Ecologically Sustainable Plant Protection and Postharvest Processing of Cassava in Cuba

A project proposal

Submitted to: **International Fund for Agricultural Development (IFAD)** – Rome, Italy

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A. Context

A.1. Description of subsector

Over 70,000 ha of cassava are cultivated in Cuba: however yields are relatively low (5.2 ton/ha) because of losses caused by pests, diseases and weeds. These factors not only reduce yields but often lower the quality of roots, which reduces market prices. Almost all current cassava production is sold as fresh roots and is consumed by humans. Pork is the preferred meat and lack of fodder is increasing demand for the production of dried cassava chips (which are a good supplement to soybean), of which there is currently only artisanal production for on-farm usage.

A.2. Host country strategy

Cuba currently cultivates 70,000 ha and the government would like to increase this to 100,000. They also consider yields to be very low (5.2 ton/ha) and want to raise the yields by about 50%, which is close to the average for other Latin American countries. The country has put a high priority on the use of integrated pest management (IPM), biological control and sustainable crop management. The country has well-developed extension system which permits rapid adoption of new methods of crop protection and management. However, the country has been fairly isolated and needs access to advanced methods, exotic biological control agents and cassava germplasm. They hope that this project will provide these missing elements.

A.3. Prior or ongoing assistance

There is no other ongoing assistance to Cuba in this subsector. In the past 20 years CIAT has trained many Cuban investigators who are still working with cassava. The most recent training was in 1996. CIAT has also periodically supplied Cuba with cassava germplasm, most recently in 1997.

A.4. Institutional framework for subsector

Cuba maintains a center for agricultural research on root and tuber crops and plantain (INIVIT, in Santo Domingo) which employs 14 "investigators" (scientists with undergraduate, MSc or PhD degrees) working on pests, diseases, weeds, crop production and postharvest utilization of cassava. The country also maintains a national agricultural extension system (*Dirección General de Sanidad Vegetal*) which deploys about 50 extension agents. National program agents (Estaciones Territoriales de Protección de las Plantas) also make monthly surveys of crop production problems and inform cooperative managers what to look out for. This program also maintains small facilities (CREE, *Centro de Reproducción de Entomofagos y Entomopatógenos*) in each township to produce biological control agents for local use.

Agricultural production is conducted by three types of crop managers and farmers:

1) independent farmers who own 1-20 ha (*campesinos*; however, they form cooperatives [CCS, *Cooperativos de credito y servicio*] that permit them to have access to Government credit).
2) voluntarily-formed cooperatives formed by formerly independent farmers (CPA, *Cooperativo de Producción Agropecuaria*).

3) government-formed cooperatives (UBPC, *Unidad Basica de Producción Cooperativa*) in which workers can cultivate land that is owned by the government (about 30-40 workers on 200-300 ha).

All categories of crop managers and farmers are eligible to buy fertilizers, pesticides and other supplies at subsidized government prices. The extension program also serves all crop managers and farmers. Professional crop managers (*tecnicos*) are employed by UBPC & CPA cooperatives as well as by the more profitable (larger) independent farmers. This well-developed system permits rapid adoption of new methods of crop protection and management. Some crop managers and farmers (UBPC & CPA) are required to sell up to 20% of their production to the government at prices lower than the free market, but most production is available to the free market.

CIAT's mission is to contribute to the alleviation of hunger and poverty in tropical developing countries by generating technology options which benefit the poor and contribute to lasting increases in agricultural output while preserving the natural resource base. CIAT has the CGIAR global mandate for cassava and has over 25 years of experience in this crop. Scientists working on cassava collaborate closely with national agricultural research scientists (NARS) in the development of crop varieties, integrated crop management, integrated pest management, biological control for many pests and diseases, and development of postharvest processing technologies and markets. CIAT also collaborates with IITA (Benin, Africa) and other advanced research institutions on the development of classical biological control (e.g., cassava mealybug and the cassava green mite in Africa), and strategic research on cassava varieties, entomology, plant pathology, postharvest processing and farmer participatory research (FPR). CIAT scientists are applying and refining techniques to evaluate new technologies directly with farmers (FPR), originally developed by CIAT's Participatory Research Unit, for the development and dissemination of improved cassava germplasm and cultural control practices. Additionally, CIAT has pioneered a highly successful demand-driven integrated approach to crop commodity research and development. CIAT also has a Land Uses Unit, which has the latest GIS technology for mapping cassava microregions in Latin America, integrating edaphoclimatic and socioeconomic data, and equally advanced Biotechnology and Germplasm Units to support strategic research on cassava.

B. Project justification

B.1. Problem to be addressed: the present situation

Over 70,000 ha of cassava are cultivated in Cuba, about 66% of which is used for direct human consumption, 20% for animal feed (primarily pigs) and 14% has other uses or is lost as waste[1]. Cassava is a principal source of carbohydrates for Cubans that is served at almost every meal. FAO reports an average per capita consumption of 17 kg per year[2]; which sounds like a gross underestimation. Despite its importance, average yields are very low (5.2 tons/ha reported by

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[1] The 65,000 ha producing 250,000 tons cited in FAOSTAT (1995), as reported by Cuban Agriculture Ministry, does not include substantial production by farmers who consume their own produce.

[2] The 17 kg per year cited in FAOSTAT (1995), as reported by Cuban Agriculture Ministry, does not include substantial production by farmers who consume their own produce.

INIVIT) compared to the potential (24 t/ha)[3]. Low yields are the result of a combination of factors including pests and diseases. There is currently practically no use of pesticides because of high cost and concern about toxicity to humans and the ecosystem. Therefore, the national agricultural research program (INIVIT) is trying to develop integrated pest management solutions to the principal pest and disease problems. This involves the use of resistant cassava varieties, and cultural and biological control. However, because of international political pressure and lack of internal resources, the country has been able to obtain little information or help from other research centers.

B.1.1. Crop production

Cassava plays an important role in Cuba's strategy to develop the production of roots and tuber crops because of its capacity to produce yields under poor growing conditions, despite the lack of agricultural inputs, which is the situation for 80% of the region where it is currently cultivated. Furthermore, the crop can be left in the field to be harvested later when other crops are not available, thus providing a food source throughout most of the year. Cassava has also proven to be useful, in combination with soy beans, as pig feed, producing weight gains of 600 g/animal/day. There is a growing demand for pork in the country, which is an important source of protein and fat. The area being planted to cassava is expanding, particularly in regions where soil quality is too poor for other root and tuber crops. Current yields are relatively low (5.2 ton/ha) because of losses caused by pests, diseases and weeds and because of poor soil management. Previous experiments conducted in Cuba show that yields can be raised to at least 10 t/ha and to 20-25 t/ha with sufficient inputs, such as fertilizer.

B.1.2. Pests and diseases

Principal pests of cassava in Cuba include the cassava hornworm (*Erinnyis ello*), a migratory moth whose larvae can completely defoliate a field, causing losses in root yields of up to 15% and losses of starch content of up to 50%. The shoot fly (*Silba pendula*) damages up to 15% of growing tips, causing up to 20% loss of root yield. The stem borer (*Lagochirus dezayasi*) has sporadic, localized attacks that cause up to 15% yield loss and damage to the plant stem reduces the amount of planting material available. Scale insects (*Saissetia miranda*, *Aonidomytilus albus*) have many natural enemies; however, care must be taken to eliminate them from planting material to avoid spreading the pests. Mites (*Mononychellus tanajoa*, *Tetranychus urticae*) have increased in recent years, particularly in warmer, drier regions, increasing the need to find new natural enemies and more resistant cassava varieties. The root bug (*Tominotus communis*) has become a regional problem in western Cuba causing losses up to 50% in the clone CMC-40, because the roots become completely unsuitable for human consumption. The citrus root weevil (*Pachnaeus litus*), which feeds on both leaves and roots, has recently been reported to attack 75% of some cassava clones in Matanzas Province. Damaged roots are completely unsuitable for human consumption.

Pathogens attacking cassava include bacteriosis (*Xanthomonas campestris*) which causes up to 10% yield loss. Superelongation disease (*Sphaceloma manihoticola*) causes up to 100% losses in the clone CMC-40. and anthracnosis (*Colletotrichum gloeosporioides*) which causes up to 5-10% loss. An unknown pathogen causing symptoms similar to frogskin disease occurs in the central region of the country, directly destroying roots.

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[3] Henry, G (1995): Global cassava sector constraints and estimated future R&D benefits. CIAT, Cali, Colombia.

Weeds can also seriously reduce production, especially when the plants are young, and this requires substantial labor, which is sometimes scarce.

B.1.3. Postharvest processing and markets

Traditionally Cubans, especially poor small land-holders, have used cassava residues to feed their animals. Based on studies conducted by INIVIT, interest in the utilization of cassava to feed animals, especially pigs and birds, is growing. The introduction of improved cassava varieties with greater dry matter content, the use of both foliage and roots, as well as the construction of processing plants and machinery to dry cassava will increase the utilization of cassava as animal feed.

The utilization of cassava as a basis for animal diets depends on it being supplemented. Although at first this appears to be a disadvantage, practical experience shows that the majority of the dietary protein is supplied from sources available in Cuba, such as soy meal, fish meal, leaves of forage trees, etc., which provide a balanced nutrition. INIVIT has obtained weight gains of 624 g/day in Yorkshire pigs with a food conversion rate of 3.5 (gaining 1kg of pig for every 3.5 kg dry feed), reducing by 25% the amount of protein required as recommended by NRC (National Research Council, 1988). This has greatly assisted in raising the utility of this crop as a high quality energy source.

Recent results of the utilization of cassava flour as feed for semi-rustic chickens show promising potential for the production of eggs and meat. In the case of the pig production, the utilization of the cassava in form of pellets has considerably reduced the cost of production. It avoids the need for milling and packaging since it is easy stored as dry granules until used. There is a strong demand for protein of origin animal in Cuba, and the utilization of the cassava in integral form is profitable for small and medium scale producers which have access to free markets.

Cassava permits the development of a variety of products and uses, and in particular it could be used as a starch substitute, replacing maize, which is currently being imported for a variety of uses. Traditionally cassava is consumed as fresh cooked roots in all provinces throughout the year, and the marketing studies that we have carried out so far indicate that this root has extraordinary potential.

B.2. Expected end of project situation

1. Quantification of the major pest and disease constraints to cassava productivity in each of six agroecological zones in Cuba.

2. Increase cassava production by at least 45% percent on 24 cooperatives and 300 small farms, where the farmers have been trained to use improved crop production technologies.

3. Train 14 scientists (including 3 MSc degrees), 50 extension workers, 100 crop managers, 350 cooperative farmers, and 300 small-holding farmers in the principles and practices of economic sustainable crop protection, production, processing and farmer participatory research methods.

4. Dissemination of the pest management and crop production technologies that were successful in pilot farmer participatory experiments to 1000 farmers.

5. Fresh cassava will become available in markets throughout the year rather than for only four months, stabilizing supply and prices and increasing farmer income.

6. Construction of six Pilot cassava processing plants which will produce dry chips, flour and starch, diversifying cassava markets to absorb increases in productivity, shifting the consumption of cassava from fresh roots (down from 80% of market to 40%) to include more value-added products (increasing from 20% of market to 60%).

B.3. Target beneficiaries

- **Small-scale cassava crop managers, farmers and processors.** Increased production and productivity will increase rural employment opportunities and incomes. Improved access to existing and new markets will stimulate farmer demand for and adoption of new technological options. Increased participation of farmers in decision-making processes for development and transfer of improved technologies will help to create demand for technology and information from research and extension agencies and will facilitate the establishment of locally adapted technology testing activities and services. Increased processing and added-value activities through increased volumes, improved traditional markets and new products and end uses will increase employment opportunities and incomes for cassava crop managers and farmers and processors.
- **National Research and Extension agencies.** Adoption of a farmer participatory approach by agricultural sector agencies will led to more client-responsive organizations with facilitated links and penetration to rural areas, improving the focus of their research agendas according to the real needs and priorities of farmers groups in target regions. New training opportunities on the use of farmer participatory based methods for policy-makers, researchers and extensionists will help to develop the human resources of the agencies involved and will facilitate the institutionalization of these approaches into their working agendas. Overall efficiency of the technology development and transfer process will be improved through a demand-pull effect of enhanced farmer participation in technology testing activities. Information obtained through monitoring-and-evaluation and adoption-and-impact studies will help implementing agencies refine their objectives and undertake appropriate actions.

- **National Researchers and extensionists.** Increased opportunities for training on, and implementation of, technical research, farmer participatory research and extension activities will facilitate the establishment in the region of a team of technically-capable, client-responsive researchers and extensionists. Feedback from farmers regarding the adaptation and appropriateness of new technologies will help scientists to improve their knowledge of local farming systems and sharpen the focus of their strategic and adaptive research activities. Improved linkages with an international research center will open access to vital technical information.

- **Urban consumers**. Improved productivity and stabilized prices of cassava-based products will help to lower prices and stabilize food supply in urban areas. Lower prices and increased availability of cassava chips for animal feed will increase meat supplies.

B.4. Project strategy and implementation arrangements

This project was originally developed by Cuban scientists at INIVIT and has been refined after interaction with CIAT scientists. Project strategy is based on a demand-driven integrated approach to crop commodity research and development, which CIAT has found to be highly effective. First, surveys of farmers and local markets will be conducted to identify and characterize market opportunities, especially for cassava products with high elasticity of demand (i.e., stable prices). This provides the basis for choosing appropriate products and designing processing technologies (e.g. cooperative plants to produce cassava chips, flour or starch). These technologies are subsequently tested and adapted with farmer participation under market conditions at representative sites. Monitoring and evaluation help to fine-tune the technologies for subsequent diffusion over a wide area and provide feedback to target new research objectives. Similarly, farmer surveys identify and prioritize the constraints to increasing cassava production. Research to increase the productivity and sustainability of cassava cultivation focuses on soil fertility, water management, erosion control, crop management, integrated pest and disease management, and improved crop varieties. All of these technologies are low-capital, environmental-friendly, and sustainable (e.g., biological control, intercropping, crop rotation, production of high quality planting material). The simultaneous development of market opportunities with technologies to increase farmer productivity, both conducted using farmer participatory research methods, is essential to attaining long-term adoption of both. The stable and increasing price generated by the demand for value-added products stimulates farmers to adopt new production technologies, that further increase their incomes.

B.5. Reasons for assistance from UNDP/executing agency

Neither Cuba nor CIAT have the financial resources to bridge the gap in communication which prevents the development and implementation of ecologically-sound integrated development of cassava's potentials. This project links the national program to an international agricultural research institution that has advanced research capabilities and extensive experience using farmer participatory research to solve problems related to cassava production, integrated pest and disease management, postharvest processing and market development. It also provides access to natural enemies and improved varieties and information resources that are otherwise out of reach to the national program.

B.6. Special considerations

This project was inspired by the success of the UNDP-funded project, "Ecologically Sustainable Cassava Plant Protection in South America and Africa: An Environmentally Sound Approach" (ESCaPP/PROFISMA, 1993-1996), which involved CIAT, IITA and EMBRAPA (Brazil). The presently proposed project will be closely affiliated with the global project, "Ecologically Sustainable Cassava Plant Protection: A Global Strategy", which has been submitted to UNDP and IFAD, and with the other bilateral satellite proposals submitted by Brazil and Paraguay. Both Cuba and Paraguay share a subtropical climate, and they experience many of the same constraints to increased productivity. Thus, this project will benefit directly from research activities supported by the other projects.

B.7. Co-ordination arrangements

CIAT and INIVIT will be responsible for coordination of their respective activities and management of their respective budgets. A project leader appointed by CIAT will be the

institutional contact person responsible for coordinating project activities. The project coordinator reports to the Director of Research, who is responsible to the Director General and Board of Trustees. A national project coordinator will be responsible for the management and administration of project activities in Cuba and will liaison with CIAT.

CIAT will have primary responsibility for all financial matters. National program funds will be disbursed by CIAT following institutional accounting procedures. The national program (INIVIT) will be responsible for the management and administration of these funds and will provide financial status reports to CIAT's chief financial officer on a semi-annual basis. CIAT will provide financial progress reports to the donor as required.

The project will be coordinated and managed through a multidisciplinary national team to reach the various stakeholders. The national team will periodically meet with CIAT scientists to identify and develop management tools guiding project implementation, prepare technical protocols and set R&D priorities based on prior diagnoses. The national program participated in development of this proposal, and they will conduct annual reviews of their activities to revise their workplans and budgets. This will include: revised plans of operation and budgets; set performance indicators for a monitoring and evaluation; relate objectives to available inputs, personnel, funds, equipment, materials, etc.; set deadlines by when activities should begin and end; and assign responsibilities to team members and/or collaborating institutions. These kinds of consultative planning tools will remove ambiguities about responsibilities during project implementation. Exchange visits will be organized between project partners to enhance technical interactions, supervision and monitoring of project activities.

Both CIAT and INIVIT will contribute to an annual report of research and development activities for the donor.

B.8. Counterpart support capacity

Cuba can supply the scientific personnel needed to work on all the proposed within country activities, including specialists in plant pathology, entomology, agronomy, biotechnology, plant breeding, genetics and postharvest processing, who have the equivalent of M.Sc. or Ph.D. degrees, as well as others with Agricultural Engineering degrees. These Cuban scientists are well trained and dedicated workers; however, they have been fairly isolated from the international scientific community. INIVIT also has some infrastructure available, including laboratories suitably equipped for the proposed activities, and trained technical assistants. However, some additional equipment, supplies and training will be necessary, as requested in this proposal.

C. Development objective

Increase food security, increase and stabilize incomes of poor farmers (many of whom are women) and reduce use of pesticides in Cuba by improving efficiency and sustainability of cassava production through development and adoption of improved integrated pest management, crop production and postharvest processing technologies using farmer participatory methods.

D. Immediate objective(s), outputs and activities

D.1. Immediate objective 1

Determine major constraints to cassava productivity, processing and use in each of six agroecological zones by means of diagnostic surveys.

Extensive surveys will collect data on socioeconomics and on farmer perceptions of their problems. Representative sites will then be selected for subsequent intensive diagnostic surveys and field experiments that evaluate the impact of each constraint on the production and quality of cassava roots. These results will be used to determine which pests have the widest distribution and cause the highest impact on cassava productivity and which regions have the most problems. This information will prioritize the problems to be addressed and where to conduct on-farm training and experimentation.

1.1 Output 1

Formation of multidisciplinary teams and development of appropriate work plans, methods and protocols for activities in each region.

Activities
1.1.1 activity 1
Select and train the scientists and extensionists in the procedures and specific disciplines required to conduct the diagnostic surveys.

1.1.2 activity
Prepare a general work plan, define the protocols and procedures that will be used by the participants and prepare specific work plans for each region.

1.2 Output 2

Diagnosis of the fundamental constraints to cassava productivity, processing and use in each of the principal agroecological zones of Cuba.

Activities
1.2.1 activity 1
Conduct extensive surveys in the six principal agroecological zones to determine the most common pests, the currently used pest management practices, and the interests and understanding of the farmers and crop managers.

1.2.2 activity 2
Conduct intensive field studies to monitor various pests and pathogens, measure their influence on cassava yield and quality, and validate the previously collected socioeconomic data.

1.3 Output 3

Selection of sites to conduct subsequent field trials to test proposed intervention technologies.

Activities

1.3.1 activity 1
Review all the data collected from the different regions to select sites to conduct farmer participatory field experiments to adapt and evaluate prospective interventions for the corresponding production constraints that were locally identified as being important, and sites to establish pilot processing plants.

1.4 Output 4

Identification of areas of research that are needed to develop intervention technologies for constraints where current technologies are inadequate or unknown.

Activities
1.4.1 activity 1
Hold workshop to review results of survey and on-farm experiments to identify research needs.

D.2. Immediate objective 2

Test and adapt selected crop protection, production and postharvest processing technology components in trials conducted by crop managers and farmers.

Field trials will be conducted to test various proposed crop protection, production and postharvest processing technologies under different ecological, agronomic and socioeconomic conditions. These trials will be executed by crop managers, farmers and national program extensionists and scientists who have been trained in farmer participatory research methods.

2.1 Output 1

Reduction of losses to pests and diseases by at least 25% through the development and dissemination of integrated pest management technologies.

Activities
2.1.1 activity 1
Prepare promising plant protection technologies to manage each of the principal constraints identified. These technologies could include introduction of resistant plant varieties, sanitation and selection of quality of planting material, introduction of exotic natural enemies, mass-rearing and application of biological control agents (parasitoids, predators or pathogens), and cultural control methods.

2.1.2 activity 2
Conduct on-farm farmer participatory field experiments to evaluate the impact of crop protection technologies and their acceptability to farmers.

2.1.3 activity 3
Conduct community-wide surveys to evaluate the adoption and impact of intervention technologies that were tested in local farmer participatory experiments.

2.2 Output 2

Increase production by 20% and extend the harvest period from 4 months to 12 months to stabilize the supply of fresh cassava roots throughout the year.

Activities
2.2.1 activity 1
Conduct on-farm farmer participatory field experiments to evaluate the impact of cassava varieties and crop production technologies and their acceptability to farmers.

2.3 Output 3

Diversification of the uses of cassava to include production of dry chips for animal feed, and production of flour and starch, to increase and stabilize market demand (prices).

2.3.1 activity 1
Conduct market survey to determine potential demand for various cassava products (fresh consumption, flour, starch, dried chips).

2.3.2 activity 2
Review results of extensive diagnostic survey, market survey, and possible designs of processing plants with farmers, crop managers, extensionists and scientists to select the types of pilot plants to test and the construction sites.

2.3.3 activity 3
Construct and operate pilot plants to produce dried cassava chips, flour and starch in collaboration with crop managers and farmers.

2.3.4 activity 4
Evaluate the operation and impact of the pilot plants on markets for cassava products and on crop manager and farmer incomes.

D.3. Immediate objective 3

Train scientists, crop managers, smallholding farmers and extension workers in the principles and practices of economic sustainable crop protection for cassava-based agroecosystems.

3.1 Output 1

Development of training modules incorporating the principals and practices of economical, ecologically sustainable cassava plant protection for national program leaders, scientists, extensionists, crop managers and smallholding farmers.

Activities
3.1.1 activity 1
Develop a training program for scientists, extensionists, crop managers and smallholding farmers in the principals and practices of economical, ecologically sustainable cassava plant protection.

3.1.2 activity 2

Prepare didactic materials that emphasize the importance of the integration of biological control, cultural control practices and host plant resistance as the basis for economical, ecologically sustainable cassava plant protection.

3.2 Output 2

Training of national program leaders, scientists and extensionists, and crop managers and smallholding farmers in the principals and practices of economical, ecologically sustainable cassava plant protection. The training will be multidisciplinary incorporating information on plant protection (entomology, biological control, plant pathology, acarology, nematology, integrated pest management, etc.), agronomy and socioeconomics.

Activities
3.2.1 activity 1
Select candidates from the national program for postgraduate training in a variety of disciplines related to sustainable plant protection. INIVIT should receive at least three scholarships for MSc degrees at Cuban Universities financed by Cuba. Students will conduct research related to project objectives and be supervised by international scientists with part of their training occurring in CIAT laboratories.

3.2.2 activity 2
Train national program scientists in their specific disciplines giving them the background and experience necessary to successfully make technical diagnoses, implement intervention technologies, and monitor field experiments.

3.2.3 activity 3
Train extension workers, crop managers and smallholding farmers in the practices of sustainable cassava plant protection. This will be done annually in each agroecozone.

D.4. Immediate objective 4

Wide dissemination of the technologies that were successful in pilot farmer participatory experiments to other crop managers and farmers.

4.1 Output 1

Dissemination of the technologies that were successful in pilot farmer participatory experiments to other regions of Cuba.

Activities
4.1.1 activity 1
Extension agents educate crop managers and farmers in other regions of Cuba that have similar constraints and ecologies about the intervention technologies that were successful in pilot farmer participatory experiments through field days, workshops, farm visits and printed information.

4.2 Output 2

Exchange of information related to ecologically sustainable cassava plant protection activities.

Activities
4.2.1 activity 1
Conduct national workshops of all project participants at the beginning and at the end of the project to exchange results, experiences and other information pertaining to ecologically sustainable cassava plant protection.

E. Inputs

CIAT contribution per year[1]:

SENIOR SCIENTISTS:	1000 US$
Entomologist (50%)	100.0
Plant pathologist (25%)	50.0
Plant bacterial pathologist (25%)	50.0
Biotechnologist (10%)	20.0
Virologist (5%)	10.0
Postharvest (20%)	40.0
Total	270.0
Total scientist-years 1.15	

[1] including associated operation and support staff not paid by the project.

INIVIT contribution per year:

SENIOR SCIENTISTS:	1000 US$
Director of Research (20%)	30.0
Project coordinator (100%)	45.0
Acarologist (5%)	7.0
Entomologist (50%)	35.0
Plant pathologist (20%)	18.0
Virologist (5%)	7.0
Biotechnologist (10%)	10.0
Weed specialist (5%)	7.0
Agronomist (5%)	6.0
Plant breeder (10%)	10.0
Subtotal	175.0
Total scientist-years 2.3	

	1000 US$			
	Crop Protection	Crop Production	Utilization	Total
Support Staff	19.7	11.0	12.4	43.1
Operations	7.8	5.0	5.9	18.7
Capital	13.8	3.8	4.5	22.1
Student scholarships	3.8	3.8	5.2	12.8
Subtotal	75.3	25.4	53.0	153.7
Total resources				328.7

CIAT and INIVIT are both contributing substantially to the project with respect to the infrastructure needed by this project, including fully-equipped laboratories, greenhouses, experimental plots, computers, vehicles and libraries.

F. Risks

The testing and adaptive research proposed in this project involve technologies which are well known, widely accepted as safe, and already practiced in various forms around the world. In addition, all natural enemies imported from abroad for use in Africa or Northeast Brazil are passed through authorized and recognized quarantines before being certified as free of plant and animal contaminants before being released. Therefore, no major constraints are foreseen that could impede the proposed activities or threaten the livelihood of either the project team members or participating farmers and the environment.

G. Prior obligations and prerequisites

CIAT has well-established research and training facilities which will be made available, as required, to carry out the proposed activities. CIAT has the skilled staff in research, training, outreach, and administration required to successfully undertake the activities described in this project. National and state program staff at INIVIT are available to participate in the proposed activities. CIAT is recognized worldwide as a center of excellence with leaders in the fields of cassava plant protection, farmer participatory research and agricultural development in the tropics.

J. Budgets

Cuba (INIVIT): Requested funds

(1000 US$)

	1998	1999	2000	2001	TOTAL
CROP PROTECTION (Entomology, Plant pathology, Virology)	128.2	114.4	79.0	50.4	372.1
CROP PRODUCTION (Plant breeding, biotechnology, agronomy)	38.7	28.1	26.2	21.0	114.0
UTILIZATION (Postharvest processing & market development)	159.8	33.4	26.5	25.5	245.2
TOTAL	326.8	175.9	131.8	96.9	731.3

CIAT: Requested funds

(1000 US$)

	1998	1999	2000	2001	TOTAL
Entomology, Acarology	27.4	27.6	29.1	30.6	114.6
Plant pathology (root rots, bacteriosis)	29.4	30.5	30.7	30.9	121.6
Virology, biotechnology	21.2	22.4	23.6	25.0	92.2
Postharvest processing & market development	33.0	29.4	31.1	32.8	126.3
Project Coordination	11.2	11.7	12.3	12.9	48.2
CIAT overhead (23%)	28.1	28.0	29.2	30.4	115.7
TOTAL	150.3	149.6	155.9	162.7	618.6

GRAND TOTAL	477.1	325.5	287.7	259.6	1,349.9

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Figure 1. Work breakdown structure of project activities

TITLE: **Ecologically Sustainable Plant Protection and Postharvest Processing of Cassava in Cuba**

PROJECT GOAL: Improve living conditions of poor rural families by increasing ecologically sustainable cassava productivity in Cuba.

PROJECT PURPOSE: Increase food security, increase and stabilize incomes of poor farmers and reduce use of pesticides in Cuba by improving efficiency and sustainability of cassava production through development and adoption of improved integrated pest management, crop production and postharvest processing technologies using farmer participatory methods.

Outputs	Establishment of infrastructure for farmer participatory research	Diagnosis of production constraints in extensive surveys	Reduced losses of major pests & pathogens by biological control (BC)	Adoption of cassava varieties resistant to major biotic constraints	Increased yields through improved production methods	Postharvest production of value-added cassava products, and development of markets	Strengthen national program in IPM & FPR capabilities
Activities	conduct "training of trainers" course	Conduct extensive diagnostic survey	Identify the principal pests amenable to BC	Evaluate clones for resistance to major pests & diseases at CIAT & INIVIT	Implement integrated stake production at farmer research committees (CIALs)	Conduct diagnostic farmer, processor and market surveys	Training of students, scientists, extensionists in IPM & FPR methods
	Team-teach regional FPR courses	Analyze results of extensive survey	Survey for natural enemies (NEs)	Evaluate clones for resistance to major pests & diseases through FPR with CIALs	Conduct FPR in cropping systems to control root rots	Diagnose market opportunities	Training of students & scientists in specialized research methods
	Establish farmer research committees (CIALs)	Conduct intensive surveys at CIAL sites	Establish colonies of NEs and evaluate them		Conduct FPR in intercropping & crop rotation for disease & soil management	Design and construct processing pilot plants	
	Conduct participatory experiments	Analyze results of intensive surveys	Introduce exotic NEs through quarantine, mass rear and release		Develop diagnostic kits for selection of healthy stakes by farmers	Evaluate impact of pilot processing plants	
	Disseminate adopted IPM & crop production technologies to other regions				Evaluate new cover legumes for cassava production systems		

Figure 2. Chronogram of Project Activities in Cuba (1998-2001)

Activities	Year 1				Year 2				Year 3				Year 4			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1.1.1 Select and train the scientists and extensionists for diagnostic surveys	X	X														
1.1.2 Prepare work plans and define protocols and procedures		X														
1.2.1 Conduct extensive surveys			X	X												
1.2.2 Conduct intensive field studies					X	X	X	X								
1.3.1 Review survey data to select sites and prospective interventions for FPR experiments and pilot processing plants					X			X								
1.4.1 Workshop to identify research needs					X											
2.1.1 Prepare plant protection technologies	X	X	X	X	X	X	X	X	X	X	X	X				
2.1.2 Conduct FPR experiments on crop protection technologies					X	X	X	X	X	X	X	X	X	X	X	X
2.1.3 Conduct community-wide surveys to evaluate the adoption and impact of intervention technologies								X				X				X
2.2.1 Conduct FPR experiments on cassava varieties and crop production technologies					X	X	X	X	X	X	X	X	X	X	X	X
2.3.1 Conduct market survey of potential demand for cassava products	X	X	X	X												
2.3.2 Select the designs and sites for pilot cassava processing plants					X											
2.3.3 Construct and operate pilot cassava processing plants						X	X	X	X	X	X	X	X	X	X	X
2.3.4 Evaluate the operation and impact of pilot plants										X				X		
3.1.1 Develop training program on cassava plant protection	X															
3.1.2 Prepare didactic materials on cassava plant protection		X	X	X												

Activities	Year 1				Year 2				Year 3				Year 4			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
3.2.1 Select and train MSc students	X			X	X	X	X	X	X	X	X	X	X	X	X	
3.2.2 Train national program scientists in their specific disciplines	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.2.3 Train extension workers, crop managers and smallholding farmers in sustainable cassava plant protection					X				X				X			
4.1.1 Extension agents disseminate intervention technologies										X	X	X	X	X	X	X
4.2.1 Conduct national workshops of all project participants	X															X

Cuba: CROP PROTECTION (Entomology, Plant pathology)											
Item	National program contribution (1000 pesos)					Requested from donor (1000 US$)					
	1998	1999	2000	2001	TOTAL	1998	1999	2000	2001	TOTAL	
PERSONNEL											
Investigators	30.2	30.2	30.2	30.2	120.8	-	-	-	-	-	
Technicians	17.5	17.5	17.5	17.5	70.0	-	-	-	-	-	
Field workers	1.2	1.2	1.2	1.2	4.8	-	-	-	-	-	
Secretary	1.0	1.0	1.0	1.0	4.0	-	-	-	-	-	
Total personal	49.9	49.9	49.9	49.9	199.6	-	-	-	-	-	
OPERATIONS											
Supplies, services	2.0	4.2	3.5	3.5	13.2	18.5	30.0	30.0	25.0	103.5	
Vehicles (fuel, maint.)	2.0	2.0	2.0	2.0	8.0	1.0	1.0	1.0	1.0	4.0	
Communications	0.5	0.5	0.5	0.5	2.0	2.5	2.5	2.0	1.5	8.5	
Publications/presentat.	1.0	1.0	1.0	1.0	4.0	4.0	4.0	5.0	6.0	19.0	
Contingencies	0.8	1.0	0.8	0.8	3.4	3.0	3.5	3.0	3.0	12.5	
Total operations	6.3	8.7	7.8	7.8	30.6	29.0	41.0	41.0	36.5	147.5	
TRAVEL											
International	-	-	-	-	-	3.0	-	-	3.0	6.0	
National	1.5	2.2	2.5	2.0	8.2	-	-	-	-	-	
Total travel	1.5	2.2	2.5	2.0	8.2	3.0	0.0	0.0	3.0	6.0	
CAPITAL											
Vehicles	-	-	-	-	-	25.0	-	-	-	25.0	
Laboratory equipment	3.0	1.0	3.0	3.0	10.0	20.0	15.0	10.0	3.0	48.0	
Field equipment	15.0	5.0	5.0	5.0	30.0	35.0	12.0	5.0	5.0	57.0	
Mass-rearing facilities	-	5.0	5.0	5.0	15.0	-	30.0	15.0	-	45.0	
Computers software	-	-	-	-	-	10.0	10.0	3.0	-	23.0	
Total capital	18.0	11.0	13.0	13.0	55.0	90.0	67.0	33.0	8.0	198.0	
Students	2.0	8.0	18.0	8.0	36.0	1.3	2.0	2.0	1.0	6.3	
Overhead (4% to CIAT)	-	-	-	-	-	4.9	4.4	3.0	1.9	14.3	
GRAND TOTAL	77.7	79.8	91.2	80.7	329.4	128.2	114.4	79.0	50.4	372.1	51%

Cuba: CROP PRODUCTION (Plant breeding, biotechnology, agronomy).												
Item	National program contribution (1000 pesos)						Requested from donor (1000 US$)					
	1998	1999	2000	2001	TOTAL		1998	1999	2000	2001	TOTAL	
PERSONNEL												
Investigators	11.8	11.8	11.8	11.0	47.2		-	-	-	-	-	
Technicians	7.5	7.5	7.5	7.5	30.0		-	-	-	-	-	
Field workers	3.0	3.0	3.0	3.0	12.0		-	-	-	-	-	
Secretary	0.5	0.5	0.5	0.5	2.0		-	-	-	-	-	
Total personnel	22.8	22.8	22.8	22.0	91.2		-	-	-	-	-	
OPERATIONS												
Supplies, services	1.5	2.0	2.0	2.0	7.5		9.5	10.0	12.5	11.5	43.5	
Vehicles (fuel, maint.)	1.0	1.0	1.0	1.0	4.0		0.5	0.5	0.5	0.5	2.0	
Communications	0.2	1.2	0.2	0.2	1.8		1.0	1.0	0.5	0.5	3.0	
Publications/present.	0.3	0.3	0.3	0.3	1.2		1.5	1.5	2.0	1.5	6.5	
Contingencies	0.2	0.3	0.3	0.3	1.1		0.7	1.0	1.5	1.5	4.7	
Total operations	3.2	4.8	3.8	3.8	15.6		13.2	14.0	17.0	15.5	59.7	
TRAVEL												
International	-	-	-	-	-		2.0	-	-	2.0	4.0	
National	0.7	1.0	1.0	1.5	4.2		-	-	-	-	-	
Total travel	0.7	1.0	1.0	1.5	4.2		2.0	0.0	0.0	2.0	4.0	
CAPITAL												
Vehicles	-	-	-	-	-		-	-	-	-	-	
Laboratory equipment	1.0	1.0	1.0	1.0	4.0		10.0	8.0	3.0	2.0	23.0	
Field equipment	5.0	2.0	2.0	2.0	11.0		10.0	3.0	3.0	-	16.0	
Mass-rearing facilities	-	-	-	-	-		-	-	-	-	-	
Computers software	-	-	-	-	-		2.0	2.0	1.0	-	5.0	
Total capital	6.0	3.0	3.0	3.0	15.0		22.0	13.0	7.0	2.0	44.0	
Students	-	4.0	7.0	4.0	15.0		-	-	1.2	0.7	1.9	
Overhead (4% to CIAT)	-	-	-	-	-		1.5	1.1	1.0	0.8	4.4	
GRAND TOTAL	32.7	35.6	37.6	34.3	141.0		38.7	28.1	26.2	21.0	114.0	16%

Cuba: UTILIZATION (Postharvest processing & market development)												
Item	National program contribution (1000 pesos)						Requested from donor (1000 US$)					
	1998	1999	2000	2001	TOTAL		1998	1999	2000	2001	TOTAL	
PERSONNEL, National												
Investigators	25.0	25.0	25.0	25.0	100.0		-	-	-	-	-	
Technicians	10.0	10.0	10.0	10.0	40.0		-	-	-	-	-	
Field workers	1.9	1.9	1.9	1.9	7.6		-	-	-	-	-	
Secretary	0.5	0.5	0.5	0.5	2.0		-	-	-	-	-	
Total personal	37.4	37.4	37.4	37.4	149.6		-	-	-	-	-	
OPERATIONS												
Supplies, services	1.5	3.8	2.5	2.5	10.3		12.0	15.0	12.5	13.5	53.0	
Vehicles (fuel, maint.)	1.0	1.0	1.0	1.0	4.0		0.5	0.5	0.5	0.5	2.0	
Communications	0.3	0.3	0.3	0.3	1.2		1.5	1.5	0.5	0.5	4.0	
Publications/presentat.	0.7	0.7	0.7	0.7	2.8		2.0	2.0	3.0	2.5	9.5	
Contingencies	0.2	0.5	0.4	0.4	1.5		1.7	2.0	2.5	2.0	8.2	
Total operations	3.7	6.3	4.9	4.9	19.8		17.7	21.0	19.0	19.0	76.7	
TRAVEL												
International	-	-	-	-	-		5.0	-	-	5.0	10.0	
National	0.8	1.0	1.0	1.0	3.8		-	-	-	-	-	
Total travel	0.8	1.0	1.0	1.0	3.8		5.0	0.0	0.0	5.0	10.0	
CAPITAL												
Vehicles	-	-	-	-	-		-	-	-	-	-	
Laboratory equipment	1.0	1.0	1.0	1.0	4.0		5.0	2.0	2.0	-	9.0	
Field equipment	5.0	3.0	3.0	3.0	14.0		15.0	5.0	2.0	-	22.0	
Mass-rearing facilities	-	-	-	-	-		-	-	-	-	-	
Computers software	-	-	-	-	-		3.0	3.0	2.0	-	8.0	
Pilot processing plants (6)	-	-	-	-	-		108.0	-	-	-	108.0	
Total capital	6.0	4.0	4.0	4.0	18.0		131.0	10.0	6.0	0.0	147.0	
Students	1.0	6.0	8.0	6.0	21.0		-	1.1	0.5	0.5	2.1	
Overhead (4% to CIAT)	-	-	-	-	-		6.1	1.3	1.0	1.0	9.4	
GRAND TOTAL	48.9	54.7	55.3	53.3	212.2		159.8	33.4	26.5	25.5	245.2	34%

Cuba TOTAL												
Item	National program contribution (1000 pesos)						Requested from donor (1000 US$)					
	1998	1999	2000	2001	TOTAL		1998	1999	2000	2001	TOTAL	
PERSONNEL, National												
Investigators	67.0	67.0	67.0	66.2	268.0		0.0	0.0	0.0	0.0	0.0	
Technicians	35.0	35.0	35.0	35.0	140.0		0.0	0.0	0.0	0.0	0.0	
Field workers	6.1	6.1	6.1	6.1	24.4		0.0	0.0	0.0	0.0	0.0	
Secretary	2.0	2.0	2.0	2.0	8.0		0.0	0.0	0.0	0.0	0.0	
Total personal	110.1	110.1	110.1	109.3	440.4		0.0	0.0	0.0	0.0	0.0	
OPERATIONS												
Supplies, services	5.0	10.0	8.0	8.0	31.0		40.0	55.0	55.0	50.0	200.0	
Vehicles (fuel, maint.)	4.0	4.0	4.0	4.0	16.0		2.0	2.0	2.0	2.0	8.0	
Communications	1.0	2.0	1.0	1.0	5.0		5.0	5.0	3.0	2.5	15.5	
Publications/presentat.	2.0	2.0	2.0	2.0	8.0		7.5	7.5	10.0	10.0	35.0	
Contingencies	1.2	1.8	1.5	1.5	6.0		5.4	6.5	7.0	6.5	25.4	
Total operations	13.2	19.8	16.5	16.5	66.0		59.9	76.0	77.0	71.0	283.9	
TRAVEL												
International	0.0	0.0	0.0	0.0	0.0		10.0	0.0	0.0	10.0	20.0	
National	3.0	4.2	4.5	4.5	16.2		0.0	0.0	0.0	0.0	0.0	
Total travel	3.0	4.2	4.5	4.5	16.2	Trips to (	10.0	0.0	0.0	10.0	20.0	
CAPITAL												
Vehicles	0.0	0.0	0.0	0.0	0.0		25.0	0.0	0.0	0.0	25.0	
Laboratory equipment	5.0	3.0	5.0	5.0	18.0		35.0	25.0	15.0	5.0	80.0	
Field equipment	25.0	10.0	10.0	10.0	55.0		60.0	20.0	10.0	5.0	95.0	
Mass-rearing facilities	0.0	5.0	5.0	5.0	15.0		0.0	30.0	15.0	0.0	45.0	
Computers software	0.0	0.0	0.0	0.0	0.0		15.0	15.0	6.0	0.0	36.0	
Pilot processing plants (6)	0.0	0.0	0.0	0.0	0.0	$13,000	108.0	0.0	0.0	0.0	108.0	$13,000 invest ca
Total capital	30.0	18.0	20.0	20.0	88.0		243.0	90.0	46.0	10.0	389.0	
Students (3)	3.0	18.0	33.0	18.0	72.0	2 years	1.3	3.1	3.7	2.2	10.3	Trips to CIAT (2 w
Overhead (4% to CIAT)	0.0	0.0	0.0	0.0	0.0		12.6	6.8	5.1	3.7	28.1	
GRAND TOTAL	159.3	170.1	184.1	168.3	682.6		326.8	175.9	131.8	96.9	731.3	

CUBA PROPOSAL								
CIAT: Requested funds		(US$ 1000)						Inflation
	1998	1999	2000	2001	TOTAL			rate
Entomology (including Acarology)	27.4	27.6	29.1	30.6	114.6	19%		
assistant (1)	17.0	18.0	19.1	20.2				6%
supplies	8.0	8.3	8.7	9.0				4%
travel (2,1,1,1 trips x 10 d)	2.4	1.2	1.3	1.3				4%
Plant pathology (root rots & bacterio:	29.4	30.5	30.7	30.9	121.6	20%		
assistant (1)	17.0	18.0	19.1	20.2				
supplies	10.0	10.0	9.0	8.0				
travel (2,2,2,2 trips x 10 d)	2.4	2.5	2.6	2.7				
Virology + Biotechnology	21.2	22.4	23.6	25.0	92.2	15%		
assistant (1)	17.0	18.0	19.1	20.2				
supplies	3.0	3.1	3.2	3.4				
travel (1,1,1,1 trips x 10 d)	1.2	1.2	1.3	1.3				
Postharvest processing + Economics	33.0	29.4	31.1	32.8	126.3	20%		
postharvest specialist (20%)	25.6	27.1	28.8	30.5				
supplies	5.0	1.0	1.0	1.0				
travel (2,1,1,1 trips x 10 d)	2.4	1.2	1.3	1.3				
Project Coordination	11.2	11.7	12.3	12.9	48.2	8%		
secretary (.3)	5.0	5.3	5.6	6.0				
supplies & services	5.0	5.2	5.4	5.6				
travel (1,1,1,1 trips x 10 d)	1.2	1.2	1.3	1.3				
Overhead (23%)	28.1	28.0	29.2	30.4	115.7	19%		
TOTAL CIAT	150.3	149.6	155.9	162.7	618.6	46%		
GRAND TOTAL	477.1	325.5	287.7	259.6	1349.9	100%		