Proj. No. 9310601 C

PD-AAF-189-B1

PROJECT STATEMENT

March 5, 1973

A. PROJECT SUMMARY

30 p.

1. Statistical

Project Title:	Crop Production and Land Potential of Benchmark Soils of Latin America (This proposal is a geographical extension of and is linked to a similar proposal submitted by the University of Hawaii).
New or Extension:	New Project
Contractor:	University of Puerto Rico College of Agricultural Sciences Department of Agronomy Mayaguez Campus Mayaguez, Puerto Rico 00708
Principal Investigator:	Dr. F. H. Beinroth
Duration:	Three years, subject to 2-year extension
Total Estimated Cost:	$969,238

969
180
1149

Funding by Fiscal Years:

1974	-	$ 194,886	585,072
1975	-	390,186	
1976	-	384,166	
1976		180	

Add'l funds recommended PVPTC ac 3/23/76

Project Specialist: Tejpal S. Gill, TA/AGR

2. Narrative

This proposal pursues A.I.D. objectives to expand the information on management of tropical soils to increase food production. It has two principal goals: (1) to correlate food crop yields with soil properties on a network of benchmark soils of the tropics, and (2) to test and establish soil criteria for the transfer of agrotechnology among tropical countries. It is intimately linked with a parallel project developed by the University of Hawaii as regards rationale, approach and methodology, but focuses on Latin America.

Crop production and soil management experiments will be carried out on carefully selected benchmark soils in two South American countries, and in Puerto Rico. Sorghum and cassava will be the main test crops, but corn, pigeon peas, forage and root crops will be added to conform to local needs.

The benchmark soils will be selected on the basis of similarities in their classification and their importance as land resources. Soil classification is employed on the rationale that the family category of the U.S. Soil Taxonomy is proving a useful means for the transfer of agrotechnology in temperate regions, but has not been tested for the tropics. The network of benchmark soils will be established in deep, red upland soils (Ultisols and Oxisols) because these soils are inadequately utilized in most tropical countries but have shown to be highly productive in Puerto Rico and Hawaii.

During the proposed project's initial duration of three years it is planned to establish the network of experiment sites and carry out crop and soil management experiments. Research results from these Latin American experiments and those from Africa, Asia and Hawaii will be evaluated to determine relationships between crop production, management and soil properties. These data will be related to the practical needs of farmers and government planners, and the results will be disseminated through seminars and field demonstrations.

It is anticipated that the study will demonstrate the considerable agricultural potential of deep, red upland soils. It should further establish the feasibility of employing soil classification in the process of transfer of agricultural knowledge in the tropics. By virtue of linkages with other A.I.D. contracts, and national and international institutions (CIAT, ICA, IICA), the work will contribute to the efforts of many research institutions working on agricultural problems of the tropical world.

B. EXPANDED NARRATIVE STATEMENT

1. Proposal Description and Background

a. Proposal Description

Yields of several food crops, namely sorghum, cassava, corn, pigeon peas and possibly root crops will be correlated with land potential and properties of tropical upland soils under conditions of different levels of management. Sorghum and cassava will be used to provide uniformity with the experiments carried out by the University of Hawaii in Africa and Asia. Corn, pigeon peas and root crops were selected

because of their importance as food crops in Latin America. Forage is included on the assumption that pasture will be a major future land use in the more remote areas of South America, and because Puerto Rico has established an excellent reputation in the management of tropical forages.

To achieve a uniform basis of comparison, the crop studies will be carried out in a series of linked-parallel experiments on soils which are classified in similar soil families of the USDA Soil Taxonomy. The location of the experiment sites will depend on the results of the initial soil investigations. It is anticipated that in addition to Puerto Rico, two suitable benchmark soils can be established in either Venezuela, Colombia, Peru, Brazil, or in the Dominican Republic.

The results of the crop experiments and the soil studies will be evaluated to establish those soil parameters which must be taken into account for a successful transfer of agricultural knowledge within the tropics. In particular the validity of soil families as defined in Soil Taxonomy will be scrutinized, as this level of classification provides a sound basis for extrapolation in the temperate zone.

The technically coordinated investigations to be carried out by the Universities of Hawaii and Puerto Rico in Africa, Asia, Hawaii, Puerto Rico and South America will constitute the nucleus of this proposal. With the cooperation of related A.I.D. research contracts and national and international research institutions, the original network of benchmark soils may be extended to other areas in the tropics in later phases of the study.

b. Background

The population growth rate for Latin America averages about 2.9% and is highest for the countries located in the tropical part. If these demographic trends continue, the population is expected to double in approximately 25 years.

In view of advances in agronomy and South America's vast land resources, meeting the basic food and protein needs for the growing population is a real possibility. However, a large portion of the land resources available for future development is made up of deep, red, acid soils of low natural fertility. These soils have so far proved difficult for most people to manage. This fact is documented by the "UN Conference on the Application of Science and Technology for the Benefit of Less-Developed Areas" (Geneva, 1963), and in the recently published "Soils of the Humid Tropics" (National Academy of Sciences, 1972). The magnitude of the problems of managing tropical soils was also discussed by several speakers during the Fourth Latin American Congress of Soil Science held in Maracay, Venezuela in November 1972.

An appreciation of the potential of these deep, red upland soils under different levels of management is indispensable not only to assist local farmers to insure basic food needs, but also to plan a modern agricultural development and to create the progressive rural structure proposed by Mosher (1969). The study of this group of soils was, therefore, chosen as a project target.

The extrapolation of agricultural experience from temperate regions to the tropics has met with varying success. The transfer process should, therefore, be primarily within the tropical regions. But no evidence has yet been obtained to determine the extent to which agricultural technology can be transferred. However, there are indications that soil classification constitutes a valuable tool for the complex process of technology transfer.

The now completed Soil Taxonomy has been developed over the past 20 years by the Soil Conservation Service of the USDA with active cooperation of the Land-Grant Colleges and scientists in foreign countries. It is by far the most comprehensive and precise soil classification system yet developed. Soil Taxonomy is a multi-category scheme in which each category reflects a different level of generalization. The fifth subdivision of the system is the soil family. Soil families are differentiated primarily on the basis of properties important to the growth of plants, and attempt to provide relatively homogeneous groups with respect to soil-water-root relationships. Therefore, soils classified into the same soil families should have essentially the same management practices and similar potential for crop production. This points to the importance of classifying soils at the family level. Reasonably direct transfers of agricultural knowledge should be possible within common families, and maximum production results of one soil should be achieved for all soils in the same family.

This concept is proving successful on the U.S. mainland, and limited testing in Hawaii indicates that it can also be used in the tropics. But more extensive investigations are needed to substantiate the validity of family criteria for purposes of agrotechnology transfer in tropical soils.

2. Significance to A.I.D. Objectives

It is one of the major A.I.D. objectives to support research which will effectively accelerate agricultural and rural development in the less-developed countries. Within this framework, studies aimed at improving knowledge regarding the management of tropical soils to increase food production is of particular interest to A.I.D.

This proposal is centrally related to these objectives because its basic concern is to increase food production through transfer of agrotechnology within the tropics. The study proposed attempts to effectively demonstrate the potential of important soil resources in a manner intelligible to the farmer and convincing to government officials. This is anticipated to be of immediate impact at the small farmer's level, and to have long-term implications for the governmental planning of agriculture and infrastructure development.

The proposal's goals further are in concert with A.I.D. objectives to incorporate improved management practices into national, regional and international programs. In cooperation with the University of Hawaii, research results from experiments carried out on a network of benchmark soils in tropical Asia, Africa, South America, and Hawaii and Puerto Rico will be interrelated. Through linkages with national and international research institutions, and A.I.D. projects and missions in these countries, the experiences could readily be disseminated.

3. Relation to Existing Knowledge

Estimates of the amount of South America's potentially arable land vary between a conservative 30 percent (Bramao, 1962) and an exceedingly high of 90 percent (Pawley, 1972) of its total surface. More realistic estimates consider about 70 percent, or roughly 12 million square kilometers, arable (Beek and Wright, 1971). At present, some 4.4 percent or 0.76 million sq. km. are under cultivation.

An analysis of the soil map of South America indicates that, assuming a high population growth rate (2.7%) and a five-fold yield increase per surface unit during the next hundred years, the 70 percent of the surface of South America which is considered suitable for intensive cultivation could feed the South American population twice the diet of today, and in addition another 13 percent of the world population living in parts of the world where land resources are more limited. Required, however, are an annual increase of the cultivated area of 3 percent and a yield increase per surface unit of 1.6 percent per year (Beek and Wright, 1971).

For tropical South America it is estimated that more than nine-tenths of the total area reclaimable have major land development problems; apart from drainage mainly fertility constraints. These soils are mainly Oxisols and Ultisols, the deep, red, acid upland soils selected for this study.

To assess the soil resources in more detail, active soil survey programs are being carried out at varying degrees of accuracy and at different scales in most of South America (Costa de Lemos, 1971). In

many countries, notably, Colombia, Peru and Venezuela, efforts are being made to classify the soils according to the U.S. Soil Taxonomy. However, analytical data are as yet not sufficiently complete to allow placement at the family level which is critical for agricultural considerations.

It is proposed to assemble the missing criteria and establish the classification at the family level for important soils in Brazil, Colombia, Peru and Venezuela. This will greatly improve the agronomic value of the local soil maps and enhance the correlation with soils from other countries.

In addition to the agricultural experience that has accumulated over many years of experimentation in Puerto Rico and Hawaii, there exists a considerable body of pertinent knowledge in Latin America, as indicated by a recently published review of soils research in Latin America (Sanchez, 1972). It is one of the major objectives of this proposal to prove the possibility of transferring agricultural research results within the tropics and thus render this information directly useful to farmers and governments. This constitutes, in essence, a shortcut to accelerated agricultural development.

4. Relation to Other Research

This proposal is technically closely coordinated with a parallel study developed by the University of Hawaii. It forms part of an interlocking research program on tropical soils supported by A.I.D. contracts: North Carolina State University has two contracts; one related to agronomic-economic research on tropical soils (AID/csd-2806), and one on international soil fertility evaluation (AID/la 646). Cornell University is investigating soil fertility requirements of tropical soils under contract AID/csd 2490. Close cooperation with these projects is anticipated.

This proposal differs from the projects mentioned above in that it is of regional character and attempts to establish a basis for the transfer of research results from specific experiment sites to wider areas throughout the tropics. It thus forms an important link between agronomic experimentation and its extensive, practical application. For example, the results expected to materialize from the proposed study should help to delineate the areas in Latin America where the findings obtained by Cornell University in Puerto Rico under contract AID/csd 2490 will likely be applicable.

This proposal complements the College of Agriculture's AID/211(d) grant. Conversely, this grant will allow drawing on the expertise of the A.I.D. University Consortium on Soils of the Tropics consisting of Cornell University, University of Hawaii, Prairie View A & M College, and the University of Puerto Rico.

The proposal is further related to two FAO activities: Regional FAO/UNDP Project (LAT 70/32) centering on soil and water resources of Latin America, and Regional FAO/UNDP Project (LAT 70/457) dealing with evaluation and management of the soils of the Amazon region.

The research carried out at national and international institutions in Latin America, in particular CIAT, ICA, and IICA, is highly pertinent to the work of this proposal. The University of Puerto Rico maintains relations with these institutions, and their cooperation in selecting soils and crop varieties is assured.

For assistance in soil selection national soil survey institutions, the World Soil Geography Unit of the Soil Conservation Service, USDA, and FAO will be consulted.

5. Proposed Work Plan

a. Scope of Work

The work will correlate food crop yields, soil properties and different soil management practices on deep, red upland soils in several locations in Latin America. Through the research carried out by the University of Hawaii, the network will be extended throughout the tropical world.

Sorghum and cassava will be grown at all locations to provide comparable data for technology transfer within the network. Corn, pigeon peas, forage and possibly root crops will be added because of their importance in Latin America.

The main objectives of the crop experiments are (1) to determine soil productivity under different levels of management, (2) to determine optimum plant populations for local conditions, and (3) to test if soils from different regions but belonging to the same soil family respond predictably and similarly to the same treatments. (Details of the experiments are given under Research Methodology.)

The main series of experiments will be conducted at three benchmark locations; one in Puerto Rico and two in South America, either in Colombia, Venezuela, Peru or Brazil. In addition, a number of satellite locations will be established in the same country as the benchmark site or in neighboring countries. These locations will carry fewer experiments with locally important food crops. The objective of these experiments is to serve as demonstration plots for local farmers and to test the transferability of experience from the benchmark location.

The choice of the countries with benchmark locations will depend on the results of the initial soil investigations, particularly the availability of common soil families. The soils selected should further constitute important land resources. It is expected that the work will be conducted in Oxisols and Ultisols because they are very extensive in tropical South America. Puerto Rico and Hawaii have two common soil families of these soils and it will be attempted to match these families in South American Oxisols and Ultisols.

To produce the desired land potentials, capabilities and transferability information, soils, yields, management and climatic data will be processed by multivariate analysis.

Dissemination of the results obtained will be primarily in the respective countries through field days for farmers and, at a higher level of sophistication, for government officials and professionals. Participation in some of the seminars to be organized by the University of Hawaii will insure internal communication.

A.I.D. Missions, national and international institutions will be asked to cooperate by assisting with the collection of soils and environmental data, crop variety selection, arrangements with governments and with the dissemination of results.

b. Program of Work

Initial Phase (July 1973-June 1976)

Item	Starting Date	Expected Completion
First Year		
1. Compilation of soil maps and environmental data of Latin America; establishment of contacts	July '73	Oct. '73
2. Collection and analysis of soil samples to determine family classification of selected areas	Nov. '73	June '74
3. Determination of sites for crop experiments; experimental design	June '74	June '74
4. Participation in Meeting on Crop Production and Intensive Management in Hawaii	Jan. '74	Jan. '74

5.	Workshop on Crop Production and Agrotechnology Transfer in Puerto Rico	March '73	March '74
6.	Recruitment of staff, selection of fellows for graduate studies at UPR-CAAM	July '73	June '74

Second Year

7.	Preparation of experiment sites, installation of climatologic equipment, uniformity trials	July '74	Dec. '74
8.	Field experimentation in Puerto Rico and three Latin American countries	Jan. '75	June '75

Third Year

9	Continuation of field work at benchmark locations	July '75	April '76
10.	First assessment of experiment results, calculation of regression equations, preliminary computation of land potential.	April '76	June '76
11.	Compilation of agronomic data from other Latin American research centers	Jan. '76	June '76
12.	Selection of satellite locations in other Latin American countries.	June '76	June '76

Extension Phase (July 1976 - June 1978)

Continuation of field work at benchmark sites and expansion to satellite locations; re-design and modification of experiments as necessary.

Completion of field work; establishment of relationships between soil parameters and land potential; preparation of report on crop production targets and transferability of agrotechnology; economic analysis.

Workshops, seminars and field days for dissemination of results to local farmers and government officials.

Compilation of all experiment results and collection of agronomic data from other research institutions of Latin America; preparation of handbook on management of soils studied.

6. Research Methodology

a. Selection of Soils

A comparative study of soil and climatic maps will be conducted to delineate probable areas of interest. Initially these efforts will be concentrated on Colombia, Venezuela, Peru and possibly Brazil. These countries have active soil survey programs and should be able to provide most of the information needed at this stage. The World Soil Geography Unit of the Soil Conservation Service, USDA, and the FAO Regional Office in Chile will be consulted for international correlations.

Extensive soil sampling and detailed field and laboratory investigations will be necessary to obtain the information needed to classify the soils at the family level. These studies are crucial to determine the soils to be included in the network of benchmark soils for linked-parallel experiments on food crop production. This work will be carried out mainly by resident project personnel. The determinations will include such physical, chemical and mineralogical soil parameters as particle size, bulk density, aggregate stability, water retention, buffer curves, pH, delta pH, N, OM, CEC, Ca, K, Mg, P, Fe, Al, zero point of charge and clay mineralogy.

The data will be coded according to a program developed by the University of Hawaii and entered into a Soil Data Bank. Yield and capability descriptions will be obtained wherever possible and will be included in the data bank. This will allow a first comparison between soil families and production levels.

With this information available, benchmark soils and their location will be determined. For the selection of sites A.I.D Missions, national and international research institutions such as CIAT, ICA and IICA will be consulted. The soils to be designated as benchmark soils of the network should be classified into the same families and should

also be of importance as land resources. On these benchmark soils a series of linked-parallel food crop production experiments will be carried out.

b. Crop and Soil Management Experiments

To achieve uniformity within the worldwide network, these experiments will be identical to those carried out by the University of Hawaii in Africa, Asia and Hawaii. They will follow the recommendations of the Panel on Volcanic Ash Soils in Latin America (1969) in having standard, simple experimental designs and will include the determination of important meteorological parameters such as daily rainfall, temperature and sunlight, in addition to the soil characteristics mentioned above.

The following food crop experiments at the major sites will have durations of three to four years and will provide a basis for evaluation of the transferability of agronomic experience:

- Studies to determine the potential productivity of soils under different management inputs;

- Studies to evaluate the performance of individual crop species under continuous cropping throughout the year.

The potential productivity of soils at each location will be determined with an N x P x K experiment to allow correlation with soil parameters and evaluation of transferability of agricultural technology. The aim is to attain maximum or near-maximum production with appropriate levels of these nutrients under optimum management conditions, i.e., adequate irrigation, adjusted pH levels, plant protection (weed, disease and insect control), and plant population.

Under these conditions the soil-potential as well as local climate become the limiting factors and can thus be evaluated. Since N is often considered the most limiting nutrient in tropical soils, a minimum of three and possibly more N levels will be included at each location depending on the crop. Soil analyses will be used to guide the levels of P, K, and Mg at each site so that comparable soils will be evaluated at essentially the same levels of these nutrients. Soil pH values will be adjusted to correct Al-toxicity.

Soil P will be evaluated with different methods, including the P sorption isotherm method of Fox and Kamprath and soil levels will be adjusted to about 0.10 ppm P in solution, if they are not at this level. The 0.10 ppm P levels are required to produce maximum yields in many crops. Similarly, levels of K, and Mg for maximum growth will be determined by different methods suitable for tropical soils developed at the University of Hawaii and will serve as guides for differential rates of these nutrients. All fertilized plots except those mentioned below will receive a blanket application of micronutrients including Zn, B, Cu, Mo and others considered essential for the soils and crops used.

The experimental design will be an augmented block with the basic 2 x 2 x 2 factorial replicated at least three times and the other treatment combinations unreplicated. This will allow data for regression analysis as well as provide information on interactions between the variables tested. There will also be a complete control plot which receives no fertilizer at all, but is irrigated and otherwise treated as the fertilized plots. This treatment will serve as an indication of the "natural potential" for the soil without fertilizer and will be compared with similar plots in other soils. In addition, a plot will be given the highest fertilizer combination but will not be given the blanket micronutrient fertilization to allow a preliminary evaluation of possible micronutrient problems in the soil. These two plots will be incorporated at random in the experiment.

A second set of experiments testing various levels of management will be installed at the major sites. The objective of this experiment is to demonstrate the increase in yield potential with improved management practices. Practices to be compared are different tillage intensities, irrigated vs. non-irrigated, limed vs. unlimed, and plant protection vs. no plant protection. These practices will be maintained at two fertility levels, no additional fertilizer vs. the highest level of fertility used at that site. All treatments will be replicated three times in a split-plot design with irrigation levels as the whole plots. Local farmer practices will be included as a comparison, and for purposes of demonstration.

A third set of experiments designed to determine the optimum population for various crops will be installed at the major sites. These will have several population levels at the highest level of fertility under irrigated and non-irrigated conditions and will be replicated three times if needed. These experiments will be coupled with a study concerning the optimum time of planting.

A series of crops as mentioned above is to be grown at each of the major locations. The cropping cycles will be arranged so that a particular crop will be grown in the same season at all locations, i.e., due to locations being north and south of the equator, a particular crop grown in the spring in the North will be grown in the comparable spring in the South which may be 4-6 months later. Crops will be planted in succession, with as much overlap as possible to capitalize on the principle of multiple cropping and to provide the farmer with a number of alternative crops in a year so that should one fail, he will not be without some crop production for the year. The continued rotation of crops with seasons will also provide information on the optimum cropping period for various species, as well as species adaptability to several seasons of cropping.

In the forage experiments the technology package developed by Vicente-Chandler and co-workers (1964) in Puerto Rico will be applied. These experiments will serve to verify and demonstrate the Puerto Rican experience.

A fourth experiment will evaluate production of major crops studied throughout the year under conditions of continuous cropping and intensive management. Each of the crops will be planted repeatedly or allowed to ratoon, in the case of sorghum, so that the optimum season for production can be determined and problems associated with production in various seasons evaluated.

Plot size in many of the experiments will be about 20 x 30 ft. or 600 sq. ft., therefore, about 3 acres per major site will be required for this series of experiments. It would be desirable to have a total of 6 acres available for ancillary experiments that appear necessary and also for storage sheds and other light structures.

In order to test information obtained at the major sites, experiments will be installed at "satellite" locations. These are rural locations of similar soils on which simple experiments would be installed for farmer benefit.

Through the use of modern methods of data processing, correlations between crop yields and soil properties and production functions for crops in relation to many soil and management factors will be developed, using methods similar to those develoed by Voss and Hanway and other workers. The results of the experiments, when combined with the soil family data, will provide the information required to establish the extent to which agricultural technology is transferable and to develop the land potential and capability units for phases of soil families in different tropical regions.

7. Research Competence

The University of Puerto Rico's Mayaguez Campus has established itself as one of the leading universities and research institutions located in the tropics. It has excellent facilities for both field and laboratory work and has one of the world's finest libraries in tropical agriculture; it is Latin America oriented in research as well as culture.

This project will be carried out in the Department of Agronomy of the College of Agricultural Sciences at the University's Mayaguez campus. Overall direction of the project will be the responsibility of Dr. F. H. Beinroth, Associate Professor of Soil Science. Other members of the research team will include; Dr. H. Lugo, Soil Fertility Specialist; Mr. R. Pietri, Professor of Agronomy; Dr. G. L. Spain, Professor of Agronomy; and Dr. B. G. Capo, Professor of Statistics. Curriculum vitae of the principal investigator and his team are attached as Appendix C.

8. Contribution to Institution Building

To implement the creative approach to accelerate agricultural development in the tropics which the project proposes, it will work through the strengths of national and international research institutions such as CIAT, ICA, IICA. The seminars and workshops to be held at these centers should lead to increased soil-based research along the lines that this proposal suggests.

The University of Puerto Rico will be substantially strengthened by the project. The staff will gain greater insight into the problems of tropical agriculture and will increase its knowledge through contacts with other research scientists. This expertise will in turn greatly strengthen the University's AID/211(d) contract and thus significantly contribute to the quality of teaching at the University. The Soil Conservation Service of the USDA stands to benefit from this proposal because it will test the criteria employed in the U.S. Soil Taxonomy. It is recognized that the classification of the soils to be studied here (Oxisols) is far from completion. The findings of this study are, therefore, expected to be of great value to the authors of Soil Taxonomy.

The project's results will further be of interest to FAO because these findings will provide the basic data needed to evaluate the usefulness of the recently published FAO/UNESCO Soil Map of South America for agricultural development planning.

9. Utilization Plans

The results of the proposed work will serve as a vehicle to demonstrate that transition from the traditional to modern intensive agriculture can be made systematically and efficiently by means of technology transfer from one tropical region to another. In this case the transfer is based on taxonomic classification at the soil family level.

The key to utilization of the results will be a clear understanding of the methodology of transferability or applicability by national scientists and administrators. To facilitate their understanding there will be at all stages an intimate working relationship between the LDC scientists involved in the project and the University of Puerto Rico participating scientists. Not only will the actual results be stressed but, more importantly, their implications in transfer of the involved technology to the same and closely related soil families within a particular area.

It will be apparent that a basic knowledge of soil resources is a requirement for effective utilization of the results. Consequently, delineation of the relevant soil families becomes a requirement. In some cases such information will be available, in other countries additional soil survey/classification will be required. However, national involvement in this activity is important in characterizing one of the country's most valuable natural resources. This project can serve as a stimulus and rationale to move ahead expeditiously to classify soils down to the family level. The cost of such survey would be small in relationship to the anticipated benefits derived. It will create a pipeline through which agricultural technology could be transferred "wholesale" for an LDC for years to come and that, too, in a most economical way.

Every possible means at the disposal of the contractor will be utilized to alert and assist the LDCs to understand, accept and promote this methodology on both a national and regional basis.

10. Budget Analysis

An estimated yearly budget in expanded form is attached as Appendix B. A summary is given below:

	FY 1974 ($000)	FY 1975 ($000)	FY 1976 ($000)
Salaries and Wages	88	161	178
Fringe Benefits	14	27	29
Overhead Charges	41	74	82
Consultants	-	1	2
Travel and Transportation	17	10	13
Supplies and Services	13	47	42
Publication and Information Dissemination Costs	1	2	5
Equipment	21	48	13
Fellowships	-	20	20
TOTAL	195	390	384

The relatively small budget for FY 1974 covers expenditures for starting experimental work at one Puerto Rican site and selection and preparation for two sites in Latin America. About 70 professional man-months and 18 non-professional man-months will be required to do this job. During FY 1975 work will be initiated at two sites in Latin American countries and the work force of 140 professional man-months and 125 non-professional man-months for the three sites will be at full strength for the project.

The cost of publications and information dissemination which increases gradually over the years is perhaps somewhat low in totality, considering the number of planned satellite studies of the project.

11. Internal and External Reviews

The proposal has been reviewed and considered sound and promising by the TA/AGR Project Review Committee and the Inter-Bureau Technical Committee (Agriculture). Recommendations of the review have been incorporated into the proposal. The Latin America Bureau representative on the Inter-Bureau Technical Committee remarked that the proposal was very pertinent and of significance to that region. The project proposes a close working relationship with the international centers, particularly with CIAT, Colombia. After review of the proposal at A.I.D.'s request, CIAT has stated that its staff will be happy to collaborate on the project in any way possible and has invited the Puerto Rican scientists to visit the Center in this regard.

12. Proposing Office General Evaluation

TA/AGR is fully satisfied with the concept of the proposal and the capability of the University of Puerto Rico to handle the program. The proposal has high probability for technical success. It is envisioned that information produced by the project will set a basis for rapid technology transference and thus the development of land resources of various countries. Perhaps the suggested methodology could very well be considered as a forerunner to an agricultural sector analysis study of a developing country.

During the third year and thereafter, the emphases will shift more from gathering basic information to that of data transference, training and dissemination workshops for the cooperating countries. At its conclusion the project will leave behind a number of established research stations, with trained professional and non-professional staff, that are affiliated with local institutions.

Based on the interest expressed by the Latin American Bureau as well as other regions and overall opportunities for high pay-off, TA/AGR strongly recommends that this project be given high priority for approval and funding beginning in FY 1974.

Attachments

Madison Broadway

Omer J. Kelley, Director
of Agriculture

Tejpal S. Gill

Tejpal S. Gill
Project Specialist

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1. BUDGET SUMMARY BY YEARS

Budget Category	Initial Funding			Total	Extension Funding		Total
	Year 1	Year 2	Year 3	3 Years	Year 4	Year 5	5 Years
DIRECT COSTS							
Salaries	87,800	160,800	178,300	426,900	181,600	186,200	794,700
Fringe Benefits (16.5% of salaries)	14,487	26,532	29,420	70,439	29,964	30,723	131,126
Consultant Fees		1,000	2,000	3,000	1,000	2,000	6,000
Non-Expendable Equipment	20,500	48,000	13,000	81,500	15,000	2,000	98,500
Expendable Equipment and Supplies	13,500	47,500	41,500	102,500	46,500	38,000	187,000
Travel and Subsistence	17,000	10,000	12,500	39,500	8,000	9,000	56,500
Publication and Utilization costs	1,000	2,000	5,000	8,000	5,000	10,000	23,000
Fellowships		20,000	20,000	40,000	20,000	20,000	80,000
TOTAL DIRECT COSTS	154,287	315,832	301,720	771,839	307,064	297,923	1,376,826
INDIRECT COSTS							
(Overhead, 46.24% of salaries)	40,599	74,354	82,446	197,399	83,972	86,099	367,470
TOTAL CONTRACT FUNDS	194,886	390,186	384,165	969,238	391,036	384,022	1,744,296

2. ANALYSIS OF DIRECT COSTS FOR FIRST THREE YEARS

Budget Category	Year 1 M-M*	Year 1 Costs	Year 2 M-M	Year 2 Costs	Year 3 M-M	Year 3 Costs	TOTAL
SALARIES							
Project Leader	12	18,000	12	18,500	12	19,000	55,500
Assistant Soil Scientist	12	13,500	12	14,000	12	14,500	42,000
Soil Chemist	9	12,000	12	15,000	12	15,500	42,500
Assistant Chemist	9	9,000	12	12,500	12	13,000	34,500
Agronomist	3	4,000	12	15,000	12	15,500	34,500
Associate Agronomist			12	14,000	12	14,500	28,500
Agricultural Economist	3	4,000	3	4,500	6	7,500	16,000
Programming & Statistical Staff	6	5,000	4	3,500	6	7,500	16,000
Research Assistants	12	6,500	48	27,000	48	28,000	61,500
Administrative Assistant	6	4,500	12	9,000	12	9,500	23,000
Draftsman	6	3,300	6	3,500	6	3,500	10,300
Secretaries	12	5,000	24	10,300	30	13,300	28,600
Non-Professional Field Staff			84	12,000	96	15,000	27,000
Student Help (hourly wages)		3,000		2,000		2,000	7,000
Subtotal-Salaries		87,800		160,800		178,300	426,900
FRINGE BENEFITS (16.5% of salaries)		14,487		26,532		29,420	70,439

*M-M = man-months

ANALYSIS OF DIRECT COSTS (Cont. 2)

Budget Category	Year 1 Days	Year 1 Costs	Year 2 Days	Year 2 Costs	Year 3 Days	Year 3 Costs	TOTAL
CONSULTANT FEES							
Soil Scientist					10	1,000	1,000
Agronomist			10	1,000	10	1,000	2,000
Subtotal - Consultants				1,000		2,000	3,000
NON-EXPENDABLE EQUIPMENT							
Office Equipment		4,000		4,000		1,000	9,000
Laboratory Equipment		10,000		4,000		2,000	16,000
Field Equipment		2,000		25,000		10,000	37,000
Motor Vehicles		4,500		15,000			19,500
Subtotal - Non-Expendable Equipment		20,500		48,000		13,000	81,500
EXPENDABLE EQUIPMENT AND SUPPLIES							
Books and Periodicals		1,500		500		500	2,500
Office Supplies		3,000		2,000		1,000	6,000
Agricultural Supplies		2,000		20,000		15,000	37,000
Scientific Supplies		5,000		5,000		5,000	15,000

ANALYSIS OF DIRECT COSTS (Cont. 3)

Budget Category	Year 1 Costs	Year 2 Costs	Year 3 Costs	TOTAL
Expendable equipment and Supplies cont.				
Other Supplies and Services (rental, utilities etc.)	2,000	20,000	20,000	42,000
Subtotal-Expendable Equipment and Supplies	13,500	47,500	41,500	102,500
TRAVEL AND SUBSISTENCE				
Domestic Travel	2,000	3,000	3,000	8,000
Foreign Travel, Project Staff	8,000	6,000	8,000	22,000
Foreign Travel, Consultants		1,000	1,500	2,500
Meetings and Workshops	7,000			7,000
Subtotal - Travel and Subsistence	17,000	10,000	12,500	39,500

ANALYSIS OF DIRECT COSTS (Cont. 4)

Budget Category	Year 1 Costs	Year 2 Costs	Year 3 Costs	TOTAL
PUBLICATION AND UTILIZATION COSTS				
Publication Costs	1,000	2,000	2,000	5,000
Utilization Costs			3,000	3,000
Subtotal - Publication and Utilization Costs	1,000	2,000	5,000	8,000
FELLOWSHIPS		20,000	20,000	40,000
TOTAL - DIRECT COSTS	154,287	315,832	301,720	771,839
INDIRECT COSTS*	40,599	74,354	82,446	197,399
TOTAL-CONTRACT FUNDS	194,886	390,186	384,166	969,238

* Overhead costs, 46.24% of salaries

CURRICULUM VITAE

APPENDIX C

NAME

Friedrich H. Beinroth

TITLE

Associate Professor of Soil Science

DEGREES

1961	B.S.	University of Stuttgart, Germany
1963	M.S.	University of Stuttgart, Germany
1963	Ph.D.	Univerisity of Stuttgart, Germany

FIELDS OF SPECIALIZATION

Soil genesis and classification, soil-geomorphology

EXPERIENCE

1963 - 1964	Nov. - May	Soil Surveyor with Sudan Government
1964 - 1965	July - Febr.	Graduate Assistant in Soil Science, University of Stuttgart, Germany
1965	March-Oct.	Postdoctoral fellowship with the Soil Conservation Service, USDA
1965 - 1966	Nov.-Jan.	University of Stuttgart, Germany
1966 - 1971	Feb.-July	Assistant Soil Scientist, Agricultural Experiment Station, University of Puerto Rico, Rio Piedras, P.R.
1971 - present		Associate Professor of Soil Science, College of Agriculture, University of Puerto Rico, Mayaguez, P.R.

SOCIETIES

Soil Science Society of America
International Society of Soil Science

INTERNATIONAL TRAVEL/FOREIGN EXPERIENCE Kenya, Nigeria, Sudan, Uganda Dominican Republic, Jamaica, Mexico, Venezuela, Germany, Italy, Netherlands

PUBLICATIONS: 13 (see formal proposal for details)

CURRICULUM VITAE

NAME

Raúl Abrams

TITLE

Chairman and Professor Department of Agronomy and Soil Science

DEGREES

1950 B.S.A. College of Agriculture, University of P.R.-Mayaguez

1956 M.S. Iowa State University

1963 Ph.D. Iowa State University

FIELDS OF SPECIALIZATION

Plant Breeding and Crop Production

EXPERIENCE

1951 Research Assistant Agronomist, Agricultural Experiment Station, University of Puerto Rico.

1957 Assistant Plant Breeder, Agricultural Experiment Station, University of Puerto Rico.

1963 Associate Plant Breeder, Agricultural Experiment Station, University of Puerto Rico.

1967 Plant Breeder, Agricultural Experiment Station, University of Puerto Rico.

1969- Present
Plant Breeder and Chairman and Professor, Department of Agronomy and Soil Science, University of P.R., Mayaguez.

SOCIETIES

American Society of Agronomy
American Society of Hort. Science
Caribbean Food Crop Society
American Society of Hort. Tropical Region

Gamma Sigma Delta
Phi Kappa Phi
Sigma Xi

INTERNATIONAL TRAVEL/FOREIGN EXPERIENCE

Caribbean Islands, Latin America, Africa

PUBLICATIONS: 22 (see formal proposal for details)

CURRICULUM VITAE

NAME

Jose Badillo

TITLE

Assistant Agronomist

DEGREES

1960	B.S.	College of Agriculture and Mechanical Arts, Mayaguez, P.R.
1964	M.S.	Rutgers - The State University, New Brunswick, New Jersey
1971	Ph.D.	Rutgers - The State University, New Brunswick, New Jersey

FIELDS OF SPECIALIZATION

Soil Fertility

EXPERIENCE

1960 - present	Research work, Agricultural Experiment Station, University of P.R. Isabela Substation

INTERNATIONAL TRAVEL/FOREIGN EXPERIENCE

Panama
Far East

PUBLICATIONS: 3 (see formal proposal for details)

CURRICULUM VITAE

NAME

Bernando G. Capó

TITLE

Technical Consultant, Agricultural Experiment Station

DEGREES

1929	B.S.	University of Puerto Rico
1941	M.S.	Cornell University
1942	Ph.D.	Cornell University

FIELDS OF SPECIALIZATION

Soil Technology, Statistics

EXPERIENCE

1929-36	Analytical Chemist, Puerto Rico, Dept. of Agr.
1936-42	Assistant Chemist, Agr. Exp. Sta., U.P.R.
1942-43	Acting Head, Soils Department, Agr. Exp. Sta. U.P.R.
1943-44	Biometrician, Agr. Exp. Sta., U.P.R.
1944-48	Biometrician and Head, Agronomy Dept., Agr. Exp. Sta., U.P.R.
1948-50	Head Agronomy Dept. and Assistant Director, Agr. Exp. Sta., U.P.R.
1950-51	Acting Director, Agr. Exp. Sta., U.P.R.
1951-52	Assistant Director, Agr. Exp. Sta., U.P.R.
1966-present.	Technical Consultant, Agr. Exp. Sta., U.P.R.
1952-65	Associate Director, Agr. Exp. Sta., U.P.R.
1946-48	Technical Director, Ancram Paper Mills, New York.
1964-66	Project Manager, United Nations Special Fund Project (Agricultural Research Station, Damaseus, Syria).

SOCIETIES

American Statistical Association.
Institute of Mathematical Statistics.
International Society of Sugar Cane Technologists.
College of Chemists of Puerto Rico.
Sociedad Puertorriqueña de Estadísticas.
American Society of Agricultural Sciences.
Gamma Sigma Delta.

INTERNATIONAL TRAVEL/FOREIGN EXPERIENCE

Syria

PUBLICATIONS

: 10 (see formal proposal for details)

CURRICULUM VITAE

NAME

Héctor M. Lugo

TITLE

Assistant Professor

DEGRESS

1960	B.S.	College of Agriculture and Mechanics Art, Mayaguez, Puerto Rico
1962	M.S.	North Carolina State University at Raleigh, Raleigh, North Carolina
1972	Ph.D.	North Carolina State University at Raleigh, Raleigh, North Carolina

FIELDS of SPECIALIZATION

Soils Science

EXPERIENCE

1962 - present	Research and Teaching in Soils, College of Agriculture, University of Puerto Rico at Mayaguez

PUBLICATIONS : 5 (see formal proposal for details)

CURRICULUM VITAE

NAME

Rafael Pietri ✓

TITLE

Professor of Soil Science and Leader 211 (d) Grant Program

EDUCATION and DEGREES

1938-1942	University of Puerto Rico	B. S. A.
1946-1947	Texas A & M University	M. S.
1953-1955	University of Missouri	

FIELD of SPECIALIZATION

Soil Chemistry and Mineralogy

EXPERIENCE

1942	County Agent War Emergency Food Production Program
1943-1946	Member US Armed Forces
1947	Instructor, Faculty of Agriculture, U. P. R.
1950	Assistant Professor, Faculty of Agriculture, U. P. R.
1958	Associate Professor, Faculty of Agriculture, U. P. R.
1958	Consultant, Hydroponics Corporation for Food Production
1960	Professor, Faculty of Agriculture, U. P. R.
1971	Leader, 211 (d) Grant Program

SOCIETIES

American Society of Agronomy
Soil Science Society of America
International Society of Soil Science
American Society of Agricultural Sciences
Clay Minerals Society
College of Agronomists of Puerto Rico
Gamma Sigma Delta
Phi Kappa Phi

INTERNATIONAL TRAVEL/FOREIGN EXPERIENCE

West Indies - Dominican Republic, Trinidad, Barbados, Granada, St. Vincent
Venezuela
Africa - Nigeria, Kenya, Australia, Japan, Philipines, Taiwan

PUBLICATIONS : 5 (see formal proposal for details)

CURRICULUM VITAE

NAME

Geno L. Spain ✓

TITLE

Associate Agronomist - Professor

DEGREES

1951	B.S.	Texas Technological College, Lubbock, Texas
1956	M.S.	University of Wisconsin, Madison, Wisconsin
1961	Ph.D.	University of Wisconsin, Madison, Wisconsin

FIELDS OF SPECIALIZATION

Crop management, ecology and plant physiology

EXPERIENCE

1955 - 1958	Instructor in Agronomy, Texas Technological College
1958 - 1961	Research Assistant in Agronomy, University of Wisconsin
1961 - 1963	Range Conservationist (Research) Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado
1963 - 1964	Plant Physiologist USDA, ARS, Cheyenne, Wyoming
1964 - 1972	Associate Agronomist, Agricultural Experiment Station, University of Puerto Rico
1972 - present	Associate Agronomist - Professor, Agricultural Experiment Station, College of Agriculture, University of Puerto Rico

SOCIETIES

American Society of Agronomy

INTERNATIONAL TRAVEL/FOREIGN EXPERIENCE

Caribbean

PUBLICATIONS : 8 (see formal proposal for details)