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PROJECT APPRAISAL REPORT (F)

1. PROJECT NO.	2. PAR FOR PERIOD:	3. COUNTRY	4. PAR SERIAL NO.
AID/csd-2806	5/15/71 TO 10/12/73	Worldwide	

5. PROJECT TITLE

7p

Agronomic-Economic Research on Tropical Soils

6. PROJECT DURATION: Began FY 71 Ends FY 75	7. DATE LATEST PROP	8. DATE LATEST PIP	9. DATE PRIOR PAR 5/74

10. U.S. FUNDING	a. Cumulative Obligation Thru Prior FY: $1,128,360	b. Current FY Estimated Budget: $380,000	c. Estimated Budget to completion After Current FY: $100,000

11. KEY ACTION AGENTS (Contractor, Participating Agency or Voluntary Agency)

a. NAME	b. CONTRACT, PASA OR VOL. AG. NO.
North Carolina State University, Raleigh, N.C.	AID/csd-2806

I. NEW ACTIONS PROPOSED AND REQUESTED AS A RESULT OF THIS EVALUATION

A. ACTION (X) AA	AID/W	Other	B. LIST OF ACTIONS	C. PROPOSED ACTION COMPLETION DATE
		X	Assist host government agencies in setting up satellite test - demonstrations of recommended soil and water management practices.	
		X	Work with Soil Testing Project, AID/ta-BOA-1080 (formerly La-646) on basing recommendation on Buol soil classification. Arrange for data feed back.	July 1975
		X	Initiation of long-term, cooperative fertility and management field research programs in three areas representative of large ecological regions in the Latin America tropics, Brasilia, Brazil savannas, Yurimaguas, Peru Jungle, and Guatemala for the Central American Highlands.	December, 1975
	X	X	Participate in AID/TAB/AGR Soil and Water Management Workshop.	February, 1975

D. REPLANNING REQUIRED REVISED OR NEW: ☐ PROP ☐ PIP ☐ PRO AG ☐ PIO/T ☐ PIO/C ☐ PIO/P

E. DATE OF MISSION REVIEW

PROJECT MANAGER: TYPED NAME, SIGNED INITIALS AND DATE: John L. Malcolm JSMalcolm

Office DIRECTOR: TYPED NAME, SIGNED INITIALS AND DATE: Leon F. Hesser 11/26/74

Project Appraisal Report - Part III

NARRATIVE

Agronomic-Economic Research on Tropical Soils
North Carolina State University, AID/csd-2806

This project has been reviewed several times and a formal progress report submitted to the RAC. The consensus of the various reviews is that this has been an outstandingly productive project. It has been commended particularly for concentrating effort in the field rather than on campus and for involving local and other institutions in the work on an ongoing and continuing basis.

Although confined to Latin America, this project is working on a variety of problems in critical areas which will affect many farmers with very limited resources. The work in the Campo Cerrado in Brazil has been the most dramatic todate. In part, this comes from the concerted effort of NCSU and Cornell with the Ministry of Agriculture. The work in Peru, aimed at defining the best ways to move from clearing to a permanent agriculture is tackling one of the most persistent, and yet to be resolved challenges of the tropics. In Central America the research has followed several lines. One is direct identification and assessment of problems indicated by work under the International Soil Fertility Evaluation and Investigation Project, AID/La-646. Another is to understand, test, and improve on multiple and simultaneous cropping commonly practiced throughout the area. The third is working with the highland farmers on producing year-round forage and fodder.

This project is relatively new and has not had an extensive impact on commercial agriculture. It promises to allow major improvements in farm systems and to provide good economic criteria on which their adoption can be recommended. An emphasis has been placed first on understanding the soil-plant relationships involved and then working out the most reasonable and economical means for gaining maximum yield from the available inputs. The learning and training elements which are an integral part of the project promise that most of the information gained, not just the principal findings will be spread throughout Latin America and eventually to all of the tropics.

APPLICATIONS OF RESEARCH

Although the field work on this project is hardly more than just underway, it has proven useful. Within this and the Cornell project, the results at Brasilia are the point of departure for current and future experiments. In addition, farmers seeing the plots at Brasilia have sought counterparts. Officials within the GOB have expressed keen interest in developing a series of satellite experiments throughout the Campo Cerrado to verify the findings at Brasilia.

The work in Peru is not quite so far advanced but has shown clearly that the lands in the upper Amazon can be developed without resorting to grandiose and capital intensive schemes. This has sparked interest in both the GOP and GOB. Similarly in Central America the main pay-off to date has been a stimulation of interest among the senior staff of the counterpart institutions. This was particularly notable at IICA, Turrialba, where there has been a renewed interest in multiple cropping.

UTILIZATION AND IMPACT TO DATE

Accomplishments: Completion of the review of literature pertinent to Latin America which covered over 1000 references since 1960 was the main effort during the first phase of this project. Both reports of original research and comprehensive reviews of earlier work were critically analyzed and evaluated to determine specific areas for new research. This has been important to the project. The original printing has been exhausted, a second printing in English and a Spanish translation are in press.

The agronomic experiments were keyed to the locations at which they were conducted. The work in Brazil, at Brazilia, on an old Oxisol faced a serious combination of nutrient deficiency and growth-inhibiting aluminum toxicity. In spite of all the potential difficulties, yields of 3 tons of corn per ha. (127 bu/A.) were obtained with the best combination of treatments.

Control of aluminum toxicity was found to be the key to growing corn on these soils. Further, it was found that modest applications of lime, worked into the soil to a depth of 30 cm., gave excellent results. The cost of material was only $20 per ha.

Nitrogen and potassium can easily be supplied in these soils and conventional rates are quite high enough. Phosphorus was found to be another matter. First, the P-fixing capacity was determined to be 2650 P_2O_5Kg/ha. Attempts to circumvent this fixation by banding were only partially successful. At 320 Kg/ha broadcast applications were more effective than the same amount banded. Greatest returns appear to have been obtained with a combination basal application broadcast and seeding application banded at 160 to 480 Kg.

Both lime and mixed fertilizer with N, P, and K could be applied without visible benefit unless zinc was included in the fertilizer. When the other needs were met, 10 Kg of zinc was included in the fertilizer and was sufficient. When the other needs were met, 10 Kg of zinc per hectare was the difference between a good crop and a total failure.

The soils in Peru, at Yurimaguas, in the upper Amazon basin were found to be much more tractable than those in Brasilia. They contained much less active aluminum, more calcium and had a relatively low phosphorus-fixing capacity, only 230 KgP_2O_5 per ha. The most interesting part of the first work in Peru was the clear superiority of the slash and burn method, the traditional one, over the "modern" mechanical clearing. Infiltration measurements showed that the open structure of the soils was maintained

during cutting and burning but was broken down with the compaction and sealing where heavy machinery was used for clearing. This should be good news for the champions of the small farmer and those appalled by the logistics of maintaining fleets of heavy equipment in remote areas.

Two activities in Central America grew directly out of the soil testing project. The first was the minor element survey in which both zinc and sulfur were implicated. Bad weather made the results of controlled experimentation less than conclusive but it is quite clear that a serious deficiency of both elements is common in the highlands of Guatemala. Along the coast, in areas previously planted to bananas, copper toxicity was identified as a serious problem.

The simplified soil classification system developed by Dr. Buol has been tested and refined for tropical soils as one of the phases of this project. To-date 700 soils have been classified.

Various methods have been tested for predicting economic returns from fertilizers. Predictions were based on straight line and curvilinear response curves. For practical purposes, the results were tested on 12 sets of data from Brazil. The crops tested were corn, beans and rice.

Response functions were also developed for potatoes in Peru. When the results from 73 experiments were sorted according to Buol's soil classification system, fertilizer recommendation gave $150 greater net return than when a generalized recommendation was used. When the Buol based recommendation was further modified according to soil tests, net return increased to $195. per ha.

A fertilization program for intensive forage sorghum production during the rainy season in Northern El Salvador was found to be a simple solution for counteracting the severe weight losses of dairy cattle during the dry season. Heavily fertilizer forage sorghum can be preserved in inexpensive trench silos and used as the principal source of feed during the dry season.

Linkages: The counterpart institutions, DIGESA, CENTA, CATIE, TURRIALBA, ONPEA, EMBRAPA, the Ministries of Agriculture in Costa Rica, Peru and Brazil are directly working on the project. Close linkage is maintained and assistance received from CIP, CIAT and ICA Colombia. CIAT, in particular, has furnished cultivators for test of aluminum tolerance. The University consortium funded under AID 211(d) grants has provided a ready made forum for exchange and dissemination of the results on this project.

Special mention should be made of the sister soil testing project funded by the Latin America Bureau, AID/la-646. This project is not only the source of many of the ideas and questions being tested by the research project but has cooperated fully with it. The work in Guatemala and in Brazilia is particularly noteworthy for the mutually reinforcing value of these two projects.

Dissemination: Although most of the data generated so far is not sufficiently conclusive for making unqualified recommendations, concerted efforts have been made to disseminate the available results as quickly and thoroughly as possible to an audience of working soil scientists and key administrators. At the field stations, contacts have been made with nearby farmers, local research and extension agencies.

Publication has been the most obvious and most easily quantified method of spreading the word of the results on this project. The review, already mentioned, has drawn worldwide attention to the problems and state of our knowledge concerning their possible solution. Thirteen other technical publications have come out of the work so far. Three of these are in Spanish, reaching an audience with a critical need which might otherwise be missed.

The major newspaper in Brasilia has a regular agricultural section which has featured the work of the project. The work with lime was given particularly good coverage.

North Carolina maintains a regular system of information exchange, with a mailing list of 450 soil scientists and institutions throughout the world. Reprints distributed to this group reinforce the journal publication which may be overlooked.

Personnel development and interpersonal contacts play an important role in dissemination of project findings. Five full-time project scientists are posted overseas. Six members of the faculty at Raleigh are directly involved in the project. In addition, eight research assistants at Raleigh are preparing for overseas work and will be carrying this "experience" with them.

POTENTIALITIES OF THE RESEARCH

Anticipated Findings: It is expected that cheaper sources of P fertilizer and more efficient ways to use conventional sources will be found. If not it may be possible to demonstrate that a heavy initial dose of P is economical but must be treated as a capital investment and worthy of support through long-term bank or concessional development loans.

Practical means must be obtained for securing deep penetration of lime within a relatively short time. It is possible to work the line in to a depth of 30 cm. with conventional equipment but it is costly and requires a lot of power.

A merked difference in Al tolerance has already been demonstrated among species. Stargrass is extremely tolerant whereas sorghum was the most sensitive among the plants tested. Lines within the important crop plants which have significantly higher Al tolerance will be sought. CIAT will be the principal source of these lines.

The project has had time to demonstrate some principles of soil chemistry on the Brasilia Oxisols. It seems certain that these findings can be extended to many new areas.

A series of sustained yield farming systems should come out of the work in Peru. One of the major objectives is to reduce the cost of purchased inputs, encouraging the small farmer to become an owner developer rather than a hired laborer on an extensive estate. The systems being tested provide food for the family, for sale in the immediate vicinity and meat from pasture as the cash "export." The results of this research will have a great impact on the development planning in the upper Amazon by both the GOP and by Brazil.

The work in Central America points toward successful farming of areas which are not productive either because of multiple deficiencies or toxicity. The multiple cropping work is expected to improve the small farmer income by expanding the options available to him without requiring that he abandon traditional methods of farming. The work on pasture in the highlands is reaching out to one of the poorest groups of farmers in all of Central America. This will have both economic and social impact of basic value.

ACTION

Ongoing Activity: It is essential that the ongoing research under this project be continued with a minimum of interference. Much of the encouraging work in the opening phases must be verified with replication through time. Additional data are needed to permit valid economic analyses. Many of the separate activities are, in fact, successively closer approximation to the desired goal. Particularly, more efficient and less costly means of obtaining the same ends must be sought and found where possible. A final note of caution. In agriculture initial success does not assure sustained yield. Before a concerted effort is placed on carrying news of this work to farmers; the long-term effects should be judged.

Field Testing: As part of the verification proceudre above, testing at a number of sites will be required, even for those practices which can be followed without question. There is no other way to determine how effective our recommendations are and what risks we are asking a farmer to assume when he follows our advice. These test-demonstrations should be conducted by research or extension officers of the country. Both the Peruvians and Brazilians have shown a keen interest.

Cooperation with the Soil Testing Project: A systematic effort is needed to include the best results obtained so far into the procedures and recommendations for the soil testing project. Classifying the incoming samples according to the Buol scheme will increase the value of the recommendations with a very small increase in cost. Furthermore, there is a need for feedback from the soil testing project on the results of the recommendations as a check on the research and the value of the whole advisory service.

Continuing the zinc and sulfur work and defining the areas which are likely to be deficient is important. Chemical tests are expensive and should be applied where there is a need but not indiscriminately.

Coordination Seminar: The staff of this project will be expected to take part in a coordination seminar. The objective of the seminar is to formalize the information exchange among the universities and institutions working on soils and water projects financed by AID.

The principal participants should be from the consortium universities: Cornell, North Carolina State, Prairie View A&M, University of Hawaii, University of Puerto Rico, Arizona State, Colorado State, and Utah State.

Individuals or other representatives of their institutions which might also be invited are: Dr. Earl Heady, Iowa State; Dr. David Adams, Cost Research Corporation; Dr. James Spain, CIAT; Dr. B. T. Kang, IITA; Dr. Richard Sawyer, Valverde, La Molina, Peru; and Dr. Paul J. Stangel, TVA.

Formalize Technical Assistance: A Basic Ordering Agreement has been arranged to tap the expertise now available from the staff under this project. At least six countries are expected to use this leaver to obtain service from NCSU within the next year.