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Proposal for Continuing Support under the Agency for International Development Institutional Grants Program

Applicant:	University of Hawaii
Date:	August 1975
Grant Title:	Soil Microbiology and Mineralogy
Amount and Term of Original Grant plus Amendments:	$500,000 Nov. 2, 1970 to Nov. 1, 1975
Amount and Term of Proposal:	$500,000 extended to Nov. 1, 1977
AID Sponsoring Technical Office:	Office of Agriculture, Bureau for Technical Assistance

Grant Project Statement

211(d) Institutional Grant

University of Hawaii

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INSTITUTIONAL GRANT PROJECT STATEMENT
Extension/Revision
University of Hawaii
AID/csd-2833
Soil Microbiology and Mineralogy

I. RELEVANCE OF PROBLEM AREA AND NEED FOR EXPERTISE

Not until the morphology and genesis of a soil are known can new and improved soil management systems be planned most effectively for crop production. Without such organized knowledge purely empirical mass plot work alone is based simply in the hope that something will work which in most cases does not. This is the situation now with many tropical soils. Basic knowledge in soil mineralogy, soil physics and soil chemistry, and its relation to the behavior of applied soil amendments (e.g., lime phosphates, trace elements, etc.) and water retention, can assist in the classification of soils from various parts of the tropics that can be translated into crop productivity indexes.

New rules for management of the soils of the tropics are needed. These rules must come from those equipped with knowledge of such soils. State-of-the-art (SOTA) work on priority soil problems can provide these rules. These rules in turn must be disseminated to those regions where they will do the most good. An information storage, retrieval and dissemination system for immediate delivery of these rules needs to be developed. The system must not only provide information upon request, it should foster utilization of information to alleviate the plight of small farmers.

Through SOTA studies and soil inventories it is possible to identify, e.g., that some tropical soils are so low in nutrients, notably phosphate, and have such high fixation capacities that they should never be developed

unless means are found to block the fixation with cheap chemicals or that plants are found that can grow with very low nutrient requirements. This might suggest a two-pronged management approach for such soils . . . . either leave such soils in native vegetation or select species and varieties within species that require minimum nutrient application or none at all.

Over the past five years AID has invested heavily in building an institutional capability at the University of Hawaii to enable that institution to work on LDC problems relating to management and food production on the tropical soils. Implicit in this building process was the assumption that tropical soils are fundamentally different from soils that occur in technically advanced countries of temperate regions. That this assumption is largely correct has been amply demonstrated through the efforts of the University Consortium on Soils of the Tropics. Lack of appreciation of these differences in the past has been perhaps one of the major causes for the slow agricultural development of extensive, flat, well drained regions of Latin America, Africa and tropical Asia.

II. GRANTEE PERFORMANCE AND RESULTS TO DATE

A high level of performance in tropical soils science should come easily to Hawaii. Hawaii is part of the tropics and produces many of the crops common to the tropics. While Hawaii is noted for its high technology plantation agriculture, research for its two main crops, sugar and pineapple, is largely supported by private industry.

The University of Hawaii's College of Tropical Agriculture is, therefore, mainly involved with assisting the small independent farmer

who works the most marginal agricultural lands. The fact that the small farmer has survived and continues to survive in a highly competitive, high technology society on marginal land is the miracle of Hawaii's agriculture. The problem of serving the small farmer is many times more difficult than that of serving large corporate agriculture. Corporate agriculture is served by highly trained scientists and technicians who can modify technology to suit its needs. The small farmer on the other hand is at the mercy of public servants who are frequently oblivious to the farmer's needs. Development of new technology is one thing, getting it to the small farmer level is another.

The University of Hawaii's main strategy under the 211(d) grant was to test Hawaii's long experience with tropical soils elsewhere in the tropics. The questions kept constantly in mind were (1) Does the technology based on fundamental principles which applies to soil conditions in Hawaii also apply elsewhere, and (2) How can this technology be modified to suit the needs of the LDC small farmer? An example illustrates how this strategy operates.

The Hawaii experience consistently shows that if a soil is deficient in phosphorus, maximum yields are obtained when sufficient phosphorus is added to a soil so that the soil solution phosphorus concentration attains a given value. In some tropical soils as much as 500 to 1000 kg P/ha must be added to attain the desired concentration. In Hawaii land is scarce, fertilizer is relatively inexpensive and it pays to add as much phosphorus as is needed to attain near maximum yields.

The situation for the LDC small farmer is different. He simply cannot afford to add 50, much less 500 kg P/ha. The small farmer must concentrate

what little fertilizer he has into a band so that the soil solution phosphorus concentration in the band is optimum. This optimum value is the same for the small farmer in the LDC as it is for the farmer in Hawaii who broadcasts his phosphorus fertilizer. The fundamental principles are the same but the utilization and application of fundamental principles differ depending on the resources available to the farmer. Any deviation from this principle (in this case the optimum phosphorus concentration in the soil solution) results in loss to the farmer.

The small farmer is not interested in scientific principles. His concern is to improve the quality of life for himself and his family. The farmer understands and appreciates farming practices which contribute to his well-being. These practices in turn must be delivered to the farmer by the public servants who not only possess the technical skills but the desire to help the farmer.

The search for new principles, the modification of management practices for the benefit of the small farmer, and the training of LDC public servants require the efforts of many institutions and agencies. The University of Hawaii is just one of such institutions.

In a comprehensive review of the University of Hawaii institutional development grant, the AID review panel wrote:

> "it was the unqualified conclusion of the review team that the University of Hawaii has made very substantial progress in building institutional capability to work with LDCs on problems of management and food production on tropical soils. In fact, their progress has undoubtedly been the best of all the institutions with simlar grants."

III. GRANTEE COMMITMENT TO LONG-TERM INVOLVEMENT

By virtue of geography, climate and soil, the University of Hawaii is not only committed to long-term involvement in management of tropical soils, but to every aspect of food production and the maintenance of a healthy environment for human habitation in the tropics. The multi-ethnic make-up of its people and the recentness of their arrival to Hawaii generates strong sympathy for the plight of peoples in developing countries. Government officials and the public continue to voice support for international programs.

The faculty of the College of Tropical Agriculture of the University of Hawaii possibly constitutes the largest single concentration of scientists dedicated to optimization of food production and processing in the tropics. The college has a competent, highly motivated staff. Through proper negotiations with University and college administration AID can tap this rich resource to meet Agency objectives.

Hawaii has much to gain from strong linkages with sister agricultural institutions in the tropics. Thus Hawaii's commitment to international agriculture is founded not simply on humanitarian reasons but for quick exploitation of agricultural innovations developed in experimental stations and international centers located in the tropics.

The need to form linkages steadily rises as the quality of research at centers of excellence sharply rises. If the rise in quality is rapid, the exchange of ideas and the training of people to use new ideas are slow.

The University two years ago, undertook to examine the question of

information transfer for research and training in a joint U.S. Agricultural Research Service/University of Hawaii project "Research on Information Retrieval Systems for Tropical Research and Training Centers in the United States." It is designed to test how existing knowledge can be uncovered through modern means and transmitted for utilization in research and training in the tropics.

Hawaii's physical isolation forces it to seek unconventional means to keep abreast of modern technology. While Hawaii's intellectual isolation differs from those of the LDCs, the means to overcome it are the same. Hawaii's commitment to international agriculture is a commitment to survival.

IV. RATIONALE FOR REVISION/EXTENSION

What Hawaii lacks is not experience and knowledge about tropical agriculture, but faculty understanding of LDC problems. The LDCs are not politically, socially, economically, or technologically static. By definition a developing country is a changing one. The faculty needs to acquire a feel for the moods, needs and aspirations of the LDC small farmer, technician, and decision maker. The faculty in addition must be made aware of the U.S. role in each region. Only then can a scientist begin to think about how he can contribute to the well-being of the small farmer.

Under the past grant several faculty members acquired a good measure of understanding of LDC problems. These skills need to be sustained, and more faculty need to be involved to enlarge the institution's response capability.

Hawaii's focus will continue in mineralogy and biology. Mineralogy is a cause of the uniqueness of tropical soils. If the cause is known, the manipulation of effects is rendered easier. The effects are such problems as soil erosion and its control, water holding capacity and irrigation management, phosphorus adsorption and fertilizer economy, and soil structure and tillage. Hawaii's aim is to relate mineralogy to soil management in a utilization mode. Were it not for mineralogical constraints, the highly weathered soils of the tropics would respond to the same treatments as the soils of the midwestern United States.

It is the intent of the University, in conjunction with sister Consortium Universities, LDC and International Center scientists, to organize existing knowledge by preparing state-of-the-art papers on priority topics. No state-of-the-art on soil mineralogy is needed, but Hawaii will bolster each state-of-the-art effort with expertise in mineralogy. Soil acidity and liming, like the phosphorus problem, would be incomplete without mineralogical input.

Hawaii will broaden its information storage, retrieval and dissemination systems to include a tropical soils data base. This data base will include all key soils of the state as well as new data from experiment stations and international centers throughout the tropics. Information transfer among widely dispersed stations throughout the tropics is the goal for developing and storing such a data base. The rationale for the soil data base is that management recommendation can be tailored for a soil only if a measure of the soil is available.

Hawaii will also enter into a new developmental aspect in the grant extension. The new element involves developing a response capability in the field of soil biology - more specifically, microbiology and biological nitrogen fixation. The sudden rise in nitrogen fertilizer cost, the unknown quantity of legume symbiotic nitrogen fixation in pastures, and recent claims of high levels of associative biological nitrogen fixation in grasses all point to a profitable area for investigation. Largely through AID efforts, the University will examine the magnitude of biological nitrogen fixation in crops, the factors which limit or contribute to fixation, and the impact of biological nitrogen fixation on production of animal protein in the tropics.

V. REVISED GRANT PROJECT DESIGN

The general purpose of the 211(d) grant extension and revision is to capitalize on the response capability developed under the grant over the last five years, and to sustain this capability at the University to assist developing countries in overcoming development constraints related to mineralogy of oxidic soils, and to develop new competence in the field of biological nitrogen fixation in tropical range and pastures.

The grant extension and revision differs from the initial grant by focusing on modification of existing knowledge for use by the small farmer. It is similar to the initial grant in the area of biological nitrogen fixation in that development of expertise is emphasized.

Hawaii's weakness in soil biology was pinpointed by the Intra-agency Review Team during the on-site Comprehensive Review. The Team also

faulted the University for failure to report significant developments attained under the grant to AID and the missions.

The expected outputs generated by the grant extension can be grouped into the following categories:

(1) Expanded Knowledge Base

As far as they relate to soil mineralogy, research and study programs on procedures, techniques and policies for soil management to optimize food production and economic development will be continued but with emphasis on utilization and focus on small farmers. To identify areas where new technology and principles can be brought to bear on the development and management of land, SOTA studies will be initiated. These studies will involve an analytical review of the knowledge accumulated by research and practices, setting forth the established principles, how and where they can be used, and identifying the gaps in knowledge needing research for establishment of better principles.

Specifically the University will take leadership in developing a SOTA study on soil phosphorus for the tropics - on the present status of research and knowledge, a review of management practices and a consideration of the problems and implications associated with this technology for the small farmers in LDCs. Other SOTA studies such as biological nitrogen fixation, etc. will be identified by AID and University of Hawaii group when specific output are discussed for the grant project proposal. These studies will be done by literature review, by consultations with appropriate LDCs, AID field personnel and international organizations and in cooperation with U.S. and non U.S. institution expertise.

(2) Advisory Capacity

To have the required flexibility to respond quickly and adequately to requests for technical assistance to LDCs, the University of Hawaii will make available faculty members from a variety of appropriate disciplines related to soil management and land use in the tropics.

Two full professionals will be hired to release tenured senior staff to respond to LDC needs. The University will enlarge their staff with four (4) technicians to assist in the development of soil data bank, the Information system, the preparation of SOTA report, and for field monitoring of biological nitrogen fixation studies. The support staff enables the permanent faculty to concentrate on LDC related problems without crippling existing University programs.

The faculty members will teach, consult and perform application oriented research with special consideration to problems in developing nations, and will participate in SOTA studies.

The grant will also fund a small amount, not to exceed $10,000 per year, for consultancy time to be provided in emergency situations where individuals are needed on very short notice and other instruments cannot be used without causing unacceptable delay.

(3) Information Capacity

To develop an effective means for assistance in the transfer of knowledge, the University of Hawaii will develop and maintain an up-to-date information center of special competence in the broad areas encompassing soil taxonomy, soil mineralogy, soil physics, soil chemistry and and soil microbiology (biological nitrogen fixation) as they relate to

the tropics. The center will collect, evaluate and disseminate information useful to LDCs in their effort to improve the quality of life of the small farmers. Dissemination of information from scientific investigations to farmer utilization will require a crucial intermediate step - the organizing and packaging of research results into simple rules which can be implemented by para-technicians and followed by farmers.

Information system will also be developed to describe soil management systems via interpretation of organized knowledge such as incorporated in U.S. technology.

Under a grant from U.S. Agricultural Research Service, the University is currently testing and developing an information system which will have access to most of the major agricultural information systems in the world. This effort will be strengthened. The University is also developing a soil data bank for the State of Hawaii. The identification of LDC problems, current and anticipated will be made possible through the enlargement of this facility. This open-ended data bank will be systematically fed soil data from key LDC experiment stations and Research Centers.

(4) Education and Training

The education and training program is designed to insure maximum utilization of information to solve LDC problems. The dove-tailing of the problem to the information requires trained LDC public officials who:

a. can identify problems and bottlenecks

b. know where to go for help

c. can persuade decision makers to act

d. can follow through on decisions

The University, in a united effort with sister Consortium institutions, will hold workshops in LDCs to illustrate how mission-oriented action can be employed to solve problems in production agriculture. These workshops should be held in conjunction with state-of-the-art work. The state-of-the-art work on soil acidity can hold a workshop in Indonesia to illustrate how correction of soil acidity on the Ultisols of Sumatra, Kalimantan, or Suluwesi can contribute to greater success of Indonesia's Trans-migration program. The phosphorus workshop can do the same for the Oxisols of Colombia and Brazil or the Volcanic ash soils of Central America. The final objective of these short courses will be the development of a set of materials which can be utilized in LDCs or teaching aids for soil management practices. The University will continue to recruit students from LDCs into the academic programs in tropical soils. New instruments such as X-ray Quantometer, electron microprobe and scanning electron microscope gives the University research and training capacity it did not possess before. These instruments will break new grounds in soil mineralogy and microbiological field.

(5) Linkage and Network

The University linkages with Bureaus and Missions are expanding through AID grants and research contracts. Under the University/AID Contract "Crop Production and Land Capabilities in a Network of Tropical Soil Families", a network of experimental sites in Asia and Africa will be organized to test the hypotheses of agrotechnology transfer. A similar and parallel contract will enable Puerto Rico to do the same in Latin America. The Hawaii and Puerto Rico contracts are closely linked. The University is organizing a major seminar early next year at ICRISAT that

will bring together from 25 African and Asian countries, a group of soil scientists and government officials. The seminar will focus on the use of U.S. soil taxonomy as an instrument for planned agricultural development in LDCs. The University will develop meaningful linkages with soil scientists from various LDC experiment stations during the seminar. The University will cooperate with all those experiment stations that wish to have their soils analyzed completely for the purpose of developing a common base to facilitate exchange of agronomic information among the tropical regions.

The International Centers and key LDC Experiment Stations will be linked to the University through the Soil Data Bank. The University will link its networking capability to CID (Water Consortium) Information System.

To maximize subject field utilization in LDCs the University will spend at least 2 man-months per year (2 people, a month each) with AID/Washington to: a) sufficiently understand AID's short term and long term goals, b) explain updated Institutional response capability to the Bureaus, and c) establish smooth personal linkages with the Bureau personnel.

The proposed budget shown below by inputs and program categories is subject to detailed negotiation with the University, will fund the activities and outputs described above for a two-year period, i.e. until November 1977. At the mid-term, the utilization rate and need for additional grant support, if any, will be reviewed.

Total Estimated Cost by Inputs and Outputs

November 1975 to November 1977

INPUTS

Salaries and Benefits	$300,000
Travel	95,000
Equipment and Supplies	25,000
Library and Publications	50,000
Other (Consortium)	30,000
TOTAL	$500,000

OUTPUTS

	a. Bio. N-fixation	b. Mineralogy
Expanded Knowledge Base	40,000	70,000
Advisory Capacity	55,000	80,000
Information Capacity	50,000	60,000
Education and Training	40,000	50,000
Linkages and Network	15,000	40,000
TOTAL	200,000	300,000

The University's on-going program in tropical agriculture, supported by State and Federal funding, is largely directed towards local and regional needs. AID's goal is to build on this existing expertise and add momentum to the University's commitment to international agriculture.

The University now provides a significant input to the program. The grant provides no overhead, therefore, such items as office space,

laboratories, utilities and some supplies are provided by the University. In addition, a significant portion of faculty and administration time and facilities are made available for grant or grant oriented activities without charge.

VI. COMPLEMENTARY ACTIONS AND MANAGEMENT CONSIDERATIONS

This grant is planned as an extension and revision of the existing 211(d) grant to the University of Hawaii and is a part of a much larger package of Agency activities in soil and water management field. There are several on-going programs which relate closely to this grant. These are noted in a cover statement to the package of grants (4) of which this grant is a part. Briefly stated they include 4 grants in tropical soils, 5 grants in water management field, and 6 centrally funded research projects - 4 in tropical soils and 2 in water management. Two AID supported international seminars in tropical soils were held at international centers in Africa and Latin America. A seminar in tropical soils is scheduled for January 1976 in Asia at ICRISAT, another international center.

The focal point within AID for technical, substantive, and managerial aspects of this grant will be the Soil and Water Management Division, Office of Agriculture, Technical Assistance Bureau (TA/AGR). Liaison with the University of Hawaii will be through the Grant Project Officer, Dr. Tejpal S. Gill. Contacts with AID missions will be handled through TA/AGR and appropriate Bureaus, and the University will initiate and sustain contacts with other research and educational institutions, both within the U.S. and abroad, on a direct basis.

Demand imposed on AID offices, other than TA/AGR, by management of the grant should be quite limited. Regional Bureaus and field personnel will, however, be contacted for advice and consultation on research, state-of-the-art, and training aspects and invited to participate in grant-sponsored activities.

The grant should continue to be centrally funded and managed to take advantage of cooperative relationships with the related centrally funded and managed programs, to permit a global sphere of influence and study, to allow for interregional coordination and cooperation among agencies and international centers, and to facilitate management within AID.

TA/AGR: 8/7/75