will be fundamental to its success.

Panama's Agricultural Research Institute (IDIAP), can play a leading role in this Project, given that it has been mandated by, and receives the support of, the Ministry of Agriculture to adopt and transfer technology, along with the micropropagated material, to farmers' organizations and individual farmers.

The IDIAP also has ties with the private sector, to which the micropropagation technology will eventually be transferred with a view to increasing the impact of the Project.

IDIAP will gradually transfer the micropropagation technology to the private sector.

The IDIAP has qualified personnel and some appropriate infrastructure, which, though limited, can be used to begin execution and training for the technical team who will be in charge of the Project.

5. Legal Framework

There are no legal problems involved in having the IDIAP conduct the Project. Since this is an innovation in the country, it is advisable to organize and coordinate the participation of private-sector organizations, and have the IDIAP sign letters of understanding with the recipients of the final product -- in this case, farmers' organizations, national institutions, farmers' associations and private seed-producing enterprises.

New legal instruments and biosafety regulations will not be required for the new germ plasm. The introduction of the germ plasm will take place under the supervision of the Plant Protection Program of the Ministry of Agriculture. Also, necessary steps will be taken to guarantee the property rights of those who receive the products (seed).

It is recommended that letters of understanding be signed between the IDIAP and those to receive the germ plasm, in order to avoid any legal problems that may arise from this innovative activity.

6. The Project in the Context of Regional Integration

The Project will generate important practical information related to the commercial micropropagation of both banana and cassava. The experience gained in developing production systems for the

two (from the laboratory to the field) can be shared with the other Central American countries, all of which have similar problems and can benefit from this experience.

Experience gained will be shared with the other countries of the isthmus. CATIE's participation will ensure that research and training are disseminated.

The Tropical Agriculture Research and Training Center (CATIE), whose mandate includes support to research and training in its member countries, will play an important role. It will play an important role as a coordinating agency, by promoting, training and facilitating technology transfer. It will also provide the germ plasm needed for the Project.

II. PROJECT DESCRIPTION

1. Justification

The Project will use state-of-the-art technology which will make it possible to produce, in the short term, and meet the demand for, high-quality, disease-free banana and cassava seed, contributing to the development of small- and medium-scale farmers and the national economy.

The adoption of micropropagation techniques by private enterprises will make it possible to produce large quantities of plants which are healthier than those obtained with conventional methods and less expensive than those imported.

The availability of abundant, high-quality seed would do much to eliminate the most serious limitations to banana and cassava plantation expansion.

2. Objectives

General

Principal objective of the Project. To increase banana and cassava production in the short term by producing less expensive and healthier seed in the laboratory.

To increase production of high-quality banana and cassava plants through micropropagation, in order to achieve commercial production of healthier, less-costly seed in the short term

Specific

- To design and install commercial-scale micropropagation modules for both banana and cassava
- To transfer the micropropagation technology of the pilot modules to private seed-producing enterprises

3. Strategy

The strategy is divided into three stages:

Stage 1. Selection of superior genotypes

One of the first steps is to select superior genotypes.

Individual banana and cassava plants will be selected.

Stage 2. Installation and start-up of the two micropropagation laboratories

Once propagation material for both species has been selected, the two modules will be installed at the IDIAP. Subsequently, CATIE will provide training for technical personnel and farmers will be instructed in the use of the initial material.

The Project includes, under a single management structure, all the steps required to make commercial production of banana and cassava seed feasible and to serve domestic needs.

Stage 3. Technology transfer to the private sector

This stage includes the following activities:

- Evaluation of the efficiency of the modules at each stage of production
- Facilitation of the participation of the private sector
- Transfer of Project output to the private sector

Of special importance is the transfer of micropropagation technology to the private sector.

The strategy is illustrated below, including a fourth financially self-sustaining stage:

Stage 1-2-3 External Financing			Stage 4 Self-financing		
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
National institution IDIAP		Transition stage		Private sector	
0	1	2	3	4	5	6

Years of execution

4. Subprojects and Components

The Project is divided into two subprojects: one for each species. The equipment, reagents, materials and training needed to establish the micropropagation laboratory are similar for both subprojects.

Subproject 1. Commercial module for propagation of banana

The commercial module for bananas will begin operation with 16,000 explants.

In the meristematic tip culture laboratory, the commercial module for bananas will begin operation with 16,000 tissues (explants).

Technology in the module for micropropagation of banana in one year. Annual output is 1.6 million plants.

The process used allows for ongoing control of plant health.

Accrued time in days	Number of plants (X 1000)	Technology
0	16	Isolation and disinfection of 16,000 explants and establishment in vitro
23	16	Transfer to micropropagation medium
45	56	First micropropagation (X 3.5)
67	196	Second micropropagation (X 3.5)
89	686	Third micropropagation (X 3.5)
111	686	Root induction
133	686	Nursery
155	686	Field
365	1 600	

Note: Calculations for this production plan are very conservative. However, there is a commitment for a base production of one million plants per year. Ten-percent losses from contamination and other causes must be considered.

Subproject 2. Commercial module for propagation of cassava

The cassava module will begin operation with 1,000 tissues.

In the culture laboratory for meristematic tissues, the commercial module for cassava will begin operation with 1,000 initial tissues (explants).

Module for micropropagation of cassava in a year. Output is 830,000 plants per year.

Various efforts under way to micropropagate germ plasm are part of a growing biotechnological revolution in Central America.

Accrued time in days	Number of plants (X 1,000)	Technology
0	1	Isolation of meristematic tips and establishment in vitro
23	1	Transfer to micropropagation medium
45	7	First micropropagation (X 7)
67	49	Second micropropagation (X 7)
89	343	Third micropropagation (X 7)
111	343	Root induction
133	343	Nursery
155	345	Field
365	830	

Note: These calculations are very conservative because production is estimated at more than 50 percent (400,000 plants). Losses of 10 percent from contamination and other causes must be taken into account.

5. Goals

The goals of the Project are:

— To commercialize production of 1 million banana plants through micropropagation by the third year. In the case of cassava, to stabilize production at 400,000 plants, also in the third year.

By year three of the Project, production will stabilize at one million banana plants and 400,000 cassava plants annually.

Years	Banana plants	Cassava plants
1	40 000	50 000
2	160 000	150 000
3	1 000 000	400 000
4	1 000 000	400 000
5	1 000 000	400 000

— To transfer technology to private enterprise for commercial production of propagules

— To support the establishment of three private seed-producing enterprises by the third year, replicating the Project modules

— To support the establishing of an association of private seed-producing enterprises

6. Project Beneficiaries

Direct beneficiaries of the Project will be 60 to 70 banana producers, and some 40,000 cassava producers. The Project will establish commercial production of superior banana and cassava plants.

Direct beneficiaries: banana and cassava growers Technical personnel will also benefit from highly-specialized training.

Technical personnel who participate directly in the Project will also benefit.

7. Support Services for Production

Panama's Agricultural Research Institute (IDIAP) will receive technical and logistic support from CATIE, at CATIE headquarters in Turrialba, Costa Rica, and through its office in Panama.

Should additional germ plasm be required, it will be provided by the Biotechnology Unit of the International Center for Tropical Agriculture (CIAT) in Colombia.

The Project will need the support of the Ministry of Agriculture (Plant Protection) and other national agencies.

III. ORGANIZATIONAL STRUCTURE

1. Executing Unit

Executing Unit: Panama's Agricultural Research Institute (IDIAP)

IDIAP will serve as Project executing unit. As coordinator, it will promote the integration of the two micropropagation models.

The executing unit, through different actions (executive meetings, technical and trade missions and intensive training) will encourage the creation of three private seed-producing enterprises which will use micropropagation techniques.

2. Plan of Action

The plan includes the following actions:

The Tropical Agriculture Research and Training Center (CATIE), a multinational agency headquartered in Turrialba, Costa Rica, will provide technical support.

Description of specific actions	Place of execution	Year of execution		
		1	2	3
Establishment of multiplication unit	IDIAP	■		
Training of technical personnel	CATIE/CIAT	■		
Preparation of germ plasm for micropropagation	CATIE	■		
Operation of modules and micropropagation	IDIAP		■	■
Establishment of plants in greenhouse	IDIAP		■	■
Establishment of plants in field	IDIAP/ Farms			■
Interaction with private sector	IDIAP			■
Evaluation of modules and preparation of final report	CATIE			■

3. Resources

The Project will require the following resources:

The bulk of the resources earmarked for the Project will be used to cover installation of the multiplication unit and laboratories, equipment, training and salaries of technical personnel.

- Human resources: A professional (M.S.) to operate the laboratory, and four assistants. The executing unit will hire support personnel and laborers.
- Infrastructure: construction and outfitting of multiplication unit, including equipment, furniture and other needs
- Additional laboratory, greenhouse, nursery and field equipment

— Maintenance of the multiplication unit

— Electricity, communications facilities, logistic and administrative support, transportation, etc.

4. Participating Institutions

Panama's Agricultural Research Institute (IDIAP), as executing unit, has the support of the Ministry of Agriculture for conducting this Project.

The IDIAP has technical resources and infrastructure which will serve as a starting point for execution of the Project.

IV. COSTS AND FINANCING

1. Costs

The total cost of the Project is estimated at US$836,500. The major budget items are:

Total cost of the Project: US$8,365,000

Items	Total (US$ X 000)
1. Salaries of technical personnel	162.0
2. Equipping of installations	40.0
3. Laboratory equipment: micropropagation unit	39.0
4. Reagents and inputs	27.0
5. Installation: multiplication unit (including greenhouse)	220.0
6. Furniture and equipping of installations	23.0
7. Maintenance: multiplication unit	41.0
8. Technical cooperation and consultancies	95.0
9. Experimental trials	28.0
10. Technical and trade missions	44.0
11. Training of technical personnel	25.0
Subtotal	744.5
Executing unit	92.0
Total	**836.5**

Infrastructure installed for the Project will be used in the future for further research into and production of germ plasm in Panama.

The schedule of investments for the three years is as follows:

Item	Years			
	1	2	3	Total (US$ X 000)
1. Salaries of technical personnel	54.0	54.0	54.0	162.0
2. Equipping of installations	40.0	—	40.0	
3. Laboratory equipment: micropropagation unit	39.0	—	—	39.0
4. Reagents and inputs	21.0	4.0	2.0	27.0
5. Installation: multiplication unit (including greenhouse)	220.0			220.0
6. Furniture and equipping of installations	23.0			23.0
7. Maintenance: multiplication unit	13.0	13.5	14.5	41.0
8. Technical cooperation and consultancies	30.0	20.0	45.0	95.0
9. Experimental trials	6.0	11.0	11.0	28.0
10. Technical and trade missions	12.0	12.0	20.0	44.0
11. Training of technical personnel	8.5	8.5	8.5	25.5
Subtotals	466.5	123.0	155.0	744.5
Executing unit	30.6	30.6	30.8	92.0
Totals	**497.1**	**153.6**	**185.8**	**836.5**

Experiments to be carried out under the Project will open new doors in science and technology.

2. Financing

The Project will be financed as follows:

Source	Short term	Long term	Total (US$ X 000)
External		744.5	744.5
Internal	92.0		92.0
Totals	**92.0**	**744.5**	**836.5**

Local contributions will completely cover the expenses of the executing unit.

V. ANALYSIS

1. Technical Analysis

The Project is technically sound. It has been clearly shown that micropropagation, and more specifically the culture of meristematic tips, is the best way to obtain large quantities of disease-free plants. Obtaining healthy plants through micropropagation is the most efficient means of multiplying plants that reproduce asexually.

The IDIAP has the support of the government, farmers and the private sector. Support will also be provided by the Tropical Agriculture

Research and Training Center (CATIE), whose mandate includes providing training in the latest agricultural techniques.

2. Institutional Analysis

The IDIAP has the logistic support needed to carry out the Project. The Project includes the following components: administrative unit, multiplication unit, greenhouse and farmers' group.

The private sector will gradualy become involved in Project activities.

The Project will also have a diagnostic laboratory, an advisory committee and a system for promoting the Project among the farmers.

3. Legal Analysis

The Project falls within the existing legal framework. Consequently, there will be no legal obstacles to implementation.

4. Financial and Economic Feasibility

In Panama, imported banana plants cost between US$.60 and US$1.20 each. This Project will produce plants at between US$0.25 and US$0.35 each. This difference, which is more than 50 percent in the best case, illustrates the economic feasibility of the Project.

Foreign-exchange savings resulting from local production of seed demonstrate the economic feasibility of the Project.

Using the same personnel and infrastructure, some 400,000 cassava plants will be produced at minimum cost. Total costs per plant will decline as the number of plants increases.

The indicators of net present value (NPV), internal rate of return (IRR) and benefit/cost ratio (B/C), demonstrate the financial feasibility of the Project. Calculations were made on the basis of a 12 percent interest rate:

Net present value	NPV	US$1,385,500
Internal rate of return	IRR	> 100%
Benefit/cost ratio	B/C	2.3

The sensitivity study show that the Project is profitable. The variables considered were:

Variable	NPV	IRR	B/C
1. Increased costs +10%	1 247.9	> 100%	2.1
2. Reduced revenues -10%	971.8	> 100%	1.9

Additional parameters and scenarios:

In order to facilitate financial and economic assessment of the Project, a further analysis was made, using alternate scenarios. The following results were obtained:

- For the financial analysis, the following parameters were used: Revenues and costs at market prices; discount rate, 12 percent, and useful life of the Project, 20 years. The following results were obtained: internal rate of return (financial), 60 percent; B/C, 2.21, and NPV, US$2.17 milion.
- For the economic analysis, the following parameters were used: elimination of taxes and subsidies; correction factor for skilled labor, 80 percent. The internal rate of return (economic) was 59.1 percent.

5. Project Impact

The principal impact of the Project will be:

The Project will contribute to the modernization of agriculture, generate foreign-exchange savings and lead to increased production. It will also promote better use of genetic resources.

- Modernization of agriculture
- Reduced expenditure of foreign exchange on seed
- Increased availability of better quality products, for both the domestic and export markets
- Better use of genetic resources
- Greater uniformity in the commercial output of the plantations
- Higher-quality products for consumers and the international market
- Progress in biotechnology

FECHA DE DEVOLUCION			

Autor Regional program on the

Título development of biotechnology

Fecha Devolución	Nombre del solicitante