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ANNUAL REPORT SUMMARY SHEET

Crop Production and Land Capabilities of a Network of Tropical Soil Families
(The Benchmark Soils Project)
ta - C - 1108

Project Title and Contract Number

L. D. Swindale University of Hawaii

Principal Investigator and Contractor

Department of Agronomy and Soil Science, Honolulu, Hawaii

Contractor's Address

May 31, 1974 - May 30, 1977 Contract Period (as amended) From-To	May 31, 1974 - June 30, 1975 Reporting Period From-To
Total Expenditures and Obligations Through Previous Contract Year	$87,777
Total Expenditures and Obligations For Current Contract Year	$540,434

I. NARRATIVE SUMMARY OF ACCOMPLISHMENTS AND UTILIZATION

The objectives of the Benchmark Soils Project are to correlate food crop yields on a network of benchmark tropical soils, and to determine scientifically the transferability of agroproduction technology among tropical countries.

The project will concentrate initially upon well-weathered, upland soils with mean annual soil temperatures around 22° C, in the taxonomic subgroups of Hydric Dystrandepts, Tropeptic Eutrustox and Orthoxic or Humoxic Tropohumults. These are approximately: soils from volcanic ash in humid climates; deep, red, uniform soils from intermediate or basic parent materials in subhumid climates; and deep, red soils with heavy clay subsoils in humid climates.

Benchmark soils sites have been established in Hydric Dystrandepts in Hawaii, and are being established in Indonesia and the Philippines. A benchmark soil site has been established on a Tropeptic Eutrustox soil in Hawaii in a common soil family with a soil site established in Puerto Rico.

The Cameroons, Ethiopia, Kenya, Rwanda, Tanzania, Sri Lanka and Western Samoa have expressed interest in participating in or cooperating with the Project. Assistance in soil survey and classification, establishing the network of benchmark sites and in carrying out the project experiments has been requested.

A workshop on experimental designs to be used by the Benchmark Soils Project was held in May, 1974. Results and recommendations of the workshop were published as "Report of the Workshop on Experimental Designs for Predicting Crop Productivity with Environmental and Economic Inputs" by J. A. Silva (Hawaii) and F. H. Beinroth (Puerto Rico). The proceedings of the workshop containing papers presented and discussions will be published.

A primary site of 5 to 10 hectares in size and three or four secondary sites of 1 hectare in size will be established on each soil family in each country. A transfer experiment for testing the hypothesis of transferability of agricultural information will be established at each site. Variety experiments and crop management experiments will be installed at the primary site. Maize will be the main test crop. Soybeans, cassava and other crops will be included according to the wishes of participating countries.

The Project has disseminated information about soil classification, and its usefulness in development to fourteen developing countries in Asia, Africa and the Pacific. Most of these countries have a keen interest in the U.S. Soil Taxonomy, would like to receive copies when it is published, and be trained in its use. The Project has established linkages with national institutions in several countries, and with IITA, CIAT, ICRISAT and IRRI. It has assisted with soil survey and mapping in the Philippines and in soil characterization in several countries. It has trained a few people from LDC's in the conduct of project experiments.

A seminar on "Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development in the Tropics" is being organized and will be held at ICRISAT in January 1976. The Seminar will provide opportunities for program planners and soil scientists from tropical countries in Africa, Asia and the Pacific to report, discuss, and learn about the practical usefulness of soil

classification in interrelating research studies on soil, water, and crop management to each other; in land use planning and regulation; and in planning and implementation of agricultural development for food production.

The Seminar will introduce more participants to the Benchmark Soils Project and explore the possibilities of extending the soils research network to additional soil families.

II. PROJECT OBJECTIVES

Objectives are to correlate food crop yields on a network of benchmark tropical soils and to determine scientifically the transferability of agroproduction technology among tropical countries.

Crop production and soil management experiments will be carried out on carefully selected benchmark soils in the same soil families -- in the Philippines and one other country in tropical Asia, one country in tropical Africa and in Hawaii.

Within the first three years of this project it is expected that contractor will have accomplished the following:

a. Establish the network of soils

b. Carry out transfer and soil management experiments

c. Determine relationship between production and land capabilities for benefit of farmers and government planners in participating countries.

The University of Hawaii will correlate food crop yields, soil properties and different soil management practices on deep, upland soils. Purpose of the experiments is to assist tropical countries in realizing the value of soil classification in formulating agricultural development plans. A second goal is to assist them to realize the potential of upland areas for intensive cropping and of intensive soil management.

III. ACCOMPLISHMENTS TO DATE

A. FINDINGS

1. SOILS

In the first year, three soil groups have been selected for inclusion in the project.

Hydric Dystrandepts. One family of soils derived from volcanic ash, the thixotropic, isothermic family of Hydric Dystrandepts will probably be used in all countries participating in the Benchmark Soils Project with the University of Hawaii. These are well-drained, upland soils used for both plantation crops and diversified agriculture by small farmers. Many are still forested, particularly those on steeper slopes.

The soils are generally recognized as desirable for agriculture in all countries, but they are not being fully utilized. They can be problem soils in engineering use, and maintenance of roads in these areas is difficult. They are easily located by experienced soil surveyors with adequate local knowledge.

The soils have dark brown to dark reddish brown surface layers that are moderately to extremely acid overlying dark brown to reddish brown subsoils that are silty clay to clay in texture, smeary, low in bulk density and slightly to moderately acid. The mineralogy is dominated by amorphous materials. Mean soil temperatures at 50 cm depth are higher than 15° C but lower than 22° C, and the mean summer and winter temperatures differ by less than 5° C.

Cation exchange capacities are high; base saturations low. The soils fix phosphorus in forms that are only slowly available to plants.

The soils have good physical conditions for plant growth. They require large amounts of phosphate fertilizers to make them productive. Because of the permeable nature of the soils, and their occurrence in locations with wet climates, nitrogen and potassium fertilizers need to be applied frequently to ensure high production. The soils also need calcium, but seldom as much as the low pH would suggest.

Tropeptic Eutrustox. The soils that will be used in Hawaii to link with Puerto Rico are members of the clayey, kaolinitic, isohyperthermic family of Tropeptic Eutrustox. These are well-drained, red, upland soils of subhumid regions. Natural vegetation is savanna, deciduous forest or semi-deciduous forest. In Hawaii they are highly productive soils when properly managed, and are used almost exclusively for the production of sugarcane under irrigation and pineapple.

These soils have not yet been found by the project in Asia but they are expected to be common in Africa.

The soils are developed in residuum or old alluvium from basic rocks. They are nearly level to moderately steep. The rainfall tends to be concentrated in a rainy season.

They have surface layers that are dark reddish brown to dark red sandy clay loams to clays with moderate to strong structure. Subsoils are similar to the surface in color and texture, but have generally weaker structure. Mean soil temperatures are 22° C or higher at 50 cm and the mean summer and winter temperatures differ by less than 5° C. The soils are moderately acid to neutral throughout.

Cation exchange capacities are low; base saturations are higher than 50 percent. Organic matter is moderate to low. The soils are high in kaolin minerals and iron oxides.

The soils have excellent to good physical conditions for plant growth, although heavy equipment can cause compaction in the subsoil. The heavy textures make plowing difficult. The soils are well supplied with many nutrients, but require fairly high phosphorus and nitrogen fertilization for maximum yields. Much of the phosphorus is fixed when first applied, but continues to be slowly available to plants over many cropping seasons. The soils need at least supplemental irrigation for maximum use.

Tropohumults and Tropudults. The extensive red upland soils in the humid regions of tropical Asia are Ultisols; acid soils with red, clayey, dense subsoils. In the warmest parts of these regions the soils belong to the Great Group of Tropudults. Where the temperature regimes are cooler, and there is more humus in the profile, they belong to the Great Group of Tropohumults.

The soils are underutilized because problems in their management have not been solved. Several countries have asked the project to concentrate to some extent on these soils.

Soil surveys in areas where these soils occur have generally not been detailed enough to provide data for soil family classification. Much soil survey and characterization work will be required before suitable benchmark sites on these soils can be located.

2. COUNTRIES

United States - Hawaii.

Soils in the thixotropic, isothermic family of Hydric Dystrandepts occur on the Island of Hawaii. Three soil series have been selected; their locations are as follows:

Soil Series	Location	Principal Land Owners
Niulii	Kohala	Kohala Corporation
Kukaiau	Hamakua	T. H. Davies, Ltd.
Moaula	Ka'u	C. Brewer, Ltd.

The Kukaiau and Moaula series are used primarily for sugar production; the Niulii series is used for both sugar cane and pasture. Cultivation of sugar cane on the Niulii series is scheduled for termination at the end of 1975 because of low sugar yields. Reduced yields have been attributed to poor soil and extremely windy conditions. It would be of benefit to the project and to those farming in

the immediate vicinity to learn why sugar cane grew poorly on the Niulii series and well on the Kukaiau and Moaula series.

Two benchmark sites have been established. Lease agreement for one hectare at either $45/per hectare per year or 3½% of gross annual proceeds from sugar production for one hectare on the Kukaiau site, and for 4 hectares at $100 per hectare per year on the Niulii series have been completed. Negotiations are continuing for one hectare on the Moaula series. A minimum period of three to four months was required to select and to negotiate a lease agreement for a given site on land owned or leased by private agricultural companies.

The Lihue series on Kauai and the Wahiawa series on Oahu belong to the clayey, kaolinitic, isohyperthermic family of Tropeptic Eutrustox. Sugar cane and pineapple are the principal crops grown on the Lihue and Wahiawa series, respectively. Lease negotiations with Lihue Plantation Co., Ltd. for possible sites on the Lihue series are proceeding slowly. A site on the Wahiawa series has been located at the Poamoho Experiment Station of the Hawaii Agricultural Experiment Station.

The main obstacles in establishing experimental sites within the state of Hawaii are (1) availability of sites currently used for long-term sugar cane or pineapple production, (2) lease rents, and (3) availability of water sources for installation of drip irrigation systems.

Republic of Philippines.

Soils in the thixotropic, isothermic family of the Hydric Dystrandepts occupy nearly 20,000 hectares in the Bicol Region on the island of Luzon. Only a small percentage is used for agronomic crops. Other soils from volcanic ash occupy nearly 50,000 hectares in the Region.

Four possible benchmark sites were located in these soils. First choice is on the campus of the Philippine Union College, Naga View Campus. Other possible sites are located on the farms of Mr. Trevino and Mr. Jimenez. Few areas are available for leasing. At present, Hydric Dystrandepts are not being used extensively for upland food crops, and experimental research stations are non-existent on these soil types.

Additional benchmark sites on these soils are needed. The island of Negros was surveyed, but suitable sites were not found. The island of Mindanao, where these soils are known to be extensive, has still to be surveyed. The mineralogy of Andepts is characterized by amorphous materials. The soil mineralogy of a few selected samples was determined by X-ray diffraction at the University of Hawaii. X-ray diffractograms indicated the presence of imogolite as well as the amorphous materials. Subsequent electron micrographs of the clay fraction from one subhorizon confirmed the presence of imogolite. Imogolite is a common secondary mineral constitutent of some Andepts, but has not previously reported as occurring in Andepts of the Philippines.

The clayey, kaolinitic, isohyperthermic family of Tropeptic Eutrustox have not been located in the Philippines, although their occurrence is generally acknowledged. Mindanao seems to be the most probable island for their occurrence. Extensive soil survey and characterization will be needed to establish the extent of these soils and to find suitable sites.

Tropudults and tropohumults are important and extensive agronomic soils in the Philippines. They are often termed problem soils, and the Republic of Philippines would like to have these soils included in the project. Additional soil survey and laboratory analyses will be needed to locate and classify suitable sites.

The Republic of Philippines wishes to participate in the Benchmark Soils Project. The Philippine Council of Agriculture Research (PCAR) has been designated as the coordinating agency for the Project. Other agencies or institutions directly involved will be the Bureau of Soils, in soil survey and soil analyses and land capability projections, and the Department of Soils of the University of Philippines at Los Banos in transfer, variety and management experiments.

Detailed soil descriptions with analyses obtained by the project has provided the Bureau of Soils with new information to update their knowledge of the extensiveness of soils from volcanic ash in the Philippines. This new information led to the establishment of new soil series and redefinition of others. Although soils in the particular family of Hydric Dystrandepts were not located on the island of Negros, the Bureau of Soils was helped to define some of the major soil types on that island. Ultisols do occur on Negros, and if these soils are incorporated into the network of soils, possible site locations have been located.

With the locating of the Hydric Dystrandepts, it is now possible for the Benchmark Soils Project to proceed with land lease agreements with landowners. A long term agreement between the cooperating agencies and the University of Hawaii can be finalized.

Indonesia.

Hydric Dystrandepts occur extensively throughout Indonesia. These soils are used extensively for vegetable production, and for corn and upland rice where there is sufficient rainfall. Although highly permeable, these soils are even used for paddy rice where sufficient water is available. Detailed soil survey and characterization is needed to classify the soils down to families, and to locate suitable benchmark sites.

A large area of Sumatra is mapped as Red-Yellow Podzolics by the Soil Research Institute - (LPT). These soils are considered problem soils because of their low fertility and low productivity. The Institute would like research on management of these soils incorporated into the Benchmark Soils Project. Field and laboratory data is needed to classify these soils in the U. S. Taxonomy.

The Government of Indonesia wishes to participate in the Project. The Soil Research Institute of Bogor has been designated as the cooperating agency. The Director General of Agricultural, Government of Indonesia, the University of Hawaii, AID/Jakarta and AID/Washington have agreed that the Benchmark Soils Project will work under the "umbrella" of the USAID Project Assistance to Agriculture, Project No. 497-11-110-189.

By working through an existing AID project, the logistics of the Benchmark Soils Project in Indonesia should be easier, and sound working and communication relationships with AID/Jakarta can be established.

Sri Lanka.

Subhumid red Oxisols occur in northern Sri Lanka. The soils are derived from transported materials from the Basement Complex and contain much sand-sized quartz. They are classified in families that do not occur in Hawaii, but are extensive in Africa and South America.

The Land Use Division of the Ministry of Irrigation and Power was designated as the probable cooperating institution. Cooperation with the Ministry of Agriculture was assured by the Director of Research, Dr. C. R. Panabokke.

Because the soils occupy different families from those that will receive initial concentration, cooperation with Sri Lanka may be delayed until the Project is extended to additional Benchmark Families. It is possible that the Land Use Division may link informally with the Project by undertaking project experiments, and comparing the results with those obtained in other countries.

Western Samoa and other Pacific Island Countries.

The possibilities of cooperation with Western Samoa, the Cook Islands and Fiji were investigated. Some soil analyses have been performed for these countries to determine whether a basis for cooperation exists. It seems possible that Western Samoa will cooperate with the project through a Western Samoa/University of Hawaii subcontract of an existing WS/FAO/UNDP project. Details of the extent of the cooperation have yet to be determined.

Cooperation with Cook Islands appears possible through an informal link with New Zealand's aid program to that country. Soils are being analyzed in New Zealand to determine their family classification.

Cooperation with Fiji will be informal. The University of the South Pacific has asked to be kept informed of the Project and its work with the possibility of future active cooperation.

African Countries.

The Project development in Asia, in determining which soil families will receive initial concentration, has the effect of limiting the possible participating and cooperating (i.e. not receiving substantial financial input from the Project) countries in Africa to Cameroon, Tanzania, Kenya, Ethiopia and Rwanda. Guidelines for the selection of benchmark soils were sent to soils institutions in all countries. Responses have been received indicating the probable existence of one or more of the soil families in all countries.

Preliminary field exploration and soil characterization are needed to determine more certainly the occurrence of the correct soil families. Negotiations with interested governments will then be undertaken.

Cooperation with Puerto Rico.

The two similar contracts between AID and the Universities of Hawaii and Puerto Rico are being operated in close cooperation. The workshop on "Experimental Designs for Predicting Crop Productivity with Environmental and Economic Inputs" was conducted jointly by both Universities and AID.

The Coto soils in Puerto Rico and the Lihue and Wahiawa have been jointly selected as sites for the common experiments. Varieties of maize to be used at each site have been jointly determined.

A memorandum of agreement defining the nature of the cooperation between the two contracts has been signed by both Universities. The agreement provides for the two Universities to undertake joint field sampling wherever possible, that the same experimental designs, crops and climatic equipment will be used, that all workshops will be joint, and that the principal investigators of the two contracts will in future hold annual coordinations meetings. All semi-annual, annual and published reports will be exchanged.

Hawaii has undertaken to carry out much of the soil and plant analyses for the two projects.

3. EXPERIMENTAL WORK

A Workshop on experimental designs and research methodology that could provide valid scientific tests of agrotechnology transfer was held in Honolulu at the recommendation of the Research Advisory Committee of the United States Agency for International Development. Summaries of papers presented and of discussions on the "best" experimental design have been published (Silva and Beinroth, 1974). The Workshop has led to several significant changes in the types of experiments to be undertaken, and the number of sites to be used.

Types of Experiments.
Three types of experiments will be installed at the primary site. These are: (1) transfer experiments, (2) variety experiments and (3) management experiments.

Transfer Experiments. Transfer experiments for testing the hypothesis of transferability will be kept very simple, with only 2 variables. The variables will be related to characteristics of the soil family. P x pH, and N x P were two suggested treatment combinations. The same treatment combination will be used in all sites of the same family, but treatment combinations may differ among families. The variables may also be those that are expensive to control, so that results from the experiments may have greater immediate economic value. In order to keep the experiments manageable, and yet obtain sufficient information to develop production functions, 5 levels of the factors will be used. A wide range of the factors is more important than many levels. The anticipated optimum level should be near the middle of the range of levels selected. The experiments have been designed so that all other controllable factors, i.e. irrigation, other nutrients, plant protection and plant density, are maintained near optimum levels so that treatment effects will be clear.

Three replicates of each transfer experiment will be set out at each site. The cost of replicates is small by comparison with the cost of selecting and establishing the site, and many things can affect the survival of experimental plots.

The experimental design to be used in all transfer experiments is a 5^2 partial factorial developed by Escobar, and described in the paper by Laird and Turrent of CIMMYT presented at the workshop (Silva and Beinroth, 1974). It was chosen on the basis of (a) appropriateness for use in a graphic estimation of economic optima, (b) relatively small bias error, (c) number of treatment combinations, (d) flexibility in number of factors and number of levels of each factor, and

(e) relatively small variance error. It also has good coverage of the factor space with its 13 treatments.

Variety Experiment. It has been decided to use the "best adapted local variety" as the test crop in the transfer experiments. Yield experiments on all the varieties will be necessary in several places on primary sites for comparative purposes. Randomized block designs will be used in these experiments. Where there is doubt about the best adapted variety for a location, some preliminary variety experimentation may also be necessary.

Management Experiments. Management experiments on maize will be installed at the primary site in each country. The objectives of these experiments will be (1) to provide information to local governments on ways to increase production by improved availability and utilization of resources; and (2) to provide basic information to local farmers with limited resources to indicate how they can increase their yields. Management variables to be investigated, each at two levels (with and without) will probably be: irrigation, lime, weed control, insect and disease control, N, P, and K. Details of the management experiments and other research to be conducted will be worked out with each participating country.

Number of Sites.

Primary Sites. In each country on each soil family a primary site is being established. All transfer, variety and management experiments will be conducted at the primary sites. To provide sufficient land for the many experiments envisaged, it may need to be 5 hectares or more in extent. It will continue to be in use throughout the duration of the project. It should be located on an existing University or Government research station in participating and cooperating countries. Complete weather stations and adequate storage (including water storage) and office facilities will be established at each primary site where these do not already exist.

Secondary Sites. The transfer experiments will be conducted at three to seven secondary sites on each soil family. The Workshop determined that this was necessary to fully test the transfer hypothesis, and to account for significant, uncontrollable variables. The actual number of sites will depend upon the nature of local variability in climate, distances between soils in the same family and the number of crops to be used in the experiments. Weather instruments at each secondary site will record daily rainfall, daily sunshine and maximum, minimum and average temperatures. The secondary sites will need to be up to 1 hectare in size and be available for up to two years. They will be fenced but not otherwise equipped, except for water storage facilities where needed.

Additional Benchmark Families. As the value of the family concept becomes evident in each country, it is expected that participating countries will wish to extend the approach to other soils. The project will assist countries design and install experiments on Additional Benchmark Families. Additional participating and cooperating countries may also be included. Discussion concerning Additional Benchmark Families have been held in several countries, particularly in relation to soils important in country development plans that are not in families receiving initial concentration.

It is indicative of the interest that the project has engendered, that several countries appear anxious to commence work immediately on Additional Benchmark Families.

4. CLIMATE RECORDS.

Climate is an uncontrolled variable in the design of agronomic experiments. Hence, it is essential that significant climatic variables be measured at each experimental site to have meaningful transfer of agrotechnology from one site to another. Temperature, rainfall, relative humidity, solar radiation, wind direction and wind speed will be monitored at each primary site, and temperature rainfall, relative humidity and solar radiation at each secondary site. Soil temperature and pan evaporation may be measured.

Meteorological instruments have been selected for reliability, accuracy, and low maintenance. A self-contained, battery-operated mechanical weather station (model 755W) from WeatherMeasure Corporation of Sacramento, California is under test for probable installation at each primary site. It is capable of recording changes in temperature, relative humidity, rainfall, wind direction and wind speed simultaneously and continuously on a strip chart recorder. Solar radiation will be monitored by a wig-wag radiometer manufactured by Beckman Instruments exclusively for the Hawaiian Sugar Planters' Association. The wig-wag radiometer operates on solar energy and has been in use for many years in Hawaii. A hygrothermograph, a standard, recording rain gauge and a wig-wag radiometer will be installed at each secondary site. Budget limitations will not permit installation of mechanical weather stations at all sites.

B. CHANGES IN RESEARCH DESIGN

Soils experts in possible participating countries are quick to see the potential value of the soil family concept. They recognize that its use will increase the significance to national and regional development of their programs of soil survey. They are anxious to obtain copies of the U.S. Soil Taxonomy as soon as it is published, and look to the Project to help them obtain it and train them in its use.

Some countries require close relationship of the Project to their development plans as a condition of their participation. To meet this requirement it may be necessary to establish sites on more than one benchmark soil family in these countries. Because the classification of some of these desired families is difficult, a greater input than was planned into soil survey and classification will be required of the Project.

The Workshop on Experimental Designs for Predicting Crop Productivity with Environmental and Economic Inputs proposed significant and costly changes in research design which are now being incorporated into the project.

The number of replicates and sites for the transfer experiments have been

increased. The use of "best adapted local varieties" in the transfer experiments necessitates yield experiments on all varieties at most primary sites. The number of management experiments has also been increased.

In the original proposal, it was intended to test the information obtained at the major sites by installing experiments at "satellite" locations. These were envisaged as simple experiments on farmers fields. The locations have been upgraded to secondary sites and increased in number.

Maize will be the test crop in transfer and management experiments. Soybeans and/or cassava will be included according to the wishes of participating countries. Other crops can be included if participating countries will bear the costs involved.

The meeting on Crop Production under Intensive Soil Management planned for Hawaii has been shifted to ICRISAT and changed somewhat in purpose. It is likely to give greater visibility to the project amongst the LDC's and heighten their interest in participating in or cooperating with it. The meeting is likely to give considerable impetus to AID's efforts to establish a research network on tropical soils.

IV. DISSEMINATION AND UTILIZATION OF RESEARCH RESULTS

A. PROJECT OUTPUT

PAPERS AND PUBLICATIONS, 1974-75

Silva, J. A. and F. H. Beinroth. 1974. Report of the Workshop on Experimental Designs for Predicting Crop Productivity with Environmental and Economic Inputs. Departmental Paper 26, Hawaii Agricultural Experiment Station, College of Tropical Agriculture, University of Hawaii.

Silva, J. A. and L. D. Swindale. 1975. A project to determine production and land capabilities of a network of tropical soil families. Proc. Fertilizer I.N.P.U.T.S. (Increasing Productivity Under Tight Supplies) Project, Planning and Organizational Meeting, East-West Center, Honolulu, Hawaii. pp 158-161.

Silva, J. A. 1974. Field experimentation to allow economic evaluation of management and environmental effects on soil productivity. Proc. of Workshop on Experimental Designs for Predicting Crop Productivity with Environmental and Economic Inputs. University of Hawaii, Honolulu, Hawaii (In press).

Swindale, L. D. 1974. Crop production and land capabilities of a network of tropical soil families - a description of the UH/UPR/AID Benchmark Soils Research Projects. Proc. of Workshop on Experimental Designs for Predicting Crop Productivity with Environmental and Economic Inputs. University of Hawaii, Honolulu, Hawaii (In press).

B. DISSEMINATION OF PROJECT INFORMATION

1. CORRESPONDENCE

The following people were sent the "Guide to the Selection of Benchmark Soils" for possible cooperation and assistance in the project.

Mr. W. G. Sombroek	Kenya
Mr. R. F. van de Weg	Kenya
Mr. J. S. Mburu	Kenya
Mr. P. K. Gota	Kenya
Mr. Harold M. Jones	Kenya (AID)
Mr. J. K. Gitau	Kenya
Minister of Planning and Territorial Management	Cameroon
Mr. Lawrence A. Beery	Cameroon
Mr. Johnson Gabuin	Cameroon
Dr. M. Rashdan Baba	Malaysia
Mr. Law Wei Min	Malaysia
Mr. F. T. Underhill, Jr.	Malaysia (U.S. Ambassador)
Mr. J. Mariano	Philippines
Dr. Frank W. Sheppard	Philippines (AID)
Dr. Nyle C. Brady	Philippines (IRRI)
Prof. Ir. A. Adiwilaga	Indonesia
Mr. Tjetje S. Hassan	Indonesia
Dr. Sherwood O. Berg	Indonesia (MUCIA)
Dr. D. Muljadi	Indonesia
Miss Ratna Wahab	Indonesia
Dr. O. Koswara	Indonesia
Mr. Gaylord Walker	Ethiopia (AID)
Dr. L. H. J. Ochtman	Ethiopia (FAO)
Dr. B. R. Singh	Tanzania
Dr. Oleen Hess	Tanzania (AID)
Dr. U. J. Grant	Colombia (CIAT)
Mr. Christopher Van Hollen	Sri Lanka (U.S. Ambassador)
Dr. C. R. Panabokke	Sri Lanka
Dr. Herbert Albrecht	Nigeria (IITA)
Mr. James W. Ford	Ghana (AID)
Dr. Henry Obeng	Ghana
Dr. J. F. Moutappa	Ghana (FAO)
Mr. Robert E. Frits	Rwanda (U.S. Ambassador)
Dr. M. D. Froment	Rwanda
Mr. Fletcher E. Riggs	Thailand (AID)

Travel to these countries was planned on the basis of responses received.

2. SOILS DATA

The data obtained was primarily soil characterization data which was essential for site selection. Within Hawaii all data was made available to cooperating

plantations and institutions, the Soil Conservation Service, USDA, and to other University of Hawaii projects, e.g. the Soil Data Bank. The data was made available to AID contracts and 211(d) grants through the Consortium on Tropical Soils, and to international and national research centers such as FAO, CIAT, IITA, IRRI and ICRISAT. Data about the Philippines, was made available to the Bureau of Soils, USAID, and the Department of Soils of the University of the Philippines at Los Banos. Farmers and institutions from which soil characterization samples were obtained, were sent copies of the results and a short narrative explaining data applicability.

Monthly meetings were held with project staff to discuss the results and to inform each member of project progress. In this manner the research finds were constantly being reported to the academic community. Letter reports were sent to each cooperating country to maintain rapport and to report significant findings.

Dr. Uehara presented a slide presentation in Indonesia to a combined group comprising staff of the Soil Research Institute, Central Research Institute for Agriculture and the Agriculture University at Bogor. The presentation related soils of one country to another, and showed that soils similarly classified should have the same management requirements and productivity indexes. Dr. Swindale presented a lecture to the Soil Bureau staff of New Zealand on current soil-related research at the Hawaii Agricultural Research Station.

3. VISITORS

Frank Moormann	IITA
Thelma Richmond	University of South Pacific
Steve Reynolds	Western Samoa, FAO
D. Muljadi	Soil Research Institute, Indonesia
Ratna Wahab	BAPENAS, Indonesia
Virginia C. Perelli	USAID/Washington
Adama Sy	Mauretania
Fred Beinroth	University of Puerto Rico
Gene Spain	University of Puerto Rico
D. M. Lang	Rothamsted Experimental Station, U.K.
J. S. Kanwar	ICRISAT
B. Krantz	ICRISAT
T. S. Gill	USAID/Washington
Kimo Taber	Hawaii Agronomics
	Malaysia

Dr. Nugyen Kha, a National Science Foundation Exchange Fellow from Nancy, France accompanied Benchmark Soils personnel to both Hawaii and Kauai to acquaint himself with soils found in Hawaii. Mr. Lee Ingamells, U.S. graduate assistant in the Department of Agronomy and Soil Science, and Mr. Adama Sy, a student from Mauretania presently attending Oregon State University, traveled to Hawaii to learn techniques in laying out experimental plots and in installing drip irrigation systems.

C. UTILIZATION OF PROJECT RESULTS

The field survey for Andepts in the Republic of Philippines was very beneficial to the Bureau of Soils. A general soils map of the Philippines based on the U.S. Soil Taxonomy had been prepared by the Bureau of Soils. Most of the soil had been classified from previous reconnaissance soil survey reports. The search for Andepts allowed the Bureau to test the reliability of the map, redefine establish and reclassify soil series, and update the map. The survey allowed Dr. A. Briones, Associate Professor of Soil Science, UPLB, to obtain field experience in locating and describing soil profiles as well as Bureau staff.

In Hawaii, the soil characterizations have benefited the SCS, sugar and pineapple plantations. On Kauai, the area described and mapped as Lihue series has been shown to comprise two separate series. A new series with oxidic mineralogy must be established. Plantations have been able to use the chemical data obtained on project sites to calculate liming, fertility and water requirements for their sugar cane operations. Plantations in Hawaii and Philippines have furnished the project with useful climatological data, vehicles and hospitality.

D. FEEDBACK

A number of requests have been made either to the project or to the Department of Agronomy and Soil Science staff. A list follows with requests from specific countries.

Fiji. Mrs. Thelma Richmond, University of South Pacific (USP) was given assistance in the classification of a few Fijian soils at the family level, reports on the progress of the project, and publications on P-isotherms for tropical soils. Professor Dandy, USP, was assisted with mineralogical analyses of 6 soil samples to be used as standards for undergraduate instruction.

New Zealand. The Director of the New Zealand Soil Bureau, Dr. R. B. Miller received a copy of Soil Survey Investigation Report No. 1 (SSIR No. 1), and requested copies of the U.S. Soil Taxonomy. Dr. R. Northey, Chief of the Soil Engineering Section, received information on the engineering characteristics of the Hydrandepts and Dystrandepts. Dr. P. Rankine and Mr. Whitten, Soil Chemists received information about the X-ray fluoresence Quantometer.

Indonesia. Dr. Weiss of LPT received copies of SSIR No. 1 and requested the U.S. Soil Taxonomy. Mr. Hassan, Padjadjaran University, requested a soil color book and other simple aids to be used in an introductory soils course.

Sri Lanka. Dr. Joshua, Soil Physicist in the Department of Agriculture, received all of U of H publications on physical properties of soils. The Land Use Division, received Soil Science Society of America Proceedings for the years 1972, 73 and 74.

Republic of Philippines. Mr. J. Derting FAO/UNDP soil project, received reports and publications on soil survey interpretation, photo interpretations and requested the Soil Taxonomy. Bureau of Soils received SSIR No. 1, and requested the Soil Taxonomy. UPLB, Soils Department received SSIR No. 1, and chemicals used in thin section work, and requested the Soil Taxonomy.

E. LDC INVOLVEMENT

The countries approached for possible participation in the Project have willingly cooperated in developing information about their soils. In Indonesia, the Philippines and Sri Lanka field trips were arranged for project and country staff. These required careful planning, including, in some cases, the preparation of soil pits in advance, and soil analysis following the trips. They constituted a diversion of professional and support people from other important activities.

The project sent a soil scientist, Mr. Wayne Hudnall to the Philippines for six weeks to locate suitable benchmark sites. Prior to his arrival Mr. Valmidiano of the Bureau of Soils with assistance from Dr. Aurelio Briones and Dr. Henry Samonte of University of Philippines at Los Banos undertook preliminary investigations. Possible sites were visited, and samples taken. Analyses were done by the Department of Soils, UPLB.

The Bureau and the Department accompanied Mr. Hudnall on his field trips and provided logistical support, scientific services and advice throughout. Approximately 50 samples were collected. Physical and chemical analyses were performed by the laboratories of the Bureau of Soils.

While in Negros, the Victoras (VMC) Milling Company provided a vehicle and driver for the project's use. Mr. Escobar, vice-president, VMC, was most helpful in suggesting areas where particular soil families might be located.

The UNDP/FAO Soils projects in Indonesia and the Philippines provided advice on possible benchmark sites. Mr. John Derting, Project Director of the UNDP/FAO project in the Philippines, furnished a vehicle for the field trips.

The AID Missions in Indonesia and the Philippines and the U.S. Embassy in Sri Lanka were interested in the project and provided assistance and advice. Both Missions assisted with logistical support. The Mission in Indonesia has agreed to formal involvement in the project.

V. WORK PLAN FOR THE COMING YEAR

During the period July 1, 1975 to September 30, 1976, the project will have established itself in the field in three countries in Asia and Africa and in Hawaii. Collection of data to test the various hypotheses of the project will be underway and some analyses of results will have been made. Counterpart personnel will have been appointed, and will be working their way into the project. Through the seminars and workshops of the project and through visits, linkages already established will be strengthened and additional LDC's will be cooperating voluntarily with the project. A considerable body of information about the benchmark soils of agricultural research stations throughout the tropics will have been collected and will be used to assist LDC's assist each other.

By October, 1976
The project will:

1. Complete agreements with participating countries. AID Missions will be requested to provide advice and assistance where the project conforms with Mission goals and objectives.

2. Establish 2 primary and 2 secondary sites in participating countries and one or two additional secondary sites in Hawaii.

3. Undertake transfer experiments on all established sites, variety experiments as necessary and appropriate, and management experiments on maize at primary sites.

4. Assist participating countries in use of Soil Taxonomy and in field soil survey work for common soil families and the benchmark sites.

5. Analyze results of experiments and prepare modifications in experimental design as necessary.

6. Collect additional soil family and use data for the Soil Data Bank, and make initial tests of the land capability model.

7. Undertake training workshop for project leaders and counterpart professionals in Hawaii.

8. Select first graduate fellow for the project.

9. Conduct Seminar on Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development in the Tropics.

10. Commence establishment of research network of benchmark soils throughout the tropics, and advise cooperating countries on types and designs of experiments.

11. Establish linkages with IITA, ICRISAT and national institutions in participating and cooperating countries, and disseminate and obtain information and advice about the project, soil survey and classification, agronomic experiments and crop varieties.

Budget for the period July 1, 1975 - September 30, 1976

	July 1, 1975 to September 30, 1976
Salaries	$160,474
Fringe Benefits	18,356
Consultants	2,308
Equipment, Supplies and Services	221,358
Vehicles	10,000
Freight	12,184
Travel and Subsistence	34,391
Publications	15,563
Indirect Costs	65,800
	$540,434

VI. INVOLVEMENT OF MINORITY PERSONNEL AND WOMEN

Four Orientals have been employed by the project. Of these, two are women. They are employed as a secretary and a laboratory technician. The project associate and a graduate research assistant are the other two employed by the project. Job and position advertisements have been placed in accordance to guidelines set forth by the Office of Economic Opportunity. All future advertisement will continue to follow these guidelines. No difficulties have arisen thus far in our hiring procedures.

SMITHSONIAN
SCIENCE INFORMATION EXCHANGE, INC.

NOTICE OF RESEARCH PROJECT

Supporting Agency	Agency's Number(s):
Agency for International Development	Contract No: ta-C-1108

Title of Project

Crop Production and Land Capabilities of a Network of Tropical Soil Families

Principal Investigator, Associate	School or Division	Department
Dr. Leslie D. Swindale	University of Hawaii Hawaii Agricultural Experiment Station	Agronomy and Soil Science

Recipient Institution:	Period for this NRP:
Name and Address: University of Hawaii 3190 Maile Way Honolulu, Hawaii	Start Date: May 31, 1974
Include Zip Code. 96822	End Date: June 30, 1975
	Annual Funding: $258,093

Summary of Project (Include objective, approach, current plans and/or progress) 200 word max.

The purposes of this project are to correlate food crop yields on a network of benchmark soils and to determine scientifically the transferability of agroproduction technology among tropical countries.

Crop production and soil management experiments will be carried out on carefully selected benchmark soils in the same soil families -- in two countries in tropical Asia, one country in tropical Africa and in Hawaii. A parallel project developed by the University of Puerto Rico will extend the work to Latin America. The family level in the U.S. Soil Taxonomy is that level at which transferance of agrotechnology is proving possible in the temperate zones and within Hawaii.

The benchmark soils in each country will belong to isothermic or isohyperthermic families of Hydric Dystrandepts, Tropeptic Eutrustox and/or Orthoxic or Humoxic Tropohumults.

The project is initially planned for three years in two phases -- and, depending upon progress made, extension for another two. Further extensions are possible. Results of the research will be disseminated through meetings, seminars, field days and research training fellowships. Local personnel will be trained to develop soil family and soil use information for planning and development purposes.