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ROOT AND TUBER FOOD CROPS RESEARCH

IN CAMEROON

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To:

The Agency for International Development
YAOUNDE - CAMEROON

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INTRODUCTION

I.

Food production in most parts of Africa is on the decline while the population is on a rapid increase. Most African countries are food importers, while many others are on food emergency relief. Thus, increased production of root and tuber crops and reduction of post-harvest loss should support AID program objectives in many African countries.

Poor performance of the agricultural sector in sub-saharan Africa is well known. Problems associated with the depressed state of Africa's agriculture demonstrate that yields per acre for cereals and other food crops are the lowest of any region in the world. Growth in aggregate food production since 1960 averages less than two percent per annum. Per capita food production for the past two decades has steadily declined. The result has been the growing dependence on food aid and increasing use of scarce foreign exchange for food imports rather than for other pressing development needs.

The U.S.A. has a unique ability for making a major contribution to research for alleviation of problems of poverty and malnutrition in sub-Saharan Africa. It has a large share of the world's best-trained scientists, best equipped laboratories, and effective agricultural research institutions. U.S. agriculture researchers have already made major contributions, with very high economic returns, to the productivity of the U.S. agriculture. In addition, with support of funds from U.S. foundations, U.S. official foreign assistance and private industry, U.S. research scientists have made great contributions to the beginnings of the modernization of agriculture in many of the developing countries.

While 1890 institutions have agricultural research capabilities, they also are unique because they have extensive experience in working with limited resource farmers. This unique experience lends itself to undertaking research that will adapt the U.S.A. technological experience in food production to the African situation in an attempt to reduce the hunger and malnutrition in sub-Saharan Africa. The technical expertise envisioned for the proposed project is multidisciplinary in nature. The formation of the collaborating group of universities provides the required expertise needed and our experiences and institutional capabilities are very complimentary.

In response to an earlier proposal on "Tropical Legume Germplasm Centre: Collection, conservation and Utilization" submitted by the three 1890 institutions to AID in Washington, a planning grant was approved by AID for scientists of the three participating 1890 Land Grant Institutions (University of Maryland Eastern Shore, Alabama A&M University and Florida A&M University) to visit West Africa and certain countries with legume and other crop resource centers to gather information relevant to the needs of LDCs in sub-Saharan Africa. The information was to be used in revising the original proposal submitted to AID for funding.

On October 31, 1984 the collaborating universities submitted a report on their AID sponsored visits to Senegal, Liberia, Ethiopia, Niger, Cameroon, Nigeria, Rome (UN-FAO) and London (Tropical Development and Research Institute). The four primary countries (Senegal, Liberia, Niger and Cameroon) were selected to provide information on the widest possible ecological and weather conditions and diversity in agricultural production and potential. The report identified a number of general and specific concerns, problems and constraints in agricultural production, with recommended action. This proposal benefited greatly from the views and comments of the USAID mission in Cameroon, as well as the Cameroon research scientists involved in root and tuber research work.

Root, stem, tubers and corms constitute the main source of the daily energy needs of Africa's people. Because little improved work has been done, they still possess a high potential for increased yields as demonstrated by research work at IITA from 1970 to date. In some cases, a doubling of present yields is possible. Improved yields, ready availability of seedstock and reduction in post-harvest losses are necessary if food and animal feed supply are to keep pace with population increases.

Food production in tropical Africa is the preoccupation of millions of small farmers (both men and women) over 90% of whom cultivated less than five hectares and produce the bulk of the food. This fact becomes a major concern in considering the performance of the food production sector of agriculture and in planning and developing effective programs aimed at finding solutions to African food production problems.

Sub-Saharan Africa is the only region in the world where per capita food production declined over the past two decades. This decline exacts a high price in both human and economic terms. The human price is inadequate nutrition. The economic price of inadequate food production is an increasing demand for food imports at a time when prices are rising and many African governments face balance of payments and foreign exchange problems.

Most food production occurs on small scale farms, where there is little use of commercial inputs which might improve yields, and most of labor for cultivation is provided by people working with relatively simple hand tools. Adequate availability of improved planting materials, as well as labor at critical production periods place constraints on the additional acreage which can be cultivated. In addition, the natural environment, soil, diseases, and pests play an important role in crop production. If African food production is to increase, ways must be found to make a transition both to a more commercial system of production and marketing, as well as viable methods for more intensive cultivation with higher yielding planting materials and lower post-harvest losses.

A potential approach to solving the food problem in tropical Africa is to increase the level of farming efficiency by carrying out research on the best methods of farming for a given area, having in mind crop varieties, soils, rainfall, farmer objectives, institutional and other

support systems. Greater applications of fertilizers, pesticides, insecticides and the better use of water for irrigation can be productive, but often the expense is prohibitive, especially to countries and farmers who really cannot afford to buy improved chemicals at present-day inflated prices. Probably an ideal solution to the problem of increased productivity is to improve yields per hectare through a combination of improved management and use of improved planting materials as demonstrated with rice at the International Rice Research Institute.

Colonial agricultural policies promoted the neglect of the development of most of the indigenous food crops whilst favoring tree crops. These policies still constitute a major stumbling block in efforts to increase food production in Cameroon as it is in many developing countries. The neglected food crops (tuber and many legumes) have not received much research and development attention and have stayed underdeveloped and under-exploited for their usefulness in meeting the food and nutritional requirements of the local populations. Recent efforts at IITA have improved the situation.

II. PROJECT RATIONALE

The Cameroon National Root Crop Improvement Program (CNRCIP) in the Institute of Agronomy Research (IRA) has made considerable progress in the development of improved cultivars of sweet potatoes and cassava that are suitable for the various farming systems in Cameroon. IRA's efforts in developing improved cultivars of cocoyams has been less successful due to the fact that as of now it has not been able to breed for cocoyam cultivars that are resistant to Root Rot and Blight Complex.

Given IRA's success in generating improved cultivars for cassava, and sweet potato, it is now a logical necessity to develop systems that will facilitate mass production of seedstock planting materials for the farmers.

One of the major constraints in the production of root and tuber crops is the lack of readily available improved planting materials. In many tropical countries including Cameroon there are no coordinated system to mass produce and distribute planting materials to farmers. The farmer is therefore compelled to select from his own produce or use part of it as planting material. The use of part of the produce (especially in the case of the yam) as planting material results in less available amount of yams for consumption. Available supply of planting materials will increase the of supply of the produce for consumption. Inadequate storage practices for seedstock as well as the food produce also lead to substantial loss during post-harvest period.

While there are many yam producers, there are only a few seed-yam producers. For example, white yam production in West Africa has been declining partly because of scarcity of planting materials, which is also the source of food. The seed-yam production is a specialized enterprise which is labor intensive and costly. Onwuene[1] as well as Lyonga[2] estimate that the cost of seed-yam is about one-third of the total outlay of yam production, a major constraint to increase yam production. Development of a low cost seed production system would therefore advance the efforts in increased productivity in yam. The difficulties expressed above for yam production are also encountered to a different degree in the production of cassava, cocoyam and sweet potato.

Significant advances have been made in the development of improved cultivars of cassava and sweet potato and selection of elite varieties of yams in Cameroon. It is anticipated that if seed stock for the improved varieties of the crops are made available to farmers with the necessary supporting facilities, significant increases in productivity and production will occur.

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1. Onwuene .I. "Strategies for Progress in Yam Research in Africa, in Terry, E.R., K.A. Odupo and F. Cavenss Ede, Tropical Root Crops". Research Strategies for the 1980, PP 176-776.

2. Lyonga, S.N., "The Economics of Yam Cultivation in Cameroon", in Science and Technology Review Vol 2, Dec. 1980 p 50, 1980

It is estimated that due to defects and inadequacies in post-harvest handling, transportation, storage and marketing of food products, losses of more than 25 to 30% occur, especially in less developed tropical and subtropical countries. One of the potential ways to increase food supply in the short run is to reduce losses of crop products from the ravages of insects, fungi, bacteria, viruses, nematodes, and other pests after harvesting. A major and often neglected step toward offering a higher volume of nutritious food is to prevent its loss between the time of harvesting and consumption. New and improved varieties of agricultural crops become important agricultural inputs only when good quality seed or their germplasm become available to farmers in adequate quantities at the right time and place. The post-harvest conservation of seed and food is thus an important and hitherto neglected dimension to increase food supplies in a most effective manner. It is being increasingly realized that the production of more and better food alone is not enough. The food must be delivered to the ultimate consumer through the post-harvest system without much loss.

Given that most root and tuber crops do not store well, it is imperative to develop systems which will facilitate storability of the crops as well as to develop innovations in processing and utilization to expand the total availability and utility from the root and tuber crops.

The general problems within the context of root and tuber crop production, storage, processing and utilization in the National Root and Tuber improvement efforts in Cameroon is the lack of and need for:

a. Development of improved varieties of cocoyam which are resistant to Root Rot and Blight Complex.

b. Development of system capable of supplying improved cassava, yam and cocoyam planting materials to farmers.

c. Research and development of feasible technology to reduce post-harvest losses of root and tuber crops at the farm gate.

d. Exploration of more intensive use and/or additional processing and utilization of root and tuber food crops.

e. Domestic human capital formation in root and tuber seed technology, storage and processing to strengthen IRA's capacity.

III. PROJECT GOAL, PURPOSE AND OUTPUTS

Cassava, yams, cocoyams and sweet potatoes are the major root and tuber food crops produced and consumed in Cameroon. It is recognized that each plays a different important role in the food calendar in various regions of the country. In this project the focused root and tuber food crops will therefore be cassava, yam and cocoyams.

Goal

The goal of the project is to contribute to the improvement of Cameroon farmer socio-economic welfare through increased productivity of root and tuber food crops.

Purposes

The project has four purposes which are to:

1. Develop domestically acceptable varieties of cocoyam which are resistant to Root Rot and Blight Complex.

2. Develop feasible (technical and economical) yam, cassava and cocoyam rapid seedstock multiplication system.

3. Study the nature and magnitude of Post Harvest Losses of root and tuber food crops, the processing and utilization constraints of root and tuber food crop systems and recommended researchable problems and opportunities for improving the systems.

4. Assist in the Institutional Development of IRA in root and tuber crops research.

Outputs

The expected outputs of the project are:

1. Improved cocoyam varieties resistant to Root Rot and Blight Complex.

2. Improved cocoyam varieties acceptable to local taste.

3. Rapid seedstock multiplication methods for root crops that are technically and economically feasible.

4. An efficient seedstock storage method for cassava, yam and cocoyam.

5. A survey report with recommendation on researchable problems and opportunities for more efficient and low cost on-farm cassava, yam, cocoyam and sweet potato storage methods.

6. A survey report with recommendation on researchable problems and opportunities for more efficient and low cost enhancement options for processing and explore additional ucilization of cassava, yam, sweet potato and cocoyam.

7. Demonstration developed rapid seedstock multiplication systems through on-farm research.

8. Four (4) Cameroonians trained at M.S. level and two (2) trained at the Ph.D. level in project related subjects.

9. Six (6) Cameroonians trained in project related areas (in USA, Cameroon and third countries) through short term training.

10. Tissue culture laboratory established that supports seed stock multiplication and agronomic research.

Purpose one (1) will be accomplished through outputs (1), (2). Outputs (3) and (4) will be utilized to fulfill purpose (2). The attainment of purpose (3) will be the culmination of outputs (5) and (6). The combined outcomes of outputs (7), (8), (9) and (10) will satisfy purpose (4).

IV. RELATIONSHIP OF PROJECT TO AID AND CAMEROON NATIONAL DEVELOPMENT STRATEGY

The Government of the Republic of Cameroon (GRC) has consistently stressed that the development of its agricultural sector of the economy is one of high priority. This is reflected by the level of allocation of development funds to the Agricultural Sector. In the Fourth Development Plan, $2.7 billion was proposed for development investments over a five year period. The agriculture and livestock sector received the third highest allocation second only to the transport and mining/manufacturing sector. This project will contribute towards the general long-term strategy for the GRC for increased crop production. The project will specifically contribute to the achievement of the following goals in the Fifth Development Plan.*

(a) facilitate the establishment of nurseries for the supplies of planting materials to farmers.

(b) it will support continuation of research, storage and preservation of root and tuber crops and

(c) strengthen Cameroon's domestic agricultural research capabilities in food crops.

The outputs of the project will also be a significant contribution to the attainment of the CNRCIP goals and objectives.

Within the context of USAID's development strategy in Cameroon, this project will complement the National Cereals Research and Extension Project to generate a more complete system for Research and Development Strategy for food crops in Cameroon. The output of this project will facilitate the systematic though incremental study progress towards the central goal of increased food production in Cameroon. The project is also consistent with AID Africa Bureau's new strategy for the development of Agricultural Faculties and Research Institutions in Africa. Given that Cameroon is identified as one of the "technology generating" countries in Africa Bureau's strategy, the outputs of this project will specifically contribute to the fulfillment of IRA's capacity to develop agricultural technologies consistent with resource endowment of its various farming communities.

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* For details see pages 87 and 88 of the Fifth Development Plan of Cameroon.

PROJECT ELEMENTS

A. Project sites and Research Methodology:

The proposed research and development project will be carried out in the Republic of Cameroon. Cameroon has large variation in Agro-ecological zones which are broadly classified into five zones. The main characteristics of these agro-ecological zones are presented in Table 1 and the general importance of the different root and tuber crops are presented in Table 2. Because of the adaptive nature of the project, it is proposed that it be carried out on a pilot basis on a limited scale in one agro-ecological zone. Agro-ecological zone II is therefore selected as the project site.

The geographic coverage for the zones is presented in figure I. The two agroecological zone include the provinces of Littoral and Southwest.

All on-station research and development activities for the production and storage of "mother seedstock" will be done in collaboration with IRA counterpart scientists at Ekona, which is in the coastal lowland ecological zone and close to the Western highland zone where root and tuber crop farming is most important. In the same coastal lowland ecological zone is another research center (Njombe) where the research and development activities in processing and utilization of root and tuber crops in Cameroon is carried out. Njombe center therefore will be the focus for the processing and utilization activities of the project.

Ekona has a modest research library and other structural facilities that could easily be renovated to support the seed stock multiplication and farm gate storage activities. Njombe has a newly constructed laboratory for root and tuber processing and staff who will provide leadership to the processing and utilization surveys. The administrative office of the project will be located at Ekona.

All field surveys, on-farm research and pre-extension activities of the Agronomic Program will be carried out at Ekona, Njombe and some selected substations of the two Centers to cover the zones 1 and 2. The diagnostic survey of the storage, processing and utilization of root and tuber crops will be limited to agroecological zones 1 and 2.

The detailed research methodology to be used for the project is presented in Annex A.

PROJECT RESOURCES

As indicated earlier, the focused crops and research activities under this project are: (a) Breeding research in cocoyam, (b) Rapid seedstock multiplication system (technologies) for cassava, yam and cocoyam and (c) diagnostic survey of Post-harvest storage, processing and utilization of cassava, yams and sweet potatoes.

The inputs required to effectively accomplish the outputs of the project are categorized into (1) Human Resources and (2) Physical Resources.

B. USAID Funded Resources

TECHNICAL ASSISTANCE

A total of 132 person months of longterm and 12 person months of short term technical assistance will be required plus22.7person months of short-term consultancies from U.S.A. This will consist of:

a. Chief-of-Party/Agricultural Economist: This will be a production Economist/Farm Management Specialist to be responsible for the socio-economic analyses associated with seed stock multiplication, post-harvest storage losses and food processing and utilization. About 50% of his time will be devoted to the Coordination and Administration of the field activities of the project.

b. Breeder/Agronomist. This will be an individual with experience in breeding vegetative production of seedstock. He or she will be responsible for the on-station and on farm multiplication of seedstock.

c. On-Farm Storage, Processing/Utilization Specialists: These will consist of food technologists, agricultural engineers, home economists and nutritionists. Their responsibility will be to work with other social scientists to study the problems and opportunities in the current on-farm storage, processing and utilization systems of root and tuber food crops.

d. The 22.7 person months of short-term consultancies will be in post-harvest storage tissue culture, minisetts and microsetts techniques of seedstock multiplication, virology, micro computer and data management and root and tuber crop processing and utilization. These services will be provided mostly by UMES and its collaborating universities plus selected regional and international consultants.

Distribution of persons for each position

	1986	1987	1988	1989	1990	
A. Long Term:						
1. Chief of party (Agricultural Economist)	12	12	12	12	12	UMES
2. Breeder/Agronomist (root & tuber specialist)	12	12	12	12	12	UMES
B. Short Term:						
1. Post-Harvest Storage Survey-consultants	4	2				Florida A&M
2. Food Processing/Utilization survey-consulting	4	2	-	-	-	Alabama A&M

Distribution of Technical Assistance by Institutions
Person months

UMES		Alabama A&M		Florida A&M	
1. Chief of Party	(60)	1. Food Processing/ Utilization Survey	(6)	1. Post-Harvest storage survey	(6)
2. Breeder/ Agronomist, Root & Tuber	(60)	2. Short term Consultant	(15)	2. Short term Consultant	7.7
3. Short-term Consultants	0				
	120		21		13.7

Both UMES and GRC are cognizant of the importance of women actively participating in the implementation of a project of this nature.

UMES and its collaborating institutions will seek and include professional women, with the skills required for the implementation of the project in their short term technical assistance personnel. The role of the coordinator of the project at the UMES office is very critical to the overall administration and management of the project. The position of the project coordinator will be filled by a woman.

TABLE 1 Characteristics of the different agro-ecological zones of Cameroon.

ECOLOGICAL AREA		RAINFALL						
		PHYTOGEOGRAPHIC AREA	ANNUAL RAINFALL	RAINY DAYS PER YEAR	NO OF MONTHS DRY: (> 50mm)	NO OF MONTHS WET: (> 50mm)	MONTHS OF MAXIMUM* RAINFALL	ALTITUDE
WESTERN HIGHLAND	I	Mountain group	200mm (MONOMODAL)	150-220	2-3	10-9	9,7,8	HIGH (>1000m)
COASTAL LOWLAND	II	Evergreen forest	2000mm 180-240	180-240	I	II	9,8,7	LOW (500m)
SOUTH-CAMEROON CONTINENTAL LAND	III	a) Semi-decidous FOREST	1500mm (BIMODAL)	120-165	2-3	10-9	10,9,5,4	MEDIUM (500-900)
		b) Post-forest savanna	1500mm (BIMODAL)	120-165	3	9	10,9,5	MEDIUM (500-900)
ADAMAOUA	IV	Sudan-Guinea savanna	1200-1500mm	110-150	4-5	8-7	9,7,8	HIGH (1000-1400)
NORTH-CAMEROON	V	a) Sudan savanna	900-1200mm (MONOMODAL)	70-120	5-7	7-5	8,9	MED-LOW
		b) Steppe	900mm (MONOMODAL)	30-70	6-9	6-3	8,7,9	LOW-HIGH (200-1000)

Source: Cameroon National Root Crop Improvement Program Annual Review 1984

TABLE 2 Importance of Cassava, Cocoyam, yam, and sweet potatoes in the different agro-ecological zones of Cameroon.

ROOT AND TUBER CROPS	AGROECOLOGICAL ZONES						
	I	II	III		IV	V	
			a	b		a	b
1. CASSAVA	XX	XXX	XXX	XXX	XXX	XX	X
2. COCOYAM	XXX	XXX	XXX	XX	X	X	–
3. YAM	XXX	XXX	XX	XXX	X	XX	
4. SWEET POTATOES	XXX	XX	XX	XX	XX	XX	XX

The presence of the crops has been indicated as follows:

(X) : sometimes
(XX) : quite frequent
(XXX) : abundant

Source: (Adapted from E. Westphal et al. (1981): l'Agriculture autochtone au Cameroon)

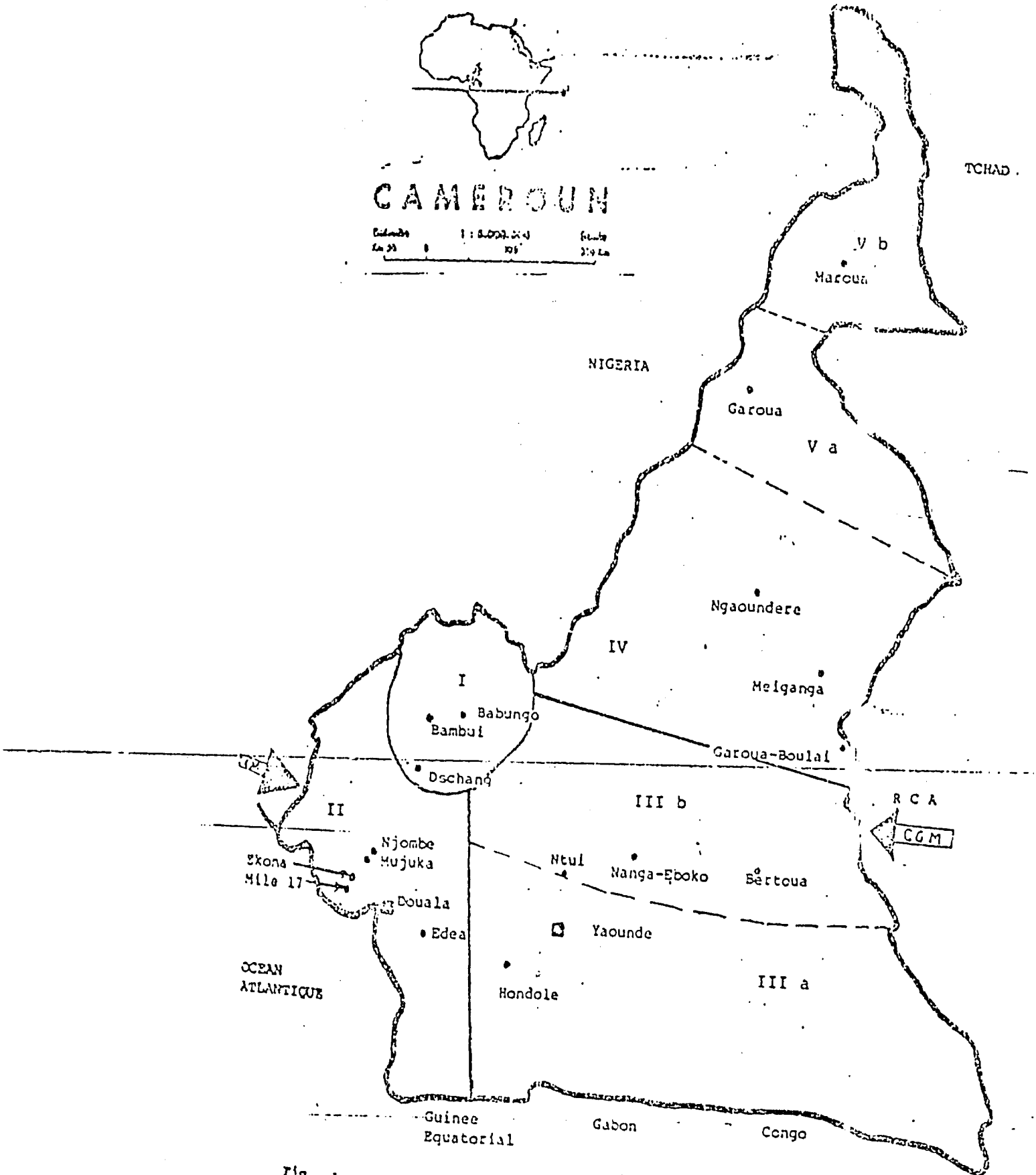

Fig 1 : Agro-ecological zones of Cameroon

Participant training

The human resource development component of the project is aimed at training Cameroonian citizens in the project topics to improve GRC's capability to provide domestic expertise to effectively maintain and improve the systems developed under the project. The training activities will include:

I. Degree Training:

(a) One (1) Ph.D Agronomy/Breeding
(b) One (1) M.Sc. Horticulture Pathology/Tissue Culture
(c) One (1) Ph.D Food Processing/Biochemistry
(d) One (1) M.Sc. Food Processing/Product Development
(e) One (1) M.Sc. Agriculture Economics (with major in production Economics.)
(f) One (1) M.Sc. with specialization in On-Farm Storage Root and Tuber.

II. Third Country Training (short-term)

(a) It is proposed that two Cameroonian scientist counterparts (M.Sc. or Ph.D) be sent to IITA for intensive short courses in Tissue Culture Techniques.

(b) Two (2) Laboratory Technicians be trained at IITA to support the Tissue Culture Lab to be established at Ekona.

(c) Two (2) Technical Officers be trained at IITA for up to six months each in technical field management of seedstock multiplication farms.

The selected participants for degree training will be placed in U.S. universities which have the academic programs that would best meet the training needs of the participants. Those working on M.Sc. and Ph.D programs will be encouraged to conduct their field research work for thesis and dissertation in Cameroon through the project activities. The degree of training activities should be started in the very early stages of the project. This will ensure that participants would complete their training and return to work with their U.S. counterparts for one to two years before the end of the project.

III. In-country Training

Series of short-term in-country training workshops will be organized under the project. The focus of such workshops will be determined by needs assessment studies.

IV. Research Fellowships (Short term)

There is a need to provide opportunities for Cameroonian researchers who have their terminal degrees or graduate degrees and are collaborating with the U.S. scientists on this project. Research fellowships of up to 3 months per person will enable them to be attached to research institutes in the U.S. to keep up with the state of the art in their specialized areas and topics or issues directly related to the project activities.

USAID Supported Physical Resources*

AID funds will be utilized to provide the following physical resources:

1. Equipment and facilities for tissue culture laboratory
2. Equipment for Agronomic Research
3. Construction of a green house and renovation of a green house
4. Vehicles
5. Rental of two houses
6. Office and house furniture and furnishings

C. GRC Supported Human Resources**

A total of 435 person months will be contributed by the GRC during the five years of the project. It consists of:

a. Chief of Root and Tuber Program at Ekona Research Center and Chief of Processing and Utilization Program at Njombe Research Center. Each Chief will contribute approximately a fourth of his time as administrative counterpart to the Chief of Party for the project.

b. Two (2) Cameroonians, Agronomist/Breeder and Horticulturist/Tissues Culture Specialist will be assigned as the counterparts to Breeder/Agronomist from the U.S.A. The individuals will spend a considerable portion of their time in formal training.

c. Two (2) Cameroonians in food processing will be assigned as the counterparts to the food processing/utilization specialist from USA. The individuals will spend a considerable portion of their time in formal training in USA.

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* The details of all inputs are found in Annex B.

** Details of GRC's contribution is found in Annex C.

d. One (1) Cameroonian agricultural economist will be assigned as the technical counterpart to the agricultural economist (Chief of the Party). He will also be trained in USA.

e. One (1) Cameroonian with a B.Sc. in agriculture to be trained to the M.Sc. level in on farm storage methods.

f. GRC will also provide lab technicians, instrumentation specialists, field assistants, drivers and field laborers to support the project.

GRC Supported Physical Resources*

The following resources and their recurrent maintenance expenses will be provided by GRC:

Thirty (30) nectares of land.

Administrative offices, two scientist offices and office buildings for Cameroon technicians.

Vehicles and motor bikes for Cameroonian staff

Office furniture for Cameroonian staff

Transportation of commodities from port to research center

Stand by generator

Tractor and implements

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* The details of GRC's contribution is found in Annex C

VI. BENEFICIARIES OF THE PROJECT

The primary beneficiaries of the project will be the numerous small scale farmers who produce the bulk of root and tuber food crops in Cameroon. The expected output from the project will make readily available improved planting materials at substantial low cost to the farmers. This may lead to increase in productivity and subsequently lead to increase in small scale farmer income. The development of a Root Rot resistant cocoyam variety will bring back the level of cocoyam production, the acreage of which has dropped by 50% due to the root rot problems. The current yield of cocoyam will also improve since, on the average, yield has decreased by a third due to the root rot infestation.

The anticipated increase in production and productivity is expected to translate into lower food prices with savings to the general population and perhaps an increase in export income. The result of the diagnostic survey of the root and tuber crop storage, processing and utilization will provide the basis for research and technological interventions which, when implemented, will lead to a reduction of post harvest losses and improvement in the nutritional value of products developed from root and tuber crops.

The physical and human resource capability of IRA is expected to be enhanced to permit effective research that leads to sustained agricultural production, especially that of root and tuber crops.

The secondary benefits include facilitation of the host country's development plans. The efforts inherent in the project will contribute to the state of the art methodolcgy in applied and adaptive agricultural research in developing economies.

The proposed research and development project will be a collaborative effort between the US team and the Cameroon IRA staff. The manpower training component coupled with joint research efforts are deliberate steps to develop domestic institutional and human capacity for continued research work in various aspects of agricultural production. The methodology and anticipated improved technologies have application potential and implications for the rest of the country as well as several sub-Saharan countries.

VII. PROJECT ADMINISTRATION AND MANAGEMENT

The prime contractor for the project will be the University of Maryland Eastern Shore, with Alabama A&M University and Florida A&M University as subcontractors. The specific responsibilities for each University are:

1. University of Maryland Eastern Short (UMES)

As the lead institution, UMES will be responsible for the coordination of the technical assistance personnel, participant training (this will include placement, orientation and monitoring of all training participants), procurement of all commodities and the overall financial and administrative management of the project. The management office at UMES will be made up of the following:

1. The project manager (10%)
2. Project Coordinator (50%)
3. Administrative Support - Secretary/Accountant Clerk (100%)

UMES will provide the leadership in the breeding and agronomic work in seed stock multiplication as well as the economic analyses of the project.

2. Florida A&M University

Florida A&M University will provide the leadership for the diagnostic studies of the on-farm storage activities of root and tuber food crops. Florida A&M University will also provide some of the short term technical assistance to support the agronomic research as well as the economic studies.

3. Alabama A&M University

Alabama A&M University will provide the leadership for the diagnostic studies of the processing and utilization of root and tuber food crops in Cameroon. The necessary biochemical and nutritional analyses of root and tuber food products will also be the responsibility of Alabama A&M University. Part of the other short term technical assistance that may be required will also be provided by Alabama A&M University.

4. Executive Committee

The Executive Committee will be the joint membership of the State-side Project Advisory Committee and the Host Country Project Management Committee, plus a representative of ASSRES, Director of IRA or his representative, and AID project officers of USA and Cameroon. The Executive Committee shall be responsible for major policy decisions, project direction and reviewing and approving annual plan of work. The Executive Committee shall meet once a year, alternating between the United States and Cameroon. Meetings will be chaired by the chairperson of the Hosting Advisory/Management Committee.

5. State-side Project Advisory Committee (SSPAC)

The State-side Project Advisory Committee's responsibility shall include monitoring of the project activities and progress and ensuring that set objectives are met. Its membership shall consist of the Deans of Agriculture at the three cooperating 1890 Institutions and the coordinator of the project at UMES as an ex officio member. The chairperson of the committee shall be the Dean of Agriculture of the lead institution (UMES).

6. Host Country Project Management Committee (HCPMC)

The Host Country Project Management Committee will be responsible for ensuring that the project objectives are met in Cameroon and to recommend changes where necessary of approval by the Executive Committee. The identification of all participants for training and the requirements for short term technical assistance including scopes of work will also be part of its responsibilities. The HCPMC will consist of representatives from IRA, (Chief of Program of CNRCIP and Chief of Program of Food Technology), and the Chief of Party. The HCPMC reports to the Director of IRA. A designated USAID/Cameroon project officer will serve as a member of the committee.

7. Visits and meetings

The two Advisory/Management Committees shall each meet independently at least once per year. Additional meetings may be held if project activities or issues occur that require timely attention. The Executive Committee shall meet annually. One administrative visit by the Chief Executive Officers of the three U.S. Universities should be made during the life of the project.

8. Field Project Office

A field project office will be maintained at IRA in Ekona to provide the necessary support needed by the field team. The chief of party will be the official representative of the contractor in the field. He will be responsible also for the daily financial and administrative decisions as well as the coordination of technical project activities. All technical assistance personnel (long and short term) will report to the chief of party. Figure 2 shows the organizational structure of the project. While the field project officer reports to the project manager at UMES, the office will maintain contacts with the offices international programs at the other campuses with regard to their designated responsibilities and with respect to the handling of long and short-term personnel from these campuses. The three coordinating offices will maintain effective communication among themselves. The field project office will require the following staff: - Administrative Assistant, a Stenographer Secretary, a Typist and a Messenger (all local hire). The office should be equipped with a telex. While in Cameroon, the contractors' activities will be coordinated by the chief of party. His technical counterparts will be the Chief of Root and Tuber Programme and the Chief of Processing and Technology Programme.

9. Housing Facilities for U.S. Team Members

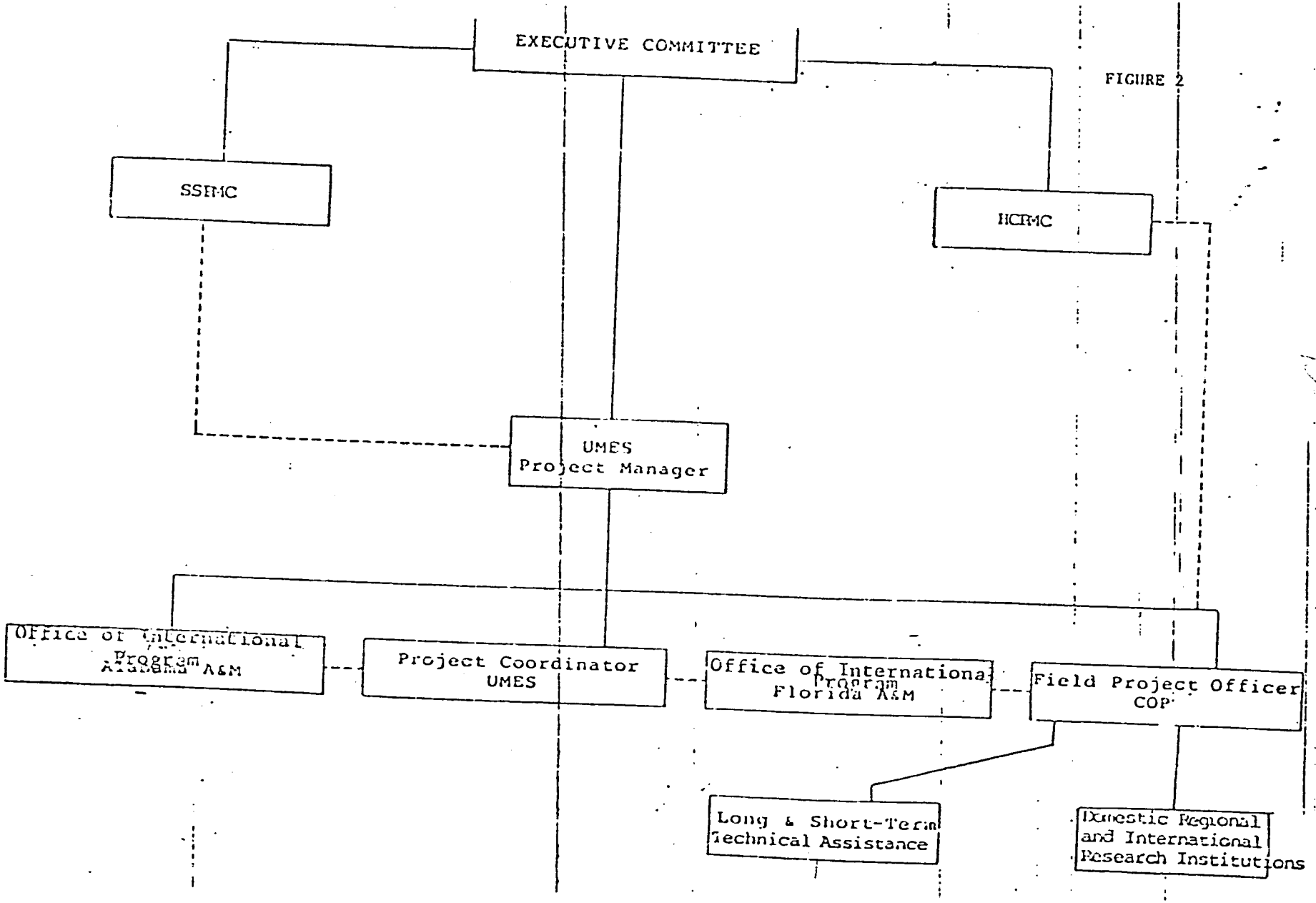
Housing will be rented for the long-term technical assistance team in Buea.

10. Subcontracting

A relatively simple, straightforward, and efficient subcontracting system is planned. The University of Maryland Eastern Shore shall be the prime contractor of this project. UMES would sign a subcontract with each of the other participating universities and any other collaborating entity. Each subcontract would last through the life of the project and will be adjusted annually in accordance with the Annual Work Plan approved by the Executive Committee. The terms of the sub contract will specify all administrative committee responsibilities as well as the technical assistance to be provided by each university.

The University of Maryland Eastern Shore has developed a particularly convenient contracting mechanism for such arrangements. Formally called a Cooperative Agreement, this will allow for simple pass-through of funds, and it can be rapidly and easily altered as necessary. The University of Maryland Eastern Shore has successful experience using this mechanism. A copy of the agreement is found in Annex G.

FIGURE 2


EXECUTIVE COMMITTEE
SSRMC
HCRMC
UMES
Project Manager
Office of International Program
Alabama A&M
Project Coordinator
UMES
Office of International Program
Florida A&M
Field Project Officer
COP
Long & Short-Term
Technical Assistance
Domestic Regional
and International
Research Institutions

VIII. MONITORING AND EVALUATION

Each technical component of the project will be required to document its activities as a basis for submitting semi-annual progress reports to the office of the project manager through the Project Coordinator at UMES. The annual reports will be prepared by the Project Coordinator and Chief of Party and submitted by the Project Manager to USAID and the project executive committee. There will be a total of two in-depth evaluations during the life of the project. These evaluations will be conducted at the mid point, plus a final evaluation during the last year of the project. The in-depth evaluation teams should include U.S.A., local and regional experts. USAID is expected to play a major role in monitoring, inspecting and analyzing the project activities. AID in collaboration with UMES and IRA will select and develop the scope of work for the evaluation teams.

IX. INSTITUTIONAL RELATIONSHIPS

The proposed project is soliciting funding from U.S. government through its Agency for International Development. The University of Maryland Eastern Shore, Alabama A&M University and Florida A&M University are proposed to implement the project. The Government of Cameroon will be represented by MESRES through IRA and is expected to assign counterpart scientists for the agricultural economist and root and tuber agronomist and participants for training in agronomy, storage, food processing and utilization. The GRC is expected to contribute at least 25% of the total cost of the project. The implementing institutions expect to develop a good working relationship with IITA. IITA is involved in the development of improved varieties of yam, cassava and sweet potato from which we are to develop a rapid seedstock multiplication system. The implementing schools would also like to develop a relationship with the faculty of agriculture at the University of Center of Dschang.

It is expected that the TLU established under the NCRE project at Ekona will provide support to this project during the on-farm experimentations as well as during the diagnostic survey of the project. The project through IRA at Ekona will appropriately inform MIDEVIV* of the progress of the project. It s expected that the project through the TLU at Ekona will cooperate with MIDEVIV during the on-farm research stages of the project.

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*It is the Seed and Food Authority responsible for seed multiplication in Cameroon.

X. IMPLEMENTATION STRATEGY

A. Implementation Plan.

The cytogenetic research on cocoyam and the rapid seedstock multiplication system for the focused root and tuber crops will be carried on concurrently from the beginning of the project. The diagnostic survey on storage, processing and utilization of root and tuber food crops will be started during the 9th month of year one and expected to be completed by the middle of year two. The training component of the project will start as early as the fourth month of the first year (depending on the length of service of selected training participants) and continue through the ninth month of the last year. See Annex E for the time phased plan of work for the project.

UMES expects that the Cooperative Agreement which authorizes the USAID funds for the project will be signed by middle of August 1986. Within a week of the signing of the Cooperative Agreement, a Protocol that details the collaboration of GRC and UMES in implementing the joint project will also be signed. Once the Cooperative Agreement and the Protocol are signed, UMES will within one week sign subcontracts with Alabama and Florida A&M Universities for implementation of the project. Procurement and other logistical arrangements will be initiated immediately after the signing of subcontracts. The month of August and September will therefore be utilized mainly for mobilization purposes.

B. Procurement Plan

The detailed procurement plan with waiver requests are found in Annex F.

PROJECT ANALYSES

a. Technical Analysis

Significant advances have been made in the development of improved cultivars of cassava, sweet potatoes and selection of elite varieties of yams in Cameroon by IRA. What is needed now is a system of rapid seedstock multiplication that could be adapted to provide for mass production of the planting materials of the improved or selected varieties of the root and tuber crops for farmer use. Without that system, the agronomic advancement made up to date in root and tuber crop research will not be widely available to the farmers. As indicated in our research methodology in Annex A, (pages 1-13) several techniques have been developed for seedstock multiplication of root and tuber crops. The challenge is the selection and integration of various techniques into a system or systems that will generate "rapid" multiplication of the seedstock and be consistent with the technical as well as the human elements of a given farming system or a region. The necessary and sufficient conditions for developing the system is the availability of physical and human resources, which if funded as proposed in the budget should lead to the development of the desired rapid seedstock multiplication system.

The use of tissue culture is increasingly becoming important in breeding and agronomic research. We are aware of research activities utilizing tissue culture techniques i.e. IITA, Colorado State University's Biotechnology - Tissue Culture project and USDA-tissue culture work at Beltsville. In the area of food storage we are also aware of other research efforts in storage and processing of food crops i.e. University of Idaho's Storage and Processing project, University of Hawaii's projects in utilization of root and tuber crops and the Post Harvest Documentation Center at Kansas State University. The lessons learned and experiences gained from these projects will be consulted during the implementation of this project.

The socio-economic acceptability of a developed technology for farmers demand careful examination and inclusion in agricultural research and development efforts in many developing economies. The economics of seedstock multiplication discussed in the research methodology in Annex A (pages 15-17) will ensure that the issues of farmer acceptability are appropriately incorporated in the research efforts of this project.

Cocoyam has a particular problem of root rot infestation. The disease has been plaguing the cultivation of cocoyam for the past ten years. Given the low base of cocoyam it is necessary to widen the germ plasm base through cytological work to develop varieties that are resistant to root rot. The Breeder/Agronomist proposed for the longterm position has a considerable experience in cytogenetics. IRA and IITA have been involved in studying the problem of the root rot in Cameroon but without in-depth cytogenetic work. Given the reports of the IRA/IITA work in cocoyam breeding in Cameroon, the requested laboratory facilities and the technical assistance as budgeted in this proposal, it is technically feasible to develop a variety of cocoyam that is resistant to root root in the five year period.

The institutional development component consists of improving the laboratory facilities (physical facilities) as well as human capital formation. The laboratory improvement is attainable in the sense that the equipment budgeted for in the project is adequate to give IRA a reasonable size tissue culture laboratory and facilities for the needed agronomic research. It is also technically feasible to accomplish the participant training component of the institutional development due to the following: (a) it is well within the capability of IRA to supply the 6 candidates for long term degree training, (b) those candidates for short term training are already on the staff of IRA, (c) there are more than enough universities and research centers in the U.S. to provide the type of training and experience required for the Cameroonians, (d) historically, participants from IRA have successfully completed their programs and returned home on scheduled.

If the above reasons hold, which they should since the requirements and standards of selection of personnel for IRA have not changed, then the training program should be accomplished on schedule.

With respect to the diagnostic survey of the storage, processing and utilization of root crops, the experiences of the three 1890 institutions coupled with that of the staff of the food technology group at Njombe center is more than adequate to effectively implement the study within the two year period.

Given the experiences of other research projects indicated in our research methodology, the advances made in cytogenetics, our proposed research methodology (both agronomic and economic) and the funding level requested, it is concluded that the accomplishment of the project outputs is technically feasible.

b. Financial Analysis

Financial Summary

The total cost* of the project is estimated to be US $7,807,492 over the five year project life. UMES, through a grant from USAID, will contribute an amount of US $5,737,512 which makes up 73 percent of the total project cost. The GRC will contribute the sum of US $2,069,980 which amounts to 27 percent of the total cost.

A. COMPOSITION OF USAID FUNDS

1. Technical Assistance: $2,639,416

UMES and its collaborating institutions will provice 132 longterm person month plus 22.7 person months of short term consultancies. See sections I and III of ANNEX B for the detail budget of technical assistance.

The total cost includes salaries, allowances, international travel and overhead costs. The longterm technical assistance component costs $2,320,380 and includes administrative support at UMES, US field staff as well as the Cameroonian field administrative support staff. The short term 22.7 person months of technical consultancies amounts to $319,036

2. Short term travel: $253,157

This consists of travel of (a) project field administrative and management personnel to the US, (b) visit by UMES project management personnel to Cameroon, Executive visit of chief administrators to the three collaborating 1890 universities, (c) evaluation teams. The details of the travels are found in Section II of Annex 3.

3. Language Training and Transulation: $70,000

Although the primary activities of the project will be in an Anglophone section of Cameroon it is still important for technical assistance personnel to be able to speak and understand French. It is proposed that French training be provided to the longterm personnel prior to their assignment in to Cameroon. While in Cameroon their level of competency would be improved by attending French classes at the bilingual institute of Buea. It is also essential to allocate funds for translation of documents from English to French or vice versa since Cameroon is officially a bilingual country.

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* All costs are given at April 1986 prices with inflation adjustments made for subsequent years. A conversion factor of CFA 360 = US $1.00 has been used for all the conversions from CFAF to US dollars.

4. Participant Training: $447,000

Six Cameroonians will receive advance degree training in U.S.A. through the project. Two will study for Ph.Ds while four will acquire MSc. degrees. See section V of Annex ... for details. Of the training amount $40,000 is allocated for short courses in third countries and additional $20,000 is earmarked for pre-vulgarization and demonstrations.

5. Commodities: $882,487

Commodities to be funded under the project include: Tissue culture laboratory and research equipments, green and screen house construction and renovation, vehicles, household and office furniture and appliances. The detailed commodity items and expenditure are found in Sections VI, VII, VIII and XII of Annex B.

6. Recurrent Cost: $593,338

The recurrent cost consists of expenses to be incurred annually from year 1 through year 5 to support the project activities. It includes: books, journals and publications, office supplies, in-country travel of local support staff; in-country travel of professional staff; gasoline and lubricants, vehicle repairs, maintenance and spare parts, research supplies, on-farm research costs, vehicle insurance, and miscellaneous administrative expenses. See Section XI of Annex B for details.

7. Other Costs: $297,795

A provision of $188,395 is included to rent and maintaining houses for the two long term technical assistance personnel for five years. An amount of $25,400 is allocated for field support of the diagnostic surveys on storage, processing and utilization of root and tuber crops during the first two years. A total of $34,000 is allocated for the freight shipment of commodities from to Cameroon. See sections IX, X, XIII of Annex B for details.

Contingency: $554,319

The provision for contingency is 10% of the above costs ($518,219) plus an estimate of seperate maintenance allowance ($36,000) for the COP.

B. <u>COMPOSITION OF GRC FUNDS</u>

1. Personnel: $1,084,277

This consists of the salary and benefits of the senior and junior staff from IRA that will be directly involved in the project. Section I of Annex C gives the details for the personnel costs.

2. Utilities: $67,197

The use of electricity directly for the project activities is estimated to cost $30,391, while water is estimated to cost $36,806 for the duration of the project.

3. Participant Training: $34,500

This consists of 12 roundtrip economy tickets for the participants for degree training in U.S.A.

4. Laboratory Equipment and Implements: $135,485

The laboratory and green house and flow of services from equipment and implements are estimated to be $135,485 over the life of the project. The details are found in Section VI of Annex C.

5. Vehicles and Other Transportation: $309,343

The category consists of vehicles and motor bicycles, their maintenance, running costs, and insurance plus ground transportation of all commodities from the port of Douala to the research center. Appendix C provides the details of each line item.

6. Offices and Furniture: $118,000

The GRC will construct and furnish offices for the US technical assistance team as well as the Cameroon technicians and it is estimated that it costs $118,000 for the construction offices and the furnishing of the offices for the Cameroonian technicians. The details can be found in Annex C.

7. Land: $100,000

A total of 30 hectares of land will be made available for field experiments at the main research centers as well as sub center fields in the study area.

8. In-country Travel: $27,629

A total of $27,629 is allocated to support in-country travel expenses for local support staff as well as the professional staff for the five year period. The annual allocations are found in Annex C.

9. Contingency: $187,649

The provision for contingency is 10% of the above costs.

C. AFTER-PROJECT RECURRENT COST AND IRA ABILITY TO MEET THE COSTS

The major factors which will bring a recurrent expenditure to IRA after the life of the project are: Maintenance of the tissue culture and agronomic research laboratory, retention of professional and laboratory support staff, retention of drivers and field laborers, maintenance of project vehicles and reproduction of planting materials for cooperating farmers.

Since 1983 the GRC has more than doubled the operational budget of IRA. Because of the high priority that the government attaches to agricultural research and development, it is expected the government's allocation of funds to IRA all continue to increase during the life of the project. IRA already has plans to build a national tissue culture laboratory at Njombe Center and will integrate the laboratory facilities at Ekona with those at Njombe. The necessary budget support will also be provided. The retention of the professional staff as well as the technicians is not a problem since they are permanent or classified employees of MESRES.

The Administrative Assistant to the Chief of Party and the supporting secretarial staff will all be employed on term contract basis and will be released accordingly at the end of the project when their contracts expire. The drivers for the project vehicles will be normal IRA drivers to be assigned to the project and will be reabsorbed into the system after the project terminates.

Given the study and stable growth of the Cameroon economy, the high priority assigned to food crop research especially the interest in root and tuber crops that is inherent in the Cameroon National Root Crop Improvement Project, the interest in and commitment of MESRES/IRA to the project and the historical track record of GRC in honoring its recurrent costs associated with development projects, it is logical to assume that the recurrent costs that will be generated by this project will be absorbed by the GRC.

It is also important to note that the primary output of the project is to develop system(s) for rapid seedstock multiplication coupled with institutional development of IRA. These outputs are also essential inputs for the GRC efforts to adapt the system and mass produce and distribute low cost planting materials for root crop producers. It is therefore in the government's best interest to maintain the core infrastructure to be developed by the project to facilitate its breeder goal. In fact, one should expect the domestic financial support of the project activities to increase after the project when the GRC moves into mass production and distribution of planting materials.

TABLE 3 UMES EXPENDITURE BY YEARS

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
1. Technical Assistance						2,639,416
(a) Prof. Field Staff	280,417	248,732	279,536	305,113	359,254	
(b) Home office personnel	86,730	95,178	104,470	114,690	125,931	
(c) Field office personnel (Cameroonians)	27,568	28,946	30,393	31,913	33,509	
(d) Alabama A&M University Consultants	56,000	28,000	-	-	-	
(e) Florida A&M University Consultants	56,000	28,000	-	-	-	
(f) Short term Consultants	100,000	100,000	59,518	59,518	-	
2. Short Term Travel	40,000	61,052	61,052	61,053	30,000	253,157
3. Language Training & Transportation	25,000	13,000	12,000	10,000	10,000	70,000
4. Participant Training	100,000	100,000	100,000	100,000	47,000	447,000
5. Commodities	791,327	18,000	73,160	-	-	882,487
6. Recurrent Cost	104,612	130,628	116,365	117,800	123,933	593,338
7. Other Costs:						297,795
(a) House Rental & Maintainence	30,858	33,944	37,340	41,073	45,180	
(b) Diagnostic Surveys	13,000	12,400	-	-	-	
(c) Freight Shipment	60,000	24,000	-	-	-	
8. Subtotal	1,771,512	921,880	873,834	841,160	774,807	5,183,193
9. Contingency						
(a) 10% of Line 8	177,151	92,188	87,383	84,116	77,481	518,319
(b) Seperate maintenance allowance (COP)	7,200	7,200	7,200	7,200	7,200	36,000
10. Subtotal	184,351	99,388	94,583	91,316	84,681	554,319
11 GRAND TOTAL	1,955,863	1,021,268	968,417	932,476	859,488	5,737,512

TABLE 4
G R C CONTRIBUTION

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
PERSONNEL	196,239	206,049	216,351	227,172	238,469	1,084,277
UTILITIES	6,500	6,825	17,089	17,943	18,830	67,197
PART. TRAIN.	7,500	-	10,000	13,500	3,500	34,500
LAB. EQUIP.	101,497	8,497	8,497	8,497	8,497	135,485
VEHICLES, MAINTENANCE AND TRANSPORTATION	106,934	47,500	47,325	51,506	61,453	309,343
OFFICE & FURNITURE	118,000	-	-	-	-	118,000
LAND	20,000	20,000	20,000	20,000	20,000	100,000
INC. TRAVEL	5,000	5,250	5,513	5,788	6,078	27,629
SUB TOTAL	561,670	294,121	324,775	344,406	356,827	1,881,800
Contingency 10%	56,167	29,412	32,478	34,441	35,632	188,180
TOTAL	617,837	323,533	357,253	378,847	392,510	2,069,980

c. Economic Analysis

A major objective of economic analysis for a project is to provide enough information to enable the determination of the social profitability of an anticipated project. The attainment of such objective requires that an ex ante analysis has to be made. Ex ante economic analysis of an agricultural research and development project become very difficult since most of the critical parameters needed for such analysis are not specifically known before the project is started. The problem areas include when the scientific breakthrough will occur, actual yields, adoption of the technology etc. Despite the "unknown" nature of critical factors it is still necessary to provide information for policy decisions to be made in investing in agricultural research.

A review of ex-post economic analyses of several agricultural research projects by Ruttan[1] indicates high rates of return to investment in agricultural research. Almost all the projects reviewed yielded between 10 to 15 percent above inflation levels. The consistency of the high rates of return in those agricultural research projects including LDC cases, reassures one of the high probability of similar outcome in agricultural research in Cameroon.

There are no similar studies of ex-post analysis of agricultural research in Cameroon to be used for comparison. The nature of this project also creates some methodological problems of measuring benefit streams which are mostly intangible. Due to the problems raised above in performing "proper" ex-ante economic analysis, it is impossible therefore to determine the internal rate of return with refined data for this project. However, it is still necessary to provide policy makers with reasonable information about the project to enable them to make a decision on investing scarce resources on the proposed project. The economic analysis will therefore focus on:

(a) Potential economic gain from the project.

(b) Estimation of project benefits and costs to determine potential internal rate of return.

(c) Evaluation of intangible and spill over benefits.

(d) Feasibility of achieving the estimated benefits.

(e) Project Alternatives.

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1 Ruttan, Vernon. W. Agricultural Research Policy, University of Minnesota Press, Minneapolis, 1982, pp. 241 - 249

A. RELATIONSHIP OF PROJECT TO BROADER SYSTEM OF AGRICULTURAL RESEARCH AND TECHNOLOGY DEVELOPMENT

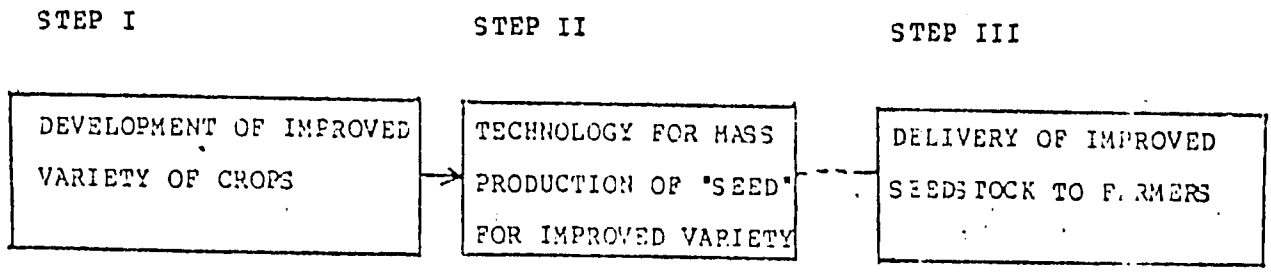
The three major components of the project could be considered as sub systems of a broader agricultural research and development system. Conceptually, the technological development of improved varieties of root and tuber crops for farmer use consists of:

(i) Development (Breeding) of varieties with desired characteristics, including high yield.

(ii) Development of technology for rapid multiplication of seedstock with potential for supplying farmer input requirements.

(iii) Delivery of improved planting materials to the farmers.

A diagrammatic representation is:



Traditionally Step I is the responsibility of research institutions. In most LDCs the technology for Step II is adopted from a research outfit and utilized by a division of Ministry of Agriculture (usually seed multiplication unit) and finally Step III falls in the domain of extension service or some parastatal organization with specialized function for seed delivery. In recent years such compartmentalization of functions are being coordinated into a system approach through integrated projects. In such cases it is very easy to attribute the benefit of the research and development efforts to one project. The history of seedstock multiplication for root and tuber crops in Cameroon has not taken the holistic approach. The activities in Step I have been funded by IDRC and AGCD and implemented by IITA AND IRA. This project is primarily responsible for accomplishing Step II and limited involvement in Step III through on-farm testing and supply of planting materials for limited number of collaborating farmers.

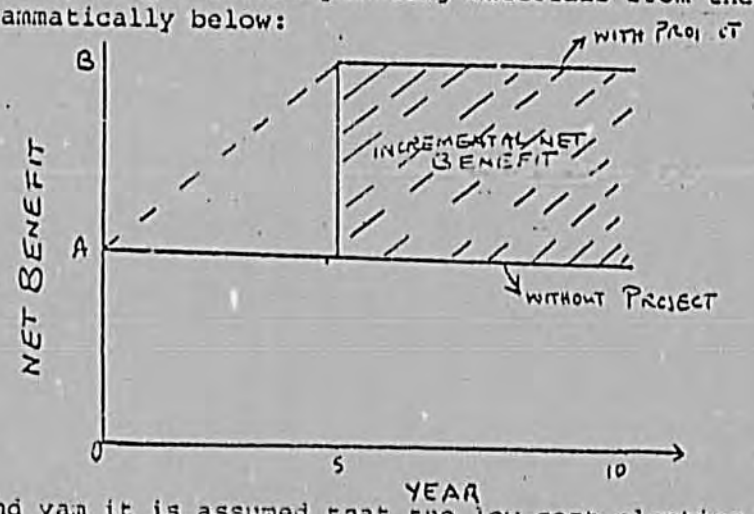
In the case of cocoyam, the project activities will involve Steps I and II and similar degree of involvement in Step III as stated above. It is therefore easy to attribute all the estimated benefits from the cocoyam activities to this project. The case of cassava is a little bit fuzzy since the improved material was developed in Step I by IITA and IRA. However, since materials are not currently available to farmers it

is argued that without this project the planting materials will still not be available to the farmers and hence the estimated benefits would not occur. The system of rapid seedstock multiplication to be developed is expected to reduce drastically the costs of production. This, in turn, will increase net benefits. Thus, a with/without analysis justifies a portion of the estimated benefits to be attributed to the project. The level of assumed usage of new planting materials has been grossly underestimated to reduce the risk of over estimation of the project benefits. A portion of the rate of return should be attributed to IRA and IITA activities in Step I.

In the case of yams we are dealing with a situation of utilizing elite varieties that have been selected by IRA without genetic improvement research as is usually expected in Step I. Hence the assigned benefits to the project in the yam activities is also reasonable.

B. Potential Economic Gains From The Project

The limited supply and high cost of planting materials is considered as a major impediment in root and tuber food crop production. As indicated in the research methodology section dealing with the economics of seedstock multiplication, the cost of planting materials is estimated to be as high as 33% (and some cases more than that) of the total cost of production. It is estimated that with rapid seedstock multiplication system to be developed by the project, the cost of planting material will be cut by at least 66%. Such a reduction in production cost is expected to result in lower average cost per hectare and subsequently lower prices for consumers. Conceptually, the potential economic gain from utilizing low cost planting materials from the project is illustrated diagrammatically below:

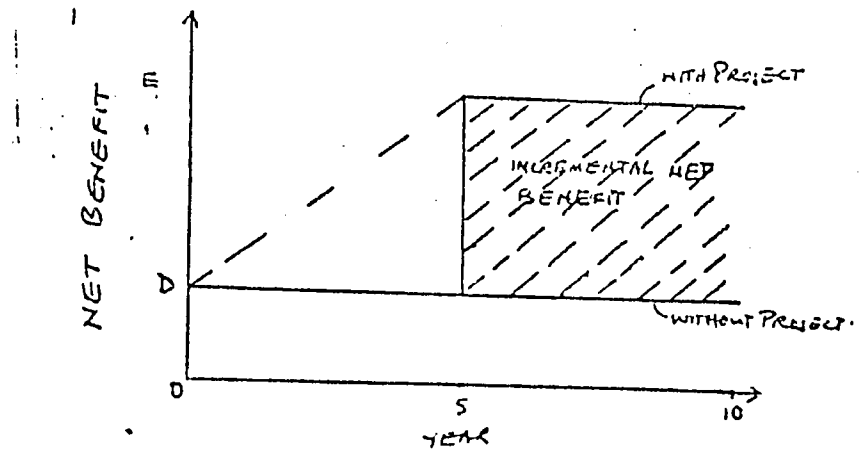


0 = before project

In the case of cassava and yam it is assumed that the low cost planting material will be available to farmers for use at the beginning of year 5. The net benefit to be derived using the current planting material methods will be at A for a given hectarage. From year 5 through year 10, with the same hectarage cultivated as in the previous four years but with planting materials from the project, the expected net benefit will be at B.

The magnitude of change in net benefit from A to B will be larger if the variety utilized is of an improved high quality.

In the case of cocoyam, the infestation of Root Rot has led to about 50% reduction in area planted under cocoyam. Also the yield of those hectares that remain in production loses about 30% of their output due to Root Rot infestation. The development of a root rot resistant variety as well as the development of low cost planting materials is expected, other things remaining the same, to lead to increase in acreage and productivity per area planted.



In year five the expected net benefit for the cultivation of cocoyam with root rot resistant variety and low cost planting material will be at E, while without the project the net benefit will have been at D. The change from D to E consists of lower cost of production plus increase in production level due to root rot resistant variety. The increment benefits do not change after year five since we have assumed the area to be cultivated with the new planting material will be the same throughout year 10.

C. <u>Estimation of Project Benefits and Cost and Determination of Potential Internal Rate of Return.</u>

The cost benefit analysis for the project is presented in Table 5. In the following section the estimation procedures and assumptions used to derive the stream of benefits and costs for the project are presented. The benefits from the project have been limited to increments in the production of cassava, cocoyam and yam. While these are separable, the costing element of the project is inseparable and is therefore determined on aggregate basis. The streams of benefits for each crop was determined separately and then aggregated for the cost benefit analysis.

Estimates of output prices:

There are no reliable up to date records on prices, yields, costs of production and other factors essential for the calculation of the cost benefit analysis for this project. In the case of prices of the various crops, the latest published information from the year book of Agricultural Statistics for 1982/83 was adjusted by a 10% annual rate of inflation to estimate 1986 prices. The estimated prices were: cassava - 91 CFAF/kg = $.25/kg; yams - 268 CFAF/kg =$.74/kg; and cocoyam 123 CFAF/kg = $.34/kg. Observation of prices in the project area were comparable to our estimates.

ii Yields per hectare

Yams: The average yield of the elite varieties under monocropping and research conditions was 15.2 tons/Ha. We estimated that under real world intercropping conditions, attainable production level would be 9.12 tons/Ha, which is about 60% of the research yield.

Cassava: The average yield of the improved varieties under monocropping and research conditions was 22 tons/Ha. It was estimated that under farmer intercropping conditions average yield would be 15 ton/Ha, which is about 68% of the research yields.

Cocoyam: The average yield of cocoyam with root rot infestation was 2.1 ton/Ha, but with root rot resistant variety, it is estimated that it will increase by 33% to 2.79 ton/Ha.

iii. Cultivated area with the project output

It is assumed that in the cases of yam and cassava 5 percent of the currently cultivated hectarage will be planted with planting materials from this project in Year 5 through year 9.

In the case of cocoyam it is assumed that 10% of current cultivated hectarage will be planted with materials from the project from year 5 through year 10. The estimated areas under cultivation in the project site are: Yams - 55766 ha, Cassava - 65501 ha and Cocoyam - 112011 ha.

iv. Total Cost

The total cost consists of the research and development cost plus the on-farm incremental cost that is associated with the adoption of output from this project. The estimated on-farm incremental production cost per hectare for each crop using planting material from the project is:

Yam:	731,520 CFAF/Ha	=	$2032/Ha
Cassava:	216,000 CFAF/Ha	=	$ 600/Ha
Cocoyam:	182,880 CFAF/Ha	=	$ 508/Ha

As stated earlier the research and development cost of the cassava variety should have been included in the calculation of the total cost. However, such data could not be obtained during the design of the project and hence not included in the calculation of the total cost. It is proposed that such cost information should be traced and utilized during the life of the project to determine the internal rate of return that is solely attributed to the project.

Based on the cost benefit analysis result presented in Table 5 the internal rate of return for the project is approximately 95%. Such a return is within the range of IRRs associated with agricultural research with technological emphasis. The project is therefore deemed to be economically viable.

D. Evaluation of Intangible and Spillover Benefits

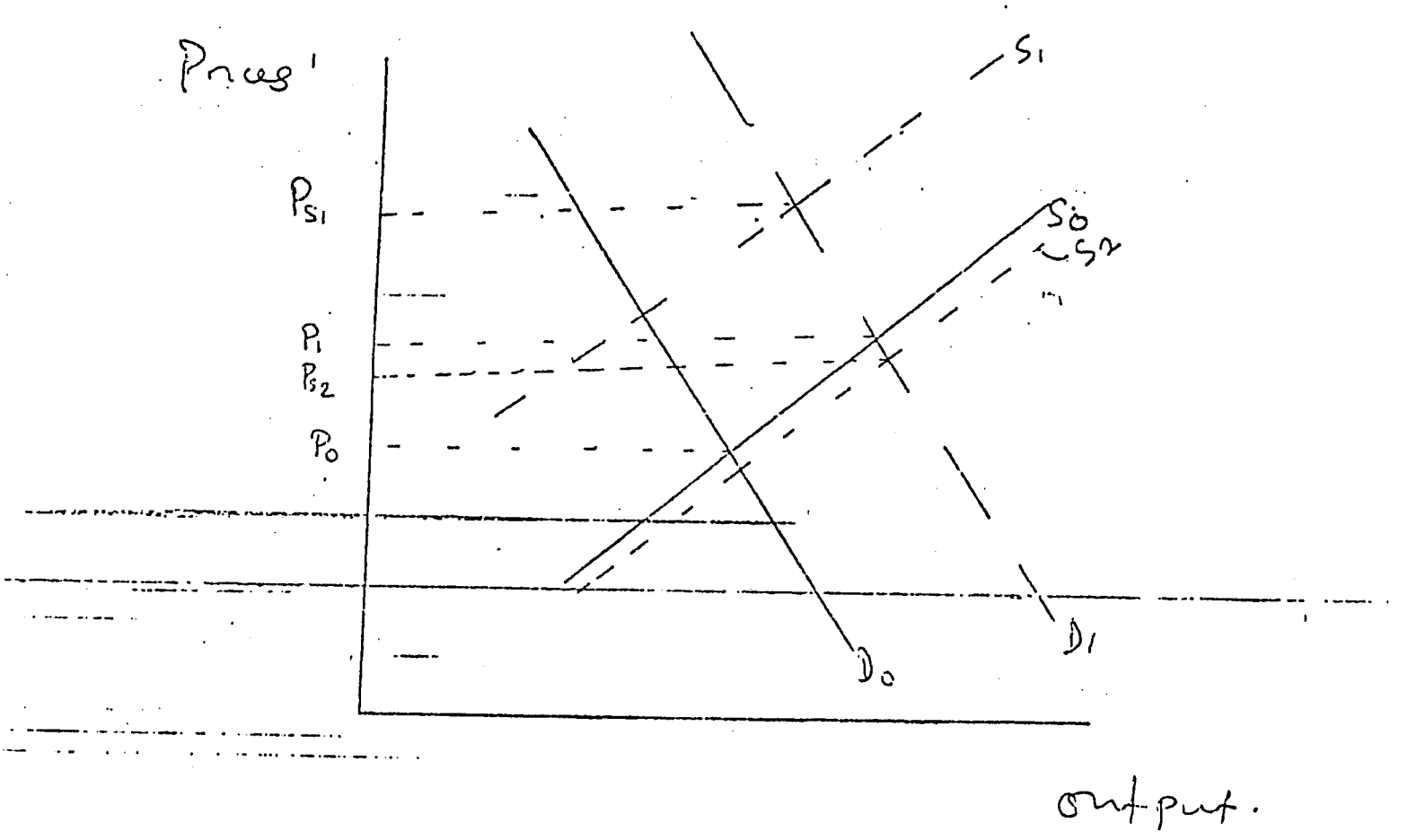
There are other benefits which are intangible and difficult to quantify and also some quantifiable spillover benefits have not been included in the Cost Benefit Analysis for the project. Such benefits include:

(a) Price and income effect on producers and consumers of the root crops
(b) Institutional Development of IRA.
(c) Spillover benefits across agroecological zones.

a. The technological advancement from the project is expected to lower cost per production and subsequently lead to increase in net incomes of farmers who will adopt the technology. In the short to medium run the price per unit of the crops would decrease and reduce the total cost of food for most of the consumers. In addition to the advantages from the low cost of production, the availability of planting materials of new varieties of cassava and cocoyam has implications for the long run prices of the crops.

Given the rate of growth of the population in Cameroon, the food calendar and preference in the country, the future demand for the root crops is expected to increase. With net out migration from rural areas, the aging of the farming population and decline of youth taking farming as profession, the supply of the same crops are likely to decrease without technological intervention. As indicated in Figure 8 below, the availability of improved varieties through rapid seedstock multiplication system will help to stabilize the prices of the crop. Without this intervention the long run prices of the food crops is expected to increase.

Figure 8



The expected long run prices without the technological intervention would, given constant supply and expected increase in demand to D_1 be P_1. It is possible that with the root rot problem and the current high cost of planting materials coupled with less labor in farming, that supply may decrease in the long run to S_1. With increase in Demand to D_1, the new prices would be then higher at P_{s1}. However with the new technology, supply would increase to S_2 and with the expected increase in Demand at D_1 prices would be at P_{s2}, which is less than P_1 and P_{s1}. The future savings from the P_{s2} price level to consumers is classified as intangible at least for this analysis.

b. Institutional Development of IRA

The institutional development component of the project will increase the technical skill as well as the physical capability of IRA to provide research support for future technological development. The improvement of the research capability of IRA that is attributable to the project cannot be quantified now, but is definitely one of the important outputs of the project.

c. Spillover Benefits Across Agroecological Zones

Due to movement of farmers from one agroecological zone to another, and given that some of the on-farm research trial farms will boarder agroecological zones III and IV, it is possible for farmers in these zones to adopt the technological innovation from the project. However, the calculations of the projected stream of benefits for the project have been limited only to the project site. Such potential stream of benefits have therefore not been considered in the cost benefit analysis.

d. Feasibility of Achieving the Estimated Benefits

The yield levels used for the calculation of the cost benefit analysis are very modest and substantially below the potential level in the project area. Another major factor in determining the feasibility of attaining the estimated benefits is the percentage of hectarage that would be planted using the output of the project. The 5% adoption rate for yam and cassava production is grossly underestimated. The farming communities are already aware of the result of the cassava varieties that have been developed, and are constantly inquiring from IRA the possibility of obtaining the planting materials. So one expects a higher adoption rate as soon as the varieties are released to the public.

With respect to the low cost of planting materials, there is no doubt that there is a real demand in the farming community for low cost planting materials. The major problem is the lack of the technology to mass produce the planting materials. IRA will have the capability through the project to supply up to 40% of planting materials for the project area. The only limitation is that it does not have the mandate to produce and distribute planting materials. So during the life of the

project, it will provide that service through its collaborating on-farm research farmers, until MIDEVIV or other seed multiplication organizations are ready to adopt the recommended technology. If the story of the variety of sweet potato TIBI developed by IRA is an indication of how farmers will accept new varieties from IRA, then one might put the adoption rate to almost 70-80%.

There are other potential impediments to the feasibility of achieving the benefit streams, but these are mainly exogenous in nature. Notable ones are favorable weather conditions, government policy on agriculture and changes in food preference. Given the level of interest of the GRC in agricultural development, it is assumed that its development policies will continue to favor the agricultural sector. It is anticipated that the prices of root crops will continue to be set by market forces, which have over the years exhibited enough incentive for food production. One does not anticipate any significant change in the food preference of the average Cameroonian during the life of the project that could adversely affect the demand for the root and tuber food crops. In general it is perceived that both the endogenous and exogenous factors are favorable for the achievement of the estimated benefits.

e. Project Alternatives

Due to the research nature of the activities to be performed to address the problem at hand, there is no real alternative approach to attaining the output of the project. One remotely conceivable option is to carry out the project through MEDEVIV. But that would not be cost effective since MEDEVIV does not have the research institutional capability needed to develop the technology or system of rapid seedstock multiplication. In the area of cytogenetic research in cocoyam, there is no other institution in Cameroon which is better prepared than IRA to conduct such studies. The most logical approach to solving the stated problem is for IRA to develop and test the necessary technological system for rapid seedstock multiplication and in some future date assist an organization like MEDEVIV to mass produce and distribute the planting materials to farmers.

TABLE 5

COST/BENEFIT ANALYSIS OF RFR PROJECT ($000)

I. COSTS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
A. USAID COSTS	2,048	1,012	1,030	1,006	917	-	-	-	-	-
B. GRC - PROJECT AND RECURRENT COSTS	618	324	357	379	387	339	359	357	378	399
C. INCREMENTAL ON-FARM COSTS	-	-	-	-	13,321	13,321	13,321	13,321	13,321	13,321
TOTAL COSTS	2,666	1,336	1,387	1,385	14,625	13,660	13,680	13,678	13,699	13,720
II. ESTIMATED BENEFITS	-	-	-	-	42,062	42,062	42,062	42,062	42,062	42,062

Net present value of costs using a discount rate of 95% = $3,013

Net present value of estimated benefits using a discount rate of 95% = $3,006

d. Social Soundness Analysis

The social usefulness of the project is imbedded in the domestic food self sufficiency policy of the Government of the Republic of Cameroon. It is of paramount interest to the government to ensure that the country is capable of providing adequate food for its citizens. In that regard any activity which facilitates sustained adequate domestic supply of foodstuff is very useful to the society at large. The major root and tuber food crops (yams, cassavas, cocoyams and sweet potatoes) in the aggregate constitute a major component of the food calendar of most parts of Cameroon.

The project is located primarily in the coastal lowland areas of the country. A number of ethnic groups of Bahonin as well as forest tribes dominate the study area. Among the forest tribes, there is a sharp division of labor between sexes. Men are responsible for cocoa and coffee production. Men clear away the forest for the main food crop fields where women grow a mixture of interplanted crops including cassava, the major staple food, cocoyams, plantains and yams. The yam fields are mostly operated by women with men providing poles to build the yam storage huts. The focused crops for the project form the major component of the agricultural enterprise in the region and therefore reinforces the agricultural economy of the areas.

The acceptability of the varieties being worked with is very important and the taste and values of the people will be a major factor in determining acceptable varieties to be included in the research efforts.

The major output of the project is improved varieties of low cost planting materials. Given the high cost of root and tuber planting materials, the availability of low cost rapid seedstock multiplication system will make it more likely for the very poor farmers to acquire and plant high yielding varieties. The current high cost of planting materials, especially yams, limit the ability of the very poor farmers to intensify or expand their root crop enterprises with the appropriate supporting distribution system. The timely availability/supply of the planting materials will save time and other resources that go into farmer selection, storing, and preparation of planting materials.

Farmers in general should be motivated in utilizing the output of the project because it will reduce their average cost of production, plus give higher yields. There are no additional resource requirements for participation that would prevent the poorer farmers from utilizing the results of the research since the cultural practices of preparing planting materials are common among all root and tuber farmers.

Initially only the cooperating farmers will have access to the seedstock. This is because of the pilot nature and the limitations that IRA is not the legitimate organization responsible for seed multiplication and distribution. However if the technology is found to be acceptable, the appropriate government agency will adopt it and the technology will then be available to all root and tuber crop producers.

The Spread Effects

Despite the pilot nature of the project, the results will be communicated to farmers and policy makers through on-farm as well as on-station demonstrations and workshops. The majority of those to be invited to attend such field or demonstration days will be farmers from the project sites as well as other parts of the country. It is hoped that once the technology is found to be acceptable, MEDEVIV will be given the appropriate support to adopt the technology to mass produce planting materials for farmers all over the country.

Social Consequences

An examination of the major constituents of the food calendar indicates that the crops which are the focus of the project form the basic core of main food dishes in almost every province of the country. In fact most of the southern part of the country depends heavily on root crops as source of food. Table 6 summarizes the consumption of root and tuber crops in order of importance for all the provinces in the country.

The food calendar/preference in a given area in Cameroon does not change much with the income level of the individual and hence it is reasonable to assume that research benefits from the project would accrue to the population in general.

In Table 7 we have estimated the population of Cameroon to be about 10,002,696 with 2.7% annual rate of growth from the 1976 census data. In the long run the majority of the people stand to gain from the outputs of this project. The short and intermediate term benefits are assumed to be limited to the Littoral and South West provinces since they form the core of the agroecological zones that we will be working in. The estimated population for the two provinces for 1986 is 2,030,602. The rapid seedstock multiplication system to be developed is expected to drastically reduce the cost of planting materials which is a major cost item in root crop production. The project outputs with the necessary support facilities are expected to result in increased productivity with increased profits to farmers and at the same time give less cost to the consumers which includes the farmers.

More than 80% of the estimated population is in rural communities with agriculture as their livelihood. Because of the intercropping nature of the subsistence sector of the agricultural industry, all farmers in the study area do cultivate root crops. In fact food production in Agroecological Zone I, II and III of Cameroon is predominated by root crops. In the long run about 80% of the population of the study area will directly benefit from the research output. The rest of the community who may be classified as the urban consumers will be indirect beneficiaries through stable supply and lower prices of the produce.

To ensure that the initial benefits are equitable, the cooperating farmers will be purposely selected to ensure that the poorer farmers are adequately represented in the cooperating farmers. The development of cocoyam that is resistant to root rot will be equitable in the sense that it will help the poorer farm families more since crop losses due to root rot have higher impact on poorer farmers than the other farmers.

The technology derived from the study with other things remaining the same, should improve profitability in farming. This is expected to increase the viability of agriculture in the rural areas as a profitable enterprise and discourage the trend of net out migration from the rural areas in search of jobs and livelihood in the urban areas.

The area of cocoyam cultivation has been reduced by about fifty percent (50%) due to the infestation of root rot. The yield of the area currently planted on the average loses about a third (33%) due to root rot. The combined impact is less production of cocoyams and subsequently higher prices to the consumer. If a variety which is resistant to root rot and acceptable to consumers is developed, then it is expected that area planted will increase with accompanying yield increases and prices would come down. From table 6 it is observed that cocoyam ranks very high in order of consumption importance in seven of the ten provinces. The cocoyam research effort should therefore be of significant importance to the society.

The variety of yam which is promoted in Cameroon has a higher crude protein content than the other varieties and readily available planting materials with supporting services has implication for nutritional improvement of the consumers. It is important to note that food preference and producer/consumer acceptability is an important aspect of the research methodology and therefore serves the felt needs of the producers as well as the consumers of the crops.

Finally root and tuber food crops are becoming cash crops in Cameroon and currently Cameroon exports such crops in a limited amount to Nigeria, Gabon and Central African Republic. If the anticipated increase in production and productivity occurs it may lead to increase in the exportation of root crops and result in increased in foreign exchange revenue for the country.

In conclusion the project is socially sound because its social consequences are positive and address the issue of equity and will not disrupt the social fabric of the community.

Table 6

CAMEROON ROOT AND TUBER CROP CONSUMPTION BY PROVINCES

P R O V I N C E

ORDER OF IMPORTANCE	NORTH WEST PROVINCE	SOUTH WEST PROVINCE	WEST PROVINCE	LITTORAL PROVINCE	SOUTH PROVINCE	CENTRE PROVINCE	EAST PROVINCE	ADAMOUA PROVINCE	NORTH PROVINCE	FAR NORTH PROVINCE
CROPS 1.	Cocoyam Macabo Taro	Macabo Taro	Macabo Taro	Cocoyam Taro	Cassava	Cassava	Cassava	Cassava	Cassava	Cassava
2.	Yam	Cassava	Yam	Cassava	Cocoyam Taro	Cocoyam Taro	Cocoyam Taro	Yam	Sweet Potato	Sweet Potato
3.	Cassava	Yam	Cassava	Yam	Yam	Yam	Yam	Cocoyam Taro	Yam	Yam
4.	Sweet Potato	Sweet Potato	Sweet Potato	Sweet Potato	Sweet Potato	Sweet Potato	Sweet Potato	Sweet Potato	Cocoyam Taro	Cocoyam Taro

ESTIMATED POPULATION - CAMEROON

PROVINCE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
EAST	366,235	376,123	386,279	396,706	407,419	418,410	429,717	441,319	453,235	465,472	478,040
ADAMOUA NORTH FAR NORTH	2,233,257	2,293,555	2,344,481	2,419,079	2,484,394	2,551,472	2,620,362	2,691,112	2,763,772	2,838,394	2,915,030
WEST	1,035,597	1,063,558	1,092,274	1,121,766	1,152,053	1,183,159	1,215,104	1,247,911	1,281,605	1,316,208	1,351,746
NORTH WEST	980,531	1,007,005	1,034,194	1,062,118	1,090,795	1,120,246	1.150,493	1,181,556	1,213,458	1,246,221	1,279,869
CENTRE AND SOUTH	1,491,945	1,532,228	1,573,598	1,616,085	1,659,719	1,704,531	1,750,553	1,797,0190	1,846,360	1,896,211	1,947,409
LITTORAL	935,166	960,415	986,346	1,012,977	1,040,327	1,068,416	1,097,263	1,126,889	1,157,315	1,188,563	1,220,654
SOUTH WEST	620,515	637,269	654,475	672,146	690,294	708,932	728,073	747,731	767,920	788,654	809,948
											10,002,596

ESTIMATED POPULATION - CAMEROON

PROVINCE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
EAST	366,235	376,123	386,279	396,708	407,419	418,410	429,717	441,319	453,235	465,472	478,040
ADAMOUA NORTH FAR NORTH	2,233,257	2,293,555	2,344,481	2,419,079	2,484,394	2,551,472	2,620,362	2,691,112	2,763,772	2,838,394	2,915,030
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NORTH WEST	880,531	1,007,005	1,034,194	1,062,118	1,090,795	1,120,246	1.150,493	1,181,556	1,213,458	1,246,221	1,279,869
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SOUTH WEST	620,515	637,269	654,475	672,146	690,294	708,932	728,073	747,731	767,920	788,654	809,946
											10,002,596

e. Administrative Analysis

The administrative capacity of the project management office at UMES and IRA is essential to successful implementation of the project. The Office of International Programs at UMES has had experience in coordinating and administering externally funded projects. UMES' experience acquired from their past and current involvement in the Zambia Agricultural Research and Extension Project coupled with that of administering a research project funded by AID/RUR Office on Bambara groundnuts in Togo and Senegal adequately prepares the management office to give an effective administrative leadership to the project.

The UMES chief of party has over the past ten years been actively involved in AID funded projects with both technical and administrative responsibilities in Ghana, Sudan, Kenya and Zambia, Jamaica and St. Lucia. He also has considerable experience in working with agricultural research institutions in developing countries and hence has an understanding of the "norms" of operations at research institutions like IRA. His experiences as the manager of several multidisciplinary research teams and as the acting chief of party for several months on the $40 million AID funded Egerton College Expansion project in Kenya (1981-1983) will be very helpful in administering this project.

IRA has a very good record in administering GRC as well as donor research projects. The current Director of IRA is highly respected for his administrative capability. He has had several years of experience in administering research projects. His most recent involvement in the administration of AID sponsored projects is the National Cereals Research and Extension project phases I and II with USAID in Cameroon. He is currently a member of board of directors of ISNAR.

The Chief of Ekona Research Center is also well known for his ability to coordinate and administer research projects. He has provided both the technical and administrative leadership for the Cameroon National Root Crop Improvement Program (CNRCIP) for the past ten years. As the leader of CNRCIP he has effectively administered several externally funded projects, the most recent of which involves IDRC, IITA and Administrative General for Cooperative Development of Belgium (AGCD).

The Chief of Njombe Research Center also serves as head of the technology program for IRA. He has acquired considerable administrative experience first as assistant chief of a research center for several years plus his six years experience as the chief of center. For the past six years he has administered the research activities of France's Institute of Research for overseas fruits (IRFA) in Cameroon. He is also responsible for the administration of research projects funded by Cameroon Banana Organization as well as those of Union of Cocoa and Coffee Associations in Cameroon.

The administrative machinery which has been carefully developed over the years in IRA, especially that of the office of the Director at the Ekona and Njombe centers is more than adequate to effectively assist in the administration of this project.

The compatibility of the field representative(s) of a contractor and the administrative staff of the host country institution is very critical to effective implementation of any project. It is important to note that during the period that the project was being designed, the chiefs of centers at Ekona and Njombe and the UMES proposed chief of party were able to work very well together as a team. Judging from this experience it stands to reason that the amicable relationship developed among these key administrative individuals for the project will continue during the implementation of the project. There has been an exceptional enthusiasm from both IRA and UMES in development of the project and the enthusiasm is expected to continue and therefore facilitate smooth administration of the project.

The administrative machinery at the Ekona and Njombe centers have met the standards of several international donor agencies in monitoring and keeping adequate records. The administrative support under this project will be tied to the services of Administration and Finance of IRA to ensure the fulfillment of both USAID and GRC regulations.

Initial Envrionmental Examination

Project Country: Cameroon

Project Title : Root and Tuber Food Crops Research

Funding: FY(S) 1986 - 1991 $ 5.8 million

IEE Prepared By: Ronald F. Ruybal
USAID Cameroon Environmental Officer

Environmental Action Recommended:

Positive Determination _____

Negative Determination X

Categorical Exclusion:

This activity meets the criteria for Categorical Exclusion in accordance with Section 216.2 (c) (2) (ii) and is excluded from further review because:

Concurrence

Bureau Environmental Officer Approved _____

Disapproved _____

Date _____

Clearance: GC/AFR _____ Date _____

1. Project Description

Roots, stem tubers and corms constitute the main source of the daily energy needs of Africa's people and little work has been done on improving their yields. One of the major constraints in the production of root and tuber crops, is the lack of readily available improved planting materials. In Cameroon, there are no coordinated systems to mass produce and distribute planting materials to the food crop farmers. Another constraint is the inadequate storage practices for seedstock as well as food produce during post harvest storage and processing.

The project will address the above constraints by; 1) the development of improved varieties of cocoyam; 2) developing seedstock multiplication systems through testing on station as well as on-farm; and 3) a diagnostic survey of current on-farm storage, processing and utilization of root and tuber crops. To assist in the attainment of project objectives, U. S. technical assistance and training will be provided.

The project zone will be in two regions of Cameroon, based mainly at two research stations within these regions. All on-station research and development activities for the production and post-harvest storage of "mother seedstock" will be done in collaboration with the IRA scientists at one research station. The research activities on processing and utilization of tubers will be carried out at the other IRA research station. The research stations will be renovated through small construction activities and supported by the procurement of laboratory commodities and chemicals for agronomic research.

The long-term beneficiaries will be the food crop farmer who will observe improvements on yields, and storage practices. IRA's institutional capability will also be strengthened by training a cadre of scientists and improving the physical structures at the research centers.

2. Issues And Impacts

No environmental issues or impacts have been identified during project design. All components of the research project will be carefully controlled and monitored by project personnel, thereby reducing the potential for environmental damage. All of the project chemicals procured with USAID funds will be EPA approved and will be administered following manufacturer guidelines (Please refer to attached list of proposed chemicals). The chemicals will be used in the research laboratory or for on-station research trials. Protective clothing will be worn by personnel when applying chemicals. It is not anticipated that chemicals will be used off-station on farmers' fields. All chemicals will be properly stored. The construction activities are small scale renovations and will not have an adverse impact on the environment. The irrigation system will be sprinkler type and will not have an adverse impact on the environment.

3. Environment Action Recommended

All the components of the project are recommended for negative determination since it is highly unlikely that significant adverse environmental impact will result. Pursuant to 22 CFR 216.3 (a)(9), if the project is revised or new information becomes available which indicates that the project might be "major" and its effects "significant", this negative determination will be reviewed and revised as appropriate.

Fertilizers and Chemicals to be used

1. Fertilizers

Mortate of Potash
Potassium Potash
Ammonium Nitrate
Ammonium Phosphate
Superphosphate
Ammonium Sulphate

2. Pesticides:

A. Benlate
B. Thiabendazole
C. Dithane
D. Malathion
E. Thiram
F. Paraquat
G. Dowfume
H. Maneb
I. Benomyl
J. Puradan
K. Nemacure
L. Diuron

3. Insecticides:

A. Cabaryl
B. Diazinon
C. Lindane
D. Lannate
E. Thimet
F. Di-syston

4. Storage Chemicals:

A. Captain
B. Malathion
C. Thiourea (U.S.)
D. Maleic Hydrazide

5. Inhibitors:

None

6. Food Preservation Chemicals:

Sodium Nitrate
Dextrose

Sodium Acid Pyrophysphate
Sorbitol
Marnitorl
Calcium Hypochloride
Irisn (PH. 7.8), Iris HCL
Ammonium Nitrate
Potassium Nitrate
Calcium Chloride

7. Tissue Culture Chemicals:

Sorbitol
Mannitol
Calcium Hypochrorite
Tris-oh (PH. 7.8), Tris-Hcl
Edta
Ammonium Nitrate
Potassium Nitrate
Calcium Chloride
Magnesium Sulphate
Potassium Phosphate
Ammonium Phosphate
Zinc Sulphate
Molybic Acid
Copper Sulphate
Cobalt Chloride
Perric Sulphate

Inositnol
Nicotine Acid
Pyridonine Hcl only minute quantities to be used (milligrams)
Thiamine Hcl
Glycine
Sucrose
Kinetin

Agar
Ethanol
Pectinase
Hemicellulase
Celluysin
Nephthalene Acetic Acid (Naa 0.2 ppm)
Benzylaminepurine 0.15 ppm
Coconut water
Zealin
Indoleacetic Acid (IAA) 0.2 ppm
Biotin
Gibberellic Acid .04 ppm

ANNEX A

RESEARCH METHODOLOGY

I. SEEDSTOCK MULTIPLICATION

A major constraint in increased root and tuber crop production in Cameroon is the absence of a well organized seedstock multiplication sector catering to the needs of the farmers. Root and tuber crop growers often produce their own seedstock. Seedstock produced by the farmers are of poor quality, often infested with viruses and nematodes and inadequate for the total demand. In the case of yams it is reported that in Nigeria the cost of seedstock consists of 20% to 30% of the total production cost[1]. Yam and sweet potato seedstocks are also stored for 5-6 months before planting. Storage losses are as high as 50% in 4 to 5 months[2]. Root and tuber crop seedstocks, therefore, are usually scarce and expensive.

A. YAMS

1. YAM SEEDSTOCK PRODUCTION

The yam seedstock can be propagated by seed, vine cuttings, tissue culture, bulbils, tubers or double harvesting (milking).

i. Propagation of yams from seed: Not all yam species or cultivars produce flowers or male flowers (15). Propagation by seed is therefore, not universally applicable. Seed production in even those with male and female flowers is too low for commercial purposes. Dormancy of seeds also exists requiring long periods of storage. Seed grown yams are also slow growing and yield small tubers with low marketability. Propagation by seed would also lead to a loss of genetic constancy.

ii. Propagation of yams by stem (vines) cuttings: This method is a possibility with a great potential for rapid multiplication of desirable varieties without using yam portions destined for food uses[3]. The vine cuttings are free of nematodes usually transmitted by tubers, maintain genetic constancy and permit propagation of non-flowering species. Commercial propagation is presently uneconomical due to the intensive care required to root the cuttings successfully and the low tuber yield from the cuttings.

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1 International Institute For Tropical Agriculture, Research Highlights for 1983, Ibadan, 1984, Nigeria, P. 105

2 IITA Annual Report, Ibadan, Nigeria, 1980. P. 66

3 Onwueme, I. The Tropical Tuber Crops, John Wiley and Sons, 1978, pp 36-37

iii. Propagation of Yams by Tissue Culture Technique: It is theoretically possible to produce millions of yam plantlets from a single desirable plant in a single year by this method. As such, the method is the most rapid for seedstock multiplication. However, the operations involved in producing the plantlets are delicate and only small quantities of materials can be handled. Presently, the method may be used to supplement other propagative methods in a rapid development of seedstock.

iv. Propogation of yams by Bulbils: This is practiced in those species which produce bulbils (D. bulbifera). The use of bulbils represents a considerable food loss. Bulbil producing capacity of plants grown from bulbils is also uncertain[4].

v. Propagation of yams from tubers: This method is the commonest and most important. Traditionally, small size tubers weighing from 250g to 1000g, storable for 3 to 4 months under ambient storage conditions, or yams setts (cut pieces of tubers) are used. The setts are subject to many rot diseases after planting in the soil. The traditional method of seed yam production results in low multiplication ratio, substantial high labor input and high costs. Improvement in techniques developed by the National Root Crops Research Institute at Umukike, Nigeria and improved by I.I.T.A. scientists has resulted in up to 10 fold increase in multiplication ratio over the traditional method, eliminates weeding and staking, reduces leaf disease problems, conserves moisture and hence reduces the cost of mother and ware stock[5].

vi. Propagation of Yams by Double Harvesting (Milking): This method is practiced by some peasant farmers. Usually, only the most vigorous plants in the field are "milked". About 4 to 5 months after emergence of plants, the soil is carefully removed from one side of the root zone of the plant to expose the tuber. Care is taken not to cut the roots. The yam tuber is carefully severed from the plant just below its attachment to the corm, taking note not to leave part of the tuber behind as this will be the source of rot infestation. The tuber is removed and the soil replaced on the exposed roots. The photosynthates that come down from the source hang on this wound in the form of solution. This develops into a profusion of tubers.

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4 Ibid page 36-37

5 Stranss, M.S. and J. Arditti, *Planted Regeneration From Shoot Tip Cultures. Annual of Biology 1980, pp 209-212

Very often, the farmers put a small stone just below the cut surface to spread out the solution. This ends up giving multiple seed yams. In some cases, the spreading of the accumulated solution can be enhanced by an obstruction leading to multiple seed yams. When the plants have finally reached senescence, a second harvest will produce small but numerous tubers constituting seed yams.

2. PROCEDURES TO BE USED FOR YAM SEEDSTOCK MULTIPLICATION

i. A survey will be conducted to determine the agronomic, pests, and socio-economic constraints, in seedstock production, and the number of seedstock growers in the main yam growing areas.

ii. Based on the findings of the survey, appropriate experiments will be designed to determine procedures and requirements to adapt a single or combination of recently developed improved methods from I.I.T.A. and elsewhere in seedstock multiplication. The methods to be used are briefly discussed.

a. Tubers of the most adapted, high yielding yam variety in the project district will be obtained from the Cameroon National Root Crops Improvement Program. The variety will be cut into Micro and Mini setts and sprouted using the system developed at IITA[6].

b. Three to four months after sprouting, tissue culture techniques will be used to produce large numbers of propagules thus increasing further the multiplication rate. These will be tested and selected for freedom from virus through indexing, and nematodes studies.

c. Virus and nematode free plantlets will be transplanted into nurseries and allowed to produce tubers.

d. Mature plants will be harvested and planted the following season to produce "foundation seedstock" at the Ekona research station.

Data will be collected on the following for statistical analysis and estimation of correlation of characters.

i. Days to sprouting of Micro and Mini setts.

ii. Days to production of mature plantlets from Micro and Mini setts from tissue culture.

iii. Rate of sprouting of plantlets from tissue culture.

[6] IITA. Research Highlights for 1983, Ibadan, Nigeria, 1984, p 105

iv. Days to maturity of foundation seedstock.

v. Tuber length and weight from tissue culture plantlets. (Foundation seedstock).

vi. Days to maturity of ware yam.

vii. Tuber length and weight of ware yam.

3. ON FARM ADAPTIVE TRIALS

The technique of producing yam seedstock using combinations of Micro and Minisett and tissue culture will be evaluated at the research stations managed by the tissue culture specialist and agronomist. On-farm tests will be carried out to evaluate the adaptability of seedstock multiplication techniques and compared with traditional methods. This onfarm test will be both researcher and farmer managed. In this testing, the farmers will be supplied with the necessary minimum inputs and technical advice. Results of the tests will be compared and an appropriate and improved seedstock multiplication and ware yam production technique determined. The improved technique will be recommended to farmers on the basis of increased multiplication rate, low-cost, storability of clean, healthy tubers and production of marketable ware yams.

B. COCOYAMS (Xanthosoma sp and Colocasia sp)

1. Constraints in Cocoyam Production in Cameroon

The root rot disease of cocoyam due to Pythium myriotylum is the major constraint in cocoyam production in Cameroon. Although some agronomic practices can be used to reduce the incidence of the disease, the long term solution is the production of hybrid clones resistant/tolerant to this disease. Because of the narrow genetic base of this crop, there is need to broaden research work to effectively develop new varieties. Local collection and importation of exotic materials are also needed.

The yellow cultivar is a tetraploid and it does not produce pollen. It has not been possible to cross the yellow fleshed cultivar with the white or red flesned one. Cytogenetic studies and chromosome doubling will be needed to attempt to resolve the problem of incompatibility.

The oxalate character of the crop reduces the edibility in some ecological areas. There is therefore a need to breed for low oxalate content at a later date. Corms and cormels are used both for human and animal foods; there is therefore a need to develop rapid multiplication techniques to increase the multiplication ratio and hence large scale farm production.

2. Cocoyam seedstock production

Cocoyams are traditionally vegetatively propagated. Corm pieces, whole small corms, and cormels can be used for planting, but the preferred portion is usually the stem cutting, often called "head sett" or "huli", consisting of the corm apex plus the lower 15 to 25 cm of the attached petioles. Propagation by seed is also practiced, especially in breeding programs.

i. Propagation of Cocoyams from seed

As with many of the other tropical tuber crops, the rapid multiplication of cocoyam is made difficult by the low incidence of seed set and seed germination in the crop. Propagation by seed is normally done in plant breeding programs to provide additional sources of plant variability for selection. Commercial propagation of cocoyams by this method is presently limited because of seed set, poor germination and poor storability of seeds. Genetically, cocoyams exhibit intense heterozygosity and this makes it difficult to grow and achieve uniformity in a given period.

ii. Propagation of cocoyams by cormels

Cormels or setts cut from large cormels are commonly used for planting. Yield from cormels and setts cut from large cormels are generally lower than those of corms or setts from corms. Cormels with the petiole or leaves cut off can also be used for planting together with the main corms, which are sectioned into fourths or eights.

iii Propagation of cocoyam by corms

Corms or setts cut from large corms are the preferred method of propagation in most areas. Setts from corms normally give higher yields than those from cormels, while stem cuttings, (another method of propagation), give a higher yield than even setts from corms.

iv. Propagation by stem cutting

Stem cuttings consist of the apical portion of the corm and the lower 15 to 25 cm of the petioles. Stem cutting give a higher yield than sets which in-turn give higher yield than those from cormels. The high yields of cocoyam from the stem cuttings may be due to the fact that they produce a greater number of roots and a greater total leaf weight than the other two kings of planting material. The optimal weight of sett used for cocoyam planting is about 150g.

v. Propagation of cocoyams by Clonal and Tissue culture Technique

Where rapid multiplication of clonal material is desired, as in plant breeding work, two general methods are currently available. The first method involves essentially the removal of the apical dominance exetered by the apical bud of the corm, thereby enabling the lateral buds of the

corm to grow. In practice, the apical dominance is removed by destroying the apical bud, slicing the corm into horizontal slabs, or excising the lateral buds and growing them separately. After excision, they are planted individually and allowed to continue to grow. The second method of multiplying cocoyams rapidly involves mericloning. Meristem from the lateral buds or the corm are grown in special tissue culture. The meristem then proliferates to produce a mass of cells which can differentiate into small cocoyam plants[7].

3. Procedure to be used for cocoyams seedstock multiplication

Three rapid methods of "seed" multiplication will be employed:

(1) Apical stem cutting: Stem cuttings of the apical portions of corm and the immediate lower (15-25cm) of the petioles combined with slicing the corm into horizontal slabs will be used initially to establish clones of selected varieties.

(2) Propagation by Tissue Culture: Meristem tips will be excised aseptically from healthy plants and placed onto a suitable culture medium. After several weeks, the plantlets will be regenerated and inspected for viruses. Virus-free plantlets will then be allowed to grow three or more modes. Each mode will be excised and transferred onto new culture medium to generate more plants. Some of the regenerated plants will then be transferred to soil and grown in insect-proof glasshouses to a suitable size for virus indexing. The remaining plantlets will be retained if the test plants do not show any rita infection. They will later be multiplied by excising and culturing individual nodes to produce virus-free plantlets which will be tested and selected for freedom from virus and nematodes.

This method will permit the production of plantlets or protocorms in very large numbers. Plantlets free from virus and nematodes will be transplanted into nurseries and allowed to produce tubers. Tubers will be harvested and planted the following season to produce "foundation" seed stock at Ekona.

The "foundation" seedstock will be field tested for yield, performance, and quality.

(3) Propagation by mini and microsetts

Cormels of improved clones will be cut into minisetts and microsetts and dipped into a mixture of fungicide/wood ash before planting. Each mini or micro sett will have one or two buds.

Data will be collected on the following for statistical analysis on estimation of correlation of characters:

(i) days to sprouting of mini and microsetts

(ii) days to maturity of the plant

[7] IITA, Annual Report for 1976, Ibadan, Nigeria, 1978

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(iii) number of tubers per plant

(iv) weight to corms and cormels at harvest.

C. CASSAVA (MANIHOT ESCULENTA)

1. CONSTRAINTS IN CASSAVA PRODUCTION IN CAMEROON

Cassava is one of the most important staple food crops in Cameroon extending across all the agro-ecological zones of the country. Cassava produces more food calories per unit area than other lowland crops because it is adapted to varying climatic conditions. The leaves and roots are used for food and feed and the roots for industrial production of starch and alconol. Other recognized advantages are that it requires few production skills and limited inputs; it stays in the ground for up to 24 months until required for consumption and it remains relatively drought tolerant, surviving four to six months of dry weather.

In spite of the above favorable characteristics, cassava production in Cameroon is greatly constrained by diseases of which the most important are the cassava mosaic (CMD), bacterial blight (CBB) and anthracnose (ANT). The average cassava yield is very low, primarily due to CMD, CBB, cassava mealybug and green spider mite (CGM).

Lack of inadequate and unsuitable planting materials have also contributed to the production dilemma facing the farmer. Within the past few years, IITA has released several improved cassava clones with high yields and disease resistance.

2. CASSAVA SEEDSTOCK PRODUCTION

The use of mature hardwood cut into pieces about 20cm long has been the normal practice of planting and multiplying cassava by farmers. These are planted upright, slanted or completely buried, thus assuring a multiplication ratio of 1:10. Cassava cuttings can, however, be produced from the whole plant and rooted without any treatment with rooting hormone or do the rooting media require sterilization in water, sand or soil.

In the high rainfall area with guaranteed rainfall during the establishment period, all types of cuttings can be planted directly in the field. In the drier area, this is successful when done under irrigation and mulching to reduce soil temperature. It is safer to root the material before planting.

(i.) Use of 2 node cuttings from mature hardwood

Two node cuttings are made from mature hardwood and planted in polythene bags with the buds towards the surface at a depth of 2-2.5cm. They are placed in a shady place and regularly watered. They are serially moved into less shaded areas for hardening till field planting into pre-dug holes after careful removal of the polythene container to ensure minimum root disturbance. One can use these two node cuttings to produce rooted cuttings to further improve on the multiplication ratio.

(ii.) Use of 3-4 node cuttings from semi-mature hardwood

The semi-mature hardwood is not normally utilized as planting material for production and multiplication by the farmer. 3-4 node cuttings are made and propagated using the described system for 2 node hardwood.

(iii.) Use of 5-6 node cuttings from green parts of plant

5-6 node cuttings are made after removing the leaves. The apical bud may be used without prunning the last developing leaf. These are planted closely in an upright position to a depth of 3-4cm in a nursery with regular watering for rooting. The rooted cuttings are pruned to about 20cm above soil level to reduce transpiration and encourage branching. It is later dug out carefully taking precautions not to disturb the roots and planted in the field.

(iv.) Use of 2 node cuttings to produce rooted cuttings

Shoots developing from the 2 node cuttings are continuously removed when they reach about 20cm height just above the first node for further reproduction of shoots. After about 6-8 cuttings have been removed, subsequent shoots become spindly at which stage the initial 2 node is used as planting material.

The excised cutting is trimmed of all leaves and petiole up to the last developing leaf and opical bud. They are rooted and when well established, are hardened for field planting.

(v.) Taking cuttings from established plants

Tip cuttings are regularly taken from established plants in the field, planted in nurseries for rooting and hardening and replanted in the field. Precautionary measures are taken to prevent coagulation of late over cut surfaces to assure freshness.

(vi.) Use of 1 and 1/2 node cuttings

1 node cuttings are planted just like the 2 node cuttings but with the node to the top. In India, 1 node cuttings have been cut longitudinally through the bud to make 1/2 node cuttings. The smaller the cuttings the greater the attention they will require to ensure high sprouting rate.

(vii.) Ratooning

Field established plants can be ratooned after 7-8 months leaving stems of about 20cm above soil level to further improve the multiplication rate. It is possible to obtain a second wood crop in another 6-7 months.

(viii.) Use of Tissue Culture Techniques

The new technology of Tissue Culture has made it possible to produce virus-free clonal material of improved cultivars of cassava. The production of virus-free clones has become essential

for the exchange of clonal material without introducing new diseases into unaffected areas. The two major steps involved in the techniques are: (i) the meristem tip culture and indexing for virus.

3. PROCEDURES TO BE USED FOR CASSAVA SEEDSTOCK MULTIPLICATION

Improved varieties or clones of cassava will be requested from the Cameroon National Root Crop Improvement Programme at Ekona, and or IITA, Nigeria and one or a combination of any of the methods described earlier (i-viii), will be used to determine the most appropriate rapid seed multiplication method to be adopted.

The methodologies to be used will include the use of tissue culture to produce large numbers of virus-free clonal materials. The two major steps will involve meristem tip culture and indexing.

D. YAM AND COCOYAM STORAGE

There are four major methods of root and tuber storage namely (i) barn storage, (ii) platform storage, (iii) underground storage, and (iv) cold storage.

(i) Barn Storage: The yam barn consists of a framework of vertically arranged wooden poles each about 3m high. The poles are held together by more rigid horizontal wooden sticks as well as occasional stout vertical logs that have been dug into the ground. The yam tubers are tied to the vertical poles of the barn, the tuber being placed with its long axis horizontally (15). The barn should be in a shaded, well ventilated area to prevent rain and high humidity which may cause rot. The yams are inspected constantly for rot and sprouts, and those found defective are removed or sprouts broken off.

(ii) Platform Storage: Raised platforms constructed in the field are also used (15). Yam tubers may be placed vertically or horizontally but not on top of one another. Shading, ventilation and inspection are important in this method of storage. The platform sanould be discontinued when the rainy season starts, to avoid excessive rot. Indoor barns may then be used.

(iii) Underground Storage: Yam, sweet potato and cocoyam may be stored in ditches and covered with soil (15). Shading material is then placed over the soil. The method is very poor because ventilation is inadequate and constant inspection is very difficult. Rodents usually cause extensive damage.

(iv) Cold Storage: (Yam, cocoyam and sweet potato): Cold storage involves storing tubers on shelves in rooms maintained at about 15°C (15). Air conditioners are effective since they reduce temperature and humidity, simultaneously, and provide continuous air exchange in the room. Temperatures below 10°C cause yams to brown and are unsuitable. The air conditioner is left to run all the time to ensure low humidity. Tubers should also not be stacked one on top of another, but placed in a single layer. Low temperature storage prevents high rates of respiration, sprouting and rotting and hence reduce yam losses in storage.

Storage losses:

(i) Rot: Rot from fungi and bacteria is more pronounced when the yam's outer skin is bruised or wounded during harvesting, transportation or from nematodes. Rot may be prevented through careful harvesting, transportation, handling, curing at 29-32°C at 90-95% R.H. for 4 days, or 25-30°C at 55-62% R.H. for 5 days, or 38°C and 95% R.H. Freshly harvested tubers may also be dipped in pesticidal solutions. Fungicides, for example benlate, captan and thiobendazole, have been used against various rot inducing agents (15). Alkaline treatments with limewash or wood ash have also been found effective in reducing infection and storage rots (15). Traditional farmers usually use wood ash.

(ii) Pests: Loss from insects and rodents can also be serious. These can be controlled with insecticides or construction of rodent proof structures for storage.

(iii) Respiration: This may cause 10-20% loss in dry matter. Losses can be reduced through shading and not packing or stacking the tubers.

(iv) Sprouts: Losses from sprouts may be reduced by removing manually or chemically the sprouts with maleic hydrazide a month prior to harvesting. Gamma radiation at doses of 7.5-15.0K rad may also be used before the tubers are stored.

(v) Dehydration: Weight loss in five months storage can be about 20% of original weight (15). Shading and storage at appropriate temperature and humidity also reduce dehydration (15).

Storage Methodology

Seedstock (mother seed yams, cocoyam and sweet potato, foundation seedstock) will be stored using either shaded platforms or cold rooms.

Platform Storage

(i) Platforms with roofs and appropriate dimensions will be constructed. The sides of the platforms will be open to provide adequate ventilation.

(ii) Seedstocks will be inspected for wounds and rots. Whole tubers will be cleaned, and cured at 29-32°C and RH 90-95% or not cured.

(iii) Tubers will be weighed and treated with different fungicides and insecticides (alone or in combinations) and arranged on the platform for storage.

(iv) Stored seedstock will be inspected every week for rot and sprouts.

(v) Tubers which show signs of rotting will be removed and discarded. Sprouts will be broken and open surfaces treated with fungicide and insecticide.

Storage in Cold Rooms

(i) Nematodes and disease free tubers will be cleaned and treated with the same fungicides and insecticides as above.

(ii) Tubers will be cured at 29-32°C at R.H. 90-95% or not cured.

(iii) Tubers will then be weighed and stored in air conditioned rooms at 15°C.

(iv) Tubers will be inspected once a week for signs of rotting and sprouting.

(v) Tubers which show signs of rot will be removed and discarded and sprouts will be removed and wounds treated with fungicide and/or insecticide.

Data to be Collected

Every week at inspection the following data will be collected from the different storage systems and the insecticidal and fungicide treatments.

(i) Initial weight of tuber

(ii) Number of sprouted tubers

(iii) Number of rooted tubers

(iv) Weight of whole tubers

(v) Every two months samples will be removed from each treatment for sprouting and percent sprouting recorded.

Data will be analyzed statistically to determine the effect of treatment on storability, viability and rate of moisture loss and evidence of rot.

pI. DIAGNOSTIC SURVEY OF TRADITIONAL POSTHARVEST TECHNOLOGIES (STORAGE, PROCESSING AND UTILIZATION) OF ROOT AND TUBER FOOD CROPS IN CAMEROON

Research on root crops postharvest technologies in Cameroon have mainly focused on specific topics or crops (Favier et al[8], IRAT[9], Favier[10]). Numfor's [11] work is the most recent and comprehensive with regard to crops and geographic coverage (all Cameroon). It identifies the various storage practices, processing and utilization of root and tuber crops in Cameroon. The proposed diagnostic survey will utilize Numfor's result as a starting point and exploit in detail constraints as well as opportunities in root and tuber crop storage, processing and utilization. A detailed analysis of the role of the crops in the food calendar of various geographic divisions of the country will be made. The analysis will also focus on identifying potential opportunities in improving the traditional technologies, for storage, processing and utilization. The survey will analytically document the nutritional quality for each form in which the crops are used in geographically defined areas.

Geographic Scope: The survey will cover agro-ecological zones I and II. It is anticipated that the TLLs established under NCRE project will provide field support to the core research team during the survey. The core research team will consist of food technologists, nutritionists, Agricultural Economists, Agricultural Engineers and Agronomists from both USA and Cameroon.

Approach:

(a) Pertinent local offices (extension, local government etc) will be identified to assist in identifying producers and transformers of root and tuber crops. A very limited formal survey will be conducted in each location to reaffirm or update uses, and processing techniques documented by Numfor.

(b) The core research team will then conduct focused informal survey to appropriately document methods of storage, processing and utilization with special attention to constraints as well as opportunities for improvements.

The focused informal survey will be more intensive than usual, to enable researchers to actually observe processing as well as actual utilization of root and tuber crops. This will involve spending several days at local factories and households to observe their activities.

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8 Favier, J.C.; Chevassus - Agnes and G. Gallon, (1971): *La technologie Traditionelle du manioc au Cameroun, Influence sur la valeur nutritiave*, Annales de la Nutrition et de l'Alimentation. Vol. 25 NO. 1.

10 Favier, J.C. (1977): Valeur alimentaire de

9 IRAT 1967: Les Moyens traditionnels de conservation des cultures vivrieres au Nord - Cameroun, Le Cameroun Agricole, Pastorale et Forestier No. 108, pp 42-64.

10 Favier, J.C. (1977): Valeur alimentaire de

11 Numfor, Festus: Traditional Post Harvest Technologies of Root and Tuber Crops in Cameroon. A survey 1986

(c) A stratified random sampling technique will be used to select a sample of 2,500 from all the administrative divisions of the country.

III. ECONOMICS OF SEEDSTOCK MULTIPLICATION AND DISTRIBUTION

Onwuene[12] characterizes yam as the agricultural economist's nightmare. The critical problems of root and tuber productions have systematically been compounded with technical agronomic issues plus the economics of production. These problems are imbedded in high labor inputs, low yield per unit of input, and inadequate post-harvest storage, and preservation and processing methods.

The lack of and need for improved root and tuber planting materials is well documented. In the case of yam the limited supply and the high cost of seed of yam is still considered as a major impediment in yam production. Despite the constraints that the limited supply of seed yam imposes on yam production, only limited efforts have been made to increase the efficiency and reduction of cost of seed yam production by the farmer (13). The proposed project intends to develop a system of root and tuber seedstock production which will be efficient and less expensive. Storage of most root and tuber crops especially yam are generally uneconomical due to several modes of losses e.g., (a) weight by dehydration, (b) quality by drying and toughening, (c) rottenness as a result of heating up, (d) germination during storage. The obvious suggestion for dealing with these problems include: cold storage, mechanical harvesting, pre-storage treatments (fungicidal or pesticidal dips) and storable processed forms of yam. Most of these may not be economically feasible to small farms. Onwuene[13] discusses several of the social phenomena which have impeded advancement in yam productivity. Effective storage of root and tuber crops to reduce post-harvest losses, processing and utilization and efforts to improve the quality of processed root and tuber products as well as new product development with focus on nutritional improvement can only occur at extra cost. However, through creative and persistent integrated research efforts which take into consideration both social and economic values of Cameroonians, some advancements could be made that are consistent with the resource endowments, taste and preferences of both producers and consumers. The combined effort of the research centers of Ekona and Njombe may lead to joint public good and private good ventures which in the long run will increase productivity.

However, for the private sector (i.e. farmers and processors) to take on seedstock production and/or its storage, it should be economically rewarding. The producers of cassava, yams and sweet potatoes will exhibit effective demand for the improved planting materials if the returns on their investment in the inputs are satisfactory. The following economic and financial tests will be an integral part of the criteria for determining the most appropriate system for a given situation.

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12 Onwueme, I. Strategies For Progress in Yam Research in Africa, in Terry, E.R., K.A. ODUPO, and F. Caveness, ED. Tropical Root Crops: Research Strategies For The 1980s, 1981, pp 175-176

13 Ibid, pp 175

Ex-Ante Economic Analysis of Technically Feasible Seedstock Multiplication and Storage Methods

After the review, evaluation and identification of technically feasible seedstock multiplication methods, the following analyses will be conducted:

i. Ex-Ante Resource (cash) Flow analysis will be conducted to ascertain the sustainability of the research station (government) to support the production, storage and distribution of "mother seedstock".

ii. Ex-Ante Partial Budget/enterprise budget and breakeven analysis (sensitivity analysis) will be conducted to determine if the seedstock production system is economically viable.

iii. Ex-Ante Partial Budget and breakeven analyses will be conducted to determine if it would be economically profitable to use improved planting material for the production of ware yam, cassava and cocoyams.

iv. Ex-Ante Societal Benefit/Cost analysis for the potential alternative seedstock multiplication system.

The system which best meets the above four criteria will then be field tested. The economic analyses to be done during the testing in the field are:

i. Partial budget/enterprise budget and breakeven analyses (sensitivity analyses), cash and resource flow analyses of on-station seedstock multiplication trials. Conduct and performance analysis of external support from the research station as required by the proposed system will be conducted.

ii. Partial budget, breakeven analyses, and cash/resource flow of collaborating cassava, yam and sweet potato farmers will be made. Conduct and performance analysis of external support entities as required by the proposed system will be undertaken. The farmers

perceptions and attitude towards the use of the improved planting material will be analyzed to determine feasibility of farmers' acceptance of the new technology. The findings of the economic and financial analyses from the on-farm tests will be incorporated into modification of the system for the subsequent testings.

One major problem of agricultural development particularly in most LDCs has been the availability of improved technology which can be afforded by the small or limited resource farmers who produce the bulk of the agricultural output. Such problems have occurred due to the lack of necessary socio-economic evaluations during the development of new technologies for developing countries. It is strongly felt that the proper role of socio-economics in the development of technologies in LDCs should not be merely to test a developed technology to find whether it is useful or not after it has been developed, but rather it should be an integral part in the process of developing the technology. Since a given technology is developed for a specific user(s), it is imperative that the resources, endowment and attitudes of the users be given serious consideration from the beginning of the development effort. Given that our proposed effort is an adaptive research, socio-economic analyses will be incorporated from the beginning to the end of all activities.

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ANNEX B

I. A. ROOT AND TUBER PROJECT - LONG TERM TECHNICAL ASSISTANCE (COST ESTIMATE)

STATUS: CHIEF OF PARTY

	YEAR 1	YEAR 2*	YEAR 3	YEAR 4	YEAR 5	TOTAL
Base Salary	49,420	54,362	59,798	65,778	72,356	301,714
Post Diff. 25%	12,355	13,590	14,950	16,445	18,089	75,429
Overseas Salary	61,775	67,952	74,748	82,223	90,445	377,143
Fringe Benefits-33% [a]	20,385	22,424	24,666	27,132	29,846	124,453
Overhead - 32% [b]	26,291	28,291	31,812	34,993	38,492	160,508
Post Allowance-Cola [c]	4,110	4,320	4,410	4,530	4,590	21,960
DBA and SOS inaurance premium [d]	1,749	1,749	1,749	1,749	1,749	8,745
Initial Travel/ Home Leave/R&R/ Terminal Travel	5,000		2,500	2,500	2,500	12,500
Other Post Assignment allowances [e]	9,845				12,000	21,845
	129,155	125,365	139,885	153,127	179,622	7 7,154

*Annual salary adjustment for University of Maryland system is based on across the board increase by the State plus University merit increase. The merit increase could range from 0% to 10% due to individual's productivity. An average state increase is 4%. The estimates are based on average of 5% merit and 5% state increase.

[a] UMES factor of 33% (1986) reflects the social security, retirement, hospitalization and unemployment insurance contribution by employer.

[b] The negotiated (approved by Health & Human Services) overhead for UMES is 74% on campus and 32% off campus of salary, wages and fringe benefits.

[c] The post allowance/cost of living allowance is dependent on post classification, base salary and dependents. In April the classification for Cameroon was 35 but 30 is used for the calculation of this budget estimate.

[d] DBA = 2.67% of overseas salary, SOS = $100/person.

[e] The other post assignment allowances include excess bags, unaccompanied baggage, shipment of privately owned car and household effects, consumables.

(1) Un accompanied baggage 250lbs at $6.50lb=	$1,625.00
(2) Excess baggage 22lb at $10/lb =	220.00
(3) Shipment of household effects and consumable 9700lb in 20ft containers =	4,000.00
(4) Shipment of POV. =	4,000.00
	$9,845.00

STATUS: BREEDER/AGRONOMIST

	YEAR 1	YEAR 2*	YEAR 3	YEAR 4	YEAR 5	TOTAL
Base Salary	46,000	50,600	55,660	61,226	67,349	280,835
Post Diff. 25%	11,500	12,650	13,915	15,307	16,837	70,209
Overseas Salary	57,500	63,250	69,575	76,533	84,186	351,044
Fringe Benefits- 33%[a]	18,975	20,873	22,960	25,256	27,781	115,845
Overhead - 32%[b]	24,472	26,919	29,611	32,512	35,830	149,344
Post Allowance- (Cola)[c]	5,280	5,490	5,670	5,850	6,000	28,290
DBA ~~AND~~ and SOS Isurance premium[d]	1,835	1,835	1,835	1,835	1,835	9,175
Initial Travel/ Home Leave/R&R/ Terminal Travel	15,000		5,000	5,000	5,000	30,000
Educational Allowance	16,200	5,000	5,000	5,000	5,000	36,200
Other Post Assignment allowances[e]	12,000				14,000	26,000
	151,262	123,367	139,651	151,986	179,632	745,898

*, a, b, c, & d are same as for the COP.

[e]Individual will be accompanied by wife and two dependents.

[f]Same as for COP plus allowances for three dependents.

B. Home Office Personnel	Y 1	Y 2*	Y 3	Y 4	Y 5	TOTAL
1. Project Manager 10% 12 mo.	5.000	5.000	6,050	6,655	7,320	30,525
2. Home Campus Coordinator, 50% 12 mo.	16,500	18,150	19,965	21,962	24,158	100,735
3. Secretary/ Accounts Clerk 100%, 12 mo.	15,000	16,500	18,150	19,965	21,961	91,576
Sub Total	36,500	40,150	44,165	48,528	53,439	222,836
Fringe Benefits 33%*	12,045	13,250	14,575	16,032	17,635	73,537
On-campus Indirect Cost at 74% of SW&B	35,923	39,515	43,467	47,814	52,595	219,314
Total	84,468	92,915	102,207	112,428	123,669	515,687

*Same as in the case of COP

C. FIELD OFFICE NON PROFESSIONAL PERSONNEL (Cameroonians)

	YEAR 1	YEAR 2[b]	YEAR 3	YEAR 4	YEAR 5	TOTAL
1. Administrative Assist. 100%	11,667[a]	12,250	12,863	13,506	14,181	64,467
2. Bilingual Stenographer Secretary 100%	8,267[c]	8,680	9,114	9,570	10,049	45,680
3. Typist 100%	5,134[d]	5,391	5,660	5,943	6,240	28,368
4. Messenger 100%	2,500[e]	2,625	2,756	2,894	3,039	13,814
Total	27,568	28,946	30,393	31,913	33,509	152,329

D. ALABAMA A&M UNIVERSITY

Food Processing & Utilization Survey - Consultancy	56,000**	28,000**	84,000

Y1 = 4 person months Y3,Y4,Y5 = 0
Y2 = 2 person months

E. FLORIDA A&M UNIVERSITY

On-farm storage survey	56,000**	28,000**	84,000

Y1 = 4 person months
Y2 = 2 person months
Y3 = Y4, Y5 = 0

	112,000	56,000	
Total Survey Consultancy			168,000

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[a] A base salary of 350,000 CFA/month for Adm. Asst. includes all fringe benefits plus bilingual allowance.

[b] Salary is adjusted by 5% increase each year.

[c] Stenographer Secretary's base salary of 248,000 CFA/month includes all fringe benefits plus bilingual allowance.

** A composite figure of $14,000/month is used for consulting. This includes salaries, FB. overhead, round trip economy air travel.

[d] Typist's base salary of 154000 CFA/month includes all fringe benefits.

[e] The Messenger's base salary of 75000 CFA/month includes all fringe benefits.

* The conversion rate used is 360 CFA = $1.00.

BUDGET (Operating Costs)

	$	$
II. Short-Term Travel:		
1. Initial field project start-up site visit	1,680	
COP from UMES x $112 per diem air transportation at 2,500	2,500	4,180
2. State-side Project committee visit to Cameroon for 2 weeks. 3 persons x 2 visits x 15 days x $112 per diem.	10,080	
Air transportation: 2 x 3 at 2,500	15,000	
15% Inflation	3,762	28,842
3. Host Country Project Executive/Management committee to U.S. twice in five years for 2 weeks interval 3 pesons x 2 visits x 15 days x $139 (CFA 50.000) per diem	12,510	
air transportation 3 x 2 visits at $2,500	15,000	
15% inflation	4,127	31,637
4. AID Evaluation (3 for 3 weeks each during life of project) 5 persons x 3 x 21 total x $112 per diem	35,280	
air transportation 5 x 3 visits at at $2,500	37,500	
15% inflation	5,630	
Salary 210 person months at $14,000/person months	29,400	107,810
5. One administrative visit 7 days for x 3 presidents 7 x 3 x$112	2,352	
air transportation 3 x $2,500	7,500	
10% inflation	985	10,837
6. Domestic Annual State-Side project Advisory committee Meetings 4 persons x 10 visits x 2 days total x $75.00 per diem	6,000	
air transportation x 4 x 10 visits at $500 RT avg.	20,000	
10% inflation	2,600	28,600
7. 2 Visits by HCPMC to U.S. to consult with Project Coordinator on annual reports, plan of work, visit training participants and other TDY for 2 weeks 3 x 2 x 15 x$139 (per diem)	12,510	
Air ticket 3 x 2 x $2,500.	4,127	
15% inflation	15,000	31,637

8. Project Coordinator for UMES to visit Project sites twice the life of the project to consult with HCPMC on annual reports, financial and annual Project reviews		
2 x 15 x $112 per diem	3,360	
Air ticket 2x 2,500	5,000	
15% inflation	1,254	9,614
Total		253,157

III. Short Term Technical Assistance

22.7 person months at $14,000/month/person =	319,036

IV. Language training & Translation of documentation — 70,000

V. Participant Training

(a) $2,000/student for field research support - 6	12,000	
(b) 2,000/student for thesis allowance in USA - 6	12,000	
(c) Tuition Subsistence at $18,000/year/student for 3 years 4 MS degrees (4x3x18,000)	219,000	
(d) 2 Ph.D. for 4.0 years at $18,000/year/student (2x4x18,000)	144,000	
(e) Third Country - $10,000/year for 4 years	40,000	
(f) Preextension and Demonstration - 10,000/year for 2 years	20,000	
TOTAL		447,000

VI. LIST OF EQUIPMENT FOR AGRONOMIC RESEARCH

Items	Quantity	Unit cost	Cost
IBM PC Model XT. (Scientist use with accessories)	1	6,000	6,000
Tractors - 65 HP	1	28,000	28,000
Plows - 4 PP	1	4,000	4,000
Discs - 25 feet	1	8,000	8,000
Cultivator - 13 feet	1	45,000	45,000
Irrigation system	1	75,000	75,000
Environmental Control Chambers	3	30,000	90,000
Air Conditioners (Lab)	4	1,000	4,000
Ovens	2	4,000	8,000
Deep Feezers	3	1,700	5,100
Balances (Electonic)	5	3,000	15,000
Scales	2	4,000	8,000
Sterilizers	2	25,000	50,000
Laminar Flow Hood	1	7,500	7,500
Cold Storage (walk-in for seed store)	1	40,000	40,000
pH meters	2	3,000	6,000
Water Bath/Shakers	2	2,000	4,000
Research Microscope	1	4,000	4,000
Stereo Microscope	1	1,800	1,000
35mm Camera	2	1,000	2,000
Slide Projector with accessories	2	2,500	5,000
Protective clothing	20	30	600
Polariod Camera	1	500	500
Duplicating Machine medium capcity with collator	1	3,000	3,000
Telex machine (or Services)	1	20,000	20,000
Soft ware for IBM PC/XT, eg. MSTAT SPSS, Lotus 123	-	-	4,000

Items	Quantity	Unit cost	Cost
Digital Calculator (Administration	3	150	450
Digital Calculator with mathematical/ statistical functions	2	150	300
Software for IBM/PC XT (Adminstration) eg. Visicalc condor		2,000	2,000
Large storage room (seedstock)	1	20,000	20,000
Mower	1	2,500	2,500
Water distillation apparatus	2	7,500	15,000
Quebec Colony Counter	1	1,000	1,000
Multi Magnetic Stirrer	1	800	800
Glassware coldbox	1	1,500	1,500
Beckman L8-80 Ultra Cetrifuge	1	12,000	12,000
Clinical Centrifuge (Table top)	1	510	510
Chemical Hood	1	4,600	4,600
Automatic Dish washer (for lab. glass & equip.)	1	20,000	20,000
Inberted microscope	1	22,00	22,000
Vortex mixer	1	200	200
Hot Plate	1	650	650
Microtome	1	4,500	4,500
Oil-less pump (vacuum)	1	850	850
Microware oven	1	650	650
Ultrafiltration apparatus	1	1,500	1,500
Magnetic stirrer	1	650	650
Laboratory Cart (glassware)	2	1,240	1,240
Service Carts	2	500	500
Pipet washer	1	375	375
Tube hanger (glassware)	1	300	300
Brushes (assorted)	1	450	450
Carboys (glass)	1 case	450	450
Carboys (clear platic)	1 case	350	350
Rubber tubings (assorted)		280	280
Rubber clips	1 box	120	120
Rubber stopper (assorted)	1 box	230	230
TC media			7,500
Thermometers (Regular/Digital)			5,000
Filter paper for filtration	10	825	8,250

Items	Quantity	Unit Cost	Cost
Glassware (assorted)		7,500	7,500
Timers	6	125	750
First Aid Kit	4 boxes	250	1,000
Chemicals and Reagents		8,750	8,570
Electicity stabilizers(lab)	4	1,250	1,250
Voltage reducers	10	400	4,000
Filters for sterilizers	4 boxes	350	1,400
Filter holders	2	450	900
Microbiological supplies for bacteriology	1	1,500	1,500
Nursery supplies and equipment		2,330	2,330
Subtotal			609,785
5% Inflation*			30,489
Total			640,274

VII. CONSTRUCTION FACILITIES

Screen house for disease indexing		25,000	25,000
Greenhouse Renovation		6,500	6,500
Renovation of Tissue Culture Lab. including fixtures			15,000
Subtotal			46,500
10% Inflation			4,650
Total			51,150

* These commodities will be procured during the first six months of the project, hence inflationary changes are expected to be very minimal. Also the price in the US markets are relatively stable.

VIII.

A. VEHICLES (YEARS 1 to 3)*

Caravan (Administration)	1	8,000	8,000
Pick-up Truck - 1/2 ton	1	12,000	12,000
Mid-size Station Wagon	1	12 000	12,000
Toyota Land Cruiser (field vehicle)	1	18,000	18,000 (year 1)
Toyota Land Cruiser (field vehcile)	1	18.000	18,000 (years 2)
			68,000

B. VEHICLES (YEARS 4 & 5)

Caravan (Administration)	1	9,680	9,680
Mid-size Station Wagon	1	15,870	15,870
Toyota Land Cruiser (4 WD.)	2	23,805	47,610
			73,160
		TOTAL	141,160

IX.

RENTAL OF TWO HOUSES AT BUEA

Y1	Y1	Y2	Y3	Y4	Y5	TOTAL
House Rental**	16,680	18,348	20,183	22,201	24,421	101,833
Maintenance [1]	4,170	4,587	5,046	5,550	6,105	25,458
Guards [2]	5,838	6,422	7,065	7,772	8,549	35,646
Utilities [3]	4,170	4,587	5,046	5,550	6,105	25,458
TOTAL	30,858	33,944	37,340	41073	45,180	188,395

* Vehicles are to be replaced by the end of year 3.
** There is 10% inflation adjustment per year.
[1] Maintenance is 25% of Rental/year.
[2] Guards is 35% of Rental/year.
[3] Utilities is 25% of Rental/year.

X. STORAGE, PROCESSING & UTILIZATION SURVEYS

(1)	5 Research Assistants will be hired for 4 months. at a rate of $,420/person/month 5 x 420 x 4	8,400.00
(2)	Transportation Expenses (Fuel, Lubricants etc)	15,000.00
(3)	Stationery etc.	2,000.00
		25,400.00

XI.

RECURRENT COST

	Y1	Y2	Y3	Y4	Y5	TOTAL
(1) Book, Journals Publications	1,000	1,000	1,000	1,000	1,000	5,000
(2) Office supplies & Expenses (10% Annual Increase)	6,000	6,600	7,260	7,986	8,785	36,631
(3) Incountry Travel Local Support Staff (5% Inf.)	6,480	6,804	7,145	7,507	7,167	35,103
(4) Incountry Travel Prof. Staff (5% Inf.)	40,632	42,664	25,000	26,250	27,562	162,108
(5) Gasoline & Lubriciants (10% Inf.)	12,000	13,200	14,520	15,972	17,570	73,262
(6) Vehicle Repairs, Maintenance & spare parts	22,500	29,400	30,700	28,658	29,908	141,166
(7) Research Supplies (10% Inf. D)	8,000	8,800	9,680	10,648	11,712	48,840
(8) On-Farm Research	-	12,000	12,600	9,000	9,450	43,050
(9) Vehicle Insurance	6,000	8,160	6,460	8,779	8,779	38,178
(10) Misc. Admini-	2,000	2,000	2,000	2,000	2,000	10,000
TOTAL	104,612	130,628	116,365	117,800	123,933	593,338

73a

XII. HOUSEHOLD & OFFICE APPLICANCES FOR 2 U.S. TECHNICIANS

Items	DESCRIPTION OF ITEM	Quantity	Unit Price	Total Cost
1.	FREEZERS CHEST, CB150 15.3 CU. FT. 220/230 V 50 CYCLES WITH ACME TRANSFORMER	1	515.70	1,031
2.	REFRIGERATORS, STANDARD 220/236 V, 50 CYCLES 13.9 CU. FT.	2	406.70	813
3.	CLOTHES WASHER GE Model WW A5412 220/230 V 50 CYCLES	2	444.40	889
4.	CLOTHES DRYERS, G.E. AUTOMATIC, MODEL DD E5 211	2	332.60	665
5.	RANGES, GAS, HARDWICK, CC961W 70W' STANDARD LP OR NATURAL GAS, MATCHLESS, 220/230 V 50 CYCLES	2	328.30	657
6.	AIRCONDITIONERS AMANA, 113-5N, 12800 BTU, 220/230 V, 50 CYCLES	6	516.10	3,097

XII. HOUSEHOLD & OFFICE APPLICANCES FOR 2 U.S. TECHNICIANS

Items	DESCRIPTION OF ITEM	Quantity	Unit Price	Total Cost
7.	TRANSFORMERS, STEP DOWN, 100 WATTS	2	56.15	112
8.	TRANSFORMER COMMODITY, 1,500 WATTS	2	56.15	112
9.	TYPEWRITERS IBM	2	1,500.00	3,000
10.	RUG-COP'S OFFICE (15' X 12')	1	253.00	253
11.	OFFICE FURNITURE	4 sets	3,400.00	13,600
12.	RECEPTION OFFICE FURNITURE	1 set	2,000.00	2,000

ETHAN ALLEN HOUSEHOLD FURNITURE FOR 2 U.S. TECHNICIANS

Items	DESCRIPTION OF ITEM	Quantity	Unit Price	Total Cost
13.	TRANSITIONAL HOUSE C, 3 BEDROOM UNIT, LR, DR. BR 1, 2, AND 3, COLOR SCHEME 1	2	10,232.22	20,464
14.	RUGS, 9' X 12'	2	164.00	328
	RUGS 12' X 15'	2	253.00	506
	Subtotal			47,527
	5% Inflation			2,376
	Total			49,903
XIII.	FREIGHT SHIPMENT			80,000
	5% Inflation			4,000
				84,000
XIV.	Contingency			
	(a) 10% of items I-XIII			518,319
	(b) An estimate for seperate maintenance allowance (at 7200/year for 1 adult and 2 children) for the COP pending request and approval for SMA.			36,000
	Total			554,319
	GRAND TOTAL			5,737,512

CALCULATION NOTES

RENTAL HOUSES AND MAINTENANCE

Two houses to be rented at Buea at 250,000 CFA/months for 5 years.

250,000 = $695/month
$695 x 2 x 12 = 16,680/year.

Recurrent Cost: CALCULATION NOTES

5. Gasoline & lubricants

$3,000 year/vehicle for 4 vehicles
3,000 x 4 — 12,000

6. Vehicle maintenance, repairs and spare parts

	Y1	Y2	Y3	Y4	Y5	TOTAL
Spare parts (5% of cost)	2,500	3,400	3,400	3,658	3,658	16,616
Maintenance and Repairs (Increases by 5%/year)	20,000	26,000	27,300	25,000	26,250	124,550
TOTAL	22,500	29,400	30,700	28,658	29,908	141,166

Maintenance and Repairs: It is assumed that it costs $5,000/year/vehicle.

5,000 x 4 = $20,000 for year 1

9. Vehicle Insurance

Y1	6,000	12% of price of vehicles - ($50,000) comprehensive
Y2	8,160	12% of initial price - ($68,000) comprehensive
Y3	6,460	Third party (9.5%)
Y4	8,779	12% of price of vehicles - comprehensive
Y5	8,779	12% of initial price of vehicle - comprehensive
TOTAL	38,178	

In Country Travel - Proff Staff Notes:

A---Per-Diem (Ş112)

7 day/month x $112 =$ 784
$ 784 x 12 = 9,408/year

for 4 person:$9,408 x 4 = 37,632.00

(2 US + 2 Cameroonians)

B Air Transportation

3 trips year at $250/person. = $750.00
$750 x 4 = $3,000

=$40,632

Travel out of station declines for the Agronomists in years 3, 4 and 5.

RECURRENT COST NOTES

In-country Travel Local Support Staff

Adm. Assistant:

(a) Half per diem $\frac{94}{2}=48$

5 days/month x $48 = $240/month
240 x 12 = $2,880.00

(b) Driver (3)
Per Diem (CRA 7,500) = $20/day
5 days/month x $20 = $100/month
100x12x3 = $3,600/year.00

Total $6,480

AID 1020-24(11-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: _____

Life of Project:
From FY _____ to FY _____
Total U. S. Funding _____
Date Prepared: _____

INPUTS	MAGNITUDE OF INPUTS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
I. AID 1. Technical Assistance 2. Short Term Travel 3. Language Training 4. Participant Training 5. Commodities 6. Recurrent Cost 7. Other Costs 8. Contigency	I. AID ($5,737,512) 1. Technical Assistance ($2,639,416) 2. Short Term Travel ($ 253,157) 3. Language Training ($ 70,000) 4. Participant Training ($ 447,000) 5. Commodities ($ 882,487) 6. Recurrent Costs ($ 593,338) 7. Other Cost ($ 297,795) 8. Concigency ($ 554,319)	1. UNES and IRA Annual Budget Reports 2. Project Annual Reports	Assumptions for achieving goal targets: Input Assumptions 1. Availability of requested C[illegible] counterpart personnel. 2. Required funding will be pr[illegible] on a timely basis. 3. Availability of Rencal house at Buea.
II. HOST COUNTRY 1. Personnel 2. Utilities 3. Participant Training 4. Laboratory Equipment 5. Vehicle Maintenance & Transpotation 6. Offices and Furniture 7. Land 8. In-country Travel 9. Contingency	HOST COUNTRY ($2,069,980) 1. Personnel ($1,094,277) 2. Utilities ($6 67,197) 3. Participant Trng ($ 34,500) 4. Laboratory Equip. ($ 135,485) 5. Vehicle Maint. ($ 309,343) 6. Office & Furniture ($ 118,000) 7. Land ($ 100,000) 8. In-country Travel ($ 27,629) 9. Contingency ($ 188,180)		

ANNEX C

CRC - IRA (Contribution) Summary

1. Personnel Salaries
(5% increase for each year)

		Y1	Y2	Y3	Y4	Y5	Total
Senior Staff							
- Agronomist/Breeder	(MSc.)	16,667	17,500	18,375	19,294	20,259	92,095
- Horticulturalist/ Pathologist	(BSc.)	14,667	15,400	16,170	16,979	17,828	81,044
- Food Processor/ Biochemist	(MSc.)	16,667	17,500	18,375	19,294	20,259	92,095
- Food Processor/ Prod. Dev.	(BSc.)	14,667	15,400	16,170	16,979	17,828	81,044
- Agro Economist	(BSc.)	14,667	15,400	16,170	16,979	17,828	81,044
- On farm storage Specialist	(BSc)	14,667	15,400	16,170	16,979	17,828	81,044
- Agric Engineering Instrumentalist	(Dipl.)	7,033	7,385	7,754	8,142	8,549	38,863
- Chief of Root & Tuber Programme 20%		6,666	6,999	7,349	7,717	8,103	36,834
- Chief of Processing & Utilization 20%		6,000	6,300	6,615	6,946	7,230	33,091
							617,154
Junior Staff							
4 Lab Technicians		25,468	26,741	28,078	29,481	30,955	140,723
2 Field Technicians		12,734	13,371	14,039	14,741	15,478	70,363
6 Drivers		11,000	11,550	12,128	12,734	13,371	60,783
10 Labourers (variable)		10,000	10,500	11,025	11,576	12,155	55,256
- Social charges 15%		25,336	26,603	27,933	29,330	30,796	139,998
Sub Total		196,239	206,049	216,351	227,171	238,467	1,084,277
2. Utilities							
- Water		1,000	1,050	11,025	11,576	12,155	36,806
- Electricity		5,500	5,775	6,064	6,367	6,685	30,391
Sub Total		6,500	6,825	17,089	17,943	18,830	67,197
3. Participant Training/Travel		7,500	-	10,000	13,500	3,500	34,500

4.

LAB EQUIPMENT AND IMPLEMENTS

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
a. Equipment and stand by generator	6,944	6,944	6,944	6,944	6,944	34,720
b. Implements						
- Tractor 35 HP	500	500	500	500	500	2,500
- Plow 3 HP	75	75	75	75	75	375
- Disc. plow 13 FP	113	113	113	113	113	565
- Cultivator 12 FP	300	300	300	300	300	1,500
- Trailer 4 WH	350	350	350	350	350	1,750
- Duplicating Machine	75	75	75	75	75	375
- Ditcher (Trencher)	140	140	140	140	140	700
c. Lab and green house structures	93,000	-	-	-	-	93,000
Sub total	101,497	8,497	8,497	8,497	8,497	135,485
5.a. vehicles for Cameroon counterparts						
2 renaults	27,778	-	-	-	-	27,778
One mini bus	25,600	-	-	-	-	25,600
b. Motor bike 4 at $1389 each	5,556	-	-	-	-	5,556
c. Maintenance and running cost of Vehicle (10%) inf. and motor bike	30,000	33,000	36,300	39,930	43,923	183,153
d. Vehicles & Bike Insurance	10,000	10,500	11,576	12,155	11,025	55,256
Transportation of commodities from port to center	8,000	4,000	-	-	-	12,000
Sub total	106,934	47,500	47,876	52,085	54,948	309,343

6. Offices & Furniture	Year 1	Year 2	Year 3	Year 4	Year 5	Total
a. Administrative office and two scientists offices	70,000	-	-	-	-	70,000
b. Office Building for Cameroon Technicians and two scientist offices	34,000	-	-		-	34,000
c Furniture for Cameroon counterparts	14,000	-	-	-	-	14,000
Sub Total	118,000					118,000
	YI	Y2	Y3	Y4	Y5	Total
7. Land 30 hectares	20,000	20,000	20,000	20,000	20,000	100,000
8. Incountry Travel						
a. Incountry travel local support staff (5% inf.)	3,000	3,150	3,308	3,473	3,647	16,578
b. Incountry travel prof.	2,000	2,100	2,205	2,315	2,431	11,051
Sub Total	5,000	5,250	5,513	5,788	6,078	27,629
9. Sub Total (1 to 8)	561,670	294,121	324,775	344,406	356,827	1,881,800
10. Contingency (10%)	56,167	29,412	32,478	34,441	35,682	188,180
T O T A L	617,837	323,533	357,253	378,847	392,510	2,069,980

GRC - IRA (Contribution) Summary

1. Personnel Salaries
(5% increase for each year)

		Y1	Y2	Y3	Y4	Y5	Total
Senior Staff							
- Agronomist/Breeder	(MSc.)	16,667	17,500	18,375	19,294	20,259	92,095
- Horticulturalist/ Pathologist	(BSc.)	14,667	15,400	16,170	16,979	17,828	81,044
- Food Processor/ Biochemist	(MSc.)	16,667	17,500	18,375	19,294	20,259	92,095
- Food Processor/ Prod. Dev.	(BSc.)	14,667	15,400	16,170	16,979	17,828	81,044
- Agro Economist	(BSc.)	14,667	15,400	16,170	16,979	17,828	81,044
- On farm storage Specialist	(BSc)	14,667	15,400	16,170	16,979	17,828	81,064
- Agric Engineering Instrumentalist	(Dipl.)	7,033	7,385	7,754	8,142	8,549	38,863
- Chief of Root & Tuber Programme 20%		6,666	6,999	7,349	7,717	8,103	36,834
- Chief of Processing & Utilization 20%		6,000	6,300	6,615	6,946	7,230	33,154
							617,217
Junior Staff							
4 Lab Technicians		25,468	26,741	28,078	30,957	140,726	
2 Field Technicians		12,734	13,371	14,039	14,741	15,478	70,363
6 Drivers		11,000	11,550	12,128	12,734	13,371	60,783
10 Labourers (variable)		10,000	10,500	11,025	11,576	12,155	55,256
- Social charges 15%		25,336	26,603	27,933	29,330	30,796	139,998
Sub Total		196,239	206,049	216,351	227,717	238,469	1,084,280
2. Utilities							
- Water		1,000	1,050	11,025	11,576	12,155	36,806
- Electricity		5,500	5,775	6,064	6,367	6,685	30,39
Sub Total		6,500	6,825	17,089	17,943	18,830	67,197
3. Participant Training/Travel		7,500	-	10,000	13,500	3,500	34,500

4. LAB EQUIPMENT AND IMPLEMENTS

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
a. Equipment and stand by generator	6,944	6,944	6,944	6,944	6,944	34,720
b. Implements						
- Tractor 35 HP	500	500	500	500	500	2,500
- Plow 3 HP	75	75	75	75	75	375
- Disc. plow 13 FP	113	113	113	113	113	565
- Cultivator 12 FP	300	300	300	300	300	1,500
- Trailer 4 WH	350	350	350	350	350	1,750
- Duplicating Machine	75	75	75	75	75	375
- Ditcher (Trencher)	140	140	140	140	140	700
c. Lab and green house space	93,00	-	-	-	-	-
Sub total	101,497	8,497	8,497	8,497	8,497	135,485
5.a. vehicles for Cameroon counterparts 2 renaults	27,778	-	-	-	-	27,778
One mini bus	25,600	-	-	-	-	25,600
b. Motor bike 4 at $1389 each	5,556	-	-	-	-	5,566
c. Maintenance and running cost of Vehicle (10%) inf. and motor bike	30,000	33,000	39,930	39,930	43,923	183,153
d. Vehicles & Bike Insurance	10,000	10,500	11,576	12,155	11,025	55,256
11. Transportation of commodities from port to center	8,000	4,000	-	-	-	12,000
Sub total	106,934	47,500	47,325	51,506	56,078	309,343

6. Offices & Furniture	Year 1	Year 2	Year 3	Year 4	Year 5	Total
a. Administrative office and two scientists offices	70,000	-	-	-	-	70,000
b. Office Building for Cameroon Technicians and two scientist offices	34,000	-	-		-	34,000
c Furniture for Cameroon counterparts	14,000	-	-	-	-	14,000
Sub Total	118,000					118,000
	YI	Y2	Y3	Y4	Y5	Total
7. Land 30 hectares	20,000	20,000	20,000	20,000	20,000	100,000
8. Incountry Travel						
a. Incountry travel local support staff (5% inf.)	3,000	3,150	3,303	3,473	3,647	16,578
b. Incountry travel prof.	2,000	2,100	2,205	2,315	2,431	11,051
Sub Total	5,000	5,250	5,513	5,788	6,078	27,629
9. Sub Total (1 to 8)	561,670	294,121	324,775	344,406	356,827	1,876,434
10. Contingency (10%)	56,167	29,412	32,478	34,441	35,682	187,644
T O T A L	617,837	323,533	357,253	378,847	392,510	2,069,980

AID 1020-2011-TD

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: ROOT AND TUBER FOOD CROPS RESEARCH

Life of Project:
From FY _____ to FY _____
Total U. S. Funding _____
Date Prepared: _____

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: Contribute to the improvement of Cameroon farmers' socio-economic welfare through increased productivity of root and tuber crops.	Measures of Goal Achievement: 1. Increased productivity in root and tuber food crops. 2. Increased income of cooperating farmers.	1. Change in volume and quality of root and tuber food crops produced by cooperating farmers and reported in CRC statistics. 2. Partial Budget Analysis of cooperating farmers.	Assumptions for achieving goal targets: i. Availability of locally tested improved varieties of cassava, yam and cocoyam. ii. Favorable market conditions. iii. Stable or increase in demand for root and tuber crops. iv. Favorable weather, biotic and abiotic conditions. v. Favorable conditions. CRC continuous stress of Agric and Rural dev. as a priority in its dev. plans.
Project Purpose: 1 Develop technically and economically feasible root and tuber rapid seed-stock multiplication technology for cassava, yam and cocoyam at project site.	Conditions that will indicate purpose has been achieved: End of project status. i. Effectively functionable seed-stock multiplication methods for cassava, yam and cocoyam at Ekona Research Center. ii. Self sufficiency in high quality root and tuber seedstocks for the project site. iii. [illegible] research testing of the root and tuber seedstock technique.	i. Volume of production of root & tuber seedstock at Ekona as presented in annual report of IRA. ii. Volume of improved seedstock at project site for on-farm research iii. Evaluation of farmers reaction to the on-farm testing of the developed technology	Assumptions for achieving purpose: i. Availability of tissue culture facility fully equipped. ii. Host country continued interest and commitment in the project. iii. Continued USAID commitment for duration of project.
2 Develop a resistant cocoyam variety against root rot and for other desirable agronomic characters through cytogenetic and breeding studies.	2. 1. Availability of improved cocoyam variety resistant to root rot and having desirable agronomic characters. 2. Self sufficiency in high quality material for rapid seedstock mulplication at Ekona.	1. Field test of developed variety against available germplasm, IRA and project reports 2. Volume of improved seedstock at project site, IRA and project reports.	2. Assumptions for achieving purpose: 1. Availability of Tissue Culture facility. 2. Continued AID/IRA support and commitment for duration of project.
3. Assess the state of the Technology on Root and Tuber Crop storage, processing and utilization.	3. Diagnostic survey of root and tuber producers, manufacturers/processors and consumers.	3. 1. Survey Report and Recommendations 2. Original responses of survey instruments.	3. 1. Cooperation from MOA's Extension Staff, and MIDEVIV Field. 2. CRC's permission to conduct field interviews. 3. Cooperation from TLUs in the NCRE project.
4. Assist in the Institutional Development of IRA in Root and Tuber Crop Research.	4. 1. Completion of training for selected participants. 2. Equipped Tissue Culture and Agronomic Laboratory at Ekona Research Center.	4. 1. Number of participants under the project - project reports, IRA, reports. 2. Project and IRA reports on status of the laboratory. 3. Site visit.	4. 1. Release of candidates by CRC for training. 2. Availability of candidates with required qualifications for training. 3. Physical structure of Ekona to be renovated.

AID 1020-24(11-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: _____

Life of Project:
From FY _____ to FY _____
Total U. S. Funding _____
Date Prepared: _____

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Outputs: 1. Economically feasible rapid root and tuber seedstock multiplication technology.	Magnitude of Outputs: 1. Capability of Ekona Research Center to Produce sufficient foundation seedstock of cassava, yam and cocoyam. Sufficient seedstock for on-farm testing. 2. Capability of Ekona Center to produce sufficient seedstock for on-farm testing. 3. Capability of Ekona Center to supply seedstock sufficient to cultivate 10% of land area used for the crops.	1. i. Volume of foundation seedstock produced at Ekona Research Center as stated in Annual Reports for on-farm testing and farmers use. ii. Analysis of yield, cost, profitability and agronomic desirability of crops produced by the developed technology - on-farm results.	Assumptions, for achieving outputs: 1. i. Continued support and function of Ekona Research Center Facilities. ii. Continued support and commitment of the five-year funding requirement from USAID/GRC. iii. Availability of land and Cooperating farmers.
2. Economically, agronomically and socially desirable cocoyam variety or cultivar for the agro-ecological zones of nature resistant to Root Rot Blight complex.	2. Capability of the Ekona Research Station to produce sufficient cultivars for rapid [illegible] of multiplication [illegible].	1. Field and laboratory test of improved cultivars. Reports of Lab, on-station, and on-farm testing of developed varieties that are resistant to Root Rot and Blight complex. 2. [illegible] Records.	1. Continued support and function of Ekona Research Station. 2. Continued support and commitment of personnel and facilities at Ekona Research Station. 3. Commitment of the five-year funding requirement from USAID/GRC. 4. Access to reports/[illegible] of breeding work done by [illegible] and IRA on cocoyam.
3. a. Constraints and opportunities in storage, processing and utilization of Root and Tuber Food Crops in Cameroon. b. Potential researchable problem to improve the storage, processing and utilization of Root and Tuber Food Crops.	1. Detailed analysis of the Root and Tuber Food Crop storage processing and utilization for the entire country. 2. Specific recommendations for on-farm storage, processing and utilization research needs on Root and Tuber Food Crops.	Final Report of the Diagnostic Survey.	1. Continued support and commitment of Njombe Research Centre staff for the project. 2. Commitment of funding requirement from USAID and GRC.
4. A. Six Cameroonians trained at the Graduate Level in USA. B. Short-term in-country and third country training courses conducted for 6 Cameroonians. C. Research Fellowships at U.S. Universities and Research Centers for 3 Cameroonians.	A. Four Cameroonians with Ms degree sponsored by the project. Two Cameroonians with Ph.D. under the project sponsorship. B. [illegible] specified short-term in-country and 3 country workshop courses. C. Successful completion of three Cameroonian fellows at U.S. Universities/Research Centers.	A. Certificates and transcripts from Universities. B. Certificates and Reports of training workshops. C. Communications/Reports from host Universities or centers. D. Project Reports.	1. Release of identified candidates for training by GRC. 2. Retentions of trainees in IRA.

AID 1020-28 (11-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: _____

Life of Project:
From FY _____ to FY _____
Total U. S. Funding _____
Date Prepared: _____

INPUTS	MAGNITUDE OF INPUTS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
I. AID 1. Technical Assistance 2. Short Term Travel 3. Language Training 4. Participant training 5. Commodities 6. Recurrent Cost 7. Other Costs 8. Contigency	I. AID ($5,799,981) 1. Technical Assistance ($2,707,317) 2. Short Term Travel ($2,531,157) 3. Language Training ($ 70,000) 4. Participant Training ($ 443,000) 5. Commodities ($4,851,343) 6. Recurrent Costs ($ 606,572) 7. Other Cost ($ 341,321) 8. Contigency ($ 527,271)	1. UMES and IRA Annual Budget Reports 2. Project Annual Reports	Assumptions for achieving goal targets: Input Assumptions 1. Availability of requested GRC counterpart personnel. 2. Required funding will be prov. on a timely basis. 3. Availability of Rental houses at Buea.
II. HOST COUNTRY 1. Personnel 2. Utilities 3. Participant Training 4. Laboratory Equipment 5. Vehicle Maintenance & Transpotation 6. Offices and Furniture 7. Land 8. In-country Travel 9. Contingency	HOST COUNTRY ($2,069,980) 1. Personnel ($1,084,280) 2. Utilities ($ 67,197) 3. Participants Trng ($ 34,500) 4. Laboratory Equip. ($ 135,485) 5. Vehicle Maint. ($ 309,343) 6. Office & Furniture ($ 118,000) 7. Land ($ 100,000) 8. In-country Travel ($ 27,629) 9. Contingency ($ 187,644)		

ANNEX E

PLAN OF WORK

BREEDING/SEEDSTOCK MULTIPLICATION

YEAR I

Responsible Officer		A	S	O	N	D	J	F	M	A	M	J	J
PM, COP, AB	1. Arrival of COP/Agronomist to set up offices and laboratory (mobilization)												
PC, PM, COP, AB	2. Approved construction and renovation begins commodity procurement in USA												
COP, PMC	3. Commodity Procurement (in Cameroon)												
AB, ABC	4. Establishment of Nursery for improved cultivators												
COP, PC, ABC, COPC	5. Selection of on-farm research sites												
[illegible]	6. USA Equipment arrives and unpacked												
AB, ABC, CONS	7. Equipment installation												
AB, ABC, CONS.	8. Installation of services to laboratory												
AB, ABC	9. Sterilized soil for green/screen houses												
AB, ABC	10. Assess cocoyam germoplasm at Njombe												
AB, ABC	11. Germplasm collection of cocoyam (National)												
AB, ABC, COP	12. Equipment tested after installation												
AB, ABC	13. Media preparation begins												
AB, ABC	14. Design of Seedstock multiplication on station												
AB, ABC	15. Design and construction of storage systems on station												
AB, ABC	16. Establishment of storage facilities for seedstock												
AB, ABC	17. Collection and establishment of improved cultivators of cassava and yam												
COP, AEC	18. Monitoring of Socio-Economic Activities												
AB, ABC	19. Cytogenetic studies of cocoyam germplasm												
AB, ABC	20. Selection among cocoyam germplasm for resistance [illegible]												

sponsible ficer		A	S	O	N	D	J	F	M	A	M	J	J
	YEAR 2												
AB, ABC	1. Initial multiplication mother seedstocks												
AB, ABC	2. Nursery Production												
AB, ABC	5. Selection of resistant cocoyam germplasm												
COP. AEC	6. Monitoring and Analysis of Socio-economic activities.												
	YEAR 3												
AB, ABC, COP	1. [illegible] of developed technologies												
AB, ABC	2. Breeding (Hybridization program) in cocoyam												
COP, AEC	3. Monitoring and Analysis of socio-economic activities												
AB, ABC	4. Multiplication of mother seedstock												
CONS-	[illegible]												

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Responsible Officer		YEAR 4	A	S	O	N	D	J	F	M	A	M	J	J
AB, ABC	1. Multiplication of seedstock													
AB, ABC	2. On-farm testing													
COP, AEC	3. Monitoring and Analysis of activities and data analysis (socio-economic)													
AB, ABC	4. Genetic studies on cocoyam and seedstock multiplication and storage													

	YEAR 5
AB, ABC, COP, AEC	2. [illegible] on-farm research of seedstock multiplication system
AB, ABC, COP, AEC	3. Recommendation of feasible storage
AB, ABC	5. Demonstration of results of on-farm research
COP, AEC	6. Monitoring and Analysis of socio-economic activities.
AB, ABC, COP, AEC	Recommendation of feasible seedstock multiplication system
CONS.	6 2ND EVALUATION

PLAN OF WORK

PARTICIPANT TRAINING

Responsible Officer		A	S	O	N	D	J	F	M	A	M	J	J
	YEAR 1												
IRA, COP	1. Identification and Selection of counterparts scientist				—								
PC	2. Evaluation of transcripts and placement of Tr. participants	—											
COP, PC	3. TR. participants depart for U.S. Universities			—	—								
PC	4. TR. Participants in training in USA						—						
COP	5. Training of technicians and instrumentation person at IITA						—	—	—	—	—	—	—
COP	6. Workshop in-country on orientation for the project									—			
	YEAR 2												
COP, PC	1. Training participants depart for US universities	—											
PC	2. Participants in training at US universities	—	—	—	—	—	—	—	—	—	—	—	—
COP, PMC	3. Third country training - technicians		—	—	—					—	—	—	
COP, PMC	4. In-country training						—						

Responsible Officer		A	S	O	N	D	J	F	M	A	M	J	J
	YEAR 3												
PC, COP, AB	1. M.Sc. trainees return to Cameroon for Thesis research												
PC	2. Ph.D trainees in [illegible] at US universities												
COP, PMC	3. Third country training												
COP, PMC	4. In-country training												
	YEAR 4												
COP, PC	1. M.Sc. trainees return to US to defend Thesis												
PC, COP	2. M.Sc trainees complete training and return home												
COP, AB	3. Ph.D. trainees [illegible] dissertation research in Cameroon												
COP, PMC	4. Third Country training												
COP, PMC	5. In-country training												
	YEAR 5												
COP, PC	1. Ph.D. trainees return to US to defend Dissertations												
PC, COP	2. Ph.D. Trainees complete training and return home												
PMC	3. In-country training												

PLAN OF WORK

STORAGE, PROCESSING AND UTILIZATION DIAGNOSTIC SURVEY

Responsible Officer	TASK	A	S	O	N	D	J	F	M	A	M	J	J
PMC	1. Request for short [illegible] survey team												
PMC	2. Selection of short term core survey team												
COP, AEC, AB, ABC	3. Identification and selection of research assistants												
PMC	4. Training of research assistants												
COP, AEC, AB, ABC	5. Identification and discussions with collaborating agencies in all provinces												
CONS, COP, AEC	6. Reconnaissance survey of survey universe-Adm offices												
CONS, COP, AEC	7. Development of survey instrument												
CONS, COP, AEC	8. Pre testing of survey instrument												
CONS, COP, AEC	9. Implementation of survey												
COP, AEC, CONS	10. Survey Data management												

YEAR 2

COP, AEC, CONS	1. Survey data management												
COP, AEC, CONS	2. Analysis of survey data												
COP, AEC, CONS	3. Identification of constraints and opportunities												
COP, AEC, CONS	4. Recommendation of potential interventions												
COP, CONS, AEC	5. Draft report												
COP, AEC, CONS	6. Discuss report with USAID and IRA												
COP, AEC, CONS	7. Final Report												

Legend

PM = Project Manager

COP = Chief of Party

AB = Agronomist/Breeder

PC = Project Coordinator

ABC = Agronomist/Breeder Counterpart

CONS = Consultants

AEC = Agricultural Economist Counterpart

PMC = Project Management Committee

ANNEX F

DETAILED PROCUREMENT PLAN AND WAIVERS
FOR AID FUNDED COMMODITIES

1. Responsibilities

UMES will be responsible for the project procurement and contracting. UMES will sub contract with Alabama A&M University and Florida A&M University to provide technical assistance to implement the Diagnostic Survey on storage, processing and utilization of root and tuber food crops.

UMES will provide the two longterm technical assistant services. All short term consulting will be provided through the three collaborating universities. In special cases where outside consultants have to be used because of some unique experience, such consultants' services will be contracted through any of the three collaborating universities.

All the other commodities under this project will be procured by UMES.

2. Source/Origin

Goods and services financed by AID under the grant, will have their source and origin in the United States and the cooperating country; except as AID may otherwise agree in writing. Ocean shipping financed by AID under the grant shall, except as AID may otherwise agree in writing, be done only on flag vessels of the United States or when shipment is under bill of lading issued by a U.S. flag carrier.

3. Shelf Items

Imported shelf items having their origin in the United States Geographic Code 000 can be purchased without restrictions, except for the limitation on the total amount available for local procurement. Shelf items having their origin in Geographic Code 941 countries are eligible for local cost financing in unlimited quantities, save for the limit on local procurement funding. Shelf items having their origin in any country included in Code 899 but not in Code 941 are eligible if the price of one unit does not exceed $5,000. For goods sold by units of quantity, e.g., tons, barrels, etc., the unit to which the local currency equivalent of $5,000 is applied is that which is customarily used in quoting prices. The total amount of imported shelf items purchased from countries included in Code 899 but not in Code 941 may not exceed $25,000 or 10% of the total local costs financed by AID for the project, whichever is higher; however, in no case will the local amount of such purchases exceed $250,000 without first obtaining a specific geographic source waiver. Procurements in excess of the limits will be authorized only as source waivers in accordance with the provisions and limitations of Africa Delegation of Authority No. 140, Revised, and any redelegation thereunder.

Imported shelf items produced in or imported from countries not included in Geographic Code 899 are i[illegible]ligible for AID financing.

Procurement of imported shelf items shall conform to good commercial practices, shall be at reasonable prices, and shall not be in a manner which conflicts with local laws and practices.

Shelf item procurement procedures must be spelled out carefully in the Implementation Letter(s) so there will be no confusion on the part of the GRC as to what type of items are authorized to be procured.

4. Delivery and In-Country Transport

All commodities imported specifically for the project will be shipped CIF Douala. In-country transport and insurance will be the responsibility of and paid for by the GRC. Suppliers will provide all risk marine insurance in the amount of 120% of the CIF of the commodities. AID's marking requirements for overseas shipments will be enforced.

5. Title of Commodities

Commodities imported under the project will be titled to the Ministry of Higher Education and Scientific Research.

6. Custom Clearance

It is the responsibility of IRA to initiate documentation required for customs exoneration prior to the arrival of goods in Douala and to assure that such documentation is made available to the freight forwarder in sufficient time to permit goods to be moved from port of entry promptly upon arrival.

USAID does not pay transportation costs beyond port of entry in Cameroon. The IRA is responsible for issuing an Order of Transit to its predetermined freight forwarder promptly upon commodity arrival to move such commodities out of the port of entry to its warehouse facilities and on to the appropriate project site.

7. Condition of Goods upon Arrival

It is the responsibility of IRA and UMES to inspect upon arrival and report, immediately thereafter, any shortages or damages so that appropriate insurance claim(s) can be initiated. In the event significant shortages or damages are encountered, UMES and IRA will employ the services of an independent surveyor to prepare and submit a written report.

8. Receipt and Utilization

IRA is responsible for the proper reception and clearances of incoming project commodities. Inspections of incoming shipments must be

made, and receiving documents shall be annotated with comments on evident or possible damages/losses.

Reports of damages/losses must be made promptly; if incoming cargo has been procured in the United States, the contractor must file a claim against the ocean carrier or freight forwarder(s) involved. Once the contractor has filed its claim, the carrier must await the filing and adjudication of the claim to permit IRA to acquire more information and particulars about the claim. In most cases where damages or losses are noted, a picture of the damaged commodity and/or its container is the best possible evidence to be presented. Receiving documents properly annotated, are valuable. If damages or losses are not noted on the documents, however, there would be little or no possibility of having a claim settled.

IRA and UMES are required to put into project use all commodities procured for the project within one (1) year of receipt; USAID/Cameroon will inspect utilization reports as a matter of course.

9. Commodity Summary

The following is a summary of commodities expected to be procured for project implementation. This list may be revised as necessary by the Contractor in collaboration with IRA and USAID/Cameroon.

All prices shown (with the exception of local procurement) are CIF Douala.

ATTACHMENT ONE

ACTION MEMORANDUM FOR THE MISSION DIRECTOR May 15, 1986

FROM: Samuel T. Scott, Acting Supply Management Officer

Subject: Cameroon Roots and Tubers Project, Request for a Source/Origin Waiver and for a Waiver of the requirements of Section 636(i) of the FAA

Problem: Your approval is requested for a waiver of procurement source/origin requirements from Geographic Code 000 (U.S. only) to Geographic Code 935 (Special Free World) and for a waiver of the requirements of Section 636(i) of the Foreign Assistance Act, to allow procurement of non-U.S. manufactured vehicles.

A.	Cooperating Country:	Cameroon
B.	Obligating Document	Project Authorization
C.	Project:	Roots and Tubers
D.	Nature of Funding:	Grant
E.	Description of Commodities	Four vehicles: One Caravan (Administration) One Pick-up - 1/2 tons, one mid-size saloon, one Landcruiser Field vehicle (4WD).
F.	Approximate Value:	$50,000
G.	Probable Origin:	Western Europe
H.	Probable Source:	Cameroon

Discussion: A five year Roots and Tubers Project is being undertaken by the United States Agency for International Development under the management of USAID/Cameroon. The project will be implemented by the University of Maryland Eastern Shore (UMES). It has been determined that the project will require an estimated five vehicles, for the first three years of its life to meet the transportation needs of the project technicians. A general description of the types of vehicles that will be required is given under item E. above.

Justification: The project will be based at Ekona, Cameroon and its implementation will carry project technicians to the rural and urban areas where the roads are rough. Travel to such areas will therefore require vehicles that resistant on rough terrain and for which spare parts and maintenance support exists locally. A recent vehicle survey conducted by the Supply Management Division of USAID/Cameroon has revealed that there are no U.S. manufactured vehicle dealerships in Cameroon at this time. Renault Cameroon, the only dealer on whom the Mission counted on in the past, has withdrawn from representation of U.S. manufactured vehicles. Local mechanics are unfamiliar with U.S. manufactured vehicles.

Handbook 1 Supplement B, Section 5B4a(7) states that a waiver may be granted if there are "such other circumstances as are determined to be critical to the success of the project objectives". The success of the Roots and Tubers project will depend largely upon the provision of adequate and reliable transportation.

Section 636(i) of the Foreign Assistance Act (FAA), as amended, provides that none of the funds made available to carry out the Act shall be used to procure motor vehicles unless they are manufactured in the United States, subject to waiver where special circumstances exist, in order to carry out the provisions of the FAA.

AID Handbook 1, Supplement B, Chapter 4C2d, provides that the Section 636(i) provision may be waived on the basis of present or projected lack of adequate service facilities and supply of spare parts for U.S. manufactured vehicles.

In view of the absence of service and spare parts for U.S. manufactured vehicles and the availability of spare parts and service capacity for vehicles of Code 935 origin, the special circumstances and criteria set forth above for a vehicle waiver are met.

You have authority under Africa Delegation of Authority No. 140, after consultation with a Regional Legal Advisor and a Commodity Management Advisor, to grant the waiver.

Recommendation: Since there is no dependable dealership in U.S. manufactured vehicles in Cameroon and considering the absence in Cameroon of facilities and personnel to maintain U.S. manufactured vehicles, it is recommended that you:

1. Certify that exclusion of procurement from free world countries other than cooperative country and countries included in Code 941 would seriously impede attainment of U.S. Foreign Policy objectives and objectives of the Foreign Assistance Program,

2. Determine that special circumstances exist which justify the waiver of the requirements of Section 636(i) of the FAA, as amended.

3. Approve a source/origin waiver from Geographic Code 000 to 935, to permit procurement of four (4) vehicles of non-U.S. origin, for subject project.

Approved_____

Disapproved_____

Date_____

VI. LIST OF EQUIPMENT FOR AGRONOMIC RESEARCH

Items	Quantity	Unit cost	Cost
IBM PC Model XT. (Scientist use with accessories)	1	6,000	6,000
Tractors - 65 HP	1	28,000	28,000
Plows - 4 PP	1	4,000	4,000
Discs - 25 feet	1	8,000	8,000
Cultivator - 13 feet	1	45,000	45,000
Irrigation system	1	75,000	75,000
Environmental Control Chambers	3	30,000	90,000
Air Conditioners (Lab)	4	1,000	4,000
Ovens	2	4,000	8,000
Deep Feezers	3	1,700	5,100
Balances (Electonic)	5	3,000	15,000
Scales	2	4,000	8,000
Sterilizers	2	25,000	50,000
Laminar Flow Hood	1	7,500	7,500
Cold Storage (walk-in for seed store)	1	40,000	40,000
pH meters	2	3,000	6,000
Water Bath/Shakers	2	2,000	4,000
Research Microscope	1	4,000	4,000
Stereo Microscope	1	1,800	1,000
35mm Camera	2	1,000	2,000
Slide Projector with accessories	2	2,500	5,000
Protective clothing	20	30	600
Polariod Camera	1	500	500
Duplicating Machine medium capcity with collator	1	3,000	3,000
Telex machine (or Services)	1	20,000	20,000
Soft ware for IBM PC/XT, eg. MSTAT SPSS, Lotus 123	-	-	4,000

Items	Quantity	Unit cost	Cost
Digital Calculator (Administration	3	150	450
Digital Calculator with mathematical/ statistical functions	2	150	300
Software for IBM/PC XT (Adminstration) eg. Visicalc condor		2,000	2,000
Large storage room (seedstock)	1	20,000	20,000
Mower	1	2,500	2,500
Water distillation apparatus	2	7,500	15,000
Quebec Colony Counter	1	1,000	1,000
Multi Magnetic Stirrer	1	800	800
Glassware coldbox	1	1,500	1,500
Beckman L8-80 Ultra Cetrifuge	1	12,000	12,000
Clinical Centrifuge (Table top)	1	510	510
Chemical Hood	1	4,600	4,600
Automatic Dish washer (for lab. glass & equip.)	1	20,000	20,000
Inberted microscope	1	22,00	22,000
Vortex mixer	1	200	200
Hot Plate	1	650	650
Microtome	1	4,500	4,500
Oil-less pump (vacuum)	1	850	850
Microware oven	1	650	650
Ultrafiltration apparatus	1	1,500	1,500
Magnetic stirrer	1	650	650
Laboratory Cart (glassware)	2	1,240	1,240
Service Carts	2	500	500
Pipet washer	1	375	375
Tube hanger (glassware)	1	300	300
Brushes (assorted)	1	450	450
Carboys (glass)	1 case	450	450
Carboys (clear platic)	1 case	350	350
Rubber tubings (assorted)		280	280
Rubber clips	1 box	120	120
Rubber stopper (assorted)	1 box	230	230
TC media			7,500
Thermometers (Regular/Digital)			5,000
Filter paper for filtration	10	825	8,250

Items	Quantity	Unit Cost	Cost
Glassware (assorced)		7,500	7,500
Timers	6	125	750
First Aid Kit	4 boxes	250	1,000
Chemicals and Reagents		8,750	8,570
Electicity stabilizers(lab)	4	1,250	1,250
Voltage reducers	10	400	4,000
Filters for sterilizers	4 boxes	350	1,400
Filter holders	2	450	900
Microbiological supplies for bacteriology	1	1,500	1,500
Nursery supplies and equipment		2,330	2,330
Subtotal			609,785
5% Inflation*			30,489
Total			640,274

VII. CONSTRUCTION FACILITIES

Screen house for disease indexing	1	25,000	25,000
Greenhouse Renovation		6,500	6,500
Renovation of Tissue Culture Lab. including fixtures			15,000
Subtotal			46,500
10% Inflation			4,650
Total			51,150

* These commodities will be procured during the first six months of the project, hence inflationary changes are expected to be very minimal. Also the price in the US markets are relatively stable.

VIII.

A. VEHICLES (YEARS 1 to 3)*

Caravan (Administration)	1	8,000	8,000
Pick-up Truck - 1/2 ton	1	12,000	12,000
Mid-size Station Wagon	1	12,000	12,000
Toyota Land Cruiser(field vehicle)	1	18,000	18,000(year 1)
Toyota Land Cruiser(field vehcile)	1	18.000	18,000(years 2)
			68,000

B. VEHICLES (YEARS 4 & 5)

Caravan (Administration)	1	9,680	9,680
Mid-size Station Wagon	1	15,870	15,870
Toyota Land Cruiser (4 WD.)	2	23,805	47,610
			73,160
		TOTAL	141,160

IX.

RENTAL OF TWO HOUSES AT BUEA

Y1	Y1	Y2	Y3	Y4	Y5	TOTAL
House Rental**	16,680	18,348	20,183	22,201	24,421	101,833
Maintenance [1]	4,170	4,587	5,046	5,550	6,105	25,458
Guards [2]	5,838	6,422	7,065	7,772	8,549	35,646
Utilities [3]	4,170	4,587	5,046	5,550	6,105	25,458
TOTAL	30,858	33,944	37,340	41073	45,180	188,395

* Vehicles are to be replaced by the end of year 3.

** There is 10% inflation adjustment per year.

[1] Maintenance is 25% of Rental/year.

[2] Guards is 35% of Rental/year.

[3] Utilities is 25% of Rental/year.

X. STORAGE, PROCESSING & UTILIZATION SURVEYS

(1)	5 Research Assistants will be hired for 4 months. at a rate of $,420/person/month 5 x 420 x 4	8,400.00
(2)	Transportation Expenses (Fuel, Lubricants etc)	15,000.00
(3)	Stationery etc.	2,000.00
		25,400.00

XI.

RECURRENT COST

	Y1	Y2	Y3	Y4	Y5	TOTAL
(1) Book, Journals Publications	1,000	1,000	1,000	1,000	1,000	5,000
(2) Office supplies & Expenses (10% Annual Increase)	6,000	6,600	7,260	7,986	8,785	36,631
(3) Incountry Travel Local Support Staff (5% Inf.)	6,480	6,804	7,145	7,507	7,167	35,103
(4) Incountry Travel Prof. Staff (5% Inf.)	40,632	42,664	25,000	26,250	27,562	162,108
(5) Gasoline & Lubriciants (10% Inf.)	12,000	13,200	14,520	15,972	17,570	73,262
(6) Vehicle Repairs, Maintenance & spare parts	22,500	29,400	30,700	28,658	29,908	141,166
(7) Research Supplies (10% Inf. D)	8,000	8,800	9,680	10,648	11,712	48,840
(8) On-Farm Research	-	12,000	12,600	9,000	9,450	43,050
(9) Vehicle Insurance	6,000	8,160	6,460	8,779	8,779	38,178
(10) Misc. Admini-	2,000	2,000	2,000	2,000	2,000	10,000
TOTAL	104,612	130,628	116,365	117,800	123,933	593,338

XII. HOUSEHOLD & OFFICE APPLICANCES FOR 2 U.S. TECHNICIANS

Items	DESCRIPTION OF ITEM	Quantity	Unit Price	Total Cost
1.	FREEZERS CHEST, CB150 15.3 CU. FT. 220/230 V 50 CYCLES WITH ACME TRANSFORMER	1	515.70	1,031
2.	REFRIGERATORS, STANDARD 220/236 V, 50 CYCLES 13.9 CU. FT.	2	406.70	813
3.	CLOTHES WASHER GE Model WW A5412 220/230 V 50 CYCLES	2	444.40	889
4.	CLOTHES DRYERS, G.E. AUTOMATIC, MODEL DD E5 211	2	332.60	665
5.	RANGES, GAS, HARDWICK, CC961W 70W' STANDARD LP OR NATURAL GAS, MATCHLESS, 220/230 V 50 CYCLES	2	328.30	657
6.	AIRCONDITIONERS AMANA, 113-5N, 12800 BTU, 220/230 V, 50 CYCLES	6	516.10	3,097

XII. HOUSEHOLD & OFFICE APPLICANCES FOR 2 U.S. TECHNICIANS

Items	DESCRIPTION OF ITEM	Quantity	Unit Price	Total Cost
7.	TRANSFORMERS, STEP DOWN, 100 WATTS	2	56.15	112
8.	TRANSFORMER COMMODITY, 1,500 WATTS	2	56.15	112
9.	TYPEWRITERS IBM	2	1,500.00	3,000
10.	RUG-COP'S OFFICE (15' X 12')	1	253.00	253
11.	OFFICE FURNITURE	4 sets	3,400.00	13,600
12.	RECEPTION OFFICE FURNITURE	1 set	2,000.00	2,000

ETHAN ALLEN HOUSEHOLD FURNITURE FOR 2 U.S. TECHNICIANS

Items	DESCRIPTION OF ITEM	Quantity	Unit Price	Total Cost
13.	TRANSITIONAL HOUSE C, 3 BEDROOM UNIT, LR, DR. BR 1, 2, AND 3, COLOR SCHEME 1	2	10,232.22	20,464
14.	RUGS, 9' X 12'	2	164.00	328
	RUGS 12' X 15'	2	253.00	506
	Subtotal			47,527
	5% Inflation			2,376
	Total			49,903

COMMODITY SUMMARY:

LAB. Research Equipment	
Construction Facilities	640,274
Vehicles	51,150
Household and office appliances and furnishings	141,160
	49,903
	882,487

WAIVERS (See Attachment One)

1. Source/origin waiver is requested for one fourwheel drive Landcruiser, one Pickup Truck, one Caravan, and one mid-size Sedan	50,000

Note: Waivers are requested only for those vehicles to be procured during year 1. Future vehicles procurement waivers would be requested as and when it becomes necessary in year three.

ANNEX G

SUB-CONTRACTS BETWEEN THE CONTRACTOR AND OTHER 1890

UNIVERSITIES COLLABORATING IN A CONSORTIUM

The Universities of Maryland Eastern Shore, Alabama A&M University and Florida A&M University are mutually interested in collaboration in international education and development in the area of food, agriculture, nutrition and rural development; and

The three universities have cooperated on an informal basis to further these interests and now desire to record here their mutual understanding in this regard.

The purpose of this Memorandum of Understanding is to further the following objectives:

1. To develop cooperative and collaborative activities in furtherance of the common interests of the three universities.

2. To develop education, research and international development activities as may be of mutual interest to the institutions.

3. To enlarge and strengthen the capacities and capabilities of each university through the cooperative use of Human Resources materials and facilities which are supportive of mutually agreed to programs.

The collaborators now therefore do hereby record their understanding for the conduct of a specific project in Root and Tuber Crops in the Republic of Cameroon through a collaborative grant from AID.

A rather simple, yet serviceable, sub-contract document will be used to formalize the financial and performance details between the University of Maryland Eastern Shore, Florida A&M and Alabama A&M universities.

A draft copy of the general format for such a document is reproduced below. This document may be adjusted to meet specific conditions that the Collaborators might experience in the performance of tasks required under this grant.

SUB-CONTRACT

THIS SUB-CONTRACT, made and entered into this_____day of_____ 19_____, by and between the University of Maryland Eastern Shore, hereinafter referred to as the "Contractor" and

_____

hereinafter referred to as the "Subcontractor";

WITNESSETH THAT:

WHEREAS, the Contractor has entered into a collaborative agreement with the United States Agency for International Development (AID/Cameroon) a copy which is attached hereto and incorporated herein by reference and hereinafter referred to as the "Grant Agreement" and;

WHEREAS, the said Grant Agreement and the Contractor's proposal provides for the participation of collaborators in the performance of the Contract, and;

WHEREAS, the Subcontractor is prepared to provide services in support of Contract performance to meet the primary needs of the Government of the Republic of Cameroon in the Institute of Agronomic Research (IRA), including research on rapid seedstock multiplication of Root and Tuber Crops diagnostic survey of processing and product development for Root and Tuber Crops, technical assistance, training, and institutional development;

NOW THEREFORE, the parties hereby mutually agree as follows:

The Subcontractor shall provide, within the financial limits of the project the following services:

I. A&M university representative will serve on the State Side Management Committee and the Executive Committee as outlined in the project proposal.

II. The sub contractor shall provide the services of

_____
_____
_____
_____
_____
_____
_____
_____

III. The period of performance for this Subcontract shall be from_____ through_____ unless modified or terminated as hereinafter provided.

IV. Funds will be made available to the Subcontractor by the Contractor on a cost-reimbursement basis in a total amount not to exceed $_____. Invoices shall be prepared in accordance with the budget categories shown in the budget and consistent with AID accounting procedures and submitted to the Contractor's office at UMES not more frequently than monthly.

V. Any changes in rates of pay for Technical Assistance Personnel in Cameroon or USA or other charges which affect the Subcontract budget should be approved in advance by the Contractor's Project Manager at UMES with approval by AID as may be required before it becomes legal.

VI. Technical Assistance personnel, while serving under this Subcontract shall be responsible to the Contractor's designate representative (Chief of party) for their activities in accordance with performance requirements of the Contract.

VII. Termination of this Subcontract may be effected by either party hereto or as provided by the Collaborative Agreement. Should Subcontract termination be anticipated, notice must be provided as far in advance as possible, but with the exception of termination for the convenience of the Government of the Republic of Cameroon or USAID, notice must be provided at least sixty (60) days in advance of the intended date of termination. Costs incurred by the Subcontractor to the date of termination shall be allowable as they would have been, had the Subcontract not been terminated. In the event of termination for convenience of the Government of Cameroon or USAID, the applicable Contract provisions will govern.

VIII. Modification of this Subcontract shall be by numbered supplements executed by both parties hereto and approved by the Executive Committee as provided by the project proposal.

IX. All provisions of the Contract shall be applicable to the Subcontractor as they are to the Contractor and in the event of dispute, Contract provisions shall govern.

IN WITNESS THEREOF, UNIVERSITY OF MARYLAND EASTERN SHORE AND_____ A&M UNIVERSITY, EACH Acting through its respective and duly authorized representatives, have caused this Agreement to be signed in their names and delivered here in_____ on _____ day of _____ 198,

University of Maryland Eastern shore:_____ A&M University:

_____	_____
NAME	NAME
_____	_____
TITLE	TITLE
_____	_____
DATE	DATE