INTEGRATING IMPROVED GERMPLASM WITH BETTER CROP/SOIL MANAGEMENT FOR ENHANCED LIVELIHOODS THROUGH MORE SUSTAINABLE CASSAVA-BASED CROPPING SYSTEMS IN SE-ASIA

Coverage: Laos, the Philippines, Indonesia, Thailand and Vietnam

I. INTRODUCTION

Increased population pressure in many countries in SE Asia has led to constant migration of people from the more fertile lowlands to either the cities or to the more marginal uplands, or even the highlands. In the latter case, crops like cassava, upland rice and maize are often cultivated on slopes with minimum external inputs, which has led to environmental degradation (deforestation, increased runoff and erosion, and a general decline of soil fertility) as well as increased poverty, lack of educational opportunities and poor health. To break out of this vicious downward spiral, it is essential to develop simple and low-cost technologies that will both increase yields (and income) and protect the environment from further degradation.

Cassava (*Manihot esculenta* Crantz) is often grown by poor farmers living in these marginal areas because the crop is easy to grow, and both the roots and leaves can be used for human food or animal feed, while the stems can be used as fuel in the kitchen. In other areas, especially in Thailand, south Vietnam and Sumatra island of Indonesia, the roots are sold for processing into animal feed, alcohol or starch, providing income for the purchase of food and for other needs. Thus, improved cassava production is an excellent vehicle for improving food security and reducing poverty.

In 2002, Asia produced 51.2 million tonnes of fresh cassava roots (28% of world production) on 3.49 million ha; the average yield of 14.67 t/ha is the highest among the three continents. Within Asia, Thailand has the highest cassava production of 16.87 million tonnes, followed by Indonesia (16.72), India (6.90), China (3.85), Vietnam (4.16) and the Philippines (1.65). In the ten countries of SE Asia, cassava is the third most important crop, both in terms of area and DM production. In both Thailand and Vietnam, cassava is now listed among the "priority crops" according to the policies of the respective governments[1].

Average root yields are 7.6 t/ha in the Philippines, 12.6 in Vietnam, 12.9 in Indonesia, 16.4 in Thailand and 25.5 t/ha in India. These large differences in yield levels are partially due to the greater investment in cassava research to develop new high-yielding varieties in India and Thailand, and also due to higher inputs and better crop management in the latter two countries as compared to the others.

II. ISSUES

Cassava roots are high in carbohydrates while the leaves are high in protein (20-25% crude protein on DM basis); the combination of dry or ensiled roots and leaves can therefore produce a cheap and well-balanced feed for raising pigs, cattle, goats, poultry or fish, which can either be consumed at home or be sold for cash. The ease of cropping, its tolerance to adverse environmental conditions (reducing risks of crop failure), and its multiple end-uses make cassava a popular crop among poor farmers. However, cassava can cause serious erosion when grown on slopes with poor management. Simple and cost-effective measures to reduce erosion have been developed through on-station as well as farmer participatory research (FPR), but the most suitable practice depends on the biophysical and socio-economic conditions in a particular location and can best be selected by farmers testing various options on their own fields.

CIAT has a long-term commitment to cassava research in Asia. Over the past 25 years, a total of about 160 Asian cassava researchers have been trained at CIAT. CIAT established in 1985 the CIAT Regional Cassava Office for Asia in Bangkok, and a cassava breeder, Dr. Kazuo Kawano, was transferred from Cali, Colombia to Bangkok. Working hand-in-hand with cassava breeders in national programs, Dr.

[1] For Vietnam: see "The Master Plan for Agricultural Research in Vietnam", A UNDP/FAO document (VIE 98/019.08). According to this document, rice maize and cassava are the three priority crops in Vietnam.

Kawano developed about 25 new high-yield and high-starch varieties by crossing outstanding cassava germplasm from Latin America with Asian varieties, especially those from Thailand. These CIAT-related varieties are now grown in about 1.3 million ha in Asia, especially in Thailand where nearly 1.0 million ha, or more than 90% of the total cassava area, are now planted with these new varieties. In Vietnam, the area under new varieties is spreading rapidly, from almost none in 1996 to about 90,000 ha in 2000/01 or close to 33% of the total cassava area.

In 1986 CIAT transferred a cassava agronomist, Reinhardt Howeler, from CIAT-Colombia to Bangkok. Working closely with national cassava researchers in seven Asian countries, research on agronomic practices, especially in the area of soil fertility maintenance and erosion control, was strengthened. From 1994 to 2003 this work was fully funded by the Nippon Foundation in Japan. During the first phase of that project (1994-1998) a farmer participatory research (FPR) methodology was developed by working in 2-3 pilot sites each in China, Indonesia, Thailand and Vietnam. The second phase (1998-2003) concentrated on Thailand and Vietnam with some additional activities in China. During this phase emphasis moved gradually from farmer participatory research to farmer participatory extension (FPE). While the main objective of this project was to enhance the adoption of soil conservation practices by cassava farmers, it soon became apparent that farmers will only adopt erosion control practices if these are combined with other income-generating technologies, such as better varieties, improved fertilization practices, better weed control and intercropping (in some countries). The principle lesson learned is that *improved germplasm is an essential entry point for improved natural resources management*.

Using a farmer participatory approach in technology development and dissemination and with the help of dedicated collaborators in many national institutions (5 in Thailand, 6 in Vietnam and 3 in China) the project was able to rapidly expand to about 75 pilot sites (or villages) and achieving adoption of new technologies by at least 8000 participating farmers, including the planting of contour hedgerows of vetiver grass (130 km of hedgerows in Thailand), and *Tephrosia candida*, pineapple or *Paspalum atratum* in Vietnam. In FPR cassava variety trials conducted by 2,717 households in Vietnam during 2002, the traditional varieties (with improved management) produced an average yield of 20.7 t/ha compared with 28.6 t/ha for the improved varieties. This shows that both improved varieties and better management are necessary to increase yields substantially and to reduce poverty. The planting of new high-yielding varieties in 1,244 ha by participating farmers in 2002 resulted in a total increase in gross income of US$243,338 or $90 per household. Many other farmers have benefited by learning about these new technologies from other farmers or extension workers. The socio-economic impact of this project will be analyzed during an impact assessment to be conducted by economists in Sept-Oct 2003. A rough calculation indicates that the adoption of new cassava varieties in 92,500 ha in Vietnam has put about 18 million US dollars in farmers' pockets as a result of increased yields in 2001/02[2].

By integrating improved germplasm with improved soil management practices the early investment in cassava research is now paying off by increasing on-farm yields, leading to increased income while maintaining or improving the soil resource base. The rapid adoption of CIAT-related cassava varieties, first in Thailand and now also in Vietnam, China, and Indonesia is a clear indication that cassava farmers in Asia are anxious to adopt new technologies if these technologies have a direct economic benefit. The project proposes to work in Indonesia, Laos, the Philippines, Thailand and Vietnam since cassava is an important commercial or subsistence crop in these five countries of SE Asia. Thailand and Vietnam have strong national cassava programs which have benefited from close collaboration with CIAT; both countries, but especially Thailand, will contribute immensely to the project by providing germplasm and sharing experiences with other countries. The cassava programs in Indonesia and the Philippines were once quite strong, but have lacked behind recently due to lack of funding; the program in Laos is incipient but has strong support from Lao authorities. Recent advances in cassava breeding methodologies and biotechnology promises to result in the more rapid development of new varieties with

[2] Tran Ngoc Ngoan and R.H. Howeler. 2003. The adoption of new technologies and the socio-economic impact of the Nippon Foundation Project in Vietnam. Paper presented at the 7th Asian Cassava Research Workshop, held in Bangkok, Thailand. Oct 28-Nov 1, 2002. (in press)

special characteristics such as drought tolerance, improved nutritional quality and better starch characteristics in addition to high yield and starch content.

III. THE TECHNICAL ASSISTANCE

A. Purpose and Output

1. Purpose

The long-term goals of the project are to increase the living standards of smallholder farming communities and to improve agricultural sustainability in the less favourable areas of Southeast Asia by improving the productivity and stability of farming systems in which cassava is an important crop. Benefits should flow to all sectors of these communities and households, but particularly those at greatest disadvantage currently, and should result in greater food production, household food security, household incomes, and returns to labour, while maintaining or improving the natural resource base.

The project purpose is to develop, together with farmers, efficient and effective integrated crop and soil management practices that optimize farm productivity and contribute to the sustainability of cassava-based cropping systems.

Specific objectives

i) To support national institutions in conducting strategic and applied research in cassava production that will overcome constraints identified at the farm level,
ii) To develop, with farmers, new high-yielding cassava varieties and improved crop management practices that increase productivity and maintain the soil resource in smallholder farms where cassava is a principal crop,
iii) To disseminate new technologies at the local, provincial, national and international levels,
iv) To explore and test new and innovative farmer participatory methodologies for technology development and dissemination that are suited to special needs and conditions in each location,
v) To strengthen the farmer participatory research capacity in national institutions and in selected farming communities, and
vi) To develop procedures for monitoring the impact of new technologies developed through FPR.

These objectives are inter-related and will be pursued concurrently.

A. Justification

The Asian Development Bank (ADB) has as one of its major objectives the development of member countries in Asia, especially with respect to the alleviation of poverty, increased food security, and the protection of the environment. The Bank also emphasizes the development of human resources in these countries, especially in those areas that stimulate self-help and alleviate hunger and poverty. The goal and purpose of the proposed project are consistent with these objectives. The project will build on the foundation of 30 years of research in cassava breeding and agronomy conducted by CIAT in collaboration with national programs in Asia, as well as on ten years of experience in farmer participatory research and extension. The latter is considered essential to achieve widespread adoption of new technologies, which in turn will have impact on the conservation of natural resources and on the well-being of cassava farmers and their families. The objectives, goals and activities are also entirely consistent with CIAT's objectives and strategies as outlined in the CIAT Medium-Term Plan 2000-2004 which emphasizes "Competitive Agriculture", "Agro-ecosystem Health" and "Rural Innovation" as vehicles for improving rural livelihoods, while the two principles central to CIAT's new approach of "Doing Research Together" are:

- integration of germplasm improvement with natural resource management to alleviate poverty, protect the environment, and food security in the tropics, and
- collaboration with a range of partners to make this integrated approach succeed.

2. Outputs

The objectives will realize the following outputs:

1. New varieties and technical knowledge to support the development of new technologies and their integration into farming systems.
2. Improved varieties and more sustainable management practices for cassava-based systems tested, adapted and adopted by participating farmers.
3. Farmer selected improved varieties and agronomic practices disseminated to other farmers using FPE methodologies, and technical information made available to other researchers and extension staff.
4. Improved institutional capacity and linkages; acceptance of a participatory approach in collaborating institutions, with persons trained in FPR methodologies.
5. Indicators evaluated for monitoring progress in technology development and adoption, and assessment of the socio-economic impact of the project.

The outputs together contribute to achieving the purpose which in turn contributes to achieving the overall goal. They are expressed in tabular form together with performance indicators and monitoring mechanisms and assumptions in **Table 1 of Appendix 1**. We aim to attain these outputs through effective collaboration between researchers, extension staff and farmers in the five participating countries in southeast Asia.

B. Methodology and Key Activities

1. Project methodology

The methodology for achieving the various outputs which contribute to the purpose and goal of this project consists of three basic components:

1. Strategic and applied research to develop new cassava varieties and improved cultural practices that solve specific problems identified at the farm level (e.g. more drought tolerant varieties, grass species useful as erosion control barriers or legumes for green manures). This research will be done mainly by researchers on experiment stations and aims to provide new options for later testing by farmers.
2. Farmer participatory research (FPR) and extension (FPE) to test a range of selected options (varieties, management practices, erosion control measures) on farmers' fields. Farmers select the treatments, conduct the trials and finally select the most useful technologies for adoption from the results obtained. After adoption some farmers, in collaboration with local extension workers, will participate in the dissemination of the most useful technologies to other farmers in the community, through farmer field days and by hosting cross-visits of farmers from other villages or other regions.
3. Training of national researchers and extension workers as well as some key farmers in each pilot site in FPR methodologies and in improved cassava production practices.

2. Major activities

The specific activities that will lead to achieving the above-mentioned outputs are (**Table 2** of **Appendix 1**):

Output 1: New varieties and technical knowledge to support the development of new technologies and their integration into cassava-based cropping systems:

Activities:
-Continue breeding activities and varietal evaluations at experiment stations, in regional trials and on farmers' fields
-Continue long-term soil fertility and erosion control experiments
-Initiate new research to solve problems identified in FPR, especially in the area of improved soil management, such as conservation tillage, green manures, cover crops etc.

Output 2: Improved varieties and more sustainable management practices for cassava-based systems, tested adapted and adopted by participating farmers:

Activities:
-select FPR pilot sites; using RRA methodologies to collect baseline data
-establish FPR demonstration plots to show a wide range of options
-organize visits of farmers from selected pilot sites to demonstration plots to select

appropriate options, and/or cross-visits to other sites where new technologies have already been successfully adopted
-help farmers establish simple trials on selected topics (e.g. varieties, fertilization, weed control, erosion control) on their own fields and monitor the progress of these trials
-organize farmer field days to harvest the FPR trials, tabulate the data and discuss the results with farmers, after which farmers select the best varieties or most suitable technologies, either for retesting or for adoption on larger areas of their fields.

Output 3: Farmer selected improved varieties and agronomic practices disseminated to other farmers, and technical information made available to other researchers and extension staff:

Activities:
-Organize cross-visits by farmers from new sites to those of older sites to encourage farmer-to-farmer extension
-Organize local or regional farmer field days to let farmers explain the results of their FPR trials and show adoption in the field
-Encourage the formation of local "FPR teams" consisting of a few key farmers and a local extension worker to help other farmers conduct FPR trials or to produce planting material of new varieties or seed of green manures or erosion control barriers, etc.
-Help farmers set up community-based self-help groups (similar to Landcare groups in the Philippines) with elected officers, their own bylaws and a rotating fund, to encourage community development and decision making
-Organize FPR training courses for key farmers and local extension workers of each site to enhance the knowledge and self-confidence of the local "FPR-teams".
-Produce attractive extension booklets, bulletins, posters and videos, and facilitate dissemination of information through newspapers, radio, television and a website.

Output 4: Improved institutional capacity and linkages; acceptance of an FPR approach in collaborating institutions, with persons trained in FPR methodologies:

Activities:
-Facilitate institutional collaboration for FPR approach in participating countries
-Organize FPR training courses for researchers and extension workers
-Provide continuous support to scientists and field technicians in the use of FPR methodologies
-Provide feedback to institutional leaders

Output 5: Indicators evaluated for monitoring progress in technology development and adoption, and assessment of socio-economic impact of project:

Activities:
-Select socio-economic and environmental parameters for monitoring progress
-Collect a minimum data set for site characterization
-Collect baseline data on current practices and the socio-economic conditions in selected pilot sites
-Conduct surveys to monitor changes and evaluate progress towards achieving outputs.
-Conduct impact assessment

3. Laboratory and other equipment required for the project

The project requires a minimum of equipment, mainly a few desk or laptop computers, an LCD projector, digital camaras, GPS and other small items. A project vehicle will be leased from CIAT as indicated in the budget (included under Operations)

4. Methods of extending project outputs

These have been listed under Output 3 above.

5. Linkages and collaboration with other projects

The proposed RETA project will collaborate with the ADB-supported LLSP project which uses similar FPR methodologies for testing forage species, as well as with other cassava-specific projects, such as the Asian Consortium for Cassava Research and Development (ACCORD) to be set up in 2003 with

financial contributions from participating countries (both government and private sector), and the Cassava Germplasm Improvement Project at CIAT headquarters in Colombia. In areas where marketing of cassava products is a problem, the project will collaborate with CIAT's Agro-enterprise project in Asia to find solutions.

6. Intellectual property issues and management strategies

CIAT-related cassava germplasm is freely available to anyone interested, but no one can claim exclusive intellectual property rights to this material. New varieties produced in one country can be made available for use in other countries only with the consent of the country that produced the material.

C. Cost and Financing

Appendix 2 shows that the total estimated cost of the 3 year project is 1.57 million dollars, of which 0.993 million is requested from ADB, 0.285 million (mainly for staff salaries) from CIAT, and $ 0.29 million from collaborating partners, mainly for staff salaries and the initial contribution to the community rotating funds ($ 2,000 to each participating community).

D. Implementation Arrangements

The project will be coordinated by an experienced senior staff member of CIAT in the CIAT Cassava Office for Asia in Bangkok, assisted by a local (probably Thai) CIAT Research Fellow. In each of the four participating countries, a country coordinator will be appointed to work half-time in the project, mainly to coordinate the activities of the various collaborating institutions.

Every year the project coordinator will disburse money to each of the collaborating NARS institutions (item 6 in **Appendix 2,** Collaborative Activities) in accordance with the total budget available and the relative workload of each institution. The money disbursed by the project is to cover only operational expenses, such as travel, accommodation, supplies etc. The amount each institution receives is agreed to through the signing of a "Research Contract" between CIAT and the collaborating institution. All financial matters will be handled by the CIAT Accounting Office in Cali, Colombia, who reimburses the project coordinator monthly upon receipt of a monthly expense report supported with receipts. The Accounting Office will prepare the yearly financial statements corresponding to the project. The use of outside consultants is not contemplated except possibly for an impact assessment study towards the end of the project, upon mutual agreement with ADB.

Potential collaborators in the five countries are the following:

Laos:	National Agric. and Forestry Research Inst. (NAFRI) (Vientiane)
Indonesia:	Central Research Inst. for Food crops (CRIFC) (Bogor)
	Research Inst. for Legumes and Tuber Crops (RILET) (Malang)
	Brawijaya Univ. (Malang)
Philippines:	PCARRD (Los Baños)
	Phil Root Crops (Baybay, Leyte)
Thailand:	Dept. of Agric. (Bangkok)
	Dept. of Agric. Extension (Bangkok)
	Dept. of Land Development (Bangkok)
	Kasetsart University (Bangkok)
	Thai Tapioca Dev. Institute (Bangkok)
Vietnam:	Thai Nguyen Univ. (Thai Nguyen)
	Hue Univ. (Hue)
	Univ. of Agric. and Forestry (Ho Chi Minh city)
	Nat. Soil and Fertilizer Inst. (Hanoi)
	Vietnam Agric. Science Institute (VASI) (Hanoi)
	Inst. of Agric. Science of South Vietnam (IAS) (Ho Chi Minh city0

The national institutions hold annual planning meetings to present and discuss results obtained, and plan the next year's activities, location of new sites, type of FPR trials, training etc. The project is implemented directly by the NARS with inputs from the project and country coordinators when necessary.

E. Potential Project Impact

Starting in only a few (2-3) selected pilot sites in each country during the first year, the project is expected to expand to 4-5 sites in the second, and to 8-10 sites in the third year of the project, reaching a total number of 40-50 sites after three years. At that time it is expected that some new technologies (especially new varieties) will be adopted by about 2000-3000 farmers participating directly in the project and by at least 10,000 farmers who have obtained information and/or planting material of selected varieties through the project by other means (from pamphlets, TV, radio, or by word of mouth from other farmers or extension workers).

By developing and then adopting new varieties and production practices, farmers can increase their yields, feed more animals or sell more products leading to increases in income. From past experience it is estimated that by adopting new technologies farmers can increase their income between $100 and $200 per year per household, in some cases more than doubling their net income.

The main constraints to adoption is the lack of appropriate technologies that have substantial short-term economic benefits. Thus, continued research to identify better options that are well adapted and suitable for a particular area, is essential, both in the area of varietal improvement and agronomic practices. In areas where marketing is a problem, some on-station and on-farm research on crop utilization (e.g. use of root and leaf silage for pig feeding) may be necessary.

F. Monitoring Plan

Progress in achieving outputs will be monitored and documented in Annual Progress Reports. This will include information on the number and location of pilot sites, numbers of farmers participating in FPR trials, field days, training courses etc., as well as the number of farmers adopting certain technologies and to what extent (area). Where possible, the yields obtained with both traditional and new technologies will be determined so as to calculate increases in gross and net income.

To be able to conduct a final impact analysis, it is important to collect sufficient baseline data at the onset of the project. This will include site characterization (climatic and soil characteristics), current production practices, and socio-economic data on yield levels, prices, marketing channels, production costs, gross and net income. Towards the end of the project similar data will be collected in sites where adoption took place as well as in areas of non-adoption, in order to determine the impact of the project on the livelihoods of farmers, and identify why certain technologies were not adopted. This information will be obtained mainly through RRAs as well as a limited number of structured surveys.

G. Personnel

Tables 1 and **2** of **Appendix 3** show the basic information on scientific staff employed by the project, and their involvement over time.

The proposed project will be coordinated by Dr. Reinhardt Howeler, senior staff at CIAT, with over 30 years of experience in cassava research and development, both in Latin America (16 years) and Asia (17 years). His experience ranges from basic laboratory, greenhouse and field research to farmer participatory research and extension; during the past 17 years he has worked closely together with researchers and extensionists in many national programs in Asia, and is reasonably fluent in Thai. The project coordinator will work ^{2}/3 time for the project in the first year and ½-time during the 2nd and 3rd year. The project coordinator will contact potential collaborating institutions, discuss the objectives and proposed workplan, and request their participation. He will participate in all annual planning meetings and will visit regularly the pilot sites to see the progress and suggest improvements. He will also participate in some of the field days and training courses, but because of language, this will be mainly the responsibility of the country coordinators. The country coordinators (seconded from their own institutions and working half-time for the project) will preside over the annual planning meetings and they are responsible for collecting the FPR-trial data from collaborating institutions. The project coordinator will collate the information to write the progress reports for the donor.

The project coordinator will be assisted by a locally-hired Research Fellow, who will be stationed in the Bangkok Office and work closely with the coordinator to gain experience. With time, the Research Fellow will take over some of the responsibilities of the Project Coordinator, especially the visiting of research sites and in the collection of data. Both scientists in the Bangkok Office will be assisted by one secretary and one driver/office assistant.

Appendix 1

Table 1. Technical Assistance Framework.

Design Summary	Performance Indicators/Targets	Monitoring Mechanisms	Assumptions and Risks
A. Goal			
To increase the living standards of small farmers and improve the sustainability of farming practices in less favored areas in SE Asia	Within 10 years in the project's pilot sites: -double the net income derived from cassava-based crop/livestock systems -reduce soil losses due to erosion by 50% in cassava fields on sloping land	Government statistics and project impact analyses	Continued government support to development of the cassava sector
B. Purpose			
Develop efficient and effective integrated crop and soil management practices that optimize farm productivity and contribute to the sustainability of cassava-based farming practices by using a farmer participatory approach	Within 3 years in the project's pilot sites: -increase cassava yields by 50-100% -increase net income from cassava based crop/livestock systems by 50-100% -20% of farmers adopt soil erosion control practices -75% of farmers adopt improved nutrient management practices	-Progress reports and project impact analyses -Case studies -Final report	Continued support and collaboration from participating research and extension organizations, as well as from local government officials
C. Outputs			
1. New varieties and technical knowledge to support the development of new technologies for cassava-based cropping systems	In 3 years: -New varieties developed and released in all participating DMCs -Additional knowledge about practices to maintain or improve soil fertility in cassava fields -Varieties and practices developed to optimize cassava leaf productivity and usage	-Progress Reports -CIAT Annual Reports -Scientific publications -Proceedings of Regional Cassava Workshop -Technical publication on cassava varietal improvement and agronomic practices	Continued collaboration by national research organizations
2. Improved varieties and more sustainable agronomic practices tested, adapted and adopted by participating farmers	In 3 years in pilot sites -2000 farmers in 40-50 pilot sites have tested new varieties and production practices through FPR -2000-3000 farmers sites have adopted new varieties and/or improved practices -20% of farmers have adopted soil erosion control practices -20% of farmers in pilot sites have experimented with production and usage of cassava leaves for animal feeding	-Progess Reports -Annual Reports of results of FPR trials by each participating NARS or country	Continued interest by NARS in technology development using a farmer participatory approach -Government support for agricultural development through enhanced community involvement
3. Farmer selected improved varieties and agronomic practices disseminated to other farmers and technical information made available to other researchers and extension staff	In 3 years: -10,000 farmers in the 5 DMCs have heard about and adopted some new technologies for improved and more sustainable cassava production -1 farmer/extensionists training course in FPR and cassava technologies held in each of the 5 DMCs	-Progress Reports -Documentation of process of dissemination -Publication of extension bulletins in local languages	-Government financial support for establishment of community-based self-help groups with rotating credit funds

Table 1. (continued)

Design Summary	Performance Indicator/Targets	Monitoring Mech.	Assumptions and Risks
4. Improved institutional capacity and linkages, acceptance of participatory approach, with persons trained in FPR methodologies	In 3 years: -1 FPR training course for researchers/extension workers held in each of the 5 DMCs -improved collaboration between research and extension organization in each country -improved acceptance of farmer participatory approaches in the participating NARS of the 5 DMCs	-Progress Reports -Assessment of effectiveness of project staff in bringing about institutional change	-Adequate personnel assigned to implement the project -Administrators interested in using a participatory approach -Countries are willing to share their best germplasm and technologies
5. Indicators evaluated for monitoring progress in technology development and adoption, and assessment of socio -economic impact of project	-Gross and net incomes calculated for treatments in all FPR trials -Extent of adoption of new technologies determined and their economic impact calculated -Impact on livelihoods of participating farmers assessed	-Progress Reports -Final Impact Analysis -Case studies	Availability of impact assessment specialists within or outside CIAT

D. Activities

Design Summary	Monitoring Mechanisms
Output 1. New varieties and technical knowledge to support development of new technologies	
• Cassava breeding and varietal evaluations at experiment stations, in regional trials and on farmers' fields • Long-term fertility and erosion control experiments • Applied research on conservation tillage, green manures, cover crops and cassava for leaf production	CIAT Annual Reports Progress Reports Workshop Proceedings
Output 2. Improved varieties and more sustainable management practices tested, adapted and adopted by participating farmers	
• Select pilot sites and diagnose principle problems through RRA or PRA • Establish FPR demonstration plots • Organize farmers' visit to demonstration plots and cross-visits to other sites to select options for testing • Help farmers set up and conduct FPR trials on farmer selected topics such as varieties, fertilization, green manuring, intercropping, erosion control etc. • Organize farmers' field day at harvest of FPR trials, calculate and present data, discuss with farmers and vote on farmers' preferences	Yearly reports by country on results of FPR trials, including production costs, gross and net income of all treatments, and farmers preferences. Progress Reports CIAT Annual Reports Site visits
Output 3. Farmer selected improved varieties and agronomic practices disseminated to other farmers using FPE methodologies, and technical information made available to other researchers and extension staff	
• Organize cross-visits of farmers from new sites to those of older sites to encourage farmer-to-farmer extension • Organize local and regional field days • Encourage formation of local "FPR teams" • Help farmers set up and manage community-based self-help groups • Organize FPR training courses for key farmers and local extensionists	Progress Reports Site visits Publications

Table 1. (continued)

Design Summary	Monitoring Mechanisms
Output 4. Improved institutional capacity and linkages, acceptance of participatory approach, with persons trained in FPR methodologies	
• Facilitate institutional collaboration for FPR approach • Organize FPR training courses for researchers and extension workers • Provide technical and methodological support to scientists and field technicians in the use of participatory approaches • Provide feedback to institutional leaders • Organize Regional Workshops	Training materials Technical bulletins Site visits Workshop Proceedings Presentations and CD and website
Output 5. Indicators evaluated for monitoring progress in technology development and adoption, and assessment of socio-economic and environmental impact of project	
• Collect minimum data set for site characterization • Select socio-economic and environmental parameters for monitoring progress • Collect baseline data on current practices and socio-economic conditions in pilot sites • Conduct surveys to monitor changes and evaluate progress towards achieving outputs • Conduct final impact assessment of project	Progress reports Survey data Impact Analysis

E. Inputs

1. Research Personnel

- Project Coordinator: international resource specialist in cassava agronomy (2/3 time in first year, 1/2 time in 2nd and 3rd year) at $ 200,000 over 3 years
- Assistant to Project Coordinator: Regional Research Fellow (full-time) at $ 61,818 over 3 years
- International short-term expert in M&E and Impact Assessment at $ 14,000 for 1.5 months
- Five country coordinators (half-time) in 5 DMCs at a total of $ 67,500 over 3 years
- Office support staff (full-time secretary and driver/office assistant) at $ 61,818 over 3 years

2. Equipment

- Office equipment
- Field equipment

3. Research support, training and workshop

- Contracts with NARS partners to conduct research, FPR and FPE
- Training courses, cross-visits and workshops

4. Administration costs

- Supplies and services
- Communication and networking
- Overhead

Appendix 1

Table 2. Activity Schedule.

Output/activity	Year 1					Year 2					Year 3			
1. New varieties and technical knowledge														
1.1 breed and select new varieties	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
1.2 long-term fertility and erosion control trials	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
1.3 new on-station trials	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
1.4 prepare technical bulletins about new varieties/practices				✓					✓					✓
1.5 write scientific papers	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
1.6 organize workshops									✓					✓
2. Technologies tested/adopted by farmers														
2.1 select new sites and conduct RRA	✓					✓					✓			
2.2 establish demonstration plots	✓					✓					✓			
2.3 farmers visit demonstration plots or other sites	✓					✓					✓			
2.4 conduct FPR trials	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
2.5 organize field days at harvest				✓					✓					✓
3. Varieties/information disseminated														
3.1 organize cross-visits			✓					✓					✓	
3.2 organize farmer field days			✓					✓					✓	
3.3 prepare extension bulletins, booklets, posters, video	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
3.4 organize farmer/extensionists training courses			✓	✓			✓	✓	✓					
4. Improved institutional linkages and acceptance FPR approach														
4.1 facilitate institutional collaboration	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
4.2 organize FPR training courses for technicians		✓	✓	✓			✓	✓						
4.3 provide technical and moral support to project personnel	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
4.4 provide feedback to institutional leaders			✓					✓					✓	
4.5 organize regional workshops									✓					✓
5. Indicators evaluated for monitoring progress/impact														
5.1 select socio-economic parameters for ME	✓													
5.2 collect a minimum data set for site charact.	✓					✓					✓			
5.3 collect baseline data in pilot sites	✓					✓					✓			
5.4 conduct surveys to monitor progress				✓					✓					✓
5.5 conduct impact assessment														✓

Appendix 2

Table 1. Cost Estimates and Financing Plan. ($'000)

Item	Foreign Exchange	Local Currency	Total Costs
A. Asian Development Bangk			
1. Personnel	391	0	391
2. Travel	69	0	69
3. Operations	45	0	45
4. Institutional development	100	0	100
5. M&E and Impact assessment	2	2	14
6. Collaborative activities	240	0	240
7. Indirect costs	133	0	134
Subtotal (A)	***993***	***0***	***993***
B. CIAT			
1. Personnel (salaries)	275	0	275
2. Travel	10	0	10
Subtotal (B)	***285***	***0***	***285***
C. NARS Partners			
1. Personnel (salaries)	0	200	200
2. Travel	0	10	10
3. Community revolving fund	0	80	80
Subtotal (C)	***0***	***290***	***290***
Total	**1,278**	**290**	**1,568**

Appendix 3

Table 1. Personnel Summary.

Family name first name	Position	Int. Dom.	National	Education	Experience	E.S.
1. Howeler, Reinhardt	Project Coord. (Senior Staff).	Int.	Dutch	PhD./Cornell Uni/'70	33	IARC
2. NN	Assist. Proj. Coord. (Regional Res. Fellow)	Dom.	Thai ?	MSc or PhD.		IARC

Table 2. Staffing Schedule.

Name	Position	Months	Year 1				Year 2				Year 3			
1. Howeler, Reinhardt	Project Coord.	20	2	2	2	2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
2. NN	Assist Proj. Coord.	36	3	3	3	3	3	3	3	3	3	3	3	3