9310127-(9)
PD-AAC-571-A1

9310127000530 3
37p.

SOIL RESOURCES AND BIOLOGICAL NITROGEN FIXATION

211(d) Supplemental Grant AID/csd 2834

OK
145 I / 099
Box 11 17
9310127000350 1
PDAF lists 9310126001701

Reporting Period

June 22, 1976 to June 30, 1977

Submitted to the
U.S. Agency for International Development

New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University
Ithaca, New York 14853

TABLE OF CONTENTS

A. Title Page

211(d) Annual Report

Date Due August 31, 1977

Date: _____

Grant title: SOIL RESOURCES AND BIOLOGICAL NITROGEN FIXATION

Grantee: Cornell University

Grant Program Directors: Drs. A. Van Wambeke
Co-Directors: M. Alexander
R. Arnold

AID Sponsoring Technical Office: Office of Agriculture

Statistical Summary:

Period of Grant:	June 22, 1976 - June 30, 1978
Amount of Grant:	$450,000
Reporting Period:	June 22, 1976 - June 30, 1977

Title I. Soil Resources Component of 211(d) Supplemental Grant AID/csd-2834

Soil Resources Program Director: Dr. R. Arnold

Statistical Summary:

Amount of grant allocated:	$300,000.00
Accumulated expenses:	$ 92,088.50
Anticipated Expenses:	$207,911.00

Report Period: June 22, 1976 - June 30, 1977

B. NARRATIVE SUMMARY

HIGHLIGHTS OF ACCOMPLISHMENTS - SOIL RESOURCE COMPONENT

Soil resource activities at Cornell are undertaken to assist LDC agencies in matching land suitability and capability to the productive needs of small farmers within their local economies, primarily through our knowledge of soil resources and their inventories.

In-Country Advising - One effective means is to directly assist government agencies. At the request of AID/Near East Bureau, Dr. Armand Van Wambeke of the Agronomy Department and Dr. Ernest E. Hardy of the Natural Resources Dept., provided about 2 work-months in early 1977 reviewing resource problems and programs in the Yemen Arab Republic. Because of the completeness and logic of their report, it was used as the basis for a combined land use and soil survey inventory project of Yemen for funding by AID. The plan includes a land-use inventory using remote sensing techniques as well as a longer range soil survey program to inventory major crop producing areas.

Direct utilization of this staff capability enabled personnel from the Yemen Ministry of Agriculture, the Yemen AID Mission, and AID/Near East Bureau to move ahead in their deliberations about agriculture that ultimately affect the small farmer. In addition to the direct assistance, our linkage with the British Overseas Ministry was continued.

Dr. A. Van Wambeke advised the Near East Bureau on planning a project review on resources inventories for Syria.

Training Courses - Another way to assist is to train LDC professionals in basic soil information and methods useful in interpreting land suitabilities and capabilities information provided by soil resource inventories. With the encouragement, enthusiasm, and assistance of numerous individuals representing many agencies and institutions, it was possible to develop, organize, and conduct such a training course in the Philippines during May of this year. Initial planning was facilitated by AID/Manila, Bureau of Soils, Philippine Council for Agriculture and Resource Research, Southeast Asian Regional Center for Agricultural Research (SEARCA), University of the Philippines at Los Banos, International Rice Research Institute, and the UNDP-FAO Philippine project. Encouragement was offered by the Ministry of Agriculture and DTEK in Thailand, The Rubber Research Institute of Malaysia, and the University Pertanian of Malaysia, and members of the Consortium on Soils of the Tropics. Jointly with staff of the University of Hawaii and the University of the Philippines at Los Banos, a basic soil refresher mini-course of about two weeks was given to 42 participants, followed by two weeks of soil resource interpretation and inventory evaluation for the 22 members selected for the Soil Resources Training Course. Young professional agronomists and soil scientists came from Brazil, Puerto Rico, Indonesia, Malaysia, Thailand, and the Philippines. These people represented 10 government agencies, 5 educational institutions, and 3 private enterprises. A major objective of the course was to strengthen the participants' background of what soils are, how they occur in recognizable landscapes, their major properties useful in predicting soil behavior, and a better understanding of how to use information provided in soil maps and reports to match soil qualities to production needs of potential users. We think that a recent inquiry from the Philippines about a repeat course and another from

Thailand offering to host such a course in Bangkok indicate an assumed, or expected, benefit to the participants and their recipient agencies or sponsoring institutions. It was for us, personally, a rich and satisfying experience to be part of a chain that does reach to the lower levels of assistance.

Developing Additional Knowledge Base - A less personal means of assisting agencies, but potentially longer lasting, related to our activities of developing methods for evaluating soil resource inventories. Such knowledge is to be assembled and disseminated to people and agencies mainly in tropical zones where decisions about mapping and using soil resource inventories are of continuing concern. A Workshop on problems of evaluating soil resource inventories was attended by about 30 pedologists representing 10 countries and extensive experience throughout the tropics. Their concepts and findings will soon be available as a "Proceedings" to assist agencies, institutions, and students as they learn the complexities of evaluations and strategy design. Spurred on by the conclusion and recommendations of the Workshop, the Cornell soil resources group devised, tested, and discarded or improved procedures to measure soil map parameters that can be used in standardizing relative comparisons of soil inventories. Background information and the proposed procedures, now in draft form, will be the basis for a published "Handbook on Soil Resource Inventory Evaluation". Portions of the handbook were tested during the Philippine Training course and appear to help greatly in understanding the interactions among soil properties, land qualities, planning needs, and goals for agriculture.

An important contribution to the "Bibliography of Soils of the Tropics" was Volume II - South America, drafted under this grant and published by TAB/Washington. Work is continuing on the draft of Volume III which will include Central America and the Caribbean Islands. The bibliographies are based on card files of the USDA World Soil Geography Unit. These reports are distributed mainly throughout tropical areas, to government agencies and educational institutions concerned with soil geography and soil survey.

Currently under refinement is a computerized storage and retrieval system for soil resource inventories that are available at Cornell. Information on all soil surveys tested and evaluated with the proposed procedures is catalogued and stored on disks, enabling us to review and discuss problems with visiting scientists.

Preliminary country studies have been started and contacts with Haiti, including field work, have been made.

It is always a pleasure to have scientists visit. In addition to the 25 invited participants at the Workshop, two visiting scientists were with us for 6 months; Dr. H. Eswaran, a Malaysian working at the Geological Institute at Ghent, and Dr. M. Laker, Chairman of the Soils Department at O'Hare University in South Africa. Throughout the year, six other scientists visited the Soil Resource group at Cornell and the Senior staff initiated, maintained, or strengthened personal, in-country contacts with individuals concerned with soil resource inventories in the following developing countries: Thailand, Malaysia, Indonesia, Philippines, Dominican Republic, Mexico, Venezuela, Brazil, Ghana, and Yemen Arab Republic.

C. Detailed Report

1. General Background and Description of Problem

Agricultural production in developing countries has increased only about 1.8 percent a year during the last four years while population has increased about 2.4 percent per year.

One of the major constraints in the improvement of agricultural production in developing countries is lack of adequate knowledge of soil resources and of methodologies for assessing soil resource potential. This kind of knowledge base is important to the success of intensification of crop production of soils under cultivation, opening up new lands, developing alternative cropping systems, and irrigation and drainage programs. Government policy decisions on land use can greatly affect the well being of low income farmers as well as those with more resources. Improper land use has led to degradation of substantial land areas as a result of soil erosion, salinization, deforestation, desert expansion overgrazing, silting of irrigation reservoirs, and flooding. On the other hand, there are enough examples to show that proper management of soil resources can improve their natural productive capacities substantially.

One of the difficulties in making land use decisions is lack of soil data necessary to make good decisions. Soil resource data and evaluation are critical to almost every project involving people and land. The World Bank is concerned with assessing land suitability in the planning process, that is, matching land capability to project design. Unfortunately, this kind of information is very limited in developing countries, especially in the tropics. There is some urgency in developing criteria for soil resource evaluation in order to provide alternatives to the millions of farmers who now barely subsist on marginal and submarginal lands.

The best available estimates indicate that there are about 800 million hectares of land in the tropics which are not now under cultivation but which are potentially arable. This is a larger area than is now being cultivated. Much of this uncultivated land has favorable topography and there is evidence that substantial areas have good potential for agricultural production at relatively modest costs. In addition to the extensive areas in the tropics which are not now under cultivation, most of the soils which are cultivated have produced rather poorly. There is ample evidence to indicate that improved management practices can increase soil productivity substantially.

Decisions on whether or not uncultivated lands should be utilized or how productivity can best be increased on soils under cultivation should depend to a considerable extent on the characteristics of the soil resources and assessment of their potential. Although the United States and many European countries have programs of soil resource inventory and assessment, most of the LDCs do not. At present there are no established principles for assisting LDCs in evaluating their soil resources. Experts from various countries tend to transfer their own country experiences and methods rather than evaluating the local situation and helping develop schemes which are suited to specific areas. If there is no attempt to distill out the principles of soil resource evaluation to meet specific objectives, the diversity of soil inventories and assessment will continue. This reduces the potential for sharing knowledge and technology of efficient, effective soil surveys needed as first line information for land use policies which can meet both short and long-range goals for improving the productivity and quality of life for low income farmers in LDCs. The Chief of the Soil Resources Division of FAO, Dr. Dudal

at a February 1975 AID-sponsored workshop on Soil and Water Management, recommended that AID give top priority to accelerating the appraisal of potential arable land on a world wide basis.

2. Purpose of the Grant

The 211(d) Supplemental Grant AID/csd-2834 has the main purpose of assisting LDC agencies to match land suitability and capability to the productive needs of the small farmer within the local economy. This purpose is being achieved by:

a. Evaluating land and land use potential;

b. Developing methods to evaluate and improve soil resource inventories.

This purpose is primarily in the utilization mode in which Cornell has a large measure of response capability which can be utilized and at the same time expanded and strengthened through activities under the grant.

3. Objectives/Outputs of the Grant Restated

The objectives of the grant are considered under five types of outputs: A) broadened knowledge base, B) building and utilizing advisory capacity, C) education and improved training capacity, D) linkages and collaboration.

A. Broadened knowledge base subjects:

1. Evaluation of soil resource inventories - Cornell has assumed primary responsibility for developing a method of critical analysis of soil resource inventories that will identify and qualify, as far as possible, those characteristics that determine and define successful inventories made for specific purposes. A manual and worksheets enabling LDC soil scientists and knowledgeable administrators to evaluate and classify their soil inventories will be the major products. Technical reference documents of the many factors involved will also be available for interested education and action-oriented institutions upon completion.

2. Strategy for increasing effectiveness of soil surveys - A viable working model to develop strategies for soil surveys involves creating awareness and understanding of the interaction of the fundamental features of soil surveys and various constraints on the overall effectiveness of such programs. A procedure for recognizing types of constraints and alternative trade-offs for establishing realistic and meaningful objectives will be developed and tested. The major products will be a manual and worksheet to enable planners and soil scientists to design acceptable strategies for improving soil surveys. Technical reference materials will also be available for interested educational and action-oriented institutions. Emphasis will be placed on this objective during the second reporting period.

3. Bibliography of soils of the tropics - There are some 12,000 bibliographic cards on file at the Soil Geography Unit of the USDA Soil Conservation Service which include references to maps and texts on characteristics, classification, distribution, environment, and use of soils in all countries of the tropics. It is important for the purpose of the grant to make this information more widely available. A volume on Africa was prepared under the previous 211(d) grant. These volumes will

provide a valuable reference for soil scientists and others concerned with the tropics, facilitate communication, alleviate duplication, and extend awareness of available knowledge.

B. Building and Utilizing Advisory Capacity

Visits by pedologists to the Cornell campus and Cornell staff visits to on-going survey projects will help us maintain a knowledge base to assist others when requested. Advisory services for soil resource inventory research and operational problems of soil surveys will utilize existing competency.

C. Education and Improved Training Capacity

One objective is to develop and test a program to enable middle management soil scientists to interact effectively with planning personnel. A four-week institute jointly developed with several institutions in the Philippines was proposed to provide a test of the materials, methods, and potential usefulness of a program to assist LDC survey people in improving their capability in understanding soil resource inventories and appraisals. The institute was to also provide interpretations of soil information designed to meet the special needs of land use planners. This is further discussed under "Accomplishments", page 12.

D. Linkages and Collaboration

Continued collaboration and cooperation with CST members was to be through executive meetings each year, participating in joint workshops. Short visits were to be made to AID missions in Yemen, Haiti, Philippines, Thailand, to discuss projects of mutual concern and invited specialists were to help orient staff activities to better respond to requests for technical assistance. Short visits to learn and share viewpoints with AID/Washington regional and technical assistance personnel were to benefit the grantee and sponsor and lead to increasing utilization of capacities and capabilities of all concerned. Many new and renewed contacts were made during this reporting period and are further discussed under "Accomplishments," pages 12-13.

4. Critical Assumptions

To achieve the purposes of this grant, the following are assumptions, restated, beyond the control of Cornell:

a. LDCs will collaborate in developing methods of critical analysis of their surveys and in developing strategies to improve the effectiveness of soil resource inventories,

b. AID and other donors will assist in generating requests for utilization of the added knowledge and strengthened response capabilities in soil resource evaluation,

c. Qualified soil scientists and planning personnel of LDCs will participate in planned workshop on soil resource inventories,

d. The other CST institutions will collaborate in the joint activities proposed for soils resources evaluation, and

e. Cornell University with AID and other technical assistance agencies' support will work jointly to develop and implement follow-up activities to improve soil resource evaluation.

5. ACCOMPLISHMENTS

A. Broadened Knowledge Base

1. Evaluation of Soil Resource Inventories.

A Workshop on problems of evaluating soil resource inventories was held at Cornell University and was attended by about 30 pedologists representing 10 countries and experience in the tropics. Their concepts and findings will soon be available as a Proceedings to assist agencies, institutions, and students as they learn the complexities of evaluation and strategy design. Encouraged by the conclusions and recommendations of the Workshop, the Cornell soil resources group devised, tested, and discarded or improved procedures to measure soil map parameters that can be used in standardizing relative comparisons of soil inventories. Background information and the proposed procedures, now in draft form, will be the basis for a published "Handbook on Soil Resource Inventory Evaluation". Portions of the Handbook were tested in the Philippine Training course and appear to help greatly in understanding the interactions among soil properties, land qualities, planning needs, and goals for agriculture. Possibilities for case studies have been investigated in Haiti.

The methodology to evaluate soil maps is called the "circle method". It has been found that by counting the number of delineations occurring in a circle of standard area, several useful parameters can be calculated. These parameters are used to compare maps that may differ in scale, size and shape of the delineations on the map, and the soil classification system utilized. Thus, there appears to be a standard reference for comparing soil maps prepared at different times by various organizations.

For each soil survey report that is evaluated, a computer listing is obtained that provides bibliographic information about the report and the parameters used for its evaluation.

Also, a computer storage system is operational that permits storage and retrieval of information about soil maps based on common properties such as the country they represent or their author. The retrieval is accomplished by using the Integrated Scientific Information System (ISIS) developed by the Swedish Agency for Administrative Development. For each soil survey report, the following informatic is stored in the ISIS system: (1) country, title, author, date, map scale and area of the report, (2) the type of maps accompanying the report (climatic data, present land use, etc.), and (4) bibliographic information such as the number of pages in the report and its publisher. This ISIS program can also accomodate information such as symposium reports and reference materials about soils.

The evaluation of a soil survey report thus is a sequential process and involves first the measurement of the number of delineations per unit area, the calculation of the cartographic papameters, and the input of data into the information storage and retrieval system; at this date approximately 150 maps are in some stage of analysis in this system.

2. Strategy for Increasing Effectiveness of Soil Surveys.

Emphasis on this part of the objective of Broadened Knowledge Base will take place during the second reporting period of the grant.

3. Bibliography of Soils of the Tropics.

Volume II of the bibliography: Tropics in General and Tropical South America was published during this reporting period. Work is presently underway to compile the information for Volume III, related to Central America and the Caribbean Islands. Preparation of these manuscripts will be done under this grant, but publication and major distribution costs will require additional support.

The numbers of soil publications listed for Brazil, Venezuela, Peru and Colombia have been grouped by years and are illustrated on Figs. 1 and 2. It can be seen that there is a tremendous amount of information available, and that the general trend is an increasing production of soil inventories. The apparent 1975-1977 reduction in entries is due to delays in receiving the publications at the recording station. The graphs indicate the urgency of developing an adequate methodology to evaluate and clarify the information according to a set of criteria, covering intensity, scales, ground truth, and usefulness.

B. Building and Utilizing Advisory Capacity

At the request of AID/Near East Bureau, Dr. Armand Van Wambeke of the Agronomy Department and Dr. Ernest E. Hardy of the Natural Resources Department at Cornell provided about 2 work-months in early 1977 reviewing resource problems and programs in the Yemen Arab Republic. Their final report was used as the basis for a combined land use and soil survey inventory project of Yemen for funding by AID. The plan includes a land-use inventory using remote sensing techniques as well as longer range soil survey program to inventory major crop producing areas. Direct utilization of this staff capability enabled personnel from the Yemen Ministry of Agriculture, the Yemen AID Mission, and the AID/Near East Bureau to move ahead in their deliberations about agriculture that ultimately affect the small farmer. The Washington office of the Near East Bureau consulted Dr. Van Wambeke for planning a project review for Syria.

Cornell's advisory capacity was further enhanced through the interaction of specialists from several disciplines attending the Workshop. These scientists, familiar with resource evaluation to help in problem identification, methods of analysis and possible solutions in matters requiring interdisciplinary coordination, had input into the Proceedings which will be shared with others desiring the information in this area.

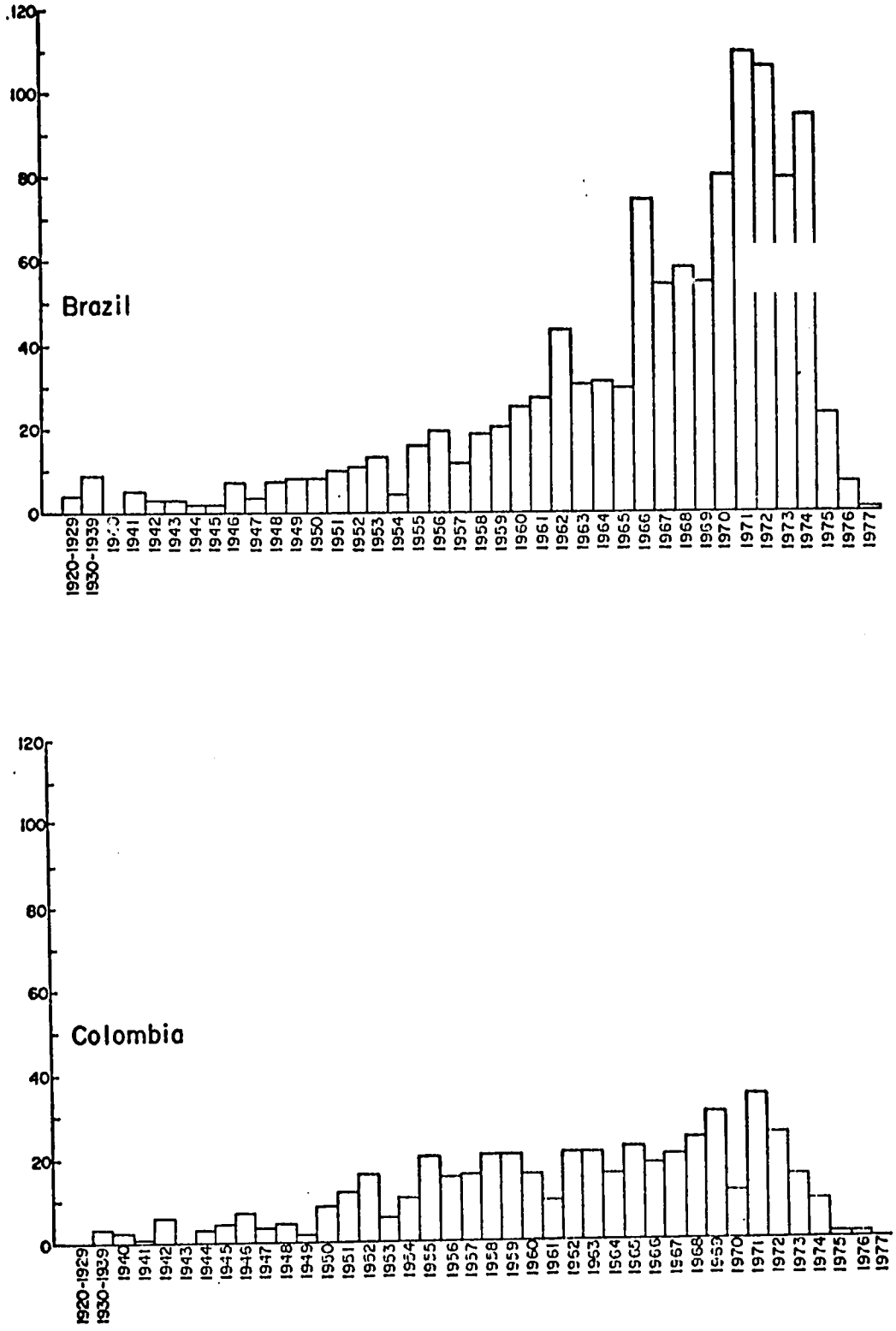

Figure 1. (Brazil, Colombia) Frequency histograms of the published references in the "Bibliography of Soils of the Tropics, Volume II - South America". Vertical axis represents the number of references included in the bibliography, while the horizontal axis represents the year the reference was published.

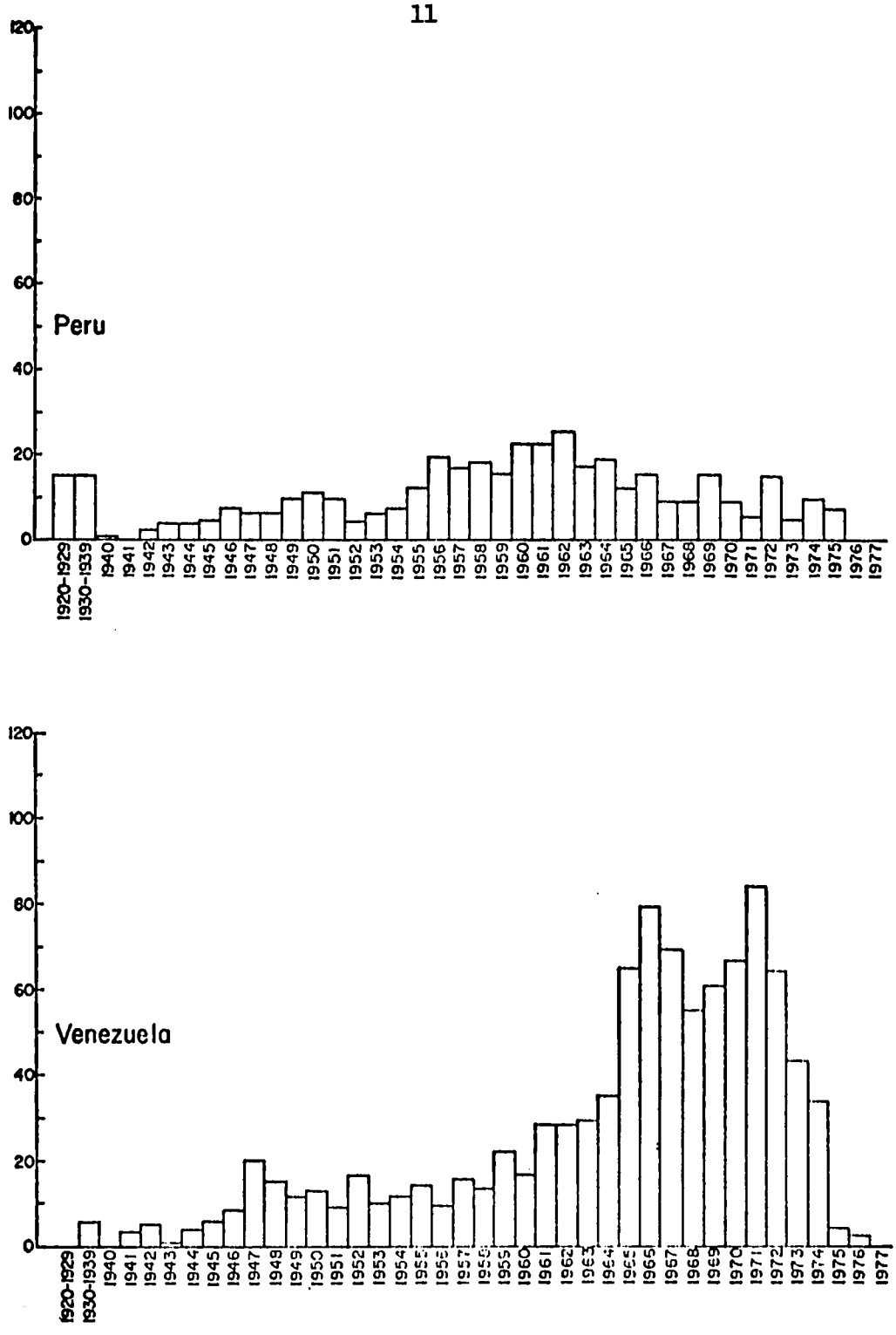

Figure 2. (Peru, Venezuela) Frequency histograms of the published references in the "Bibliography of Soils of the Tropics, Volume II - South America". Vertical axis represents the number of references included in the bibliography, while the horizontal axis represents the year the reference was published.

C. Education and Improved Training Capacity

With the planning assistance provided by AID/Manila, Bureau of Soils, Philippine Council for Agriculture and Resource Research, Southeast Asian Regional Center for Agricultural Research (SEARCA), the University of the Philippines at Los Banos, the International Rice Research Institute, and the UNDP-FAO Philippine project, Cornell University and the University of Hawaii were able to present a training course in the Philippines to train LDC professionals in basic soil information and methods useful in interpreting land suitabilities and capabilities information, provided by soil resource inventories. A basic soil refresher mini-course of about two weeks was given to 42 participants, followed by two weeks of soil resource interpretation and inventory evaluation for the 22 members selected for the Soil Resources Training Course. Participants came from Brazil, Puerto Rico, Indonesia, Malaysia, Thailand and the Philippines for this course, representing 10 government agencies, 5 educational institutions, and 3 private enterprises. A major objective of the course was to strengthen the participants' background of what soils are, how they occur in recognizable landscapes, their major properties useful in predicting soil behavior, and a better understanding of how to use information provided in soil maps and reports to match soil qualities to production needs of potential users. Drs. R. Arnold, G. Olson, and A. Van Wambeke were instructors for the course on behalf of Cornell.

D. Linkages and Contracts

Cornell is one of the five institutions associated with the University Consortium on Soils of the Tropics and has maintained and strengthened their relationship with the other Consortium Universities during this reporting period. Listed below are those agencies and institutions with whom new and renewed contacts have been made during this reporting period concerning the soil resource component of this grant:

IITA
CIAT
CIMMYT
CIDIAT
AID/Manila
PCARR (Philippine Council for Agriculture & Resources Research)
SEARCA (Southeast Asian Regional Center For Graduate Studies in Agriculture)
University of the Philippines at Los Banos
International Rice Research Institute (IRRI)
Bureau of Soils, Manila
UNDP/FAO Land Evaluation and Training Project, Manila
Peace Corps in Phillipines
U.S. Overseas Mission in Thailand
Ford Foundation (Thailand)
RED
Thailand Government Dept. of Technology and Economic Cooperation
The Rubber Research Institute in Malaysia
Department of Agriculture, Soils Division in Malaysia
Universiti Pertanian, Malaysia
OPAI (Officina de Proyectos Agricolas Integrales) Venezuela
Ministry of Public Works, Division of Soils, Caracus
CORPOANDES, Venezuela
ORSTOM, France and Ivory Coast
Soil Research Institute at Kumasi, Ghana
Kenya Soil Survey Project, National Agricultural Laboratories, Nairobi
Service National des Sols, Bobo-Dioulasso, Upper Volta

Ministry of Overseas Development, England
Agricultural University at Wageningen, Netherlands

The CST NEWSLETTER, a bi-monthly Consortium publication was initiated during this reporting period and has been very well received. Material related to broadened knowledge base, research, conferences, workshops, seminars, and projects of interest to those in the international agricultural field is sent to Cornell where it is edited, printed, and distributed according to assigned areas by the individual Consortium members. Approximately 1000 copies are distributed by the Consortium universities to the following areas:

Cornell University	Mexico, Francophone Africa, Europe, USA
Prairie View A&M	English speaking African countries
North Carolina State Univ.	South America
University of Hawaii	Asia
University of Minnesota	Mediterranean area and North Africa
Puerto Rico	Central America and Caribbean
AID/Washington	

6. IMPACT OF GRANT SUPPORTED ACTIVITIES IN ACHIEVING GRANT PURPOSE:

The grant's purpose is to develop systems which are adequate to evaluate the utility of existing soil surveys, and to suggest alternative methods to produce new ones. The goal is to train people to use these systems where adequate. How far have these objectives been accomplished?

A. Evaluation of Soil Resource Inventories

This process includes: (a) measurement of the information content shown on a soil map, and which is described in the soil survey report. During this period the soil resources inventory team studied soil survey intensities (density of lines), and soil contrast within delineations; it defined a basis for a clarification of soil maps (soil survey orders); (b) control of ground truth. This aspect needs a review of literature, and actual testing of methods in the field. Only preliminary work was done and it is planned to conduct field studies in some countries (Haiti, Cameroon).

It is expected that both aspects of the evaluation process will be fully covered in the Handbook. A tentative outline is given in Appendix I-C. Chapter 3 and 5 are reaching completion; the other parts have been started.

The overal objectives of the inventory evaluation have been discussed in a preliminary publication attached to the Workshop Proceedings (Dr. M. Cline). It is clear that a given soil survey may be useful for one purpose, and not for another. Utility, therefore, is purpose related. Some progress was made in defining standardized parameters to measure the utility of soil information for a series of land-uses, farming systems, and kinds of development plans. Much remains to be done, however, and an in-depth discussion with planners, plant breeders, and agronomists is to be held in order to restrict the number of possible land uses. This is one of the objectives of the Workshop which is forseen for the second year.

B. Strategies for Soil Resource Inventory Operations

Preliminary planning of the phase of the research has been done in conjunction with other institutions, including USDA, the British Ministry of Overseas Development, and ORSTOM, France.

How close the accomplishments stand against the final purpose is difficult to assess at this stage. To produce a complete Handbook devising methods which provide guidelines for soil survey evaluation and covers all phases of the inventory operation will probably be impossible to achieve during the rest of the grant. At least five years of research activities would be needed.

C. Training Program

The soil resources inventory course held at Los Banos has accomplished its objectives. The attached report summarizes the components of the course curriculum, and lists the participants. A large number of individuals from LDC institutions at key-positions in land development were reached. (Appendix I-B).

The task which remains is to organize, edit, and distribute the course materials to organizations which would be interested in repeating the experience. SEARCA has shown a considerable interest in this aspect of dissemination of information.

D. Bibliography of Soils of the Tropics

The work on this project component has progressed normally. It is felt that it will serve an extremely useful purpose in retrieval of information, which is a time consuming process in land development planning in LDC's.

The system, however, can be made more efficient by supplementing it by evaluation statements about the characteristics of the map; it could also be organized in different dissemination media, either computerized, card indexed with visual photographic recordings, or a combination of both. The second year of the project will suggest actions in this direction, and propose ways of updating and completing the bibliographic listings.

The distribution of Volume II, South America, will reach a large number of individuals and institutions, and contribute in achieving the purposes of the grant's objectives.

7. OTHER RESOURCES FOR GRANT-RELATED ACTIVITIES

The financial plan indicates the amount of other funding that relates to satisfying the 211(d) grant purposes. The University commitment includes 75-80% of the salaries of State-supported professors, and a large percentage of a work year advising and consulting services of other senior staff. Fringe benefits and overhead not included in University services are provided by the University based on salaries and wages. A small amount for library acquisitions related to the grant purpose are also included. Tuition of $1000/year is waived by the College for Graduate Assistants supported under the grant.

Important sources of outside funding are stipends awarded students from LDCs and other countries whose academic programs are directly related to the grant purposes. At present there are students supported by Venezuelan government fellowships, an African-American Institute supported student, several receiving support from AID, and others on Rockefeller or other fellowships. We assume that such outside funding will continue at the same level in the future.

The full-time state supported professorship in world soils insures continuity for future activities beyond the grant. Discussions with FAO and other potential sponsors indicate promise of support for continuing the activities of the grant objectives.

8. UTILIZATION OF INSTITUTIONAL RESPONSE CAPABILITIES IN DEVELOPMENT PROGRAMS

Personal interaction with AID Missions and LDC organizations conducting soil research and soil surveys provide the opportunities to share experiences and concerns about soil resource inventories and their evaluation. During this reporting period senior staff received requests for assistance from the following institutions:

AID/Near-East Bureau - request for review of resource problems and programs in Yemen, Arab Republic. The response was for Dr. A. Van Wambeke, Department of Agronomy at Cornell, and Dr. Ernest Hardy, Department of Natural Resources, Cornell; spent 2 work months on this study. Their resulting report was used as a basis for a combined land-use inventory using remote sensing techniques as well as longer range soil survey program to inventory major crop producing areas in Yemen. Thus, Cornell's senior staff capabilities enabled personnel from Yemen Ministry of Agriculture, the Yemen AID Mission and the AID/Near-East Bureau to move ahead in their agricultural planning. A total of about 2.0 man months were spent in this capacity of assistance.

AID/Near-East Bureau - Washington office requested consultation with Dr. A. Van Wambeke concerning a project review for Syria. Points of recommendations were made which will enable them to move ahead on future planning.

Other requests for assistance were received from the following institutions:

A. Soil Survey Institute in Santiago, Chile - Request for computerized soil correlation program.

B. INTA (Instituto Nacional Technicola Agricola (Argentina) - Request for soil correlation system input. This is being conducted and will be reported during the next reporting period of the grant.

C. Ministerio das Minas E Energia, Departmento Nacional da Producao Mineral, Project Radambrasil (Brazil) - Request for Soil Resources Evaluation.

At Cornell in the Department of Agronomy alone, during this reporting period, 4 specific courses in International Agriculture were taught by senior staff with enrollment of 82 graduate students and 71 undergraduate students. Of the graduate students with a professional interest in international agriculture enrolled in the Department during this period, 22 were from foreign countries, and 8 from the United States. [1] Five graduate students were abroad in Mexico, Puerto Rico, Upper Volta, Malaysia and the Philippines during this period to work on thesis data. Six graduate theses with international emphasis were completed during the first year of the grant. Considering the number of students who have had training for development work in LDCs, this is a significant use of institutional resources from the standpoint of total impact which can be expected in LDCs. Graduate students in the Department of Agronomy represent Czechoslovakia, Dominican Republic, Ethiopia, Taiwan, Nigeria, the Netherlands, Canada, Venezuela, Malawi, the Philippines and China. Continuing relationships with former students has a long term effect on agricultural development from the standpoint of future co-operative activities and the establishment of linkages and contacts for formal or informal technical assistance requests.

Visiting scientists with broad tropical experience contribute through seminars and discussions and conferences with staff and students. Among the visiting scientists who contributed to the overall objectives during this period include Dr. Elmer Wagner from EMBRAPA, Brazil Agricultural Research Organization; N. C. Brady, Director General, IRRI; Dr. Mohamed O. El-Karowu, Director, Soba Agricultural Research Station; Dr. Roger Langhor, Soil Scientist from University of Ghent; Professor D. R. Tavernier, Soil Scientist, University of Ghent; Dr. Frank Moormann, visiting scientist from Nigeria IITA; Dr. M. Laker,[2] from the University of Fort Hare, Cape Province, South Africa; and Dr. Hari Eswaran[2] from the University of Ghent.

During the remainder of the grant, and after the grant expires, Cornell plans to provide the Methodology to LDC governments for evaluating the status of Soil Resource Inventories and make available the Handbook that will provide guidelines to have these evaluations carried out by LDC institutions. It is expected that many LDCs in the tropics will have to assess their capability in measuring the potential of their soil resources. We expect that these problems will become more and more important in the next few years because most tropical countries are dependent for their agricultural development on their own resources and with the rising prices of fertilizer, the quality of land will be one of the most critical production factors.

---

[1] Two were directly supported by 211(d) funds

[2] Directly supported by 211(d) funds

3. DETAILED WORK PLAN - CORNELL 211(d) SUPPLEMENTAL GRANT AID/csd-2834 - YEAR TWO

Objective/Output 1. Broadened Knowledge Base

Subject 1A. Evaluation of Soil Resources Inventories

Relevance to Grant Purpose

Throughout the world there are many types of land evaluation methods and approaches being carried out. Many complex land use decisions are being made in LDCs. Land development schemes and projects, especially those affecting small farmers, should have realistic objectives that match the suitability and capability of the lands being considered if efficient and effective use of resources are to be realized. Are the inventories and appraisals well suited to the needs, stated or implied, of the anticipated land use plans?

With perhaps about one-half of the world's potentially arable lands still waiting additional evaluation, we believe that a procedure for evaluating soil resource inventories will be of valuable assistance by:

(a) facilitating communication among agencies, institutions and organizations involved in development processes where land resources are an integral component of that development,

(b) hopefully reducing duplication of effort in assessing various inventories and appraisals,

(c) focusing on essential items and minimal data required to meet specific objectives, and

(d) indicating components that need additional research or collaborative studies to be more useful indicators in inventories and appraisals.

It is not the intent to provide a detailed listing of all available soil resource inventories in LDCs of the tropics as this is more nearly a function of FAO, or other organizations. It is the intent to provide a system or method to evaluate properties of soil resource inventories most relevant to planning land use.

I. Activities or Work to be Performed

A. Year Two

1. Refine methodology for evaluating inventories and appraisals of soil resources. Senior staff and Research Associate.

2. Continue evaluating representative soil surveys using proposed method of evaluation and modify as needed. Samples of kinds of surveys in several climatic zones will be tested. Graduate Assistants under direction of Research Associate.

3. Coordinate information and effort with activities of the strategy portion of the project (described under Subject 1B) to avoid duplication. Mainly by Research Associate.

A. Year Two (continued)

4. Carry out ground truth evaluation of selected soil surveys in several LDCs, such as Haiti and Cameroon. Research Associates mainly.

5. Solicit comments from LDC agencies and others on the methods of evaluation, primarily through correspondence. Research Associate.

B. Beyond the Grant

1. Conduct follow-on testing and training in three LDCs, possibly Philippines, Cameroon, and Ghana working with in-country staff and planners. Such activities would combine evaluation of some existing country surveys and help develop a strategy to meet anticipated needs in one or more sectors of the country. It is not thought possible to carry on this important utilization of the developed strategies within the time span or financial support of the grant.

2. Conduct training sessions on method of inventory evaluation as part of workshop described under Objective/Output 1B.

II. Staff to be Involved

A. Armand Van Wambeke, Professor of Soil Science
B. Richard W. Arnold, Professor of Soil Science
C. Gerald W. Olson, Associate Professor of Soil Science
D. Terence Forbes, Research Associate
E. Research Associates to be hired during grant period
F. Other contributors
   1. Technical specialists hired for specific topic work
   2. Two Graduate Assistants - duties assigned to project work

III. Scheduled Events/Targets

A. Year Two

1. Publication of Proceedings of April 1977 Resource Inventory Evaluation Workshop. During the first quarter.

2. Internal testing and refinement of methodology for evaluating soils surveys to be completed during second quarter.

3. External review of "Handbook for Evaluating Soil Resource Inventories" by agencies in LDCs and other organizations to be initiated late in second quarter or early in third quarter. Compilation of responses by the end of third quarter.

4. Continued selection and evaluation of representative soil surveys. May continue through the third quarter.

5. Refinement and extension of computer cataloguing of soil maps and reports evaluated. Throughout the grant.

A. Year Two (continued)

6. Visit several LDCs to assist in ground truth evaluations of soil surveys. Forbes to Haiti in first quarter. Senior staff or Research Associate in third and fourth quarter.

7. Component part of workshop on evaluation and improved strategy of soil resource inventories. To be held late in fourth quarter, or if possible, during an extended fifth quarter.

B. Beyond the Grant

The utilization of the method of inventory evaluation and strategies for improvement of soil surveys needs testing in-country. It is not thought possible to do this within the time frame and finances of this grant.

IV. Expected Results - Year Two

A. Year Two

1. Proceedings of April 1977 Workshop to be published and distributed.

2. A Handbook for Evaluating Soil Resource Inventories. Expected to be a collection of articles explaining procedures and then an illustrated example of how to evaluate a soil resource inventory.

3. A computerized storage and retrieval program to handle information about available soil surveys and their evaluation.

4. A small group of people trained in the rationale and methods of evaluating various kinds of soil resource inventories.

V. Estimated Costs

	Year Two	6 Mo Extension	Total
Salaries & Benefits	$ 40,300	$ 21,450	$ 61,750
Travel	3,475	2,928	6,390
Supplies	500	600	1,100
Publications	4,000	455	4,455
Other	325	112	437
	$ 48,600	$ 25,545	$ 74,145

VI. Summary of Results Expected from Methods of Evaluating Soil Resource Inventories

A system of classifying the many kinds of soil resource inventories will highlight those characteristics that determine and define successful inventories made for specific objectives. A Handbook will be produced which will enable knowledgeable administrators to assess existing or proposed soil inventories. The Handbook for Evaluating Soil Resource Inventories can be reproduced by AID for distribution.

The background papers are expected to be quite technical and useful as reference documents for many soil survey and planning agencies. These will be published as scientific reference materials, primarily as the Proceedings of the Workshop held in April 1977.

Preliminary testing and training of people in the use of the Handbook will be done during the proposed final workshop. Follow-on training and application of inventory evaluation is envisioned to be done in conjunction with training in the development of strategies for improving the effectiveness of soil surveys. Current manpower, time, and financial support is not sufficient to conduct further testing in LDCs during the two-year grant period.

Subject 1B. Strategy for Increasing Effectiveness of Soil Surveys

Relevance to Grant Purpose

Effectiveness of soil surveys involves three main aspects: (1) efficiency of effort and finances used to produce the survey information, (2) accuracy or correctness of maps and associated data which may be called quality of the survey, and (3) usefulness or utility of the product for users of the inventory and appraisal.

Many types of soil surveys are produced in LDCs and throughout the world. They are often made for one limited objective such as irrigation suitability but contain information that would satisfy other objectives such as community development, road location, and so forth. Based on experience with some soil inventories it is believed that the effectiveness of surveys can and should be improved whenever and wherever possible. Strategies for improving surveys must be guided on one hand by sound theoretical considerations of the basic features of soil surveys, and on the other hand by constraints imposed on such activities. The interaction of the institutional, social, and political constraints with desires for certain kinds of information using known methodologies for providing soil survey data lead to alternative solutions or compromises. Misunderstanding by both planners and pedologists of what is wanted or needed and the means of obtaining the appropriate information was quite vividly brought out by the AID-sponsored seminar held in January 1976 at Hyderabad, "The Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development in the Tropics". This study will attempt to design alternative strategies for increasing the effectiveness of soil surveys relative to the constraints that are to be considered. It is the intent to provide material that can serve as a guide for assessing and making recommendations on appropriate strategies for specified objectives, and also provide a basis for further research training.

I. Activities or Work to be Performed

A. Year Two

1. Continue preparation of background material and summaries of material for model of strategy alternatives. Technical Specialists with senior staff as leaders.

A. Year Two (continued)

2. Compile and edit background materials provided by Technical Specialists. Under leadership of Research Associate.

3. Develop working model of soil survey strategies for internal review and testing. Research Associate, Technical Specialists, and senior staff.

4. Continue compiling information on actual operations of soil surveys in selected countries. Research Associate, Graduate Assistants, or others.

5. Test and refine method for developing strategy alternatives. Edit materials and prepare for training workshop. Research Associate, Graduate Assistants and senior staff.

6. Conduct a training and review session for leaders from LDC survey agencies and selected institutions dealing with soil resource inventories in LDCs. Expected to be a 3-day conference for 25-30 people with about 10 selected from LDCs. This is in conjunction with evaluation procedures listed under Output 1A. Senior staff and Research Associate.

B B. Beyond the Grant

Conduct follow-on testing and training in three LDCs, possibly Philippines, Cameroon, and Ghana working with in-country staff and planners. Such activities would be a package of inventory evaluation and strategies for improving their effectiveness. It is not thought possible to carry out this important utilization within the time span or financial support of the grant.

II. Staff to be Involved - Year Two

A. Armand Van Wambeke, Professor of Soil Science
B. Richard W. Arnold, Professor of Soil Science
C. Gerald W. Olson, Associate Professor of Soil Science
D. Terence Forbes, Research Associate
E. Other contributors:
   1. Technical Specialists hired for specific topic work
   2. Two Graduate Assistants - duties assigned to project work

III. Scheduled Events/Targets

A. Year Two

1. Compilation of background material prepared for strategy model. Start in second quarter and finish early in fourth quarter.

2. Initial strategy model developed during the second quarter, refined and tested internally during third quarter.

3. Compilation of operations and strategy mechanisms used in selected countries. Begin in first quarter and continue throughout grant.

4. Preliminary test of the inventory evaluation procedures and effectiveness strategy in one or more LDCs, or with personnel from LDCs. Third or fourth quarter.

A. Year Two (continued)

5. Review and training workshop to explain procedures and materials used in evaluating soil resource inventories and in developing strategies. Fourth quarter, or if extension is possible, fifth quarter.

IV. Expected Results

A. Year Two

1. Summary of case studies of how soil surveys are planned in several selected countries. Mainly designed to help us establish or confirm the nature of constraint systems.

2. A working model providing alternatives for increasing effectiveness of soil surveys. A final published document could be based on such information.

3. A small group of key people trained in the rationale and methods of evaluating kinds of inventories (see Output 1A) and also in procedures for developing alternatives to improve effectiveness of soil surveys.

B. Beyond the Grant

We believe that a major item affecting the small farmer is the set of decisions that determine or establish land use policy. When such decisions are based on a better understanding of soil and land qualities expressed in soil resource inventories, the total economy usually benefits greatly in the long run. Communicating the right information at the right time in a proper manner may be pivotal to many land use policies. The development of, and training in, procedures for evaluating soil resource inventories and designing ways to improve their effectiveness is the key element of our work that we believe leads to the type of communication that provides for better tomorrows.

V. Estimated Costs

	Year Two	6 Mo Extension	Total
Salaries & Benefits	$ 44,070	$ 14,850	$ 58,920
Travel	1,100	-	1,100
Supplies	1,000	710	1,710
Publications	-	1,000	1,000
Other	1,000	8,000	9,000
	$ 47,170	$ 24,560	$ 71,730

VI. Summary of Results Expected from Strategies for Improving Effectiveness of Soil Surveys

A model for developing strategies for soil surveys involves creating an awareness and understanding of the interaction of the fundamental features of soil surveys and of various constraints on the overall effectiveness of such programs. A procedure for recognizing types of constraints and alternative trade-offs for establishing realistic and meaningful objectives can be in a manual format with worksheets to aid in designing strategies. It is thought that mutual understanding and awareness by planners and soil survey administrators are necessary to improve survey effectiveness. Such a manual or handbook could be produced by AID for distribution.

Follow-on application and training in developing strategies are envisioned to be undertaken jointly with training in the application of the method of evaluating soil resource inventories. Current manpower is not sufficient to conduct proper testing in LDCs during the grant period.

Subject 1C. Bibliography of Soils of the Tropics

Relevance to Grant Purpose

There are some 12,000 bibliographic cards on file at the Soil Geography Unit of the USDA Soil Conservation Service which include references to maps and texts on characteristics, classification, distribution, environment, and use of soils for practically all of the countries in the tropics. This collection has been continuous since it was started in 1945. It is important for the purpose of the grant to edit and organize the file cards in a suitable format for publication. The bibliography will provide a valuable contribution to the knowledge base of soil resources in the tropics and make the information available for utilization by agricultural scientists, planners, and others.

I. Activities or Work to be Performed

The first volume on Africa and general references was completed under the previous grant and the second volume on South America has recently been completed under this grant. It is proposed to complete the editing and organization of the card files ready for publishing the volumes on Central America and the Caribbean, and Asia.

II. Staff to be Involved

Mr. Arnold C. Orvedal, formerly head for many years of the Soil Geography unit of the U.S. Department of Agriculture Soil Conservation Service, has prepared the first volumes of the bibliography and has tentatively agreed to serve as consultant to complete the bibliography contingent on availability of funds.

III. Scheduled Events/Targets

A. Year Two

1. Completion of draft copy of Volume 3, Central America and the Caribbean Islands of Bibliography of Soils of the Tropics for publication. Third quarter.

2. Initiation of draft copy of Volume 4, Asia and Oceana, of Bibliography of Soils of the Tropics for publication. Fourth quarter but possibly not completed by end of that period.

IV. Estimated Costs

	Year Two	6 Mo Extension	Total
Salary (Consulting Fee)	$ 2,400	$ 900	$ 3,300
Other	200	100	300
	$ 2,600	$ 1,000	$ 3,600

V. Distribution of Publication

We recommend that AID publish the volumes of Soil Resource Bibliographies in the same format as Volume I and handle major distribution. Cornell and other CST Members are willing to provide a list of individuals and organizations who likely would benefit from the information.

OBJECTIVE/OUTPUT 2. UTILIZING ADVISORY CAPACITY (Concerning Land Assessment and Soil Survey Operations)

Relevance to Grant Purpose

Personal interaction with AID missions and LDC organizations conducting soil research and soil surveys provide the opportunities to share experiences and concerns about soil resource inventories and their evaluation. It is important for us to understand organizational structuring and agency relationships if guidelines and methodology are to be relevant to a wide variety of conditions.

Visits by other scientists acquainted or involved in LDC resource inventories also contribute to the task of developing meaningful procedures that can readily be applied.

Participating in International Agriculture symposium of ASA on soil variability in tropical areas utilizes information directly related to evaluating soil resource inventories.

I. Activities or Work to be Performed

A. Year Two

1. Visit one or more cooperative research projects in LDCs where soil resources are being evaluated and/or integrated into project development plans. Van Wambeke to Africa, possibly Nigeria or Ghana.

2. Participant in Workshops: Soil Management in Lima, Peru; Expert Consultation on Land Evaluation Standards; Senior staff namely Van Wambeke and B. Dethier. Second and third quarters.

3. Visit two or more LDCs to become more familiar with their approaches to soil resource inventories and appraisals to help ensure that procedures developed under the grant will be relevant to their situations.

4. Bring several specialists to campus to consult on methods of evaluation and/or constraints related to survey strategies. Short visits of about one week.

5. Participate in ASA Symposium on Soil Variability in the Tropics, Van Wambeke and Arnold to Los Angeles.

6. Provide for unscheduled short-term technical advising requested and/or approved by AID. Such service for situations not covered or directly related to specified grant activities. This activity has been suggested by AID and may occur at any time throughout grant period.

II. Staff Involved

A. Armand Van Wambeke, Professor of Soil Science
B. Richard Arnold, Professor of Soil Science
C. Gerald Olson, Associate Professor of Soil Science
D. Terence Forbes, Research Associate

III. Scheduled Events and Targets

A. Year Two

1. Van Wambeke to review cooperative work on soil evaluation and/or inventory methods at an International Center or LDC agency. Six-day trip. Third or fourth quarter.

2. Visits to LDCs throughout the period of the grant.

3. Several visiting scientists for periods of one or two weeks. Possible candidates: J. Coulter, World Bank; M. Camargo, EMBRAPA (Brazil); P. Becket, Oxford.

4. Attend ASA Meeting in Los Angeles, Second quarter.

IV. Expected Results

1. Assist agencies or institutions in countries that request advice in assessing land qualities or soil and land inventory programs.

2. With AID Mission help we hope to visit soil survey and research organizations to ensure better understanding of in-country methods and constraints important in developing useful guidelines for soil resource evaluation.

3. Seminar or lecture notes of visiting scientists likely published in Agronomy Mimeo series. Discussion will increase understanding of staff and students about problems and methods of operation in tropical conditions.

V. Estimated Costs

	Year Two	6 Mo Extension	Total
Salaries & Benefits	$ 16,600	$ 8,000	$ 24,600
Travel	-	2,610	2,610
Supplies	-	-	-
Publications	-	-	-
Other	525	500	1,025
	$ 17,125	$11,110	$ 28,235

VI. Summary of Results Expected from Utilizing Advisory Capacity

Another result will be the lecture/seminar notes by visiting specialists who explain their understanding of problems in BNF and/or soil resource areas.

Through AID Mission contacts the LDC visits to soil survey organizations provide important information about in-country conditions that bear on the design of resource evaluations, strategies for improving soil survey effectiveness, and the application of such procedures.

OBJECTIVE/OUTPUT 3. Education and Improved Training Capacity

Relevance to Grant Purpose

Matching land suitabilities and capabilities to project development plans should have a favorable effect on the ability of small farmers to respond to their environment. Developing meaningful strategies for improved soil resource inventories and appraisals requires increased understanding and communication between pedologists and land use planners. A problem often occurs when soil resource specialists are not involved at any early phase in planning at regional and national levels. In many instances the pedologists have not been fully aware of the information needed to complement the planning process, nor have the planners been aware of the constraints and requirements to provide information they believe to be valuable for their purposes. In an attempt to begin to bridge this gap of communication, understanding and interaction we developed and tested a special program to assist soil survey personnel in LDCs in improving their capability in (1) understanding soil resource inventories and appraisals, and (2) providing interpretation of soils information designed to meet the special needs of land use planners and decision makers. The major objective was to develop and test a program to enable middle management soil scientists to interact effectively with planning personnel. An important aspect will be a follow-through evaluation of the utility of such a course and its impact on the planning process at different levels of government.

I. Activities or Work to be Performed

A. Year Two

1. Assemble, edit and publish training materials developed or used in the Philippine Training Course.

2. Plan and conduct a follow-up on the training course to determine its utility and suitability for further use in LDCs. Research Associate and Senior staff.

II. Staff to be Involved

A. Armand Van Wambeke, Professor of Soil Science
B. Richard Arnold, Professor of Soil Science
C. Gerald Olson, Associate Professor of Soil Science
D. Terence Forbes, Research Associate

III. Scheduled Events/Targets

A. Year Two

1. Conduct follow-up study of the effectiveness and utility of the Philippine Training Course and develop guidelines for similar types of courses. Third or fourth quarter.

2. Assemble, edit, publish and distribute training materials employed in the training course. During period of grant, plan to complete by fourth quarter.

IV. Expected Results

Teaching and training materials to be made available as a syllabus or similar format which could be published and distributed to numerous LDC agencies and educational institutions interested in using or modifying such a program.

The Soil Resource materials can be used alone or as part of the Benchmark Soils training course in Agrotechnology Transfer for Country Development.

V. Estimated Costs

	Year Two	6 Mo Extension	Total
Salaries & Benefits	$ 6,730	$ 2,900	$ 9,630
Travel	-	-	-
Supplies	500	450	950
Publications	-	1,500	1,500
Other	300	220	520
	$ 7,530	$ 5,070	$12,600

VI. Summary of Expected Results

The developed training institute will provide a syllabus of lecture material, handouts, sample illustrations of soil maps and interpretations, and a format for further use to assist the process of increased and improved understanding and communication between soil scientists and planners. The materials and procedures should facilitate internal training programs of organizations and also be available in a utilization mode for additional institutes on an approved request basis. Such materials also serve the Benchmark Soils Training component of the contracts of Hawaii and Puerto Rico.

OBJECTIVE/OUTPUT 4. LINKAGES AND COLLABORATION

Relevance to Grant Purpose

In order to utilize existing competency on one hand, and to increase the capacity to respond on the other, it is important to maintain and strengthen linkages established through the previous 211(d) grant period. We plan to increase exposure to agencies, institutions, and individuals who may assist us in better developing and utilizing the knowledge and skills related to this grant.

It is desired to collaborate as much as possible with CST members in their activities as well as participate in executive meetings. Soil resource collaboration has taken place with ITTA, CIDIAT and EMBRAPA.

To facilitate communication between the project and Bureaus of AID, it is proposed to have senior staff spend some time in Washington explaining and discussing aspects of the soil resource and BNF subject areas.

I. Activities or Work to be Performed

A. Year Two

1. Attend scheduled meetings with other CST members. Included are executive meetings and assisting with other activities. Van Wambeke and others.

2. Handle CST Newsletter. Editor and staff.

3. Prepare and present end of year-one summary and plans for year-two of grant. Van Wambeke, Arnold and others.

4. Visits to at least two AID missions to explain the grant outputs and discuss possibilities of how they might best be utilized.

5. Brief visits by invited specialists to help orient staff activities to better respond to requests for technical assistance.

6. Participate in International Soil Congress to maintain contacts and also disseminate information on grant outputs.

7. Confer with appropriate AID bureau personnel in Washington. Senior staff.

II. Staff Involved

A. Armand Van Wambeke, Professor of Soil Science
B. Richard Arnold, Professor of Soil Science
C. Gerald Olson, Associate Professor of Soil Science
D. Terence Forbes, Research Associate
E. Editorial Assistant

III. Scheduled Events/Targets

Same as the listed activities although dates or timing have not been estimated, except International Soil Congress which is scheduled to be held in Edmonton, Canada in June 1978.

IV. Expected Results

A. Continued and expanded collaboration with associates in CST, at International Centers, LDC institutions, and elsewhere.

B. Establishment of new linkages and contacts, especially in LDC.

C. Extension of information produced as outputs as well as continued international linkages.

D. Improved understanding by AID and Cornell of activities and constraints.

V. Estimated Costs

	Year Two	6 Mo Extension	Total
Salaries & Benefits	$ 9,550	$ 5,450	$15,000
Travel	666	600	1,266
Supplies	-	-	-
Publications	-	-	-
Other	825	510	1,335
	$11,041	$ 6,560	$17,601

Listed below are the estimated work-months of effort projected during Year 2 of the grant and during a possible 6-month extension to complete the Plan of Work outlined under the objectives in the Soil Resources component:

Objective I Broadened Knowledge Base

A. Evaluation of Soil Resource Inventories

	Year 2	6 Mo Extension	Total
Senior Scientists	0.5	0.5	1.0
Research Support Spec	9.0	7.5	16.5
Graduate Research Asst	22.0	12.0	34.0
Technical Specialists	10.5	5.0	15.5
Visiting Scientists	6.0	1.0	7.0
	48.0	26.0	74.0

B. Strategy for Increasing Effectiveness of Soil Surveys

Senior Scientists	1.1	0.5	1.6
Research Support Spec	6.0	3.0	9.0
Graduate Research Asst	28.0	12.0	40.0
Technical Specialist	4.3	2.0	6.3
Visiting Scientists	12.0	2.0	14.0
	51.4	19.5	70.9

C. Bibliography of Soils of the Tropics

A. Orvedal	1.3	.6	1.9

Objective II. Building & Utilizing Advisory Capacity

Senior Scientists	0.95	.5	1.45
Research Support Spec	1.0	.5	1.5
Graduate Research Asst	-	-	-
Technical Specialist	1.0	.5	1.5
Visiting Scientists	.5	1.0	1.5
Other Cornell Scientists	3.0	1.0	4.0
	6.45	3.5	9.95

Objective III. Education & Improved Training Capacity

	Year 2	6 Mo Extension	Total
Senior Scientists	1.25	0.5	1.75
Research Support Spec	-	-	-
Graduate Research Asst	-	-	-
Technical Specialist	1.20	0.5	1.7
Visiting Scientists	-	-	-
	2.45	1.0	3.45

Objective IV. Linkages & Collaboration

Senior Scientists	1.45	0.8	2.25
Research Support Spec	2.0	1.0	3.0
Graduate Research Asst	-	-	-
Technical Specialist	1.0	1.0	2.0
Visiting Scientists	-	-	-
	4.45	2.8	7.25

In support of the previously listed objectives, additional work-months are provided by secretarial staff and an administrative aide, both one-half time on the grant.

VI. Summary of Results Expected from Developing Linkages and Collaboration

Coordination of activities and assisting CST members are basic to the continuation of these grant activities. Because staff of the CST institutions will be devoting major time to their specific areas of concern there will be less time for collaborative work, yet interaction and cooperation will be maintained consistent with other duties of staff members. This helps to keep our horizons open.

Part of this output is the opportunity to better comprehend the structure, needs, and policies of AID and relationships with universities for mutual understanding of long range goals. This additional understanding by AID and Cornell should benefit both institutions.

By explaining and discussing the various grant outputs with AID mission, it is expected that dissemination, application, and training assistance will be enhanced and facilitated whenever and wherever deemed desirable.

10. Involvement of Minority Personnel and Women

Cornell has employed the following personnel under the 211(d) grant during this reporting period. Their positions - country of origin are also listed:

Milegua Laye se-Bloom	Philippines	Graduate Assistant
Pamela Piech	U.S.A.	Graduate Assistant
Kingston Nyamapfene	Nigeria	Graduate Assistant
Hari Eswaran	Malaysia	Visiting Scientist
Ann Whynman	U.S.A.	Res Support Specialist
Connie Quenette	U.S.A.	Secretary
Merrily Dethier	U.S.A.	Administrative Aide
Sheila Ferrari	U.S.A.	Editorial Assistant