

KPA 4-130
93/0/30-2
RBC Meeting
PD-MC-579-B1
March 13-14, 1972

PROJECT STATEMENT

Date: January 19, 1972 25p

A. PROJECT SUMMARY

1. Statistical

Project Title: Agronomic - Economic Research on Tropical Soils
AID/CSD-2806

Project Status: On-going

Contractor: North Carolina State University, Raleigh, N.C.
Department of Soils
P.O. Box 2907
Raleigh North Carolina 27607

Principal Investigators:

- Dr. C. B. McCants, Head, Soils Science Department ✓
- Dr. W. D. Toussaint, Head, Economics Department ✓
- Dr. E. J. Kamprath ✓
- Dr. R. K. Perrin
- Dr. P.A. Sanchez ✓
- Dr. S. W. Buol ✓
- Dr. R. E. McCollum ✓

Duration: Five years. Initial Authorization June 26, 1970

Total Estimated Cost: \$1,070,000

<u>Funding:</u>	FY 1971.....\$ 85,000
	1972..... 233,000
	1973..... 256,000
	1974..... 272,000
	1975..... 224,000

Project Manager: John L. Malcolm

Technical Monitor: Tejpal S. Gill

2. Narrative:

The first objective of this project is to make an agro-economic evaluation of soil-fertilizer yield response data already available and generated by this and related projects in the tropics. The second is to combine existing information permitting broader generalizations which are easier to apply to specific soil, crop and climatic conditions in the tropics and to test these generalizations in terms of yield response and economic return. The third is to conduct research to find solutions to fertility and management problems identified while working toward the first two objectives.

All of the field work done on this project will be in Latin America because this is the best location in which to work but has the soils, crops and social problems typical of a large portion of the tropical world. Local differences are not being either ignored or denied but principles worked out in Latin America can be applied by national institutions or international agencies to specific local problems.

Although high yields may be expected from the sunlight and moisture available in the tropics and are obtained in locations such as Hawaii under intensive management, the yields in most tropical areas are extremely low. Simple transfer of practices from one area to another has improved yields only marginally and has often proven to be unprofitable.

A thorough review of the research on tropical soils published over the last ten years, including monographs covering earlier research, has been conducted by specialists assigned to this project.

A new tentative grouping of soils has been suggested as a basis for fertilizer recommendations. This system of classification can be derived from existing soil surveys without further field work and supporting laboratory analysis.

Soils of great local potential and typical of wide areas in Latin America were examined and sampled in detail in Peru, Colombia and Brazil. Other countries were visited and plans for cooperative research worked out.

The data from potato experiments in Peru were used to develop a model, general response function, for determining the most efficient fertilizer management system.

One of the most important strengths of this project is its linkage with other projects and institutions. North Carolina State is one of five universities of the "University Consortium on Soils of the Tropics" NCSU also has the regional project "The Nutrient Needs of Soils of Latin America to Increase Crop Production" which is directed from the

Raleigh campus. Close liaison is maintained with Cornell and the University of Puerto Rico on their project on acid soils of the humid tropics. Interrelated activities are in progress or at least arranged with the Ministries of Agriculture in seven countries and the international research centers, CIMMYT, IITA, and CIAT.

B. EXPANDED NARRATIVE

1. Project Description and Background:

Low productivity is one of the most persistent problems of all of the developing countries and is particularly frustrating in tropical agriculture because of the inherent potential attested to by the native vegetation. One of the essential elements for raising agricultural productivity is improved soil management within the economic constraints of the site. To accomplish this the exact nature of the problem must be defined, the solutions found either within existing knowledge or through research, and the applicability of these solutions tested for physical possibility, cultural acceptability and economic feasibility. Once a valid system has been established for a given soil, crop and climatic area, it can be extended through generalization and adaptive research to new areas in Latin America and throughout the tropics.

The current project, authorized June 26, 1970, which builds on previous and concurrent work by the contractor and other institutions, has three major thrusts. The first is to gather existing data on both agronomic and economic factors affecting soils and crop management and the second is to explore the adaptability or adequacy of various generalizations so that information already obtained may be extrapolated. On the agronomic side, this will be attempted through a simplification of soil classification, grouping soils of widely different superficial characteristics into the least possible number of categories which segregated them according to their response to fertilizer. In the economic activity, attempts will be made to find the simplest models which will account for the productivity of a soil and management package permitting the optimizing of the inputs to reach specific economic goals for the producer and/or government. Research on specific problems will be guided by both agronomic and economic results.

Previous projects which provide a base for the present research and other on-going projects were the International Soil Testing Project AID/csd-287 with work in 14 countries and a bilateral project in Peru. The current Latin America Regional project, AID/la-646, is a direct out-growth of the former project. AID/csd-287, and is now wholly oriented towards service and research in Latin America. Further development of the contractor's research and teaching of tropical soil is

being supported by a 211(d) grant which was authorized in November, 1970. Four other universities, Cornell, Hawaii, Prairie View A & M, and Puerto Rico participate with North Carolina in the consortium which is being supported through 211(d) grants to develop and increase U.S. competence in tropical soils. All share with North Carolina State in a coordinated program. NCSU will be specializing in soil fertility and relating soil fertility to readily determinable soil characteristics, an element of the project under review. A closer tie is maintained with Cornell University through their research project on the acid soils of the humid tropics, AID/csd-2490.

The minutes of the Research Advisory Committee meeting April 1970 recording approval of this project state,

"Dr. Brady summarized the main objectives of the proposal as follows:

1. Agronomic-economic
2. Characterization of soil (chemical, mineralogical and physical properties)
3. Soil fertility - soil chemistry studies (nitrogen, phosphorus, lime, micronutrients)
4. Soil moisture.

This summary has been used in further discussion and final recommendations of the RAC.

Dr. Brady felt that the main thrust of this research should be put on the objectives 1 and 3. Some RAC members indicated that the project objectives are too broad; others expressed the view that the local research institutions should be closely associated with this project -- as a matter of fact, they should be considered prior to start of investigations.

Decision: Approval of the project without restrictions but suggested emphasis to be on objectives 1 and 3 and bringing in the objectives 2 and 4 as needed."

The project emphasis suggested by RAC was made explicit in the contract and has been a guiding principle in determining project activities and the relative effort devoted to each of these activities.

2. Progress to date:

The Annual Report for 1971 indicates that the basic objectives and the emphasis recommended by the RAC have been followed in operations of the project over the first eighteen months. Exploratory trips were made to Mexico, Guatemala, Costa Rica, Colombia, Peru, Brazil and Guyana by members of the project staff to discuss research opportunity and the needs which the project might fill with government and university faculties. Three international institutions, links in the world-wide research network, CIMMYT, IITA, and CIAT were contacted and their scientists helped in identifying Latin American institutions and individuals which could provide local cooperation in ecologically representative zones.

In starting the new project, sole dependence was not placed on experience of the North Carolina staff. An intensive review of the published research over the past decade was made systematically by specialists in various phases of soil science, soil characterization, both chemical and physical and soil reactions, soil use and management. To assist other scientists this search has been placed on record with over 1,000 abstracts which will be published.

A tentative simplified soil classification for use in fertility correlation work which comprises seven classes and ten subclasses has been worked out and will be tested against field data and experience. This could replace the thousands of series and textural classes which are used at present. This simplified physical and chemical classification is also preferable to land capability classification which has been tried previously because the proposed system is based on observable and measurable soil characteristics, most of which are already reported in a conventional series survey, but will not be dependent on economic factors which may change rapidly with development of new markets for high value crops, which may invalidate "capability" classification.

A major advance is reported in analyzing the economic implications of fertility experiments with potatoes in Peru. The results indicate that the greatest returns and the most certain, often come from radically high rates of nutrient use. On the basis of the Peru data, fertilizer recommendations based on soil testing are consistently better than those based solely on other criteria. The average increase in net return using soil test information was \$15 per acre. Indications are that the value of other inputs may be assessed from the system of analysis developed. This work will serve as a model and point of departure for subsequent economic research and to provide criteria for judging the adequacy of data for use in economic analysis.

Six representative profiles from the vicinity of Yurimaguas in the Amazon Jungle of eastern Peru were characterized by field observation and laboratory analysis. Seven profiles were examined and sampled in the Llanos Orientales of Colombia. Both chemical and mineralogical analyses were made on samples from these profiles. Similar studies were conducted on three profiles from the Llanos Orientales of Venezuela. Soils from the Campo Cerrado of Brazil were analyzed physically and chemically and studied for reactions to wetting, drying and possible clay transport. Special attention was paid to phosphate reactions, since it has been observed that phosphorous deficiency is one of the major fertility problems on these soils. Special studies on fixation of phosphates in the soils of eastern Mexico and the Llanos Orientales of Colombia were also used to compare the chemistry of these soils with the soils in North Carolina which have been studied very extensively. Similarities in the reactions of the soils from the three areas indicate that the bicarbonate soluble phosphorus provides a good index to the availability of P in all of these soils.

Agreements were worked out with the Government of Brazil and the technical officials in Colombia to begin active field work in these countries in cooperation with local Ministry of Agriculture stations. The director of the Inter-American Institute of Agricultural Sciences of the O.A.S. (IICA) has expressed interest in accommodating a project scientist at the Institute in Turrialba. This will be pursued in a site visit tentatively scheduled for January.

Eleven staff members of professional rank, three research assistants, a research technician, and a secretary have been assigned to the project full or part time. The most promising candidates have been identified for eight unfilled positions. The laboratories, equipment, library and computer have been made available to the staff as needed.

In summary, the objectives of the project seem to have been clearly defined and were acceptable to the RAC. The work to date represents significant progress toward project goals and arrangements for involvement of personnel in several countries are well advanced. This does not mean that all targets have been met or that no problems have been encountered. Problems remain, but the performance of the contractor and the achievements to date indicate more than satisfactory progress.

3. Relevance to AID Objectives:

Tropical soils remain one of the most difficult and elusive factors to control in agricultural production throughout the world. Sufficient food which will provide a nutritionally balanced diet to the lowest income persons of the world is a major goal of AID and the countries with which the agency is working. Production alone is not enough. Production must be achieved through practices and at locations such that the combined cost of growing and distributing food is within the consumers' ability to buy. All of the costs must be covered, including the incentive to the farmer to plant, the miller or other processor to prepare and the merchants to transport and sell the final product.

A productive agriculture generates both farm and urban employment. Higher yields require more labor in harvest, storage and transport. Farmers producing above their own minimum needs for subsistence provide food for the cities. City-ward migration in most countries preceded any substantial improvement in farming methods and is not likely to be halted by any labor intensive innovations which are introduced into agriculture. Men and women migrate from the farm to escape the animal drudgery. They also seek relief from long periods of unemployment which are the lot of the landless farm laborer and the farmers whose land has been subdivided into part-time garden plots. Productive agriculture will also provide a cash income, or its equivalent, to farmers. They may then buy goods and services in town providing more employment. This will be the means of livelihood for tractor mechanics, farm implement makers, dressmakers, cabinet makers, radio and TV builders, and service personnel. As surely as full employment is an AID and country objective, so is full productivity from each man and each acre devoted to agriculture.

4. Related Research:

The companion project "Soil Fertility Requirements to Attain Efficient Production of Food Crops on the Extensive Deep, Well-Drained but Relatively Infertile Acid Soils of the Humid Tropics", Cornell University, AID/csd-2490 is formally linked with this project.

This linkage is expressed in the supervisory role assigned to the senior soil scientist from the Cornell Project to be posted in Brazilia. It also is expressed in the division of labor, with Cornell working particularly on the agronomic and management aspects of the acid soils while NCSU is working more on economics and on the interpretation of classification and soil properties to plant nutrition in these acid soils and at other sites working the immature and near neutral soils.

The work under the 211(d) grant also forms part of this linkage. An up-coming trip to the International Institute of Tropical Agriculture, Ibadan, Nigeria will be in part to relate the work under this project to the work in Africa. Dr. Nichols, of IITA, was at Raleigh and discussing the Institute's program following the Project Review.

Much of the data to be used in this project has been or is being generated by the regional project, "The Nutrient Needs of Soils in Latin America to Increase Crop Production." As systems for improving recommendations are evolved they will be both tested and if advantageous adopted by the regional project.

Work done under the NCSU Peru Project on management of upland rice will provide a base for much of the work projected for Yurimaguas. The Oregon State "Control of Weeds Project in LDC's, contributed importantly to this work by supplying methods for control of weeds where mechanical control was impossible. It also pointed up the critical constraint which weeds impose on permanent agriculture in the tropics and the pressure which they exert toward slash and burn agriculture.

North Carolina has been making use of the special fertilizers developed for the tropics by the TVA. Some of the results obtained, again on upland rice have provided strong evidence that the present TVA project is too narrow in scope and should be replaced by one which will develop and test fertilizers on a range of tropical crops.

Cultivars of sorghum selected under the Purdue contract on genetic inheritance of protein characteristics will provide one source of material for testing aluminum tolerance and root penetration. These will also figure in the liming and phosphorous work undertaken by both North Carolina and Cornell.

Related projects are:

- ✓ 1. "Soil Fertility Requirements of Arid Tropical Soils", Cornell University, AID/csd-2490 - 931-17-120-505
- ✓ 2. "Control of Weeds in LDCs", Oregon State University, AID/csd-1442 - 931-17-130-463
- ✓ 3. "Capital Formation and Technological Innovation at the Farm Level in LDCs", Ohio State University, AID/csd-2501.
- ✓ 4. "Tailoring Fertilizers for Rice", TVA PASA RA(QA) 5-69 931-17-140-506
- ✓ 5. "Inheritance and Improvement of Protein Quality and Content in Sorghum Vulgare", Purdue Research Foundation AID/csd-1175 931-11-190-054
931-17-130-452
6. "Farm Equipment Development for the Production of Rice and Associated Crops", International Rice Research Institute, AID/csd-2541 931-17-130-443
7. "University Consortium of Soils of the Tropics", Cornell University, Grant AID/csd-2834; The University of Hawaii, Grant AID/csd-2833; North Carolina State University, Grant AID/csd-2835; Prairie View A & M College, Grant AID/csd-2836; The University of Puerto Rico, Grant AID/csd-2857.
931-11-120-129
931-11-120-127
931-11-120-130
931-11-120-126
931-11-120-128
8. "The Nutrient Needs of Soils in Latin America to Increase Crop Production", North Carolina State University, AID/csd-646 931-17-120-525

5. Scope and Methodology:

The field activities of this project will be limited almost entirely to Latin America for very practical reasons. Such a limitation is possible because soils which are typical of broad areas of the tropical world are to be found in Latin America. The results will be applicable in other regions as well. No matter which part of the world was chosen as the focal point, strict limitation of the project is necessary because of the limited budget and manpower available. Accepting the necessity of limitation, choosing locations in Latin America for field activities has many practical advantages. It is the region most accessible to the U.S. and therefore, the least costly in which to work. North Carolina State University has many years of

successful experience in Latin America providing both a sound technical base and professional contacts within the scientific community. Other on-going projects of the university in Latin America are complementary. Most of the senior personnel are fluent in Spanish and/or Portuguese and can communicate at a professional level without resorting to the use of interpreters or limiting their contacts to host country personnel who are fluent in English.

Experimental sites have been and are being located where they are accessible to host country personnel and usually relatively close to an established institution. Field work will be concentrated in the three areas which have been treated most thoroughly up till now, the Volcanic ash soils of Central America, the wet-dry savanahs of Brazil and the humid forest soils of the Amazon in eastern Peru.

Field work will be supported by laboratory analysis at Raleigh and to the extent facilities and manpower permit in the host countries.

For both the agronomic work and economic analysis heavy reliance will be placed on existing data both published and unpublished.

Now that the general response function model has been tested on the Peru data it will be applied to other cases as they are found and become available. Economic data will be used to guide experimental design.

6. Utilization and Dissemination of Project Results:

Since the project is only eighteen months old there has been little opportunity for utilization of the results obtained in this specific project so far. One staff member, Dr. Sanchez, presented a formal paper in the Seminar on Rice Policies in Latin America which included 300 planning, research and extension officials and rice growers from 30 countries. Meetings with various Ministry officials have served not only as planning sessions but also as ways to introduce both methods of approach and systems of management to cooperating officials.

Graduate students sponsored under the project have been drawn from the Ministries of Agriculture of the host countries and will be returning to them after their studies are completed. In the meantime the subjects for their research have been problems from their home country. In other words, the utilization is in part built into the on-going activities of the project.

7. International Cooperation:

This is truly an international project, although of necessity the

major efforts are concentrated in limited areas. Efforts have been concentrated on Peru, Brazil, Colombia, and Central America. Some work has been done on soils from Venezuela and Mexico. Cooperation has included CIMMYT, CIAT, and IICA, Turrialba. Drs. Sanchez and De Datta of IRRI recently completed a survey of the agronomic work with rice strengthening linkage with IRRI.

It now seems probable that one member of the project staff will be assigned to IICA on a full time basis to work with cooperating research groups throughout Central America and northern South America.

Project research planning, design and execution in Brazil will be done jointly with the Cornell and Brazilian Ministry of Agriculture staffs. The research will be initiated and checked periodically by teams on TDY from North Carolina but the more frequent monitoring will be by the Cornell agronomist assigned to Brazilia.

8. Evaluation of Contractor's Competence:

The Contractor has demonstrated a high degree of competence not only in conducting current work but in building further strength into his staff through exchange of personnel and recruitment of young scientists looking toward careers in tropical soil research. The staff members have demonstrated not only technical competence but also language proficiency which allows them to work effectively throughout Latin America. The physical facilities in Raleigh are among the best in the country and the similarity between the soils of North Carolina and the soils found in many tropical areas has provided an unusually strong base of relevant experience.

The interest in North Carolina in the tropics is long standing and continuing in this and other projects.

9. Work Plan:

The contractor has listed nine specific priority activities as follows:

- a. Economic analysis of crop responses via generalized response function. Additional existing data will be sought from four sources, and will be analyzed if found to be suitable for GRF analysis. The four sources are: response of rice in Peru; response of wheat in Bolivia and Peru; response of corn and cotton in Brazil; and response of corn in Central America.

- b. Testing the soil fertility classification scheme, aggregating information from existing soil surveys. A study has been made of the pertinent literature to determine the soil characteristics that have the greatest effect on soil test values and fertilizer response. Estimates have been made of the critical and definable limits for categories in a fertility capability classification system. The categories which evolved from this study will be tested to determine: uniformity of soil test critical level values; fertilizer application yield response uniformity; homogeneity of statistical and economic measures of fertility management generalizations. The classification criteria will continue to be tested and revised as new data become available through close cooperation with personnel on Contract AID/1a 646 and in cooperating ministries of agriculture and universities. A determination will be made on how the units of the various national and international soil taxonomic systems can be grouped in the fertility capability system so as to provide a working linkage with the presently available soil surveys in various countries.
- c. Determination of fertilizer nitrogen requirements to maximize production of food crops in the highlands and Pacific coastal lowlands of Central America. Field and greenhouse experiments will be established on several major soil groups representative of Central America to measure both the efficiency and requirements of nitrogen and sulfur fertilizer as influenced by method and time of application and climatic conditions.
- d. Describing the movement patterns of nitrogen in volcanic ash soils of Latin America in relation to the wet and dry seasons and the influence of position in the profile on availability to crop plants. Net nitrate movement during the wet and dry seasons will be monitored by placement of tracer substances at specific finite sites in the soil and sampling after short time intervals (a few days to a few weeks, depending upon the net rainfall). Several substances can be employed as tracers. A choice will depend somewhat upon the kind of soil and the local facilities for chemical analyses. Relative availability of nitrogen to crop plants from several vertical and horizontal positions in the root zones will be explored first by the use of nitrogen tracers. Investigations may also be made by depth placement of nitrogen in small plots, followed by crop yield and nitrogen absorption measurements.
- e. Determination of the secondary and micronutrient status of plants and soils of the volcanic ash region of the highland and Pacific coastal lowlands of Central America. A prelimin-

ary survey will be made of the major soil series developed from volcanic ash in the highlands and Pacific coastal lowlands of Guatemala. Site selection by topographic sequence within areas of the rural development program of GOG and USAID/Guatemala will be used when possible. Soil samples will be taken from the Ap, B, and C horizons of soils on which corn, dryland rice and other selected food crops are grown. Plant samples will also be taken at each site. Tissue concentrations of Zn, S and certain other elements in the plant will be correlated with those in the soil and compared with critical nutrient levels established for normal crop production to determine if the tissue levels indicate factors limiting plant growth. Field and greenhouse studies will be planned for problem areas in cooperation with appropriate host country personnel.

- f. Measurement of available potassium in volcanic ash soils as influenced by time of sampling. A number of volcanic ash soils will be selected which have tested high in available K but on which crops have responded to fertilizer K. Soil samples will be collected periodically. Half of the sample will be air dried and then extracted for K while the other half will be extracted at the field moisture content. Extractions will be made with distilled water, ammonium acetate, and with the North Carolina extractant $0.05 \text{ N HCl} + 0.25 \text{ N H}_2\text{SO}_4$.
- g. Study of certain fertility related properties, especially soil acidity and aluminum solubility, of soils of the "Campo Cerrado" in Brazil. Measurements of the effect of treatments on changes in nutrient level and availability, soil samples will be taken from experiments involving lime and phosphorus which were initiated about five years ago near Brasilia. Laboratory and greenhouse studies will be conducted on these samples to measure residual effects of these treatments on chemical, physical, and biological properties.

Planned fertility studies will be initiated on soils selected at the Ministry of Agriculture Experiment Station at Brasilia in distinct and definable geomorphic and stratigraphic positions so that the results may be extrapolated to other areas of the Campo Cerrado. These sites will be characterized to determine parameters which may vary with the wet and dry cycles and influence soil test results. Samples will be collected periodically during the year to determine the nature and magnitude of the wet and dry season influence on nutrient status and availability.

- h. Development of practices for management of humid tropical soils normally used in shifting cultivation. A cooperative arrangement with North Carolina State University has been proposed by the Peruvian Ministry of Agriculture under which they will provide a 450-hectare jungle site near Yurimaguas which possesses the soils and climate conditions that are representative of large areas of the upper Amazon Basin.

In addition to detailed soil characterization studies, long-term experiments will be initiated to monitor the changes in nutrient relationship with time under several cropping sequences or rotations. The main crops grown will be rice, pastures for beef and hog production, yucca, plantains, sorghums, and beans. The Ministry of Agriculture has indicated a willingness to provide the installations and to supply equipment, laboratories in Lima, counterpart professionals, and labor. The results should extrapolate to other areas with Ultisol, Alfisol and Inceptisol soils in the humid tropical jungles of Latin America.

- i. Aggregate implications of the adoption of fertilizer recommendations. Estimates of demand and of the supply of various input factors will be made, subject to the availability of data for the crops studied within this project. The direct implications of these estimates and fertilizer response estimates can then be determined.

WORK PLAN; ABSTRACT AND TIME TABLE

Project	Starting Date	Expected Completion
CENTRAL AMERICAN HIGHLANDS		
C-1. Nitrogen movement pattern in volcanic ash soils in wet/dry seasons	July '72	2.5 yrs.
C-2. Crop response to N in volcanic ash soils	June '72	2.5 yrs.
C-3. Crop response to P in volcanic ash soils	June '72	2.5 yrs.
C-4. Micronutrient survey and response in volcanic ash soils	Aug. '71	2 yrs.
CAMPO CERRADO (Brasilia)		
B-1. Nitrogen movement pattern in ustic oxisols	Aug. '72	2.5 yrs.
B-2. Phosphorus and liming studies in Campo Cerrado soils	Nov. '72	5 yrs.
B-3. Varietal differences in tolerance to acidity and drought	Aug. '73	2 yrs.
B-4. Micronutrient responses in Campo Cerrado soils (through Brazilian counterpart commitments)	Nov. '73	2 yrs.
UPPER AMAZON BASIN (Yurimaguas)		
Y-1. Pedological characterization of Amazon Basin soils	July '72	2 yrs.
Y-2. Forest: soil nutrient cycles	Sept. '72	3 yrs.
Y-3. Soil management in previous shifting cultivation areas	Aug. '72	5 yrs.
Y-4. Phosphorus and liming requirement in Amazon soils (through Peruvian counterparts)	Aug. '73	2.5 yrs.
Y-5. Varietal differences in tolerance to acidity and drought (through Peruvian counterparts)	Aug. '72	2 yrs.
RALEIGH CAMPUS		
R-1. Economic analysis of corn and rice responses in Peru	Jan. '72	Dec. '72
R-2. Economic analysis of wheat responses in Peru and Bolivia	Apr. '72	Dec. '72
R-3. Economic analysis of crop responses in Central America	July '72	June '73
R-4. Economic analysis of crop responses in Campo Cerrado	July '72	June '73

R-5. Aggregate implications of fertilizer demands of various crops in Peru	Dec. '71	June '73
R-6. Economic analysis of the fertility capability soil classification system	Apr. '72	June '73
R-7. The Fertility Capability Soil Classification System	June '71	June '73
R-8. Characterizing the fate of fertilizer P in soils of the three ecological regions	Nov. '71	Dec. '72
R-9. Soil acidity - aluminum relationships in soils of the three ecological regions	Nov. '71	Mar. '73
R-10. Mineralogical characterization of tropical Latin American Soils	Mar. '71	ongoing
R-11. Micronutrient disturbance characterization of soils of the three ecological regions	Aug. '71	Mar. '73

Expected status of projects by March 31, 1973

- C-1. Installation of equipment, measurements for one season
- C-2. Completion of first cropping season, planting of second
- C-3. Completion of first cropping season, planting of second
- C-4. Identification of limiting elements, initiation of field work

- B-1. Installation of equipment in two sites, one season measurements
- B-2. Installation of field experiment
- B-3. Germplasm collection prior to starting tolerance determinations
- B-4. Field observations only

- Y-1. Preliminary field work complete and part of analytical work
- Y-2. Measurements in situ for 4 months
- Y-3. Installation of experiments and preliminary data
- Y-4. Planning stage according to observations in Y-3
- Y-5. First crop complete. Preliminary results

- R-1. Completed
- R-2. Completed
- R-3. Near completion
- R-4. Near completion
- R-5. Near completion
- R-6. Recently initiated
- R-7. Evaluation system in Central American soils
- R-8. Preliminary results
- R-9. Preliminary results
- R-10. Results from experimental sites
- R-11. Primary identification complete for Central America

10. Project Management and Administration:

This project in tropical soils and economic research, along with the 211(d) institutional development program, the Technical Assistance Project--"Nutrient Needs of Soils in Latin America", and the NCSU Peru Project is an integral part of the agricultural research program of North Carolina State University. Under the direction of Dr. C. B. McCants, Head of the Soil Science Department, Dr. Sanchez is project leader and has been assigned responsibilities for the details of management and program coordination.

The economic studies are under the direction of Dr. Toussaint. Dr. Perrin is developing the analytical models, assembling and evaluating the field data and running the detailed analyses with the help of his assistants. Both economists are participating in the ongoing experimental program to assure the widest applicability of the data which is generated.

Continuing technical direction of various activities in soils will be provided by Drs. Sanchez, Buol, Kamprath and McCollum, each in his special area of competence. Within the framework of the project developed under Dr. Sanchez's leadership, each specialist will design his own program and direct the work of his assistants at Raleigh and in the field.

Additional senior staff support will be provided for both campus and field activities by members of the faculty as the need arises. Those whose services will most likely be needed have been identified and are provided for in the budget.

The full time Senior Scientist scheduled for assignment to Turrialba, Costa Rica, will be responsible to Dr. McCants through Dr. Sanchez but will of necessity work independently most of the time. Since his work will be coordinated with that of Ministry and University scientists throughout the region as well as those at IICA, no assistants will be assigned to him.

The junior scientists assigned to Brasilia and Yurimaguas will be responsible to the senior scientists in Raleigh with whom they designed their programs but will look to the senior scientists assigned under the Cornell University project to Brasilia and the Dr. Carlos Valverde, Head of the Soils Department at La Molina Experiment Station, for continuing technical support and such direction as may be needed on a day to day basis. All projected activities at Brasilia are contingent to the arrival of a Cornell Senior Scientist in July, 1972.

All of the activities will be coordinated with those of the host institutions. The program needs of the respective missions and the desires of the Regional Bureaus of AID will be taken in to consideration in both the planning and operation of the various phases of the project.

Staffing, Time Allocations and Assignments are summarized in the Table on the following page.

Staff Time Distribution and Salary
(Based on 24 days per month for full time)

Personnel	Man months pr. yr.	Estimated man-days/month - (tentative) 1972-73												Budgeted salaries		
		Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec	Jan	Feb	Mar			
RALEIGH:																
C.B. McCants	Soil Sci. Dept. Head	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4,417
P.A. Sanchez	Proj. Leader (fert & Mgt)	6	21	3	12	3	21	12	12	12	12	12	21	6	12	7,450
E.J. Kamprath	Fertility (P, liming)	4	6	4	4	24	4	6	6	4	6	8	8	24	4	7,530
S.W. Buol	Pedology	4	7	8	6	24	18	8	7	7	7	12	8	8	8	6,567
R.E. McCollum	Fertility (responses)	4	24	4	6	6	4	6	12	12	2	12	4	4	4	6,167
	Sen. Sci. (fert-capab.)	9	0	0	0	24	24	24	24	24	24	24	24	24	24	12,375
<u>Short-term advisors</u>																
W.V. Bartholomew	Soil organic matter															
F.R. Cox	Micronutrients															
G.A. Cummings	Fertility (perennials)	6	On Demand												8,000	
S.B. Weed	Soil chemistry															
L.A. Nelson	Statistics															
R.K. Perrin	Economist	2.3	4	4	4	12	4	4	4	2	2	2	2	2	2	3,422
	Research Assoc. (Econ.)	12	24	24	24	24	24	24	24	24	24	24	24	24	24	10,000
	Research Asst. (Econ.)	6	12	12	12	12	12	12	12	12	12	12	12	12	12	3,600
F. Stadler	Secretary	12	24	24	24	24	24	24	24	24	24	24	24	24	24	4,980
P. Patrick	Research Tech.	12	24	24	24	24	24	24	24	24	24	24	24	24	24	7,840
	Stat. Aide (Econ.)	12	24	24	24	24	24	24	24	24	24	24	24	24	24	6,344
Temp. Labor		6	-	-	24	12	12	12	12	12	12	12	24	12	12	2,400
OVERSEAS:																
	Sen. Soil Sci. (Cent. Am.)	12	24	24	24	24	24	24	24	24	24	24	24	24	24	22,000
	Jr. Sci. (Brazil)	8					24	24	24	24	24	24	24	24	24	4,800
	Jr. Sci. (Brazil)	8					24	24	24	24	24	24	24	24	24	4,800
	Jr. Sci. (Yurimaguas)	10			24	24	24	24	24	24	24	24	24	24	24	6,000
Temp. Labor																2,500
Total salary and wages (including overseas positions)															131,203	

The above is a projection based on seasonal events, teaching and domestic research obligations and predictable project demands such as reporting and work plan submission. The Brazil assignments are contingent on Cornell University placing a senior scientist in Brazilia under contract AID/csd - 2490.

11. Prior Year and Proposed Additional Funding

a. Data: Funding Schedule

Obligated:	7/1/70 through 3/31/72	\$339,000
Expenditures:	7/1/70 through 3/31/72	251,500
Budgeted:	4/1/72 through 3/31/73	266,000
	4/1/73 through 3/31/74	280,000
	4/1/74 through 3/31/75	240,000
	4/1/75 through 6/30/75	<u>32,500</u>
Total Cost:		\$1,070,000

Proposed Budget

April 1, 1972 - March 31, 1973

<u>Category</u>	<u>Allocation</u>
I. Salaries and Wages	\$131,203
II. Consultants	0
III. Fringe Benefits	17,682
IV. Overhead	52,250
V. Travel and Transportation	21,400
VI. Allowances	4,000
VII. Other Costs	
Communications, Data Processing, Computer Use, Language Training -	13,080
VIII. Equipment, vehicles, freight, etc.	26,000
IX. Participant Training	0
X. Subcontracts	0
	<u>\$265,615</u>

b. Budget Analysis:

The budget as proposed for 87 man months of professional service and 38 man months of non-professional service. Overhead is based on salaries only, not total budget. The cost for vehicles, equipment, supplies and freight amount to ten percent of the overall project, indicating that project funds are not being used by the contractor to equip his laboratories for other purposes. There is also a good mix of young and senior professionals on the staff keeping salaries, experience, physical energy and objectivity in good balance. This is a tight budget if all of the project objectives are to be met.

In the early phases of the project, spending fell considerably below the budgeted level. There have been a number of causes for this underspending. One was the cautious recruiting by the contractor, waiting until the best qualified man was available to join the contract.

Another cause has been difficulty in reaching agreement with all of the parties concerned in cooperative research. In some cases, four or more parties were directly concerned. Delay by one, such as USAID/Bogata, can hold up the field program for six or eight months. This points up the need for contingency planning, which is not conveniently done within the AID contracting format.

12. Internal/External Review:

The Review Committee found that the progress under this project has been satisfactory, based on the expenditures and the terms of reference. The shift in emphasis of the project giving added importance to field activities was in accordance with the original conception and very important. The integration of the economic and agronomic activities and the utilization of existing data to calculate general response functions to assist with interpretation, planning and recommendations was judged a very significant phase of the project.

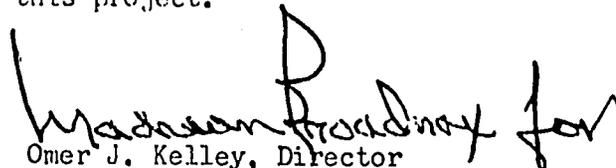
The Committee recommended strengthening of management control and defining more sharply the intermediate goals which might serve to measure progress towards the broad general goals of the project. Both of these recommendations have been followed in preparing the revised work plan and staffing pattern.

Finally, the Committee recommended that RIGC approve the project without change in objectives, scope or methodology and approved the work plan and budget as presented for 1972-73.

After the Committee Review at Raleigh, North Carolina, representatives of the Regional Bureaus met with Dr. Long, TA/RUR, and TA/AGR on January 18, 1972. The Review results were presented and there was a general consensus of agreement that many of the basic findings from this project are applicable to similar tropical soils throughout the world.

At the meeting of February 3, 1972, RIGC unanimously recommended submission of the project to RAC for approval as stated on the Project Summary.

On the basis of AGR review and evaluation, the findings of the Special Review Committee and the action of RIGC, TA/AGR recommends RAC approval for the continuation of this project.


Omer J. Kelley, Director
Office of Agriculture
Bureau for Technical Assistance

KPA 4-150
RAC Meeting
April 29-30, 1970

9. The Impact of New Agricultural Technology on Rural Employment and Income -- Cornell University
Duration: 3 years
Estimated Total Cost \$600,862
FY 70 Funds required \$ 60,902
Subcommittee: Drs. Ruttan, Hagen and Peterson

To remove any possible traces of conflict of interest, Dr. Brady asked Dr. Montgomery to chair the review and discussion of this research proposal; for the duration of which Dr. Brady left the conference room. Dr. Montgomery assumed the chairmanship and asked Dr. Ruttan to present the review of the subcommittee. After the review the RAC discussion centered around part 2 and 3 of the research proposal which according to the view of the subcommittee should receive the main thrust of this research. Also, strong suggestion has been made to limit the proposed investigation contained in part 1 of the proposal to about 10% of total efforts because, as the general consensus of RAC members indicated, the objective will not contribute significantly to the major problem to be investigated. For all concerned it was pointed out again that the first part of the project would address itself to "development of a theoretical macromodel for analysis of the relationship between economic growth and income distribution."

After a thorough discussion of the proposed project -- a discussion in which majority of the RAC members and AID staff participated -- Dr. Ruttan made the motion for approval.

Decision: Approved subject to reservation on objective 1 to bring proposal in line with statement in staff project summary.

10. Agronomic - Economic Research on Tropical Soils
North Carolina State University
Duration: 5 years
Estimated Total Cost \$1,070,000
FY 70 Funds required \$339,000
Subcommittee: Dr. Peterson, Chairman Dr. Brady and Dr. Milner

Dr. Brady assumed the chairmanship of the RAC and asked Dr. Peterson to present the subcommittee's evaluation of the project proposal. For the benefit of all present, Dr. Peterson recalled the activities and accomplishments of the North Carolina State University on project TA.AGF-031 (CSD-287 contract). Present research proposal is suggesting to tie-up the agronomic-economic aspects which are essential to the sound soil fertility program in Latin America and elsewhere. Considerable discussion ensued in which general agreement was reached on the significance of introducing economic evaluation of agronomic practices especially as pertaining to this proposal of soil fertility programs.

Dr. Brady summarized the main objectives of the proposal as follows:

1. Agronomic - economic
2. Characterization of soil (chemical, mineralogical and physical properties)
3. Soil fertility - soil chemistry studies (nitrogen, phosphorus, lime, micronutrients)
4. Soil moisture

This summary has been used in further discussion and final recommendations of the RAC.

Dr. Brady felt that the main thrust of this research should be put on the objectives 1 and 3. Some RAC members indicated that the project objectives are too broad; others expressed the view that the local research institutions should be closely associated with this project - as a matter of fact, they should be considered prior to start of investigation.

Decision: Approval of the project without restrictions but suggested emphasis to be on objective's 1 and 3 and bringing in the objectives 2 and 4 as needed.

Subcommittee report on site visit and project review

11. Water Management Research in Arid and Sub-Humid Lands of LDC's

As per RAC recommendation at its meeting on March 5-6, 1970, Drs. Revelle, Peterson, and Montgomery visited Colorado University to discuss thoroughly the project proposals. At the same meeting RAC approved the project for one year; the continuation beyond one year would be subject to review and approval by the RAC.

Reviewing the site inspection, Dr. Revelle gave the background of the project, its main goals and then stated that the subcommittee suggests the following guidelines:

1. Colorado State should attempt to concentrate its efforts in one physiographic area such as SCARP. They should also program the whole system involved in water management research (from soils to economics).
2. AID should insist that Colorado State University put full time researchers on the project - at least two people to work in Pakistan.

After a long discussion, RAC also recommended that an advisory committee, consisting of both RAC and non-RAC members, should meet with project members semi-annually over the next few years to evaluate the program. †