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RESEARCH PROJECT PAPER

Project Title: Crop Production and Land Capabilities of a Network of Tropical Soil Families (Benchmark Soils Project)

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(Extension Phase: Contract AID/ta-c-1108)

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I. Project Summary

A. Statistical

Project Title

Crop production and land capabilities of a network of tropical soil families (Benchmark Soils Project).

Extension

This is a second extension of an original three-year contract and a previous three-year extension to Contract No. AID/ta-c-1108.

Contractor

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Duration

Initial authorization: 5/31/74 - 5/30/77
Current authorization: 5/31/77 - 5/30/80
Proposed extension: 5/31/80 - 5/30/83

Total Estimated Costs

	1981	1982	1983
AID (Contract)	1,097,600	1,102,360	1,041,550
UH	64,410	66,150	65,840
PCARR (Philippine)	12,000	13,000	13,000
SRI (Indonesia)	73,000	75,000	77,000
FAO (Cameroon)	10,000	10,700	11,770
AID (Evaluation)	4,200	26,000	4,800
Funding by Years			
Total	1,261,210	1,293,210	1,213,960

Prior Funding by Fiscal Years

1974 - 1977 . . .	1,182,272
1978 . . .	975,335
1979 . . .	1,151,532
Current Year . . .	977,987

AID Project Manager

Dr. Tejpal S. Gill, DS/AGR

B. Narrative

The principal objective of the Benchmark Soils Project is to test the hypothesis that agroproduction technology can be transferred from its site of origin to other locations with similar agroenvironments in widely separated parts of the world. A system of soil classification called "Soil Taxonomy," developed by the Soil Conservation Service of the U.S. Department of Agriculture, contains the basis for stratifying agroenvironments into agroproduction niches. After 25 years of testing in the United States and internationally, this system of soil classification was released in 1975. The system was designed so that agroenvironments classified at the family level can be assumed to be sufficiently similar so that crops will perform similarly and respond alike to similar agroproduction practices.

To test this hypothesis, the Benchmark Soils Project has developed a network of experimental sites containing three soil families in the Philippines, Indonesia, and Hawaii. Negotiations to establish experimental sites in Cameroon have just been completed. A parallel and closely linked project headquartered in the University of Puerto Rico extends the network to Brazil and Puerto Rico.

Standard management practices are instituted to discover whether the test crop (maize) performs and responds alike to similar treatments in sites with similar agroenvironments (soil family).

A statistical model developed by the Project to analyze maize performance and response suggests that the same agroproduction technology is equally effective on one soil family in the Philippines, Indonesia, and Hawaii.

The participating host countries have been quick to recognize the significance of this result. Indonesia has established its own Benchmark Soils Project to facilitate successful resettlement of Sumatra through agrotechnology transfer. There are strong indications that the Philippines will also establish a national Benchmark Soils Project. Both countries have adopted Soil Taxonomy as their national soil classification system, and letters of inquiry from neighboring countries indicate that all ASEAN (Association of South East Asian Nations) countries will adopt Soil Taxonomy as the regional soil classification system. For the first time, then, this community of nations has a common language for soil communication and a uniform set of standards for comparing crop performance and sharing agrotechnology.

The Project is requesting a final three-year extension to fully test the transfer hypothesis for all three families

from all experimental sites in the network. It will focus heavily on Africa where negotiations for establishing experimental sites have just been completed. In addition, the Project will (a) conduct crop variety and soil management experiments to render transferred agrotechnology appropriate to local conditions, (b) develop a model soil and crop performance data bank for information storage and dissemination, (c) conduct training workshops to develop host-country capability to utilize Project results and products on a sustained basis, and (d) disseminate Project principles, concepts, and results to a wider, international audience.

The Benchmark Soils Project goal is to increase world food production. Its purpose is to enable resource-poor countries of the tropics to achieve self sufficiency in food production, and its principal objective is to scientifically test the hypothesis that agroproduction technology can be transferred to and from agroenvironmentally similar niches.

This proposed extension is designed to bring the Project to a close.

II. General Background

A. Rationale

In May 1974 a research contract was signed between the University of Hawaii and the Agency for International Development to test principles that would enable lesser developed countries (LDCs) to avert food shortages by means of timely adoption of the best available and most appropriate agroproduction technology. The project entitled "Crop Production and Land Capabilities of a Network of Tropical Soil Families" is more popularly known as the Benchmark Soils Project (BSP). The principles of the Benchmark Soils Project were first articulated by the English utilitarian philosopher, John Stuart Mill in his classic book "A System of Logic," in which he proposed that the purpose of any classification scheme is to organize knowledge so that knowledge may be used to predict the behavior of the objects being classified, estimate their productivity, and permit the assembled knowledge to be transferred to other places where similar objects exist. Mill's book was on the required reading list of a course in Soil Classification taught by Dr. Charles Kellog of North Dakota State University. When Dr. Kellog was appointed to head the Soil Conservation Service of the U.S. Department of Agriculture, he imbued his staff with Mill's ideas. These ideas were the basis for formulating "Soil Taxonomy," a basic system of

soil classification for making and interpreting soil surveys, issued by the Soil Conservation Service in 1975.

Soil Taxonomy makes a simple but immensely practical statement; namely, that agroproduction technology may be transferred to widely separated regions of the tropics having similar agroclimatic, agroecologic, and edaphic conditions. Soil Taxonomy contains the basis for stratifying the world into narrow agroenvironmental zones such that each zone possesses common agroproduction transfer parameters. While Soil Taxonomy was designed to enable its users to transfer knowledge and agroproduction technology, the capability to do so has never been scientifically tested.

Soil Taxonomy's untested assumptions hold great promise for increasing food production capacity in areas of the tropics where it is most needed. The principles and concepts contained in Soil Taxonomy are needed to help farmers, planners, and decision makers reduce the risk of failure when they choose or are advised to implement new technologies unfamiliar to them. The resource-poor nations and the subsistence farmers who live in them have a narrow margin for error. For this reason, the most exacting principles are needed to forecast with great accuracy the promised results. The Benchmark Soils Project's purposes and objectives are designed to achieve the goal of securing world order through prevention of food shortage. It can do so by scientifically testing an effective means to deliver appropriate agroproduction technology in a timely and cost-effective manner to the developing countries of the tropics.

The progress to date indicates that all Project objectives will be attained by the end of this proposed, second, and final Project extension (see Appendix A).

B. Accomplishments to Date

Project accomplishments are reported by objectives and activities and are also summarized in a chart according to milestone events (see Appendix B).

<u>Objective 1</u>: To determine scientifically the transferability of agroproduction technology among tropical and subtropical countries.

<u>Activity 1</u>. Establish and complete the network of three soil families.

This activity will be completed by June 30, 1980, the termination date of the first extension. The networks for two soil families (thixotropic, isothermic family of Hydric Dystrandepts; and clayey, kaolinitic, isohyperthermic family of Tropeptic Eutrustox) are complete and are generating crop performance data for the test of the transfer hypothesis.

Completion of the network for the third soil family (clayey, kaolinitic, isohyperthermic family of Typic Paleudults) was delayed because of a shift in the African Project cooperator from the International Institute of Tropical Agriculture (IITA) to Cameroon's National Office for Scientific and Technical Research (ONAREST). A memorandum of understanding has been signed between BSP and ONAREST, and the network of sites for this soil family will be in operation for the final Project extension. (See Appendix C for the soil family characteristics and network.)

No additional funding is required for this activity.

Activity 2. Establish, install, complete, and analyze transfer experiments.

This will be the major activity in the extended project. The principal aim of this extension is to generate and analyze a sufficient number of crop performance data from the network to adequately test the transfer hypothesis.

The fact that two key Project components will be established before the proposed extension ensures that Objective 1 will be achieved. These components are the network of experimental sites and the statistical model for the test of the transfer hypothesis.

The first full test of the transfer hypothesis using crop performance data from one soil family (Hydric Dystrandepts) has been reported (BSP Progress Report 2, 1979). The result confirms the validity of the transferability of crop management technology among soils of the same family. The test used crop performance data from Indonesia, the Philippines, and Hawaii.

Preliminary tests of data from the other two soil families have been made, but a larger number of data points will be needed to interpret the results objectively. A first test of the transfer hypothesis for the second and third soil families is expected by the end of the current extension.

Objective 2: To assist tropical and subtropical countries in assessing the potential of upland areas for intensive cropping and soil management.

Activity 3. Establish, install, complete, and analyze crop (variety) and soil management experiments.

Objectives 1 and 2 are integral components of the transfer process. Objective 1 looks at transfer of technical information among widely separated regions. It is called horizontal technology transfer. What is technically possible, however, may not be economically feasible, environmentally sound, or socially acceptable. Objective 2 is designed to enable each country to intercept horizontally transferred agrotechnology and assimilate this technology in a manner appropriate to its needs. Objective 2 is concerned with vertical technology transfer.

The Hydric Dystrandepts, for example, have been shown under Objective 1, to have high yield potential if provided with a heavy initial application of phosphate fertilizer. In Objective 1, this transferable information was tested by measuring the response of maize to superphosphate. This does not mean that superphosphate is the only alternative for overcoming this constraint. The farmer, once informed of the constraint, may choose to use heavy doses of chicken manure, as was the case in the Philippines, or the national planner may consider phosphate rock as an alternative, as was the case in Indonesia (see BSP Progress Report 1). In most instances, the farmer and national researchers use a combination of inexpensive and readily available inputs and crop varieties adapted to low soil fertility.

Maize variety trials clearly demonstrate that varieties are environment specific and not country specific. In the clayey, kaolinitic, isohyperthermic, Tropeptic Eutrustox, a soil family associated with warm, uniform temperature and high solar radiation, hybrid corn developed for the United States performs very well. This has been found to be true for all three locations (Brazil, Hawaii, and Puerto Rico) in the Benchmark network.

In the hot and humid tropics, on the clayey, kaolinitic, isohyperthermic Typic Paleudults of Indonesia and the Philippines, locally adapted maize varieties perform better. It is anticipated that this will also be true when this soil family is tested in Cameroon. Local plant breeders have selected varieties resistant to downy mildew, a serious pathogen of maize in the warm and humid tropics. Work under Objectives 1 and 2, however, shows that maize is protected from downy

mildew in the cool, humid tropics, on the thixotropic, isothermic family of Hydric Dystrandepts.

The capacity of the soil family to stratify agroenvironments and organize knowledge has impressed the participating host countries. Indonesia has expended and is continuing to expend its own resources to develop a national Benchmark Soils Project. It has surveyed and classified the soils of research stations in Sumatra to facilitate technology transfer for the transmigration program. The Philippines is showing signs that it too will develop its own Benchmark Soils Project. More important, both countries have adopted Soil Taxonomy as their national soil classification system. Letters of inquiry from Thailand and Malaysia about the Benchmark Soils Project clearly show that the BSP is being watched by the neighboring ASEAN countries. It is almost certain that Malaysia and Thailand will also adopt Soil Taxonomy as their national soil classification system. The ASEAN countries may be the first community of nations to adopt a uniform soil classification system. This will be a major step toward regional self-reliance in agrotechnology transfer.

Under Objective 2, the Benchmark Soils Project has an agreement with the International Fertilizer Development Center (IFDC) to test the efficacy of new, low-cost, low-technology phosphate fertilizers. The results to date show that several of the IFDC products compare favorably with superphosphate on soils of the clayey, kaolinitic, isohyperthermic family of Typic Paleudults in Sumatra. The same products were not effective on the clayey, kaolinitic, isohyperthermic family of Tropeptic Eutrustox. The soil family stratifies soils according to their responsiveness to fertilizer products. If the Benchmark concept is valid, IFDC will be able to transfer knowledge about its products to any point in the world on the basis of agroenvironments as defined by the soil family.

Under Objective 2, the BSP has also installed fertilizer placement experiments to demonstrate that fertilizer placed in narrow bands near the seed is more effective than the same quantity of fertilizer spread evenly throughout the field. The results show that the resource-poor farmer can obtain 50% of the highest yield obtained by the BSP under Objective 1 by using 25% of the fertilizer required to achieve maximum yield.

The search for cost-effective soil management practices tailored for the resource-poor farmers remains an important Project objective. Project success under Objectives 1 and 2 has been the main reason for participating-country acceptance of Benchmark principles and concepts.

Objective 3: To demonstrate the value of soil classification and land evaluation in formulating agricultural development plans.

Activity 4. Disseminate principles, concepts and results.

This is a continuing activity which largely depends on progress under Objectives 1 and 2. Progress toward achievement of Objective 3 is made through (1) organizing, assembling, and storing crop and soil performance data in a data bank for technology transfer; (2) conducting workshops and seminars and training graduate students; and (3) publication and distribution of Project accomplishments.

a. Soil and crop performance data bank.

The co-investigator of the Project responsible for operating the data bank is currently on leave in the Agricultural University of Wageningen, The Netherlands. He has been invited by the Secretary of the International Soil Science Society to visit Germany to describe the Benchmark Soils Project and explain the operation of the Benchmark Crop and Soil Data Bank to the International Soil Science Society soil fertility group. The value of the Benchmark data bank is that it combines soil, crop, and climate information to provide information about crop productivity and performance. The Benchmark concepts depend on the ability of the user to know the cause-and-effect relationship between crop performance and agroenvironments. The bank, however, has not been developed to the point where cause and effect can be obtained. At this stage, the bank is accumulating soil, crop, and climate data generated under Objectives 1 and 2. It is anticipated that, by the conclusion of the Project, the data bank will have the capability to provide transferable cause-and-effect relations for a range of crops and agroenvironments.

b. Workshops and seminars and training graduate students.

The Benchmark Soils Project conducts conferences, seminars, workshops, and training courses as part of a strategy to disseminate concepts and principles to three major audiences. These include the international development agencies, the national governments, and the research staffs of developing-country agencies.

The last audience, and the one which requires the greatest Project input, is reached through training workshops. Workshop participants are selected by the host country with the goal of developing a national capability to intercept or

deliver agrotechnology for planning and development. The majority of participants are members of national agricultural or planning agencies. The course emphasizes the development of practical skills to implement national programs in agrotechnology transfer. For example, a training workshop just completed in the Philippines required each participant to survey and map the soils of an agricultural research station in his province. Each station thus becomes a part of the national Benchmark network that delivers research results to other parts of the provinces, country, or region in a rational way. A similar workshop is planned for Indonesia in January 1980.

The diffusion of Benchmark Soils Project principles and concepts to the International Agricultural Research Centers is also becoming increasingly evident. In August 1979, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) held a symposium on Development and Transfer of Technology for Rainfed Agriculture and the Semi-Arid Tropic Farmer. The keynote address, presented by ICRISAT's Director, was entitled Problems and Concepts of Agrotechnology Transfer within the Tropics. This symposium was preceded by a workshop on Operational Implications of Agrotechnology Transference Research, co-sponsored by the Benchmark Soils Project and ICRISAT in October 1978 at Hyderabad, India.

The Project also accepts a small number of graduate students for training in Hawaii. Seven graduate students are currently working toward a degree under Project supervision. They include three students from the Philippines, two from Indonesia, and two from the United States. The Indonesian and Philippine students are selected by the cooperating national agency and will return to their respective countries to implement Project principles and concepts. The cooperating agencies send their most promising personnel to study in Hawaii, and the Project benefits greatly from student knowledge of problems and conditions in their home countries. The United States students have strong leanings toward international work. One student is responsible for testing new International Fertilizer Development Center fertilizers on Benchmark sites, and the other is responsible for identifying transferable soil family attributes such as pest (insects, weeds, diseases) management, energy relations (solar radiation, temperature), water supply (rainfall and soil water-storage capacity), soil fertility, trafficability, and erodibility. The graduate students provide invaluable assistance to the Project.

c. Publication and distribution of Project accomplishments.

Following the recommendations of the AID review team of

1976, and according to the terms of the Project Statement of 1976, the publications program was initiated with the hiring of a full-time Editor/Publications Specialist.

Dissemination of results of research through publications and visuals has stimulated and catalyzed interest in and utilization of Project concepts.

To date, external communications published include:

- Benchmark Soils News, Vol. 1-2, Nos. 1-4; Vol. 3, Nos. 1-3
- Leaflets 1 and 2, Benchmark Soils: The Key to Agrotechnology Transfer (in English, French, and Spanish); The Benchmark Soils Project: Basic Information (in English and Spanish)
- Technical Report 1, Laboratory Data and Descriptions of Soils of the Benchmark Soils Project: 17 sites--Vol. 1, Hawaii
- Technical Report 2, Classification of the Soil Series of Hawaii in Four Systems: A Guide to Correlating Tropical Soils
- Soil-Resource Data for Agricultural Development, Proceedings of the International Seminar on The Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development, ICRISAT, India, 1976, a hardcover book
- Progress Report 1, Research on Agrotechnology Transfer in the Tropics Based on the Soil Family, a joint report by the Hawaii and Puerto Rico projects
- Progress Report 2, Development of the Transfer Model and Soil Taxonomic Interpretations on a Network of Three Soil Families, a joint report by the Hawaii and Puerto Rico projects

Published for internal use only were the Annual Reports, fiscal years 1974-75, 1975-76, 1976-77, and 1977-78.

A Project logo was designed and is used consistently on publications, forms, visuals, and displays to establish Project identity. Displays for the bulletin boards were prepared and are used to acquaint visitors to Project headquarters with the BSP concepts.

In addition, presentations at workshops and conferences were upgraded by assistance from the publications division in graphics and visuals.

Since the inception of a two-color, expanded newsletter, the Project mailing list has increased from 900 to over 1400, due to individual and organization requests for copies.

Copies of the hardcover book Soil-Resource Data for Agricultural Development have been mailed to over 1000 libraries, institution and agencies, planners, and agronomy and soil specialists throughout the world. "I think it is the first global review of agricultural and pedological data related to subtropical and tropical belts," said V. Kovda, Institute of Agrochemistry and Soil Science, Moscow Region, Russia, in correspondence received in Hawaii.

The BSP mailing list includes recipients in over 50 countries. The list is computerized for ease in retrieving mailing labels and hard-copy lists of addresses, by country and organization.

Examples of feedback from information dissemination include a request from Dr. Nyle Brady, editor of "Advances in Agronomy" to submit an article on the Benchmark concept of technology transfer for publication in this monograph series; a request from Dr. W. Sombroek, Director of the International Soils Museum in The Netherlands, to display Benchmark concepts and principles in the Museum; and a request from the International Soil Science Society and the New Zealand Soil Science Society to present a full-day Benchmark Soils program in a five-day conference of the International Soil Science Society scheduled for Palmerston North, New Zealand in February 1981. The greatest number of requests for assistance and information comes from developing countries. The Benchmark Project office is geared to respond quickly and positively to requests for information and assistance.

Activity 5. Assimilate Benchmark concepts and principles into international and national agricultural development programs.

The adoption of a national system for soil classification requires decision making at high governmental levels. The Benchmark Project is linked to decision making bodies through National Advisory Committees created specifically to ensure that Project efforts are compatible with national goals. The Advisory Committee for Indonesia consists of members from the Soil Research Institute, the Central Research Institute for Agriculture, the Bureau of Planning from the Ministry of Agriculture, the USAID mission, and the Benchmark Soils Project.

In the Philippines, the Advisory Committee has members from the Philippine Council for Agriculture and Resources

Research, the National Economic Development Authority, the Bureau of Soils, the Bureau of Plant Industry, the USAID mission, and the Benchmark Soils Project.

In Indonesia and the Philippines, a considerable part of land evaluation for agricultural planning is assigned to the Food and Agricultural Organization (FAO). The Benchmark Soils Project has maintained close relationships with the FAO representatives in all participating countries to avoid counterproductive activities and duplication of effort. In Cameroon, where the national soil survey program is not as well developed as in the Philippines or Indonesia, the FAO project leader and his staff have provided invaluable assistance to the Benchmark Soils Project to negotiate a memorandum of understanding with the Cameroon government. The FAO will be an important Benchmark cooperator in Cameroon.

The Benchmark Soils Project has a continuing relationship with the FAO headquarters in Rome. In a recent letter to the Benchmark Soils Project, Dr. R. Dudal, Director of FAO's Land and Water Development Division, requested that FAO and BSP undertake a joint program to develop standard procedures for evaluating and classifying land for agricultural planning. The procedure basically involves matching crop requirements to land characteristics. For example, in the Benchmark Soils network, Irish potatoes do well in the cool-wet environments (thixotropic, isothermic family of Hydric Dystrandepts) and only marginally in the warm-wet environment (clayey, kaolinitic, isohyperthermic family of Typic Paleudults). Irish potatoes require cool soil temperatures for adequate tuber formation. In the hot and humid tropics, good top growth is obtained but tuber yields are low. Under Objective 2, BSP experiments in Indonesia obtained high tuber yields on Hydric Dystrandepts with liberal application of phosphorus.

C. Justification for Extension

Timely delivery of technology to enable the resource-poor nations of the tropics and subtropics to feed themselves hinges on an unequivocal test of the Benchmark Soils Project's hypothesis of agrotechnology transfer. It is virtually certain that methods other than the traditional trickle-down technology diffusion will be needed to feed the two billion additional people who will inhabit the world in the next 25 years.

An unequivocal test of the transfer hypothesis can be made by the end of the proposed extension. Before entering into the second and final extension, the Project will have

completed its network of experimental sites. It already has an operational model to scientifically test the transfer hypothesis. The principal Project activity during the extension will be to generate high-quality crop performance data with which to test the transfer hypothesis.

A considerable portion of Project efforts will be shifted to Africa in the Project extension. Since tropical Africa must depend on transferred agrotechnology to avert food shortages as it keeps pace with rising population, the Benchmark Soils Project will work to extend information already gained on the Typic Paleudults in Indonesia and the Philippines to Cameroon. The Benchmark Soils Project premise is that the farming systems technology developed in Sumatra is horizontally transferrable to Cameroon; thus, the Project believes that results from the Philippines and Indonesia will be duplicated in Cameroon. The Project also operates on the premise that what is technically transferable can be made locally appropriate through adaptive research.

To ensure continued dissemination of Project principles and concepts in Africa, the BSP will develop close linkages with FAO and the International Institute of Tropical Agriculture (IITA).

An important aim of the Benchmark Soils Project is to eliminate trial-and-error research, which frequently leads to rediscovery of farming methods successfully developed and already in use elsewhere in the tropics. Another aim is to provide a shortcut to self sufficiency in food production for the resource-poor nations of the tropics, and its goal is to achieve and maintain world order through prevention of food shortages.

III. Project Design

The design and methodology to test the hypothesis were developed by a group of statisticians and agronomists in a workshop held in 1974. The workshop proceedings were compiled in 1975.

In the design, distinctions are made between two types of experimental sites (primary and secondary) and three kinds of experiments (transfer, variety, and management experiments).

Primary sites are locations where all three kinds of experiments are conducted. They are fully instrumented to collect air and soil temperatures, relative humidity, rainfall, solar radiation, wind run, and pan evaporation. Secondary sites are locations where only transfer experiments

are conducted. They are needed to increase the number of experimental sites in order to have sufficient data for a statistically valid estimate of the effect of uncontrolled variables on crop yield. Uncontrolled variables that affect crop performance are soil fertility differences caused by past management and weather. Secondary sites are also instrumented for monitoring weather.

Transfer experiments are conducted to test the hypothesis that agroproduction technology can be transferred between agroenvironmentally similar sites as defined by the soil family. These experiments are designed to examine rational ways to transfer scientifically sound technology over widely dispersed locations in the tropics. In the Project, this is referred to as horizontal technology transfer.

In the transfer experiments, nitrogen and phosphorus rates are the controlled treatment variables. These treatments are imposed according to a 5^2 partial factorial modification by Escobar. In this design, crop varieties that respond to treatment variables are crucial to the test of the hypothesis.

When the transfer experiments were first designed, lime and phosphorus rates were used as the treatment variables. Project results consistently showed that application of lime to acid Hydric Dystrandepts had no beneficial effect on the test crop. This little-known, immensely practical, and highly transferable result was unsuited to test the hypothesis. The Project quickly learned that the model could not test the transferability of a management practice which has zero effect on the outcome. At the recommendation of the Project statistical consultant, the treatment variables were changed from lime and phosphorus to nitrogen and phosphorus rates in 1976.

In order to minimize variability due to uneven water stress, and to maximize the number of useful experimental data, all transfer experiments are watered with trickle-irrigation systems.

The experience with lime alerted the Project to the fact that, while the model could elegantly test the transfer hypothesis, it could not identify what was transferable other than the treatment variables. In addition, the test crop, which integrated key attributes of the soil family, was silent about what affected its performance.

In order to exploit Project principles and concepts more fully, the Project will set out in the extension to identify and list the many transferable practices and attributes linked to a soil family. For example, the Project has good

reason to believe that the absence of downy mildew in the thixotropic, isothermic family of Hydric Dystrandepts is directly linked to the soil's isothermic (cool, 22-15°C) environment. If the Project's interpretation of this finding is correct, it is possible to extend this interpretation to all soils with isothermic or cooler temperature regimes. There is also reason to believe that such factors as the occurrence of tsetse fly follows soil family boundaries since both the tsetse fly and soil boundaries are temperature dependent. John Stuart Mill in his "System of Logic" said that classification should be designed to enhance discovery of new relationships among the things being classified. The Project will exploit this taxonomic principle in the Project extension.

If the transfer experiments look at attributes and practices that are scientifically and technically correct, these same attributes and practices may not be economically feasible, environmentally sound, or socially acceptable to the same degree in all locations. Thus, the variety and management experiments are designed to tailor scientifically sound agroproduction technology for local assimilation. In variety experiments, performances of local and introduced cultivars are compared under three levels of inputs on as many soil families as are being tested in the country. The variety experiments also serve to identify "best adapted" varieties for local farmer use and for Project use. Local farmers generally select varieties that give low but dependable yields with minimum inputs, whereas the Project looks for high-performance varieties that respond to fertilizer inputs for use in the transfer experiments.

As in the past, host countries will be encouraged to participate in the design of management experiments. The experiments will be designed to maximize returns to the farmer. Inexpensive, locally available materials will be substituted and tested. Planting density, spacing, date of planting, and fertilizer placement studies will be designed to tailor horizontally transferred technology for local use.

IV. Work Plan

Activities described in the work plan are designed to achieve Project objectives. For easy reference, the objectives are restated below:

> Objective 1. To determine scientifically the transferability of agroproduction technology among tropical and subtropical countries.

Objective 2. To assist tropical and subtropical countries in assessing the potential of upland areas for intensive cropping and soil management.

Objective 3. To demonstrate the value of soil classification and land evaluation in formulating agricultural development plans.

Each objective is associated with one or more activity which, in turn, is described by what will be done, where, and with which required resources.

Inputs for Project management and administration are also included in the work plan.

A. Objective 1

Activities associated with objective 1 are:

a. Establish and complete the network of three soil families. This activity will be completed before initiation of the proposed extension.

b. Establish, install, complete, and analyze transfer experiments. This will be the major Project activity and will take priority over all others.

Activity (a) above will be completed before the proposed extension and will require no additional funding. Under activity (b), two transfer experiments (one dry and one wet season) will be conducted on a minimum of 16 sites on three soil families during the first two years of the extension, and one transfer experiment will be conducted on each site during the third year. The last half of the third year will be used for final data analysis and report preparation. A total of 85 transfer experiments will be conducted in the Project extension. They are summarized in Table 1 by country, soil family, and year.

One Project leader stationed in each of the four countries is the major input required to conduct these experiments. The Hawaii Project Leader also serves as the Project Agronomist.

Other personnel include a Computer Programmer who is responsible for organizing, storing, and retrieving experimental data as they come in from the network, and a consultant Statistician who is responsible for testing the transfer

Table 1. Transfer experiments to be conducted in the Project extension

Country	Soil family	Year 1	Year 2	Year 3	
Cameroon	Clayey, kaolinitic, isohyperthermic Typic Paleudults				
	Site 1.....	2	2	1	
	Site 2.....	2	2	1	
	Subtotal				10
Hawaii (USA)	Clayey, kaolinitic, isohyperthermic Tropeptic Eutrustox				
	Site 1.....	2	2	1	
	Site 2.....	2	2	1	
	Subtotal				10
	Thixotropic, isothermic Hydric Dystrandepts				
	Site 1.....	2	2	1	
	Site 2.....	2	2	1	
	Site 3.....	2	2	1	
	Subtotal				15
Indonesia	Thixotropic, isothermic Hydric Dystrandepts				
	Site 1.....	2	2	1	
	Site 2.....	2	2	1	
	Subtotal				10
	Clayey, kaolinitic, isohyperthermic Typic Paleudults				
	Site 1.....	2	2	1	
	Site 2.....	2	2	1	
	Site 3.....	2	2	1	
	Subtotal				15
Philippines	Thixotropic, isothermic Hydric Dystrandepts				
	Site 1.....	2	2	1	
	Site 2.....	2	2	1	
	Site 3.....	2	2	1	
	Subtotal				15
	Clayey, kaolinitic, isohyperthermic Typic Paleudults				
	Site 1.....	2	2	1	
	Site 2.....	2	2	1	
	Subtotal				10
Total number of transfer experiments					85

hypothesis. Consultants will be hired for assistance in data analysis and interpretation as the need arises.

In the Philippines and Indonesia, research aides and farm laborers are provided by the host countries. In Hawaii, the Project Agronomist is assisted by seven Agricultural Research Technicians to operate two primary and three secondary experimental sites. The Hawaii Technicians are paid from Project funds.

Direct support services for achievement of Objective 1 is provided by the Benchmark Headquarters in Hawaii. These require the services of a Soil Chemist and a Laboratory Assistant to measure pre- and postplant soil fertility tests for all 85 transfer experiments. These measurements are used to determine the treatment level for the transfer experiments and are included as site variables in the test of the transfer hypothesis.

Other inputs include farm machinery and weather station maintenance and routine operational costs. In the Philippines, Indonesia, and Hawaii, where experimental sites are located on more than one Island, travel cost will be higher than in Cameroon. Travel costs are also required for the annual coordination meetings among Project leaders.

Following the recommendations of the panel that reviewed the Project in 1979, all test crops in the transfer experiments will be analyzed for tissue nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, and trace elements. The Project will pay only 25% of the cost of each analysis; the remainder of the cost will be borne by the University of Hawaii. Each transfer experiment has 16 plots, of which 13 are design treatments, replicated three times for a total of 48 samples. Each sample, in turn, is analyzed for 12 elements.

B. Objective 2

Under this objective, the Project will install, complete, and analyze crop (variety) and soil management experiments. These experiments will be conducted on seven primary sites in four countries twice (dry and wet seasons) in years 1 and 2 and once in year 3. All tests will be conducted in both the dry and wet seasons. Two types of management experiments selected by the host country in consultation with the Project staff will be permitted in the extension. A maximum of 35 variety and 70 management (for a total of 105) experiments will be completed during the extended period. (Table 2)

No additional staff is required to achieve Objective 2. Project and host-country personnel identified under Objective 1 are responsible for conducting variety and management

Table 2. Variety and management experiments to be conducted in the Project extension

Country	Soil family	Year 1	Year 2	Year 3	
Cameroon	Clayey, kaolinitic, isohyperthermic Typic Paleudults				
	Variety.....	2	2	1	
	Management.....	4	4	2	
	Subtotal				15
Hawaii (USA)	Clayey, kaolinitic, isohyperthermic Tropeptic Eutrustox				
	Variety.....	2	2	1	
	Management.....	4	4	2	
	Subtotal				15
	Thixotropic, isothermic Hydric Dystrandepts				
	Variety.....	2	2	1	
	Management.....	4	4	2	
	Subtotal				15
Indonesia	Clayey, kaolinitic, isohyperthermic Typic Paleudults				
	Variety.....	2	2	1	
	Management.....	4	4	2	
	Subtotal				15
	Thixotropic, isothermic Hydric Dystrandepts				
	Variety.....	2	2	1	
	Management.....	4	4	2	
	Subtotal				15
Philippines	Clayey, kaolinitic, isohyperthermic Typic Paleudults				
	Variety.....	2	2	1	
	Management.....	4	4	2	
	Subtotal				15
	Thixotropic, isothermic Hydric Dystrandepts				
	Variety.....	2	2	1	
	Management.....	4	4	2	
	Subtotal				15
Total number of variety and management experiments					105

experiments. Seeds, chemicals for pest control, irrigation tubing, and fertilizers will be the main additional inputs.

C. Objective 3

Two activities identified under Objective 3 are to (1) disseminate principles, concepts, and results and (2) assimilate concepts and principles into international and national agricultural programs. For brevity, these have been combined under a single activity--disseminate and utilize Project principles, concepts, and results.

To achieve Objective 3, the Project will (a) complete development of a model soil and crop performance data bank, (b) conduct training workshops and seminars and train graduate students, and (c) publish and disseminate Project principles, concepts, and results.

a. Complete development of a model soil and crop performance data bank.

When the Project comes to a close, the data bank will contain data from over 300 transfer, variety, and management experiments from some 17 sites on three soil families in six countries (Brazil and Puerto Rico data included). The Project will have one of the most valuable sets of soil and crop performance data ever collected and assembled. The assembled information will continue to serve developing-country needs for years to come. The Project receives many requests from developing countries for assistance in developing data banks. Many of these countries have the hardware but lack the software to assemble, organize, and store data for easy retrieval and utilization. If agrotechnology transfer is to become a reality, each country must have the capability to receive and deliver information quickly and in a manner compatible with the donor and recipient. This activity is designed to develop a computer-compatible network of data banks for agrotechnology transfer which will continue to operate after the end of the Project. The Hawaii soil and crop performance bank will serve as a model bank. A Data Management Specialist will be hired on a consulting basis to assist in the refinement and operation of the data bank.

b. Conduct training workshops and seminars and train graduate students.

The Project will conduct a 3-week training workshop on Soil Taxonomy and Agrotechnology Transfer in Cameroon. As was the case in the Philippines, the Project will obtain the

services of an outstanding teacher of Soil Taxonomy to conduct the portion of the workshop dealing with Soil Taxonomy. It will use its own senior staff to teach the portion on Agrotechnology Transfer.

A Training Coordinator will work with the host country to organize and plan the workshops. He will also be responsible for the preparation of training packages.

Two students from each of the three participating countries will do graduate work toward the masters or doctoral degrees. Two United States graduate students will also join the Project. All graduate students will conduct research to achieve Project objectives. With the exception of American students, all graduate students are selected by the host countries to foster principles and concepts in their respective national programs.

An equal number of students from nonparticipating countries will work on research related to Project principles and concepts, but they will be entirely supported by non-Project funds.

In February 1981, selected Project personnel and collaborators from participating countries will present Benchmark principles, concepts, and results to an international audience before a joint meeting of the Soil Fertility and Soil Classification Division of the International Soil Science Society in New Zealand. Travel funds, per diem, and cost of preparing articles and visual aids will be required.

c. Publish and disseminate Project principles, concepts, and results.

The internal and external communications program of the BSP includes publications, posters and displays, slide shows, and packages of all of them. Use of these media will facilitate the exchange of Project information.

The basic areas of dissemination include the newsletter, annual and progress reports, technical reports of research, and utilization materials, including the instructional/training packages, programs, and proceedings.

The major purposes of the communications program are to (1) report the results of research, and (2) catalyze utilization activities. Effective internal communications is also a useful management tool.

Internal communication.

Continuing the communications link among the worldwide

corps of Project personnel is even more necessary as the number of people employed by the Project increases. Employees must be kept informed about progress in the widely separated experimental sites. Language differences must be considered. No other international project has such an enormously widespread network of sites and people working toward the same goal. This diverse set of communication problems demands special attention in the next contract period, because it is a foreshadow of worldwide communication needs upon the conclusion of the Project and the beginning of the transfer of agrotechnology. The Benchmark Soils News will continue to fulfill the need for internal, personnel communication. It combines contributions from Project personnel in Brazil, Cameroon, Hawaii, Indonesia, the Philippines, and Puerto Rico. In addition, it has articles that are of interest to scientists in the growing network of communicating and cooperating research institutions. Wide dissemination of the News is a major goal of the Project: the current 1500 copies will probably increase to 2500 in the next three years. The News is distributed to Project personnel, University administration, funding agency representatives, in-country cooperating government agencies and institutions, local AID missions, and other interested parties as a public relations piece.

The regular, obligatory, Annual Report to the funding agency will also be distributed to selected scientists and planners; 250 copies will be printed and distributed each year.

Posters and displays will be prepared and sent to Project sites from time to time to answer specific needs, e.g. instructions for operating equipment, detailing climatic monitoring procedures, and so on.

External communication.

The Progress Report of the Project will continue to be published annually as a compilation of the BSP's achievements for widespread distribution to agencies, institutions, and libraries as well as well-informed, interested individuals. Progress Report 3 will detail the final joint activities of the Universities of Hawaii and Puerto Rico as the Puerto Rico Project is phased out; thereafter, the Report will present the results of the Hawaii Project only. Substantial editorial and graphics attention is expected to be placed on this publication, since maximum reader impact is desired. This publication will continue to be the prime medium for illustrating and describing significant Project achievements.

Leaflets will continue to be prepared, as the need Currently in press is Leaflet 3, information on the possibilities and potential of the Benchmark Data Bank. Other

leaflets may include an overview of Soil Taxonomy as a tool for agricultural land-use planning; vertical vs. horizontal transfer; and global networking as a means of planning the transfer of agrotechnology in the tropics. These leaflets are designed for a quick overview by planners, scientists, and other interested people. All leaflets will be printed in both English and Spanish; some will be printed in French. They are designed to stimulate interest in Project activities and make connections with other organizations and agencies.

Highly specific technical reports on results of research will increase in number, especially now that data has been collecting for several years and is ready to be released. These reports will either be submitted to professional journals or will be prepared and printed by the Project in the Technical Report series, which is usually refereed through the Hawaii Agricultural Experiment Station review procedures. An article for "Advances in Agronomy" entitled Agrotechnology Transfer in the Tropics Based on Soil Taxonomy will be published and distributed during the extension period. An article on monitoring climatic data in the Benchmark Soils Project will also be written and published. Technical Reports on the statistical test of the transfer hypothesis and the method of determining phosphorus level of soils are currently in press.

Audio-visual slide sets will increase in number. The basic overview of the Project is now in preparation and copies of the set will be distributed to Project Leaders and selected groups which request them. Other slide sets will be prepared as part of the training/instructional packages. Visuals on soil parameters, profiles, and classification have been initiated in the preceding contract year by testing at the Workshop on the Fundamentals of Soil Taxonomy. Slides on weed, disease, and insect control; instrumentation for monitoring climatic data; and guidelines for establishment of a drip irrigation system will no doubt be prepared.

Other instructional materials will need to be prepared as the training program develops: these include workbooks; handouts, such as fact sheets on specific topics; and charts and graphs.

Poster displays and exhibits are expected to be prepared for display at international conferences and symposia.

A major Project aim under Objective 3 is to generate sufficient international momentum so that when the Project closes at the end of this proposed extension, agrotechnology transference will continue to grow and become an integral part of the total world effort to avert food shortages.

D. Project Management and Administration

The Principal Investigator will have overall responsibility for the proper conduct of the Project. He will be assisted by a Professor and Associate Professor of soil science in Project design and implementation. The Chairperson of the Department of Agronomy and Soil Science, the Associate Director for Research, and the Dean of the College of Tropical Agriculture and Human Resources and their staffs will provide administrative services to facilitate Project activities. None of the above will receive any part of their salary from the Project. The Project will have access to the full research capability of the University and will seek assistance from relevant discipline through scholarly exchange of ideas without fee.

The day-to-day Project operation will be assigned to a Project Manager. He will be asisted by a Project Accountant and a Project Secretary. Part-time student help will be used to accommodate periods with heavy workloads.

The Project Manager, Accountant, and Secretary will be salaried members of the Project.

Adequate office, storage, and laboratory space is and will continue to be provided by the University of Hawaii. The Project is located in Krauss Hall on the University of Hawaii campus where the Project Manager, Editor, Training Officer, Computer Specialist, Agronomist, Accountant, Secretary, Chemist, and Laboratory Assistant are housed. A computer terminal links the Project to the main University computer, and a telecopier located in the Project office provides ready documentary communication with the continental United States.

V. Project Product Utilization

Long after the close of the Project, six Project products will continue to serve Project purposes and goals. The creation of these products are linked to the successful attainment of all Project objectives. The connection between Project products and Project objectives, and the impact of product utilization, is tabulated in Table 3.

The Benchmark Soils Project is not only designed to achieve immediate Project objectives, but also is structured to ensure long-term utilization of Project products to attain higher purposes and goals.

Table 3. Project product utilization

Project products	Impact: If utilized	Impact: If not utilized
Objective 1		
Transfer model for horizontal agrotechnology transfer	1. Timely delivery of agrotechnology to food-deficient regions	1. LDCs require continued assistance
Transferable farming systems	1. Food shortage reduced 2. Economy of action achieved in agricultural planning and development	1. World unrest due to food shortages increased 2. Duplication of effort and rediscovery of information already known
Objective 2		
Transfer model for vertical agrotechnology transfer	1. Appropriate technology developed for each country 2. Yields in fields of small, resource-poor farmer increased	1. Technology unacceptable to recipient 2. Worsening income distribution accelerated
Training packages on technology transfer	1. Educational self-reliance enhanced 2. Goal-oriented education instituted into agricultural programs	1. Continued reliance on inappropriate, imported textbooks 2. University graduates and research staff unable to relate research to national goals
Objective 3		
Model crop and soil performance data bank	1. Uniform procedure used for land evaluation based on accurate performance data for land-use planning and agricultural development	1. Continued reliance on site-specific trial-and-error research
Internationalization of Soil Taxonomy	1. Common language available for making land-resource inventories and for transferring agrotechnology for donor and recipient countries 2. Capacity of International Agricultural Research Centers to deliver appropriate technology increased.	1. Inappropriate agrotechnology packages delivered to resource-poor countries 2. World unable to cope with worsening food situation.

VI. Relation to the Puerto Rico Benchmark Soils Project

The Puerto Rico and Hawaii Projects are linked through a common soil, the clayey, kaolinitic, isohyperthermic family of Tropeptic Eutrustox. Experimental sites for this soil family are located in Brazil, Puerto Rico, and Hawaii. The Puerto Rico Project is responsible for conducting experiments on the Puerto Rico and Brazil sites. A memorandum of agreement between the Universities of Puerto Rico and Hawaii was signed to ensure close linkage between the Projects.

Since the test of the transfer hypothesis for this soil family depends on data collected by both Projects, all data are stored in the Hawaii data bank. The model for the statistical test of the transfer hypothesis was developed jointly by consultants from the Universities of Kentucky and North Carolina State and Cornell, employed respectively by the Puerto Rico and Hawaii Projects. To ensure that data for the test of the hypothesis are collected in a standard way, both Projects use common guidelines for the conduct of fransfer experiments.

The Projects hold annual coordination meetings, the first of which was held in 1976 at Mayaguez. The second was held in 1977 in Manila, the Philippines. These meetings allowed joint discussions on the conduct of transfer experiments and permitted unilateral decisions to be made based on the consensus of the principals involved. For reasons of economy, further meetings were made on a personal rather than a group level and were set at mutually agreeable times and places. In 1978 and in 1979, both the Principal Investigator and the Agronomist of the Puerto Rico Project met in Hawaii with Hawaii-based personnel.

All Project publications, with the exception of the annual reports are joint efforts, but the editing, publication, and distribution utilize personnel and resources of one office.

Language capabilities and ethnic make-up give each institution special advantages in their respective host countries. Excellent working relations and communication enable both Projects to work toward common Project goals and objectives with a minimum of duplicated effort.

VII. Relation to Other Projects

The Project has established formal linkages with the Philippine Council for Agriculture and Resources Research (PCARR), the Soil Research Institute (SRI) in Bogor,

Indonesia, and the National Office of Scientific and Technical Research (ONAREST), in Buea, Cameroon. Through these linkages the Project will advise PCARR as it assists and finances the development of the national Benchmark Soils network by the Bureau of Soils throughout the country. It has also developed linkages of mutual interest with the AID Mission in the Philippines in relation to the Mission's work on agricultural research and assisted the Mission directly on its work on soil material suitability for use in fish pond banks.

The AID Mission in Indonesia has found the Benchmark Soils Project of interest and provides valuable cooperation and support. The Project in Indonesia was initially operated under the US/GOI "Assistance to Agriculture" Agreement Project No. 497-11-110-189 until 1978 and is currently managed under the US/GOI "Agricultural Development Planning and Administrative Project." Project personnel have met personally with the U.S. Ambassador to Indonesia on three occasions in 1978 and 1979 to provide him with a progress report of the Project.

In each participating country, the Project, in cooperation with our counterparts, has established Advisory Committees to help relate the Project goals to national development objectives and to local farmer needs, where possible, and to facilitate utilization of Project results. The committees comprise representatives of cooperating agencies, the AID Mission, the University of Hawaii, and other members as decided by the Committee.

The Project has a common objective and works closely with U.S. Consortium on Soils of the Tropics (CST). One of the Investigators of the Project is the University of Hawaii representative on the CST Executive Committee. The Project and the Consortium work together in soil family classification and in demonstrating the use of soils data in development planning.

Linkage was established in 1976 with another UH/AID project on Nitrogen Fixation by Tropical Legumes--Legume Rhizobium Symbiosis Research (NifTAL) (ta-c-1207). Field experiments were conducted by NifTAL on one of the Benchmark Soils Project's primary sites in Hawaii. The Project's Principal Investigator participated in a workshop organized by NifTAL to internationalize their work through a network of tropical research stations. It was agreed that a logical step would be for NifTAL to consider using the existing Benchmark Soils Project network.

The Project is assisting AID in the development of a tropical soils research network by providing a technical

basis through the classification of soils of agricultural research stations actively encouraging governments to participate. This work will be described under research Objective 3.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) cooperated with the Project in the Hyderabad seminar on "Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development in the Tropics" in January 1976, and adopted the Benchmark Soils Project concept into its program of work for 1977. Another workshop on the "Operational Implications of the Benchmark Soils Project" was hosted by ICRISAT in October 1978 and was attended by the Directors of both ICRISAT and IRRI, representatives from SCS and FAO, and Project country cooperators. Much of ICRISAT's work on soil and water management tends to be site specific, and the Benchmark Soils Project concept will help greatly in developing a systematic outreach program. The Principal Investigator of the Benchmark Soils Project during its first three years is currently Director of ICRISAT. He has catalyzed the creation of awareness of the objectives of the Project within the international body through conferences and seminars which he has ably planned. The latest was the conference held in IRRI in June 1979 on "Towards an Internationally Coordinated Program for Research on 'Priorities for Alleviating Soil-Related Constraints to Food Production in the Tropics'." His keynote address entitled "Soil Factors Constraining Food Production in the Tropics" focused on the Benchmark Soils Project concepts for identifying the solution to problem tropical soils.

The International Institute of Tropical Agriculture (IITA) accepted a subcontract from the Project in 1977 to carry out soil exploration work in Cameroon to find suitable Benchmark sites. Another proposed subcontract with IITA to manage Project sites was changed to accommodate recommendations by Cameroon government agencies. The Project, however, has maintained and will continue to maintain a cooperative association with IITA through its agronomists and soil specialists.

INTSOY (International Soybean Program) and CIMMYT (International Maize and Wheat Improvement Center) have provided the Project with information on planting materials for its variety experiments. In return, the Project is providing performance information on those varieties grown on Project sites.

A linkage established with the East-West Center Resource Systems in 1976 on a project designed to study the efficient use of fertilizers in Asia and the Pacific has continued through the current extension phase. The fertilizer project, INPUTS (Increasing Productivity Under Tight Supplies), includes

four types of experiments that are being conducted simultaneously in all countries. In order to establish a basis for comparison of results, the Benchmark Soils Project is helping INPUTS identify the various soils on which the experiments are conducted.

Programmed linkages with the Soil Conservation Service (SCS) of the U.S. Department of Agriculture have been strengthened through cooperative liaison in refining the classification of tropical soils. The Project has received excellent support from the SCS, both at the local level in Honolulu and from the Federal soil survey staff in Washington, in the conduct of soil surveys and in training workshops on Soil Taxonomy. Soil characterization analyses on soils of the Benchmark network are being planned by the SCS soils laboratory in Lincoln, Nebraska. The primary purpose of this joint efford is one of quality control. It also allows the SCS laboratory to gain "more experience studying tropical soils."

An additional activity of mutual interest to the Project and SCS is the recently established Office of International Soil Classification and Correlation to be housed in SCS. The Benchmark Soils Project will work closely with the office so that Benchmark products will continue to be used after the Project comes to an end.

Linkages with the Food and Agriculture Organization (FAO) were also strengthened by the excellent cooperation and support provided by the FAO Soil Resources Project in Ekona, Cameroon in soil survey, site selection, and negotiation of the memorandum of understanding between Hawaii and ONAREST. The Project received similar soil-survey assistance in both the Philippines and Indonesia in the initial and extension phases. Future cooperation with the FAO in Rome in soil interpretation and land evaluation and with the Benchmark data bank is planned in 1980 and in the second extension period.

The International Fertilizer Development Center (IFDC) and the Benchmark Soils Project have a memorandum of agreement to test IFDC's newest phosphate rock formulations in the Benchmark Project soil networks.

Through these relations, the Benchmark Soils Project is able to develop appropriate technology packages containing seed (from INTSOY, CIMMYT and Pioneer Seed Co.) inoculum (from NifTAL and Nitragin Co.), and fertilizer (from IFDC). Other projects that work with the Benchmark Soils Project benefit by discovering new features about their project products. The Benchmark Project principles and concepts enable other development projects to test products and commodities in an efficient, objective, and rational way.

VIII. Project Review and Evaluation

Project activities in Hawaii, Indonesia, and the Philippines were reviewed by an on-site review panel at the request of DSB/AGR during the period March 8-23, 1979. The three-man panel consisted of Dr. Klaus W. Flach, Assistant Administrator for Soil Survey of the Soil Conservation Service, U.S. Department of Agriculture (Team Leader); Dr. John H. Ehrenreich, Dean, College of Forestry, Wildlife and Range Sciences, University of Idaho; and Dr. Paul M. Giordano, Research Soil Chemist, Tennessee Valley Authority, Muscle Shoals, Alabana.

In their report (Appendix D), the Panel commended the Project for its leadership and management of personnel and its judicious use of financial resources to accomplish Project objectives; for an active training component, as recommended by a similar panel in 1976; for the quality and quantity of informational materials; for the competence and innovative abilities of consulting statisticians in developing a transfer model; and for the close working relationship established between the Hawaii group and host-country personnel.

The panel recommended the Project be extended another three years to 1983, to fully exploit the benefits from investments to date.

This was the second on-site review. The first review was conducted in 1976 by a three-man panel that visited Project sites in Hawaii and the Philippines. The review panel recommended an extension of the original contract to 1980 with an expanded scope of work to include a third soil family, additional sites, a major training component, and an information bank to catalyze utilization activities.

IX. Environmental Impact

Initial Environmental Examination. The activities of this project fall into the area described in environmental procedure regulations, Para 216.2 (c) "Analyses. Studies, Academic or Investigative Research. Workshops and Meetings." These classes of activities will not normally require the filing of an Environmental Impact Statement or the preparation of an Environmental Assessment. It is possible that an output of this project will be a set of procedures, guidelines or research results which when used would require such assessment. However, the Project itself only proposes research and directly supportive activities. Under these guidelines, this activity clearly qualifies for a negative

determination at the time when a threshold decision is determined.

X. Role of Women

Traditionally women in developing countries have played a major role in agriculture. They are expected to continue to play an important role in country efforts associated with this project's inputs. However, this project by itself will have no effect on that role.

XI. Budget

1. The Life-of-the-Contract budget and the budget summary are in Appendix E.

	FY 1981	FY 1982	FY 1983	TOTAL
Salaries and Wages	$ 453,050	$ 466,200	$ 468,950	$1,388,200
Fringe Benefits	117,100	126,200	130,290	373,590
Consultants	25,000	25,000	25,000	75,000
Equipment, Supplies and Services	200,800	191,500	156,300	548,600
Vehicles	0	0	0	0
Freight Costs	33,000	31,000	11,000	75,000
Travel and Subsistence	110,000	86,460	82,210	278,670
Publications	37,300	52,000	44,500	133,800
Indirect Costs	121,350	124,000	133,300	368,650
TOTAL	1,097,600	1,102,360	1,041,550	3,241,510
2. AID Evaluation Budget	4,200	26,000	4,800	35,000
GRAND TOTAL	$1,101,800	$1,128,360	$1,046,350	$3,276,510

XII. Appendices

Appendix A. Logical Framework

AID 1020-20 (1-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY _____ to FY _____
Total U.S. Funding _____
Date Prepared: _____

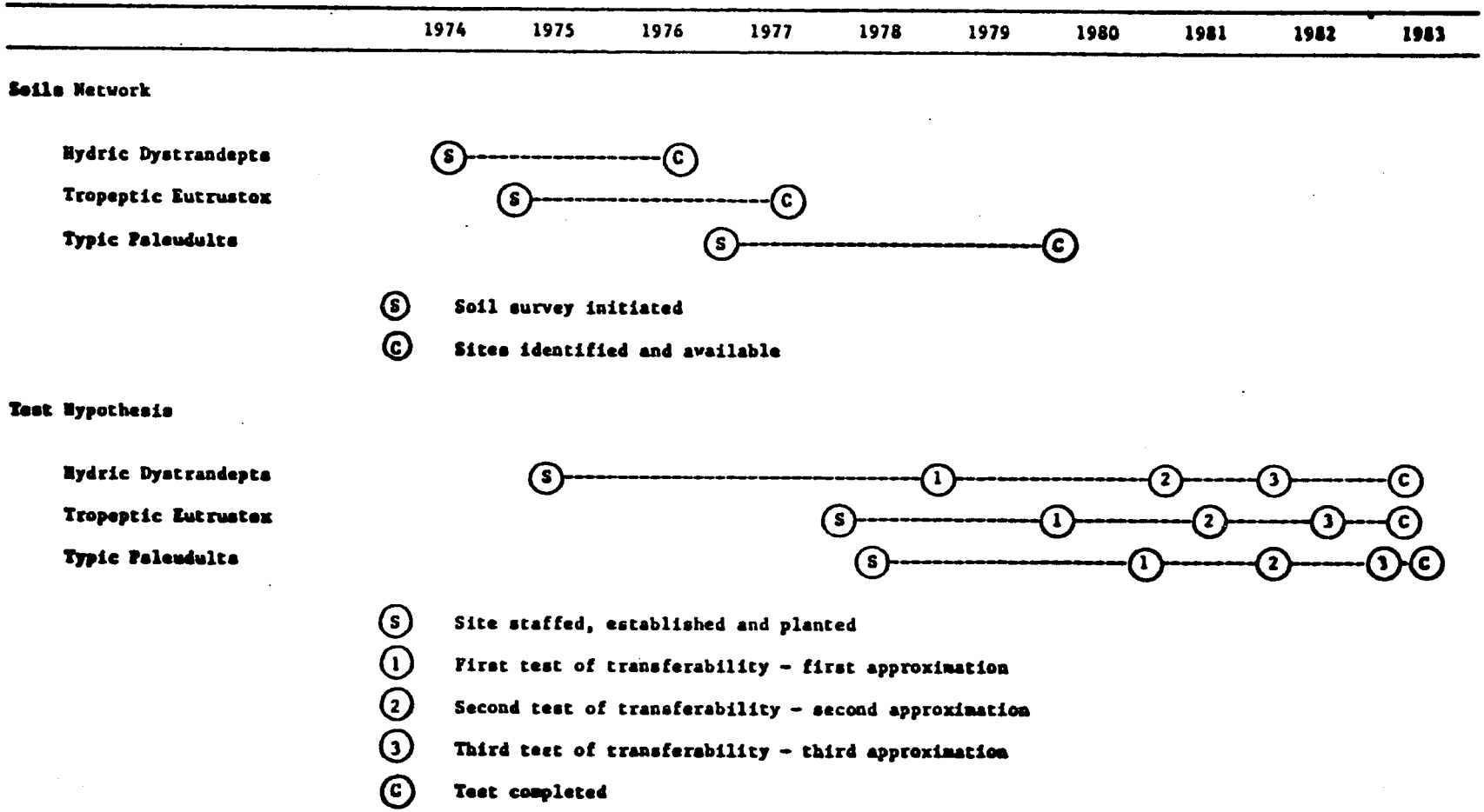
Project Title & Number: Crop Production and Land Capabilities of a Network of Tropical Soil Families, ta-C-1108

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: To increase world food production by accelerating agricultural planning and development in LDC's through agrotechnology transfer. PURPOSE: To enable resource-poor countries of the tropics to achieve self sufficiency in food production.	Measures of Goal Achievement: Transfer model adopted and utilized by host government. National benchmark soils network established.	National surveys AID Mission Extension and communication of project information to local farmers.	Assumptions for achieving goal targets: 1. Soil Taxonomy adopted 2. Agrotechnology hypothesis 3. Wide acceptance of transfer model
Project Purpose: 1. Test transfer hypothesis 2. Assess potential of upland areas for intensive cropping and soil management 3. Demonstrate value of soil classification and land evaluation in planning.	Conditions that will indicate purpose has been achieved: End of project status. 1. Network of 3 soil families established in 4 countries. Hypothesis tested. 2. Variety and management experiments installed. 3. Soil and crop performance data bank developed. *	1-2. Annual reports, Progress reports, Newsletter, and On-site reviews. 3. Data bank of stored soil and crop performance and weather parameters. Trained scientists.	Assumptions for achieving purpose: 1. Similar soil familes occur in Hawaii, Asia, Africa and Latin America. Priniciples of Soil Taxonomy valid. 2. Key soil management problem identified. 3. Soil interpretation/land evaluation system available. Training given high priority by AID Mission, host government.
Outputs: 1. Data to test transfer hypothesis. 2. Model for Agrotechnology transfer. 3. Soil and crop performance data for soil interpretation. 4. Practical systems of soil interpretation and Land classification. 5. Trained personnel for conducting national programs in planning and development through technology transfer.	Magnitude of Outputs: 1. Data from 4 countries, 3 soil families, 18 sites. 2. Transfer model for use world wide. 3. Three levels of management on 2-3 soil families in 4 countries. Data bank for world wide use. 4. 80-100 trained scientists.	1-5. Annual Reports Visit to Experimental sites Technical papers Newsletter Utilization materials	Assumptions for achieving outputs: 1. No unusual weather conditions 2. Adequate statistical model for testing transfer hypothesis. Farmer cooperation and willingness to provide input data 3. Adequate soil, production, & weather data. 4. Adequate number of participants.
Inputs: University of Hawaii 1. Professional staff in Agrotechnology. 2. Technical and administrative staff. 3. Field, laboratory, computer, library, administrative, accounting facilities. Philippines, Indonesia, Cameroon 4. Professional, technical counterpart. 5. Land, Lab, office, facilities. AID 6. Financial support 7. Project Management (DSB/AGR)	Implementation Target (Type and Quantity) 1. 108 work months 2. 990 work months. 3. Adequate for project 4. 336 work months. 5. Rentals and purchasing. 6. $3,241,510 in 3 years. 7. Adequate. *Seminar, workshops on soil classification and agrotechnology transfer conducted.	1-5. Annual reports on-site visit, newsletter. 6-7. AID and contractor records. University of Hawaii Accounting Office.	Assumptions for providing inputs: 1-2. Qualified professional, technical & administrative working on continuing basis. 3. U. Hawaii facilities accessible to project personnel. 4-5. Host countries willing to cooperate. 6-7. AID funding & project management provided.

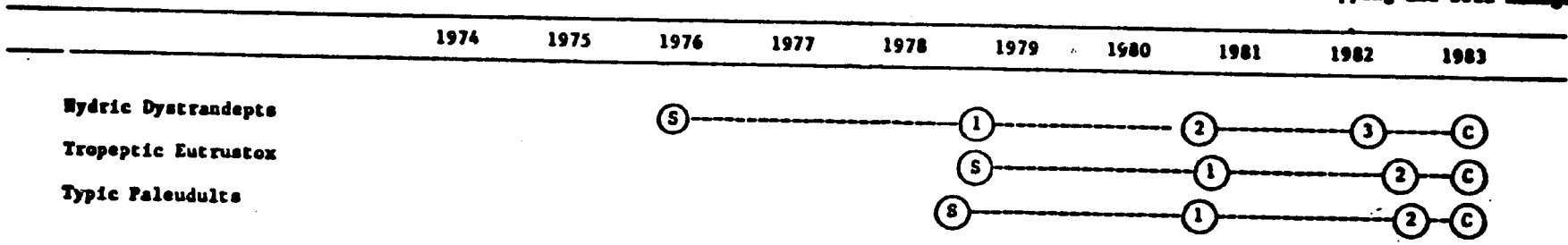
Appendix B. Milestone Events

Appendix B. Milestone Events

Objective 1: To determine scientifically the transferability of agroproduction technology among tropical and subtropical countries.



Objective 2: To assist tropical and subtropical countries in assessing the potential of upland areas for intensive cropping and soil management.



S Experiments designed and planted

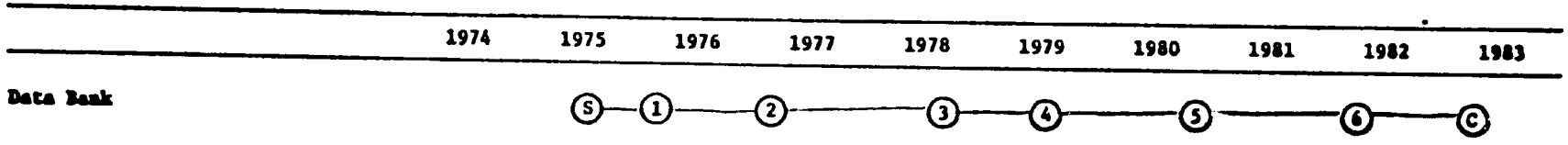
1 Recommendations formulated - first

2 Recommendations formulated - second

3 Recommendations formulated - third

C Test completed

Objective 3. To demonstrate the value of soil and land classification in formulating agricultural development plans in selective areas.



(S) Data bank conceptualized

(1) Soil data bank concept presented at ICRISAT

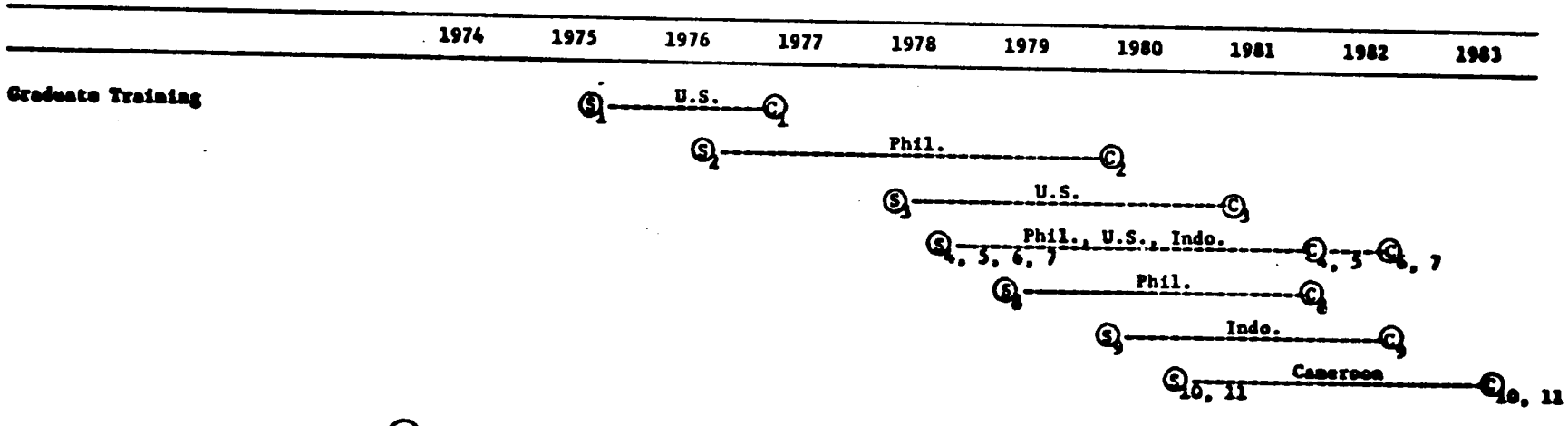
(2) BSP soils data entered into bank

(3) Framework for improved data bank system developed

(4) BSP soil, crop, and climate data file developed

(5) Model for interpretation data bank completed

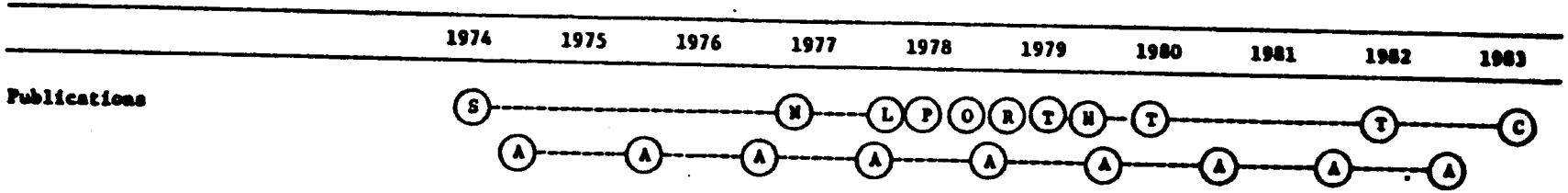
(6) Interpretation data bank operational



(S) Graduate student accepted

(C) Graduate studies completed

Objective 3. (continued)



(N) Benchmark Soils Project News -- initiated

(A) Annual Reports

(P) Progress Report series - initiated

(R) Technical Report series - initiated

(L) Leaflets on project information - initiated

(H) Handbook - initiated

(O) Others: Books, reports, audiovisuals

(T) Training Materials

(C) Final report

Objective 3. (continued)

WORKSHOPS/SEMINARS

Initial Phase: May 31, 1974 to May 30, 1977

1. Jan 1976: Seminar on "The Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development" held at ICRISAT in Hyderabad, India.

2. Aug 1976: First coordination meeting between UH and UPR Benchmark Soils Project held in Mayaguez, Puerto Rico.

3. May 1977: Workshop on "Soil Resources Inventory and Agrotechnology Transfer" conducted with Cornell in Los Banos and Naga City, Philippines.

First Extension Phase: May 31, 1977 to May 30, 1980

1. Aug 1977: Second coordination meeting between UH and UPR Benchmark Soils Project held in Manila and Naga City, Philippines.

2. Jun 1977: Participation in "First International Soil Classification Workshop" in Brazil.

3. Aug 1978: Participation in "Second International Soil Classification Workshop" in Malaysia and Thailand.

4. Oct 1978: Workshop on "Operational Implications of Agrotechnology Transference Research" at ICRISAT in Hyderabad, India.

5. Apr 1979: Third coordination meeting between UH and UPR Benchmark Soils Project held in Honolulu, Hawaii.

6. Jun 1979: Training workshop on "Soil Taxonomy" conducted at Los Banos, Philippines.

7. Jan 1980: Training workshop on "Soil Taxonomy" and seminar/workshop on "Agrotechnology Transfer" to be conducted at Bogor, Indonesia.

8. Mar 1980: Seminar/workshop on "Agrotechnology Transfer" to be conducted at Los Banos, Philippines.

9. Apr 1980: "Third International Soil Classification Workshop" to be held in Damascus, Syria.

10. Apr 1980: Fourth BSP coordination meeting to be held in Honolulu, Hawaii.

Final Extension Phase: May 31, 1980 to May 30, 1983

1. Feb 1981: Participation in International Society of Soil Science conference on "Soils with Variable Charge" to be held at Palmerston North, New Zealand.

2. Feb 1981: Fifth BSP coordination meeting to be held in Honolulu, Hawaii.

3. Apr 1982: Sixth BSP coordination meeting to be held in Honolulu, Hawaii.

4. 1982: Training workshop on "Soil Taxonomy" and seminar/workshop on "Agrotechnology Transfer" to be conducted in Victoria, Cameroon.

5. 1983: Final BSP coordination meeting to be held in Honolulu, Hawaii.

Appendix C. Selecting the Benchmark Soils

A benchmark soil is defined by the Soil Conservation Service of the U.S. Department of Agriculture as one that is of large extent and either holds a key position in the classification system or is of special significance to farming, engineering, or other uses. The purpose of conducting research on benchmark soils is to extract the greatest amount of useful information in the shortest time with the least effort. By concentrating research on benchmark soils it is possible to discover cause-and-effect relations between performance and soil manipulation, and to develop the capability to predict outcomes for many soil uses from a few key measurements.

As implied by its name, the Benchmark Soils Project has selected soils that possess characteristics that make them ideal objects for research. The Benchmark soils and their characteristics are summarized in Table 4.

Benchmark Soils Network

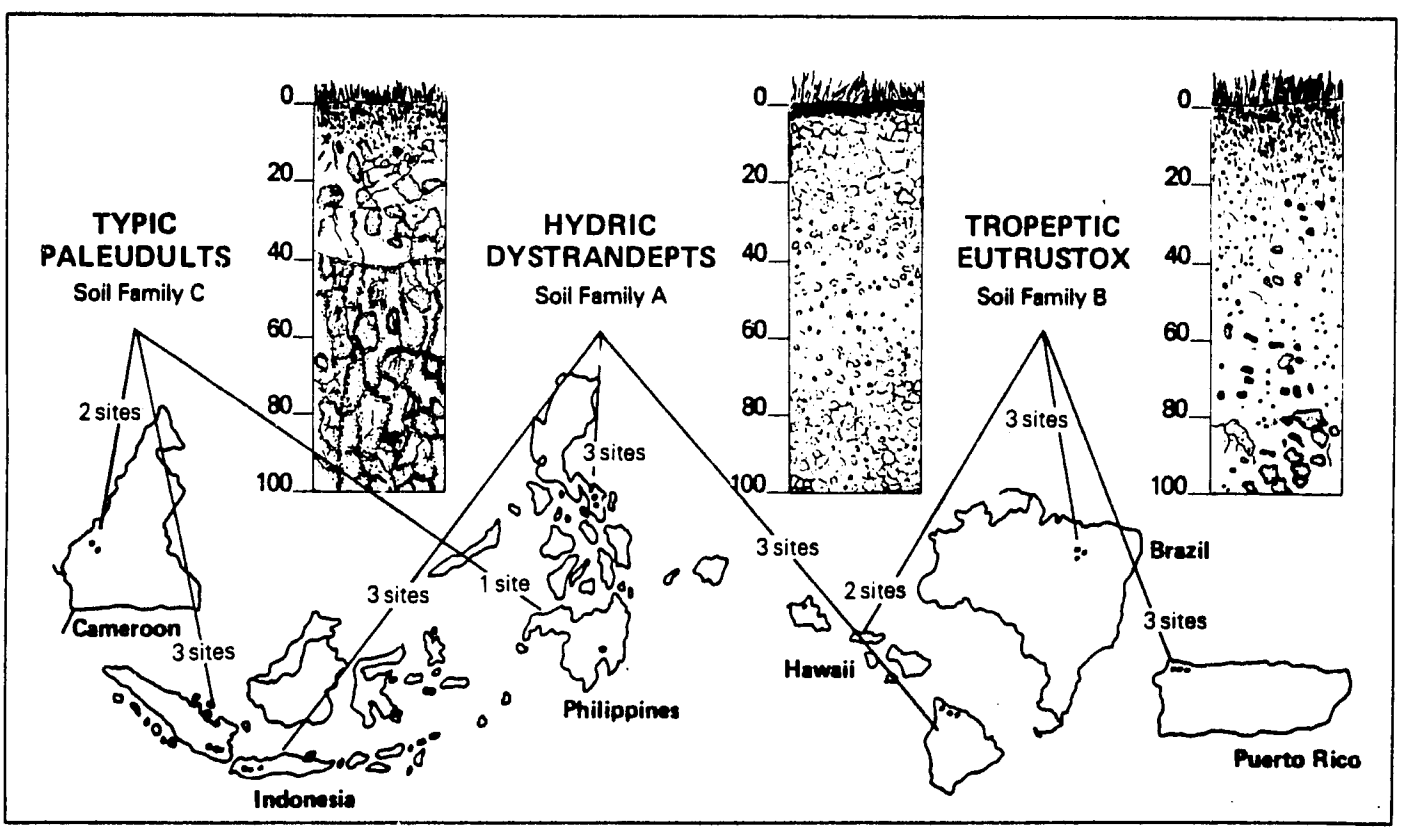


Table 4. Characteristics of Benchmark soils

Benchmark characteristics	Key soil characteristics	Associated climate	Use potential
Thixotropic, isothermic Hydric Dystrandepts			
Holds key position in soil classification system	Low fertility Excellent physical properties Non-erosive Moderately acid	Cool and humid Occurs only in tropics	Excellent for year-round vegetable production
Clayey, kaolinitic, isohyperthermic Tropeptic Eutrustox			
Holds key position in soil classification system Of special significance to farming, engineering, or other uses	Moderate fertility Good physical properties Non-erosive Non-acid	Warm and dry Occurs only in tropics	Excellent for mechanized plantation agriculture, such as pineapple, irrigated sugarcane; one of the most productive soils of the tropics
Clayey, kaolinitic, isohyperthermic Typic Paleudults			
Holds key position in soil classification system Of special significance to farming, engineering, or other uses in the tropics Of large areal extent	Low fertility Poor to fair physical properties Erosive Very acid	Warm and humid Occurs only in tropics	Excellent for subsistence crops, such as cassava and cowpea, and industrial crops, such as rubber and oil palm

Appendix D. On-Site Review Report

United States Department of Agriculture
Soil Conservation Service
P.O. Box 2890
Washington, D.C.
20013

APR 4 1979

Mr. Dean F. Peterson
Director, Office of Agriculture
Development Support Bureau
Department of State
Agency for International Development
Washington, D. C. 20523

Dear Mr. Peterson:

It is my pleasure to submit to you the report of the review panel of the Benchmark Soils Project, Contract Number AID/ta-C-1108. The panel consisted of Dr. John Ehrenreich, Dr. Paul Giordano and myself. The issues identified in the report have been discussed with the other panel members. Dr. Giordano prepared a draft of the report which was edited slightly by myself. Dr. Ehrenreich has not yet seen the written report.

I would like to use this opportunity to thank the fellow members of the panel for their enthusiastic support and their forbearance under at times difficult conditions and Dr. Gill for his skill in selecting a balanced panel and for the excellent logistic support of the review.

Sincerely,

KLAUS W. FLACH
Assistant Administrator
for Soil Survey

Enclosures

cc w/enclosure
R. M. Davis, Administrator, Soil Conservation Service, Washington, D.C.
W. M. Johnson, Deputy Administrator for Technical Services, SCS, Washington, D.C.
Dr. James Silva, University of Hawaii, Honolulu, Hawaii 96822
Dr. T. S. Gill, Department of State, A.I.D., Washington, D.C. 20523
Dr. John Ehrenreich, Dean, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, Idaho 83843
Dr. Paul Giordano, Research Soil Chemist, Division of Agricultural Development, Tennessee Valley Authority, Muscle Shoals, Alabama 35660

On-Site Review and Evaluation

RESEARCH ON AGROTECHNOLOGY TRANSFER IN THE TROPICS BASED ON THE SOIL FAMILY

Hawaii Agricultural Experiment Station
College of Tropical Agriculture
University of Hawaii

Contract Number AID/ta-C-1108

March 1979

Review Conducted and Prepared
by
Klaus Flach, SCS/USDA
John Ehrenreich, University of Idaho
Paul M. Giordano, Tennessee Valley Authority

ACKNOWLEDGEMENT

Gratitude is extended by the review team to the Benchmark Soils Project staff at the University of Hawaii for its assistance in planning and implementing the tour of experimental sites in Hawaii, Indonesia, and the Philippines. The team is also appreciative of the cooperation and courtesies extended by the Soils Research Institute (SRI) of Indonesia and the Philippine Council for Agriculture and Resources Research (PCARR) during visits in these countries.

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B. Indonesia
C. Philippines

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RESEARCH ON AGROTECHNOLOGY TRANSFER IN THE TROPICS BASED ON THE SOIL FAMILY

I. INTRODUCTION

The panel which reviewed and evaluated the second phase of the Benchmark Soils Project consisted of the following:

Dr. Klaus W. Flach, Assistant Administrator, Soil Survey, U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C. Dr. Flach served as team chairperson and is a specialist in soil taxonomy, the key element on which the project hypothesis is predicated.

Dr. John Ehrenreich, Dean, College of Forestry, Wildlife, and Range Sciences, University of Idaho, Moscow, Idaho. Dr.Ehrenreich is a member of RAC and has had experience on similar review teams.

Dr. Paul M. Giordano, Research Soil Chemist, Division of Agricultural Development, Tennessee Valley Authority, Muscle Shoals, Alabama. Dr. Giordano's specialty is in the area of soil fertility, with emphasis on micronutrient nutrition of crops.

The Benchmark Soils Project, entitled "Research on Agrotechnology Transfer in the Tropics Based on the Soil Family," has as a goal the following objectives:

1. To determine the transferability of agroproduction technology among tropical and subtropical countries.

2. To assist tropical countries in assessing the potential of upland areas for intensive cropping and soil management.

3. To demonstrate the value of soil classification in formulating agricultural development plans in selective areas.

The present review evaluates the progress and accomplishments since 1976 when the second phase of the contract began. This document will address factors such as project design, personnel, management, strategy, cooperation and interplay with other agencies, associated training programs, publication, and information dissemination.

II. ON-SITE OBSERVATIONS

The panel, accompanied by Dr. James Silva, Principal Investigator for the Benchmark Project, and other University of Hawaii personnel, toured the Maunaloa site on Molokai (Tropeptic Eutrustox) and was briefed on the background, organization, and development of the study. During the initial phase of the transfer studies, phosphorus and lime were the variables selected to test the transfer concept. However, a lack of response to lime led to the selection of nitrogen as a replacement. Although soybeans was under investigation at the time, corn has become the sole test crop in the transfer and management experiments, mainly because of the nitrogen parameter.

Visits were also made to the Iole and Kukaiau sites (Hydric Dystrandepts) on the big island of Hawaii. These were among the earliest experimental plots established in the network and have demonstrated a marked response to phosphorus but not lime. However, little response occurred beyond the first level of applied phosphorus due to an overestimation of phosphorus need by the Fox sorption method. Several consecutive corn crops have shown a significant residual carryover of phosphorus.

A conference took place in Bogor, Indonesia, at the Soil Research Institute (SRI) that included Dr. D. Muljadi and his staff, W. C. Tappan and S. H. Krashevski of the USAID mission in Indonesia, Benchmark personnel, and the review team. Dr. Muljadi described soil classification work being conducted in Indonesia and indicated that the concept of agrotechnology transfer will be employed at several research centers in surrounding areas of major crop production (upland rice, soybeans, corn, and cassava). It is also anticipated that identification and correction of soil management problems in sparsely populated Sumatra may aid in enticing transmigration from overcrowded Java. Walter Tappan, Chief Agricultural Development Officer from the USAID mission, praised the project highly and considers Benchmark to be the very best effort in Indonesia and a showpiece for visitors. He is very pleased with the application of the transfer concept within Indonesia and the outstanding cooperation and interplay with the SRI. A training course will be conducted in Indonesia in 1979 with emphasis on soil taxonomy and planning for agrotechnology transfer.

The panel traveled by car to Segunung, Java, visiting a Hydric Dystrandept site located at a research station of the Horticultural Research Institute. Two Typic Paleudult sites were observed on the island of Sumatra. The latter soil family was the last selected, principally as a result of Indonesian interest. The Typic Paleudult network now includes a site in Davao City, Mindanao, as well as the Sumatra sites and a proposed study in Camaroon (an agreement was recently negotiated to include Camaroon in the Benchmark Soils Project.)

The last Hydric Dystrandepts to be viewed were in Naga City, Philippines. It was noted that a greater response to nitrogen than to phosphorus existed at the Philippine Union College site, probably a result of previous management. Furthermore, there was some evidence that potassium deficiency may be developing in a residual management experiment which is evaluating nitrogen, phosphorus, and potassium applications. It was suggested that cropping be restricted to seasons free of typhoons because of crop losses in previous years. Arrangement of crops to avoid the August-October period should minimize the hazard. The final site visited on the tour was the Typic Paleudult in Davao City at a Bureau of Plant Industry experiment station. This appeared to be a very well-managed site and a marked response to phosphorus and nitrogen was evident.

On the final day in the Philippines a meeting was scheduled at the headquarters of the Philippine Council for Agriculture and Resources Research (PCARR) in Los Banos. Although Bill McCluskey, Agricultural Officer from the USAID mission, was to attend, he did not participate because of other commitments in Manila. The purpose and organizational structure of PCAAR was explained to the review panel in a slide presentation. The agency, created in 1975, is

not designed to actively engage in research, but rather to systematically monitor the implementation of the national agricultural research program. The Benchmark program has been well supported by PCARR. Personnel from both groups appear to interact effectively and PCARR has provided office space for Benchmark in Los Banos. A training session, sponsored by Benchmark (Hawaii), Cornell, SEARCA, PCARR, UPLB, and the Bureau of Soils, was conducted in 1977 at Los Banos, with 42 participants from Brazil, Indonesia, Malaysia, Philippines, Thailand, and Puerto Rico. Another session is planned for 1979 with emphasis on soil taxonomy and directed mainly for soil survey agencies and agricultural planners.

Upon returning to Manila, USAID headquaters were visited. During the course of discussion it was brought to our attention that the Philippine mission was understaffed to provide the close interplay necessary for administrating the many projects. However, they were complimentary of the Benchmark effort.

III. CONFERENCE ON PROJECT-RELATED AREAS AT BENCHMARK SOILS PROJECT HEADQUARTERS

Dr. T. J. Gill, Project Manager, AID/DS/AGR, joined the review team on the final day and a conference was held at the Benchmark Soils Project headquarters on the campus of the University of Hawaii. Dr. Foster Cady, consultant to the project from Cornell University, discussed the statistical treatment to be used for the transfer data. Preliminary evaluation of the prediction values appears quite promising, and Dr. Cady and Dr. Larry Nelson, consultant to the Puerto Rico project from North Carolina State University, are optimistic.

Dr. H. Ikawa briefed the panel on proposed training courses to be offered during 1979 in Indonesia and the Philippines. One of the principal goals is to train key personnel so that they will have the capability to train others in their respective countries. Although the main thrust of these sessions will be directed toward soil taxonomy, it was suggested by the review team that strong consideration be given to practical application of this information.

Mr. A. R. Hurdus, Field Operations Coordinator for the Hawaii sites, plans to study several parameters relating to the soil family as part of his doctoral research. There is indication that weed, insect, and disease problems may be stratified by soil family. For example, it has been observed on the Hydric Dystrandept sites in Indonesia and the Philippines that little incidence of downy mildew has occurred, even though the disease is prevalent and susceptible varieties of corn are being grown. A possible explanation is an unfavorable soil temperature regime (isothermic) for the pathogen.

Ms. C. L. Garver, Editor and Publication Specialist for Benchmark, commented on project-related publications printed to date and those in press, and presented a list of ideas for future publications. A forthcoming document entitled Benchmark Soil Data Bank will describe the function of the data bank, its purpose, and its ultimate utility in agrotechnology transfer.

The panel, accompanied by Drs. Gill, Silva, and Tsuji, visited with Dr. Matsuda, President of the University of Hawaii. President Matsuda has been a strong supporter of the Benchmark Project, providing for adequate personnel and excellent quarters on campus. Overall administrative support has improved since the last project review, when that panel recommended university correction of these inadequacies.

The meeting was brought to a conclusion with a detailed discussion of the commendations and recommendations of the review panel. Appreciation was expressed to Drs. Gill, Silva, Tsuji, and the other Benchmark staff for their cooperation, careful planning, and remarkable arrangement of a very tight schedule.

IV. COMMENDATIONS

The panel was very impressed with the excellence in personnel ranging from the project leaders to the field workers. The obvious esprit de corp observed throughout our tour and the quality of their research is strong testimony that the project is being executed effectively by highly competent managers and technically sound scientists. The effective use of flow charts depicting work schedules is very impressive and reflects the efficient organization at the field level. Recruitment of personnel has been outstanding, and funds appear to be used judiciously with regard to vehicle purchases, field installations, and manpower utilization. The versatility and ingenuity of the field staff was exemplified on several occasions in the form of homemade drying ovens, storage sheds, offices, etc. Also, the security of the field sites was excellent. Plots were either protected by fences as in Hawaii, or located on secure farms or experiment stations.

The project staff should be commended for their active training component, a recommendation emphasized by the previous review team. It was clear in both Indonesia and the Philippines that key personnel are in need of training in soil taxonomy and application and both countries are eager to participate.

The quality and quantity of informational material is excellent, and literature is being distributed widely. Requests for reports, reprints, and newsletters associated with the project indicate strong interest in the study.

The panel was impressed by the progress of the consulting statisticians. They are displaying a high degree of competence and innovation in developing the transfer model which is imperative for the success of the project.

The close working relationships established between the Hawaii group and host countries and the contributions by these countries is commendable. As mentioned earlier, the impact of Benchmark on independent research in Indonesia by the SRI is very encouraging. Also, the strong support by the AID mission has been a valuable asset to the project. Accordingly, cooperation with PCARR in the Philippines has been essential to the progress of Benchmark in that country. Benchmark has been publicized in the Philippines through radio broadcasts of educational programs.

V. RECOMMENDATIONS

Inasmuch as the Benchmark Soils Project is making good progress toward achieving agrotechnology transfer, has in place a qualified and dedicated team of workers, has established good working relations with host countries, and has strong support of USAID missions, the review panel recommends that the contract be extended for an additional three years to fully realize the benefit from investments to date.

The Benchmark Soils Project sites represent a unique collection of well-documented experimental sites. Establishment of sites has been expensive, but maintenance is relatively inexpensive. By the end of the current contract period, only the Hydric Dystrandepts will have adequate data. To test the transfer concept, additional data will be needed for the Tropeptic Eutrustox and the Typic Paleudult sites. Hence, adequate funding for continued operation of existing sites and for preparing documents recommended in this report will be needed. Since the Puerto Rico project is closely related to the Hawaii project and will be up for renewal in December 1980, the panel feels that continuation of both contracts is necessary to complete the network and accrue sufficient data for the three soil families. Any cutback in funding should not be at the expense of existing transfer studies, but rather a restriction in new management startups.

The review team submits the following recommendations based upon observations and discussions during the project evaluation:

A. Development of a testable hypothesis. The purpose of the project is to test the hypothesis that agrotechnology can be transferred within the same soil family. The validity of this statement cannot be tested unless objective criteria are established, that:

1. Restriction of transfer to a given family results in a prediction equation that is more precise than a prediction equation for randomly selected soils.

2. Since experimental data for randomly selected soils are not available, the hypothesis may be simplified to test that prediction equations for sites of one family are more precise than a single prediction equation for all sites.

3. The project in its current configuration is testing the hypothesis that N and P response is transferrable.

B. Factors in the prediction equation. In view of the large between-site variation, the prediction equation will be the key for testing the hypothesis. The equation should emphasize factors that can be used to define mappable phases of families such as soil temperature, radiation, soil mineralogy, and distinguish these factors clearly from management-related factors including surface soil pH (after liming) and P and K test results.

C. Laboratory data. The failure of the Fox method for soil P in this project should be documented. The use of the Fox test for technology transfer had been one of the underlying assumptions of the project. Its failure introduces a strong element of methods research and the review team recommends intensive efforts in this area to maximize the ultimate utility of the project. Similarly, values for extractable acidity are not consistent with others reported in the literature, and perhaps samples should be sent to the National Soil Survey Laboratory in Lincoln, Nebraska, for crosschecking.

D. Benchmark data bank and soil technology. One of the most useful products of the project will be a data bank system that can serve as the basis for a general system involving many available fertility experiments in tropical areas. Hence, the data system should be described in detail in a special Benchmark report. In addition, a handbook on agrotechnology transfer should be developed describing in detail techniques for statistical treatment, plot design, meteorological measurements, etc. Such information will be extremely useful, especially in countries like Indonesia and the Philippines which will be actively engaged in this research.

E. Communication among project leaders and managers. The Benchmark Soils Project is the first fully coordinated international study of its kind. Coordination and strict conformity of experimental procedures are essential. Country project leaders (Hawaii, Puerto Rico, Brazil, Indonesia, the Philippines, and Camaroon) should assemble at least once a year to exchange experiences and discuss mutual problems and successes.

F. Improvement of Benchmark visibility. Although Benchmark is doing an excellent job of publicizing its work through leaflets and progress reports of a semitechnical nature, certain aspects of the research should be prepared for publication in scientific journals. Publication will give the project needed exposure in the scientific community and should result in feedback to the project team. Some of the topics that would be of interest include:

1. Limitations of the Fox method for estimating P requirement in low-P soils.

2. Multiple extraction of P by the Truog method to predict P response.

3. Statistical treatment of the transfer hypothesis.

4. Usefulness of expressing differences in bulk density in applying soil test results.

The review panel also suggests that project exposure at a national or international meeting in the form of a workshop or symposium would be valuable. Emphasis should be on the transfer concept and the experimental statistical model.

G. Broadening of training component. The training sessions planned for 1979 are well conceived with respect to taxonomy of soils. However, the review team recommends that they be broadened to include:

1. Procedures for testing and updating Soil Taxonomy.

2. Establishing phases of soil families to reflect specific countries.

3. The use of soil taxonomy in a soil survey program indicating the design and naming of map units and the development of interpretation.

H. Management experiments. Soil management experiments are an integral part of the Benchmark effort. Successful experiments could become part of the transfer technology if properly designed and executed. For greatest efficiency, management experiments should be under strict Hawaii control and, if relevant, should be repeated in several locations within the soil family network. At this stage in the project, however, emphasis should be placed on transfer studies unless funds and time are available for new management experiments.

I. Plant tissue analyses. The panel recommends that plant tissue analyses be conducted if a response to a plant nutrient is in doubt. This would be especially appropriate on residual management experiments.

J. Documentation of criteria in site selection. Due to logistic constraints, the sites selected are not a random sample of the soil families included in the project. Some of the sites, particularly the Paleudult sites, are marginal for the taxon. Objectives and constraints of site selection should be carefully documented in future Benchmark publications.

K. Relocation of Philippine project leader. Because of the difficulty in scheduling transportation between experimental sites, it is recommended that the Philippine project leader transfer from Davao City to Los Banos. In addition, this move will locate Dr. Raymundo in closer proximity to PCARR and the Bureau of Soils. Offices are already provided by PCARR at its headquarters in Los Banos.

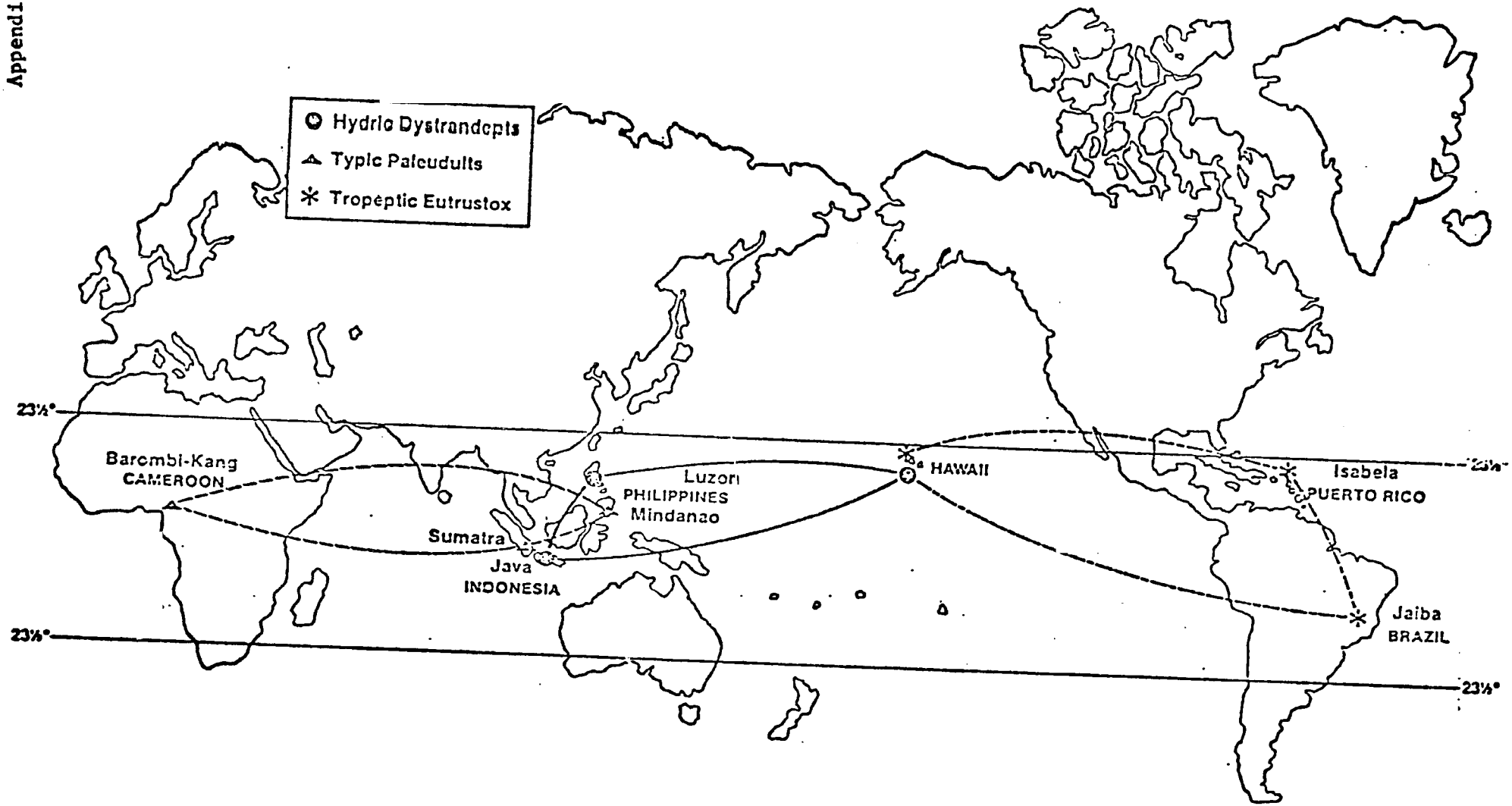
L. Philippine AID mission. Project support and interplay with AID in the Philippines has not been as effective as in Indonesia. Part of the reason lies in the fact that the Philippine mission has more agriculture-related centrally funded projects than other countries and insufficient staff to maintain close contact with each project. The panel recommends that the staffing workload of the AID mission in the Philippines be adjusted to provide for optimum interaction with centrally funded projects.

M. Need for additional consultants. During the closing stages of Benchmark, it may be desirable to contract additional consultants capable of supplying expertise in areas not presently covered by the project team. These areas could include additional statistical, agronomic, and soil taxonomy assistance as data is generated and interpretation commences.

Itinerary for AID On-Site Review

Date	Activity
March 8 Thursday	Honolulu
March 9 Friday	Honolulu - Molokai Depart 0700 - Arrive 0730 Travel: airport to Maunaloa - 20 minutes Meet at BSP field office in Maunaloa: 0815 - 0945 Field inspection: 0950 - 1100 Travel: Maunaloa to airport - 20 minutes Molokai - Kamuela (Waimea) Depart 1130 - Arrive 1245 Lunch: 1300 - 1400 (Waimea) Travel: Waimea to Kukaiau site - 25 minutes Site inspection: 1430 - 1545 Travel: Kukaiau to Mealani Farm - 15 minutes Leave Mealani: 1625 Kamuela - Honolulu Depart 1650 - Arrive 1820
Saturday/ Sunday	Honolulu - Tokyo (Narita) - Hong Kong Depart 1115 - Arrive 2035 (Sunday)
March 12 Monday	Hong Kong - Jakarta Depart 1500 - Arrive 1830 Jakarta to Bogor by vehicle, 1.5 hours; distance - 60 km
March 13 Tuesday	Meeting at Soil Research Institute with Dr. D. Muljadi and staff: 0900 - 1200 Lunch: Bogor, 1230 - 1330 Travel: Bogor to LPHS (Segunung); travel by car - 1 hour (1345 - 1445) Site visit: 1445 - 1700 Travel: Segunung to Jakarta, 1700 - 1900
March 14 Wednesday	Jakarta - Telukbetung Depart 0730 - Arrive 0805 Road travel: Telukbetung to Nakau, 2.5 hours (0825 - 1100) Site visit: Nakau, 1100 - 1300 Lunch: 1300 - 1400 Travel: Nakau to BPMD - 30 minutes Site visit: BPMD, 1430 - 1530 Travel: BPMD to Telukbetung - 3 hours (1530 - 1830)
March 15 Thursday	Leave hotel at 0700; travel time to airport - 30 minutes Telukbetung - Jakarta Depart 0830 - Arrive 0905 Meeting with USAID, SRI, and Bureau of Planning, 1300 - 1600, USAID

March 16 Friday	Jakarta - Singapore Depart 0845 - Arrive 1045
March 17 Saturday	Singapore - Manila Depart 1250 - Arrive 1640
March 18 Sunday	Manila - Naga Depart 0915 - Arrive 1010 Land travel by pickup truck, asphalt and gravel road Airport to Palestina: 1030 - 1100 Site visit: Palestina, 1100 - 1200 Palestina to Naga: 1200 - 1230 Lunch in Naga: 1245 - 1330 Naga to hotel: 1330 - 1400 Hotel to PUC: 1430 - 1445 Site visit: PUC, 1445 - 1700 Dinner at Penafrancia Resorts
March 19 Monday	Leave hotel at 0730 for Naga - 30 minutes Visit Naga office and staff: 0800 - 0830 Visit PCARR Infrastructure Buildings: 0900 - 0945 Travel to airport - 10 minutes Naga - Manila Depart 1035 - Arrive 1110 Manila - Davao Depart 1630 - Arrive 1810
March 20 Tuesday	Leave hotel at 0800 Visit city office: 0815 - 0845 Travel by car/truck on paved road to primary site at Bago Oshiro (15 km, 30 minutes) Site visit: Bago Oshiro, 0915 - 1145 Lunch: 1200 - 1300 Depart Davao at 1440 Arrive Manila at 1620 Travel to Los Banos by car
March 21 Wednesday	Meeting with PCARR, USAID, Bureau of Soils, and UPLB in Los Banos Travel to Manila
March 22 Thursday	Manila - Tokyo Depart 1320 - Arrive 1935 Tokyo - Honolulu Depart 2100 - Arrive 0830
March 23 Friday	Meeting with BSP staff, and panel summary


Hydric Dystrandepts
Typic Paleudults
Tropeptic Eutrustox
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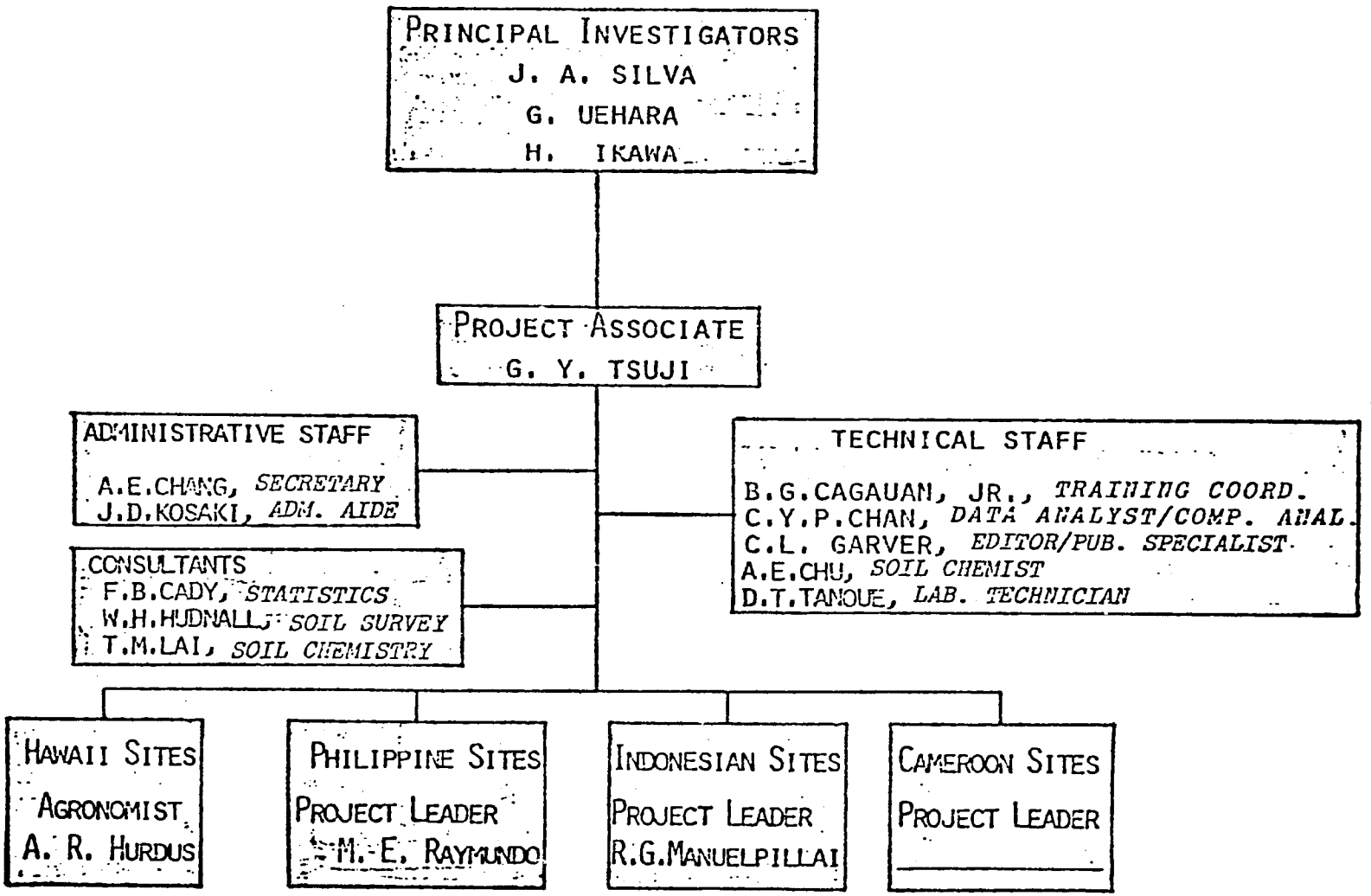
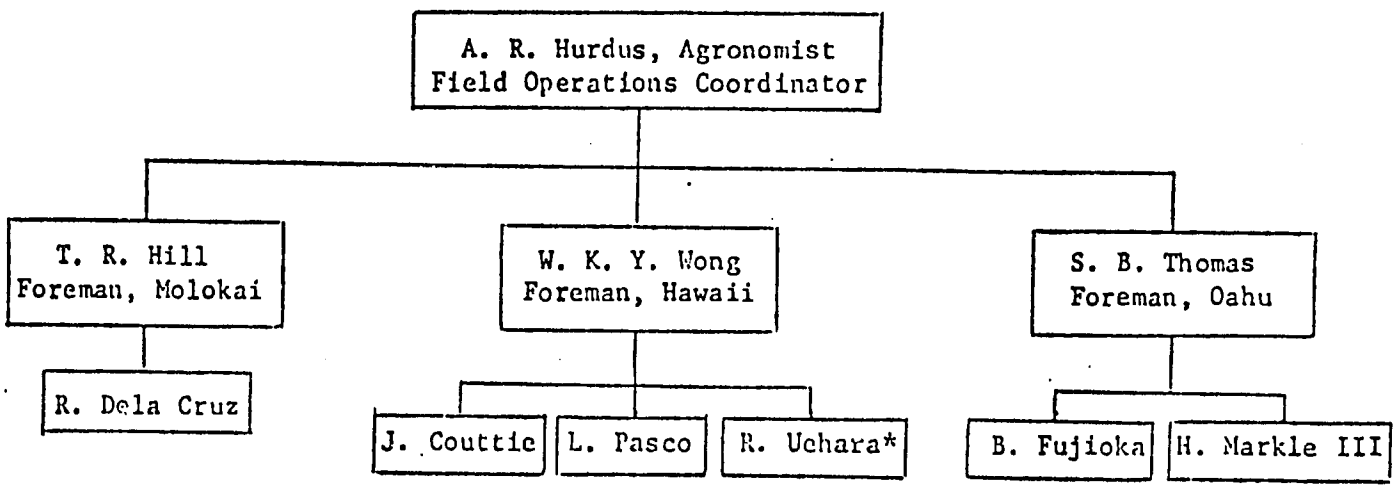
23½°
23½°
23½°
Barombi-Kang
CAMEROON
Sumatra
Java
INDONESIA
Luzon
PHILIPPINES
Mindanao
HAWAII
Isabela
PUERTO RICO
Jaiba
BRAZIL

NETWORK MAP

PERSONNEL ORGANIZATION
HAWAII PROJECT



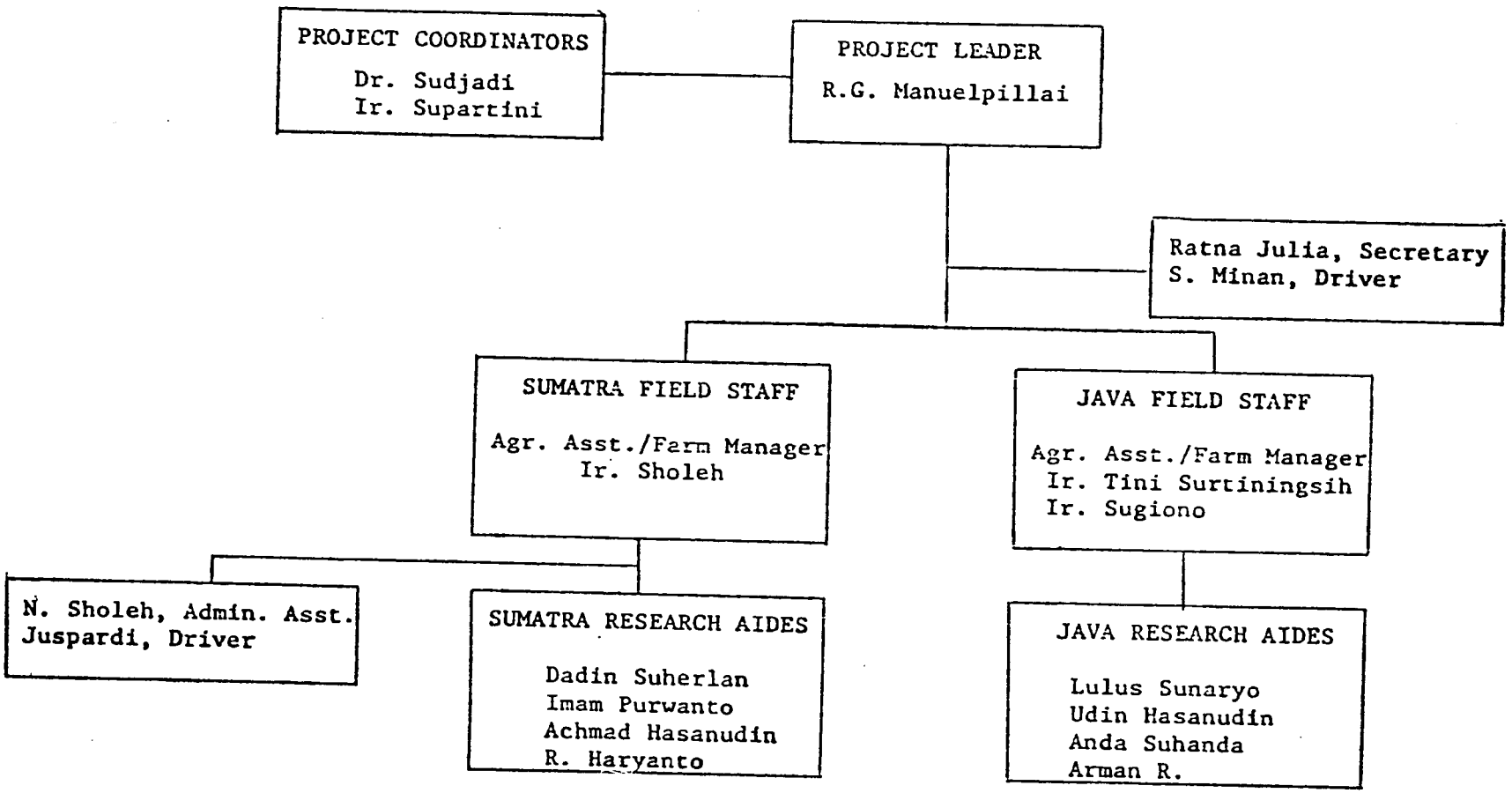
Hawaii Field Operations Organizational Set-Up



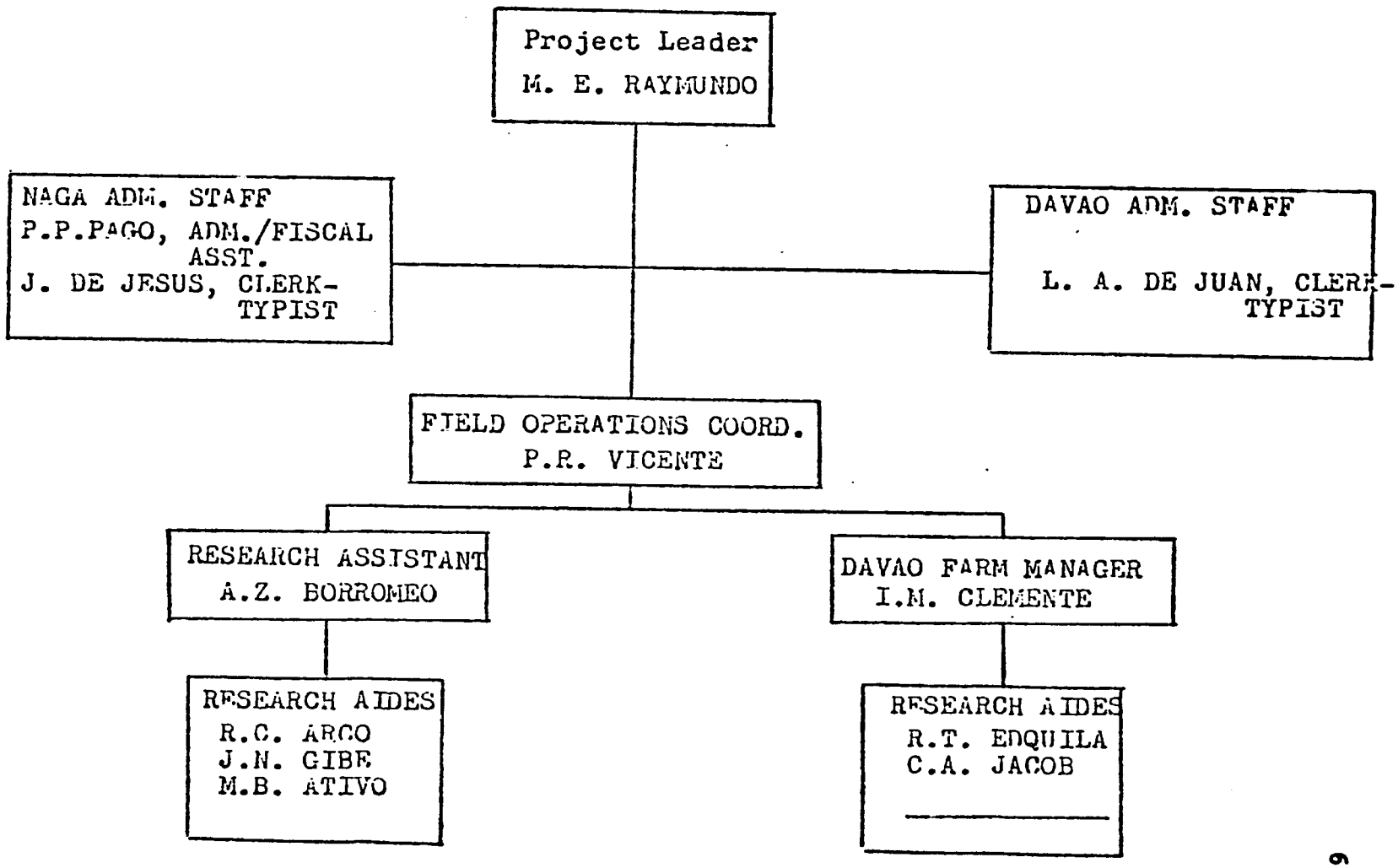
*Part Time

January 1979

INDONESIA FIELD OPERATIONS



PHILIPPINE FIELD OPERATIONS



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SUMMARY

Research on Agrotechnology Transfer of the Tropics Based on the Soil Family

Contract Number AID/ta-C-1108

A panel consisting of Dr. Klaus W. Flach, Assistant Administrator for Soil Survey, U.S. Department of Agriculture, Soil Conservation Service, as chairman; Dr. John Ehrenreich, Dean, College of Forestry, Wildlife, and Range Sciences, University of Idaho; and Dr. Paul M. Giordano, Research Soil Chemist, Division of Agricultural Development, Tennessee Valley Authority, reviewed the project between March 8 and March 23, 1979.

The objectives of the project are:

1. To determine the transferability of agroproduction technology among tropical and subtropical countries.

2. To assist tropical countries in assessing the potential of upland areas for intensive cropping and soil management.

3. To demonstrate the value of soil classification in formulating agricultural development plans in selective areas.

The panel visited sites in Hawaii, Indonesia, and the Philippines, and conferred with benchmark soils staffs at these sites, and with ADI mission staffs, and country cooperators in Indonesia and in the Philippines.

The review panel was impressed by the high quality of experimental work, the quality and enthusiasm of the staffs, the efficient field organization, the cost effective operations, and the quality of the training and informational programs. The project has established outstanding working relationships, is enthusiastically supported by the Soil Research Institute (SRI) of Indonesia, and the Philippine Council for Agriculture and Resources Research (PCARR).

The review team made recommendations in the following areas:

a. Strengthening the statistical evaluation and documentation of the project.

b. Documentating difficulties and constraints of analytical methods and the need for limited tissue analyses.

c. Increasing emphasis on the documentation of the data bank and benchmark technology.

d. Strengthening the technical visibility of the project and certain aspects of the training program.

e. Strengthening certain managerial aspects of the project such as

regular meetings of project leaders, interaction with country USAID missions, additional consultants, tighter control of management experiments and relocation of one of the project leaders.

The review panel concluded that the project is likely to meet its objectives and is making valuable contributions to the transfer of technology among countries of inter-tropical areas. Experimental data available at the expiration of the current contract (September 1980) will be insufficient to test the transfer hypothesis for two of the three soil families included in the project. Hence, an extension of the project for another three year period, possibly at a slightly reduced level, is recommended.

TEACHING/RESEARCH/SERVICE
Office of the Dean
Telephone (208)885-6441

University of Idaho
College of Forestry,
Wildlife and Range Sciences
Moscow, Idaho 83843

April 23, 1979

Dr. Klaus Flach
Assistant Administrator
Soil Conservation Service
P.O. Box 2890
Washington, D.C. 20013

Dear Klaus:

Re: Report of Review Panel for Benchmark Soils Project

The final report of the review panel which you recently submitted to Dean Peterson reflects, in general, the concensus of the discussions you, Paul Giordano and I had before leaving Hawaii. There is, however, on point with which I disagree, and a few points to which I would like to add emphasis.

I do not feel that it is necessary to have additional consultants, particularly in the statistical area, as indicated in paragraph M on page seven. Dr. Foster Cody, Dr. Larry Nelson and other statisticians with whom they have consulted, e. g. Dr. Woods, are as we agreed particularly well qualified to work on this project since they are very experienced and particularly well qualified in relation to soils experiments. Also, since the statistical procedures will be presented at international meetings and published prior to the final report, there will be ample opportunity for their colleagues to react to the new procedures being used in this research.

On page 6, paragraph F, I would like to emphasize the need to publish on the statistical approach developed for this project. The approach is unique for this type of experiment and could be one of the significant scientific contributions resulting from this effort.

On page 3, paragraph 5, it could also be mentioned that Mr. David Harris, a PhD candidate at the University of Hawaii, is conducting a complementary study in most of the field sites which is funded by International Fertilizer Center at Muscle Shoals, Alabama. I was quite impressed with Mr. Harris' work and what it can add to the basis of transfer information.

On page 4, last paragraph, it could be emphasized that not only is there excellent cooperation with the SRI in Indonesia and PCARR in Philippines, but these agencies are as a result of Benchmark instigating or planning similar studies of their own. Also, both agencies are putting very substantial dollar funding into direct support of the Benchmark Project as well as the contribution of facilities, transportation, etc.

The University of Idaho is an Equal Opportunity/Affirmative Action Employer and Educational Institution.

Klaus, it was a real pleasure to work with you and Paul on this review panel, as well as with Dr. Silva and the Benchmark personnel. I think we all agreed that Dr. Gill has also done an excellent job of project management.

Sincerely.

John H. Ehrenreich
Dean

JHE:ms

cc: Dr. Paul Giordano
Dr. T. S. Gill
Dr. Dean Peterson
Dr. James Silva

Appendix E. Budget for Life of the Contract

Appendix E. Budget for Life of the Contract

CONTRACT BUDGET AND LIFE-OF-PROJECT COST ESTIMATE

	INITIAL PHASE		1ST EXTENSION PHASE		PROPOSED EXTENSION PHASE						TOTAL EST'D LIFE OF PROJECT RESEARCH COST	
	Work Months	Est. Costs FY 1974-77	Work Months	Est. Costs FY 1978-80	Work Months	Est. Costs FY 1981	Work Months	Est. Costs FY 1982	Work Months	Est. Costs FY 1983	Work Months	Est. Costs
INPUTS												
Salaries and Wages	669	405,830	1,188	1,282,050	336	453,050	336	466,200	318	468,950	2,847	3,076,080
Fringe Benefits		32,269		203,918		117,100		126,200		130,290		609,777
Consultants		8,800		59,700		25,000		25,000		25,000		143,500
Equipment, Supplies & Services		403,270		600,720		200,800		191,500		156,300		1,552,590
Vehicles		35,500		0		0		0		0		35,500
Freight Costs		29,000		86,850		33,000		31,000		11,000		190,850
Travel and Subsistence		76,190		335,355		110,000		86,480		82,210		690,215
Publications		30,800		34,250		37,300		52,000		44,500		198,850
Indirect Cost		160,613		502,011		121,350		124,000		123,300		1,031,274
TOTAL COSTS BY INPUTS	669	1,182,272	1,188	3,104,854	336	1,097,600	336	1,102,360	318	1,041,550	2,847	7,528,636
OUTPUTS												
Objective #1 To determine scientifically the transferability of agroproduction technology among tropical and subtropical countries			517.8	1,344,649	126	355,380	126	362,570	118.8	350,868	888.6	2,413,467
Objective #2 To assist tropical countries in assessing the potential of upland areas for intensive cropping and intensive soil management			374.4	704,157	102	248,815	102	253,996	97.2	236,468	675.6	1,443,436
Objective #3 To demonstrate the value of soil and land classification in formulating agricultural development plans in selected areas			169.8	545,289	58.8	226,800	58.8	233,405	52.8	216,494	340.2	1,221,988
Administration and Coordination			126	510,759	49.2	266,605	49.2	252,389	49.2	237,720	273.6	1,267,473
TOTAL COSTS BY OUTPUTS	669	1,182,272	1,188	3,104,854	336	1,097,600	336	1,102,360	318	1,041,550	2,178	6,346,364

ESTIMATED BUDGET SUMMARY BY YEARS AND TOTALS
NON-CONTRACT AND CONTRACT FUNDS

Description	Fiscal Year 81	Fiscal Year 82	Fiscal Year 83	Total
NON-CONTRACT FUNDS:				
University of Hawaii				
Salaries	54,410	58,650	63,340	176,400
Analytical Support	10,000	7,500	2,500	20,000
Philippine Council for Agriculture and Resources Research	12,000	13,000	13,000	38,000
Soil Research Institute, Indonesia	73,000	75,000	77,000	225,000
FAO Soil Resources Project, Cameroon	10,000	10,700	11,770	32,470
Total Non-Contract Funds	155,610	160,550	163,810	479,970
CONTRACT FUNDS:				
Direct Costs				
Salaries	453,050	466,200	468,950	1,388,200
Fringe Benefits	117,100	126,200	130,290	373,590
Consultants	25,000	25,000	25,000	75,000
Travel and Subsistence	110,000	86,460	82,210	278,670
Freight	33,000	31,000	11,000	75,000
Equipment, Supplies and Services	200,800	191,500	156,300	548,600
Publications	37,300	52,000	44,500	133,800
Total Direct Costs	976,250	978,360	918,250	2,872,860
Indirect Costs[2]	121,350	124,000	123,300	368,650
Total Contract Funds	1,097,600	1,102,360	1,041,550	3,241,510

[2] Indirect costs based on 31.3% of salaries for Manoa-campus personnel, 17.5% of salaries of off-campus personnel.

ANALYSIS OF DIRECT COSTS FOR PROJECT EXTENSION

Description	FY 1981 Months	FY 1981 Costs	FY 1982 Months	FY 1982 Costs	FY 1983 Months	FY 1983 Costs	Total
SALARIES							
U.S.							
Project Manager	12	28,700	12	30,700	12	32,900	92,300
Training Coordinator	12	24,100	12	25,800	12	27,600	77,500
Editor	12	19,300	12	20,600	12	22,100	62,000
Statistician/Programmer	12	15,750	12	16,850	12	18,000	50,600
Agronomist	12	17,700	12	18,900	12	20,200	56,800
Administrative Aid	12	13,400	12	14,300	12	15,300	43,000
Administrative Assistant	12	14,350	12	15,400	12	16,450	46,200
Lab Analyst	12	20,450	12	21,900	12	23,400	65,750
Lab Technician	12	11,050	12	11,800	12	12,650	35,500
Agricultural Technician	36	34,800	36	37,250	36	39,850	111,900
Assistant Ag. Technician	60	52,300	60	55,900	60	59,800	168,000
Graduate Assistants	42	44,950	42	48,100	24	29,400	122,450
Casual Hire	48	36,000	48	38,500	48	41,200	115,700
Student Help (hourly)		45,000		29,700		31,800	106,500
Research Associate	6	6,800	6	7,300			14,100
FOREIGN							
Project Leader, Philippine	12	22,900	12	24,500	12	26,200	73,600
Project Leader, Indonesia	12	25,600	12	27,400	12	29,300	82,300
Project Leader, Cameroon	12	19,900	12	21,300	12	22,800	64,000
Subtotal - Salaries		453,050		466,200		468,950	1,388,200
FRINGE BENEFITS							
Regular		74,410		79,600		79,190	233,200
DBA		9,000		9,600		10,400	29,000
Allowances		33,690		37,000		40,700	111,390
Subtotal - Fringe Benefits		117,100		126,200		130,290	373,590
EQUIPMENT, SUPPLIES, SERVICES, AND RENTALS							
Office/Lab Equipment		10,150		2,000			12,150
Field Equipment		15,350		5,900			21,250
Office/Lab Supplies		19,660		16,500		14,460	50,620
Field Supplies		43,640		38,500		28,240	110,380
Services and Rentals		112,000		128,600		113,600	354,200
Subtotal - Equipment, Supplies, Services and Rentals		200,800		191,500		156,300	548,600
CONSULTANTS		25,000		25,000		25,000	75,000

Description	FY 1981 Months	FY 1981 Costs	FY 1982 Months	FY 1982 Costs	FY 1983 Months	FY 1983 Costs	Total
TRAVEL AND SUBSISTENCE							
Coordination Meeting		17,950		15,760		16,860	50,570
Seminars and Workshops		17,465		1,870		1,985	21,320
Consultant Travel		4,675		6,610		2,850	14,135
Graduate Students		6,685		1,310		4,010	12,005
Inspection and Training		31,600		27,530		20,970	80,100
In-country travel		31,625		33,380		35,535	100,540
Subtotal - Travel & Subsistence		110,000		86,460		82,210	278,670
FREIGHT COSTS		33,000		31,000		11,000	75,000
PUBLICATIONS		37,300		52,000		44,500	133,800
TOTAL DIRECT COSTS		976,250		978,360		918,250	2,872,860

APPENDIX F

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

Evaluation Plan

In addition to regular management reviews for the purpose of monitoring implementation, DS/AGR will sponsor evaluations which will look at the quality of outputs, test project assumptions, and measure progress toward stated objectives and the project purpose. These evaluations will occur at key points in the life of the project. At present these key points are expected to occur:

Time	Type of Evaluation	Cost
Spring 1981	In-house Review, AID/W, using DS/AGR staff, other AID personnel and not more than 2 consultants (12 consultant days)	$3,500
Spring 1982	Comprehensive Field Review (Philippines, Indonesia, Cameroon and Hawaii) using IDS/AGR staff, 1 regional bureau technician and 2 consultants (80 consultant days)	$24,000
Summer 1983	Terminal Evaluation, AID/W, using DS/AGR staff, plus 2 consultants (12 consultant days)	$4,000
	Evaluation Budget	$31,500
	Contingencies	3,500
	Total	$35,000

The first evaluation will assess the viability of the methodologies being employed in the project, management of inputs and outputs, and the adequacy of efforts towards improving information diffusion and an international soil network with a view to finding project design strengths and weaknesses.

The second evaluation will be a comprehensive field review and encompass the same efforts as the first plus assessing in the Philippines, Indonesia and Cameroon the quality of the work being performed, the data gathered and the overall project impact experienced. The rationale for the evaluation is to measure, or to make a judgement of, progress toward achievement of objectives and end-of-project status.

The terminal evaluation will sum up project experience, highlight scientific and technical information gained through the project and its applicability to the needs of developing countries, the effective-

ness of the project in obtaining its stated purpose, and its potential impact (i.e. benefits) on poor people at some specified point in the future. Particular attention should be to diffusion of project research information and ways of maintaining research network channels.

Perspective Beyond Project Completion

Coordination and cooperation at national and international level is vital to the effective transfer of agroproduction technology. For various parties the incentive for accepting the concept of the project and for collaboration, is the aim to shorten the expensive and time consuming process of making site-specific experiments all over the world to determine optimum practices.

There are a number of elements which must be considered if the project concept is to be utilized successfully. The implications of the project are far reaching. It will affect developing nations, donor agencies and various institutions over a long period and will require a great deal of resource committment on their part. To know these implications in as detail as practical, AID sponsored a workshop at ICRISAT during October 1978. The workshop brought together world leaders in soil science and agricultural development planning, representatives from the World Bank and the United Nations, the Consortium of U.S. Universities on Tropical Soils, several of the International Centers, USDA-SCS, several LDCs and AID representatives. While the proceedings of the workshop are not yet published, the attached information that was extracted from the workshop discussions suggests the type of activities and networking which will be required for successful agro-technology transference for the developing countries.

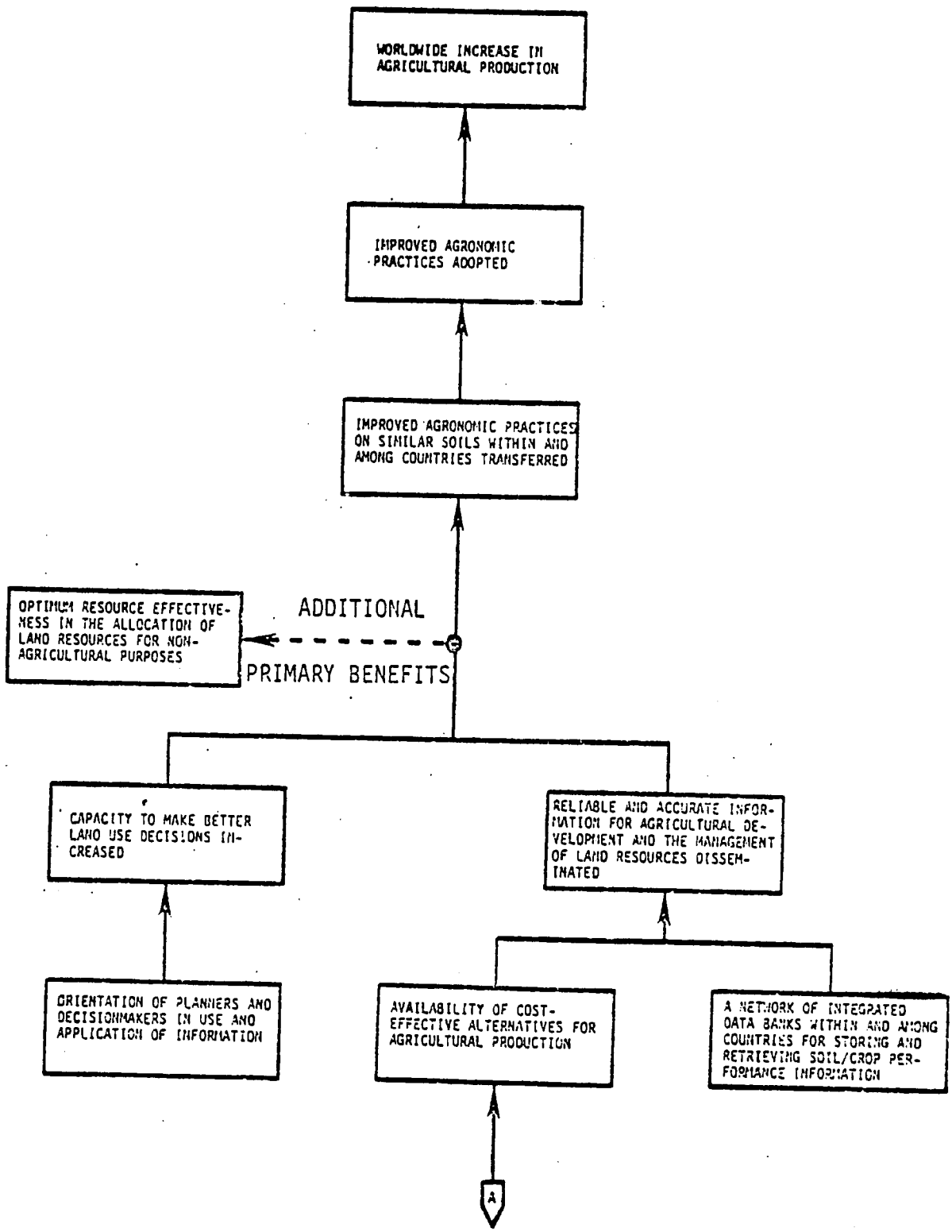
During September 1979, AID initiated a PASA arrangement with U.S. Department of Agriculture, Soil Conservation Service to provide technical assistance in the subject areas of land use, technology transference and improvement of soil classification system for the tropics. For FY 1981 AID is considering a project to establish a model international benchmark soil network including a data bank. The network will consist of about 100 international and national agricultural research centers and serve as a training center for gathering and disseminating information. It will help establish standardized procedures for national and regional networks and data banks.

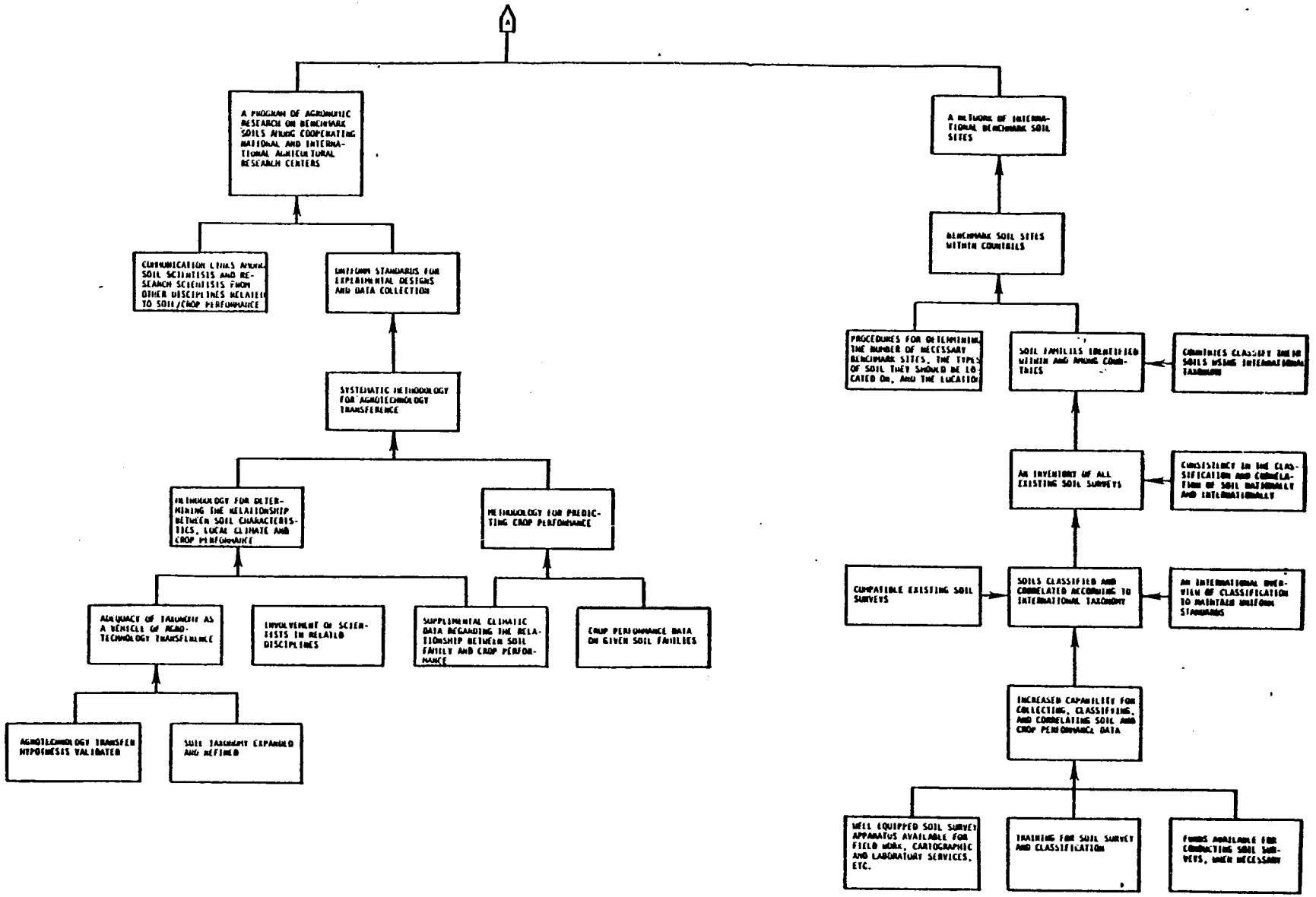
AID will continue as far as possible, follow-up activities to encourage project concept utilization. It is envisioned that the developing countries will commit considerable resources in the future for land use planning and agro-technology transfer..

Plans on Transfer of Benchmark Sites after Project Completion

The benchmark sites will be transferred to the collaborating countries at the conclusion of the project. These sites will form a nucleus of a national network of benchmark sites to be funded and managed by the countries themselves. Before its end, the project would have trained LDC staff to continue studies on these and other national benchmark sites in each of the collaborating countries. These countries have shown strong interest to become a part of an emerging international network of benchmark sites to exchange information on agro-technology.

OBJECTIVE TREE: AGROTECHNOLOGY TRANSFERENCE




A PROGRAM OF AGRONOMIC RESEARCH ON BENCHMARK SOILS AMONG COOPERATING NATIONAL AND INTERNATIONAL AGRICULTURAL RESEARCH CENTERS
COMMUNICATION LINKS AMONG SOIL SCIENTISTS AND RESEARCH SCIENTISTS FROM OTHER DISCIPLINES RELATED TO SOIL/CROP PERFORMANCE
UNIFORM STANDARDS FOR EXPERIMENTAL DESIGNS AND DATA COLLECTION
SYSTEMATIC METHODOLOGY FOR AGROTECHNOLOGY TRANSFERENCE
METHODOLOGY FOR DETERMINING THE RELATIONSHIP BETWEEN SOIL CHARACTERISTICS, LOCAL CLIMATE AND CROP PERFORMANCE
METHODOLOGY FOR PREDICTING CROP PERFORMANCE
ADEQUACY OF TAXONOMY AS A VEHICLE OF AGRO-TECHNOLOGY TRANSFERENCE
INVOLVEMENT OF SCIENTISTS IN RELATED DISCIPLINES
SUPPLEMENTAL CLIMATIC DATA REGARDING THE RELATIONSHIP BETWEEN SOIL FAMILY AND CROP PERFORMANCE
CROP PERFORMANCE DATA ON GIVEN SOIL FAMILIES
AGROTECHNOLOGY TRANSFER HYPOTHESIS VALIDATED
SOIL TAXONOMY EXPANDED AND REFINED
A NETWORK OF INTERNATIONAL BENCHMARK SOIL SITES
BENCHMARK SOIL SITES WITHIN COUNTRIES
PROCEDURES FOR DETERMINING THE NUMBER OF NECESSARY BENCHMARK SITES, THE TYPES OF SOIL THEY SHOULD BE LOCATED ON, AND THE LOCATION
SOIL FAMILIES IDENTIFIED WITHIN AND AMONG COUNTRIES
COUNTRIES CLASSIFY THEIR SOILS USING INTERNATIONAL TAXONOMY
AN INVENTORY OF ALL EXISTING SOIL SURVEYS
CONSISTENCY IN THE CLASSIFICATION AND CORRELATION OF SOIL NATIONALLY AND INTERNATIONALLY
COMPATIBLE EXISTING SOIL SURVEYS
SOILS CLASSIFIED AND CORRELATED ACCORDING TO INTERNATIONAL TAXONOMY
AN INTERNATIONAL OVERVIEW OF CLASSIFICATION TO MAINTAIN UNIFORM STANDARDS
INCREASED CAPABILITY FOR COLLECTING, CLASSIFYING, AND CORRELATING SOIL AND CROP PERFORMANCE DATA
WELL EQUIPPED SOIL SURVEY APPARATUS AVAILABLE FOR FIELD WORK, CARTOGRAPHIC AND LABORATORY SERVICES, ETC.
TRAINING FOR SOIL SURVEY AND CLASSIFICATION
FUNDS AVAILABLE FOR CONDUCTING SOIL SURVEYS, WHEN NECESSARY

PCI 72-8

GROUP 1

LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date _____

Date of this Summary _____

Project Title: Internationalization of Soil Taxonomy

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
DEVELOPMENT HYPOTHESES: If Purpose, Then Goal	Program Goal. The broader objective to which this project contributes: Increased us of Soil Taxonomy for agro-technology transfer in developing countries	Measures of Goal Achievement: Number of countries that adopt Soil Taxonomy as a basis for agro-technology transfer and land evaluation; support by development agencies for internationalization of Soil Taxonomy.	Country records on agro-technology transfer and development of land resources; statements by development agencies.	Concerning long term value of program/project: Adequacy of Soil Taxonomy for agro-technology transfer; effective communication between soil scientists and planners.
DEVELOPMENT HYPOTHESES: If Outputs, Then Purpose	Project Purpose: Further development and promotion of Soil Taxonomy for wider international application, especially in developing countries	Conditions that will indicate purpose has been achieved: End of project status. Applicability of Soil Taxonomy in developing countries with special reference to soils in tropical and sub-tropical areas; critical mass of countries initiate classification of land resources in terms of Soil Taxonomy.	Published amendments to Soil Taxonomy; translations of Soil Taxonomy; distribution of Soil Taxonomy; soil survey reports and land evaluation projects	Affecting purpose-to-goal link: Continuing SCS support for internationalization of Soil Taxonomy; recognition by developing countries of the value of Soil Taxonomy for agro-technology transfer.
MANAGEABLE INTEREST: If Inputs, Then Outputs	Outputs: Refinement of Soil Taxonomy; quality control of the application of Soil Taxonomy in participating countries (international correlation); training in the sue of Soil Taxonomy.	Magnitude of Outputs necessary and sufficient to achieve purpose. Activities of international committees on improvements of Soil Taxonomy; international correlation through on-site verification and international workshops; training workshop of use of Soil Taxonomy.	Committee reports; correlator's reports on country missions; reports on workshops; number of soil scientists trained in Soil Taxonomy	Affecting output-to-purpose link: Cooperation of participating countries, establishment of an international soil correlation entity.
	Inputs: Activities and Types of Resources Establishment of an Office for International Soil Classification and Correlation (ISCC)	Level of Effort/Expenditure for each activity. 3 Soil Correlators Clerical and secretarial staff Consultants Support for workshops Operational expenditures	COST ESTIMATES $350,000 per year	Affecting input-to-output link: Financial support for the establishment of ISCC; availability of qualified personnel.

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GROUP 2

LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date _____

Date of this Summary _____

Project Title: _____

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
If Purpose, Then Goal	Program Goal: The broader objective to which this project contributes: Increase in the availability of reliable and accurate information for agricultural development and the management of soil resources.	Measures of Goal Achievement: Number of soil surveys meetings minimum standards of accuracy and reliability.		Concerning long term value of program/project: A well-staffed soil survey apparatus is available, including sufficient logistic means for field work, as well as cartographic and laboratory services.
If Outputs, Then Purpose	Project Purpose: Increased capability within participating countries in the maintenance of uniform optimum standards for soil correlation.	Conditions that will indicate purpose has been achieved: End of project status. _____number of qualified soil correlators by the year 19__. Accurate soil classification and correlations as revealed by independent review of completed soil surveys.	1. Soil surveys completed and correlated. 2. Independent (international) review of completed soil survey.	Affecting purpose-to-goal link: International overview of country classification and correlation exists.
If Inputs, Then Outputs	Outputs: 1. Soils classified and named correctly in the participating countries according to Soil Taxonomy and optimum soil correlation standards. 2. Completed soil surveys correctly correlated within the country and with like soils in other countries. 3. Soil maps with sufficient reliability to be used universally for agrotechnology transfer.	Magnitude of Outputs necessary and sufficient to achieve purpose. Cross-check classification and interpretation to maintain consistency. Quality of completed survey favorably assessed by independent reviewers. Developing mechanisms for cross-checking classification and interpretation to maintain consistency.	Periodic technical review by international scientists.	Affecting output-to-purpose link: Country demonstrates interest in international correlation by inviting technical review by international experts.
	Inputs: Activities and Types of Resources 1. Selection and training of soil correlators. 2. Training in the use of analytical data for classification and correlation.	Level of Effort/Expenditure for each activity. 1. Field review will reveal "zero" errors in completed correlation. 2. Consistency of classification and correlation with interpretation.	Examine descriptive legend and/or the soil survey report manuscript for consistency.	Affecting input-to-output link: 1. Organizations exist or will be established for soil correlation. 2. Reservoir of enough soil scientists for soil correlation training. 3. Adequate laboratory support will be available.

DEVELOPMENT HYPOTHESES

MANAGEABLE INTEREST

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AEU
GROUP 3
26 October 1978

Project Title: Network and Sample County (Phil) Program-- A five year program (1981-1985)

LOGICAL FRAMEWORK
FOR
SUMMARIZING PROJECT DESIGN

Year One: $1.6m + 10% inflation ± equipment + infrastru
Years Two to Five: = Year One + 10% inflation + 20% ann

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
If Purpose, Then Goal	Program Goal. The broader objective to which this project contributes: Increase in the availability of reliable and accurate information for agricultural development and the management of soil resources.	Measures of Goal Achievement: Incremental production of units of information flowing into national planning and decision units.	Reports by national planners and random site inspections	Concerning long term value of program/project: National commitment to utilize available agro-technology as a basis for rural/agricultural development.
If Outputs, Then Purpose	Project Purpose: Increased capability within participating countries in the systematic collection and interpretation of soil and performance data.	Conditions that will indicate purpose has been achieved: End of project status. Existence of an institutional capability including access to decision making process.	National reports plus independent examination by "Network Advisotry Group".	Affecting purpose-to-goal link: Production of data on soils and performance at levels sufficient in numbers and quality on timely basis to permit meaningful interpretative work.
If Inputs, Then Outputs	Outputs: 1. Increased and accelerated capacity to make better land use decisions. 2. Land use evaluations are available in adequate numbers and distributed for optimal impact. 3. Methodology for predicting crop performance data.	Magnitude of Outputs necessary and sufficient to achieve purpose. Volume of data collected and interpreted.	Review of statistics and reports.	Affecting output-to-purpose link: Quality of decisions will depend on quality of data and political will to act on land use recommendations.
	Inputs: Activities and Types of Resources 1. Strengthen network units to perform duties: collect, classify, interpret. 2. Establish mechanism for network information exchange. 3. Develop inventory of individuals skilled in soil interpretation.	Level of Effort/Expenditure for each activity. (1) 1. Soil/performance data bank system ($25,000 p.a. + 3 person years ± equipment per country). 2. Communications and display system. ($200,000 + 2-3 person years ± equipment and operational expense per country. 3. Full time Program Manager and a Standing Advisory Group ($250,000 p.a.) 4. Workshops, consultants, travel ($500,000 p.a.) for network ($150,000 p.a. + 20% year increment) - for National System.	1. Expenditure reports 2. Manpower reports 3. Annual reports 4. Audits	Affecting input-to-output link: (Current status of network units) 1. Manpower availability and mobility 2. Adequate timely budgeting. 3. International network is operational. (1) All estimates subject to 10% inflationary increase.

DEVELOPMENT HYPOTHESES

MANAGEABLE INTEREST

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GROUP 4

LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date _____

Date of this Summary _____

Project Title: _____

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
DEVELOPMENT HYPOTHESES: If Purpose, Then Goal	Program Goal: The broader objective to which this project contributes:	Measures of Goal Achievement:		Concerning long term value of program/project:
DEVELOPMENT HYPOTHESES: If Outputs, Then Purpose	Project Purpose: The establishment of an international benchmark soils network based on the activities of national and international research centers and recommendations on minimum performance data.	Conditions that will indicate purpose has been achieved: End of project status. International and National Data Banks established. International and National governing boards established. Responsible person identified at each cooperating agency.		Affecting purpose-to-goal link:
MANAGEABLE INTEREST: If Inputs, Then Outputs	Outputs: 1. Commitment of IARC's, NARC's and International Agencies. 2. Structure for Governing Board. 3. Establishing standards and procedures for data management. 4. Minimum standards for experimental designs and performance data collection 5. Commitment by national and international bodies to provide assistance to national and international centers.	Magnitude of Outputs necessary and sufficient to achieve purpose. 1. 7 agreements singed with IARC's and 7 agreements signed with NARC's. 2. Bylaws established. 3. Guidelines established. 4. Standards established. 5. Agreements signed.	Documents available	Affecting output-to-purpose link: Willingness of Centers and IARC's to cooperate. Availability of national and international resources. Qualified staff available. Soil Taxonomy made adequate for inter tropical areas.
MANAGEABLE INTEREST: If Inputs, Then Outputs	Inputs: Activities and Types of Resources 1. Negotiate with IARC's, NARC's and International Agencies. 2. Develop standards for experimental designs and data collection. 3. Develop procedures and standards for data banks. 4. Develop staffing plans. 5. Develop procedures to correlate classification systems.	Level of Effort/Expenditure for each activity. See Appendix 6. Planning conferences and workshops. 7. Training Courses (international and regional)		Affecting input-to-output link: 1. S.T. funding and organization is the responsibility of another troika. 2. IARC's and NARC's will cover costs of running experiments. 3. Regional Coordination will be provided by IARC's.

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GROUP 5

LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date _____

Date of this Summary _____

Project Title: _____

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
If Purpose, Then Goal	Program Goal: The broader objective to which this project contributes:	Measures of Goal Achievement:		Concerning long term value of program/project:
If Outputs, Then Purpose	Project Purpose: A systematic methodology for agro-technology transference developed for use in participating countries.	Conditions that will indicate purpose has been achieved: End of project status.	1. Technology transferred. 2. Technology implemented. 3. Network expanded. 4. Performance data collected	Affecting purpose-to-goal link: Agro-technology available to be transferred. Similarly classified soils identified.
If Inputs, Then Outputs	Outputs: 1. Coordinating body established. 2. Sufficient network stations estd. 3. Support services assured. 4. Effective information system developed. 5. Mechanism for economic analysis established. 6. Training package sufficient for establishing, maintaining and strengthening a network developed	Magnitude of Outputs necessary and sufficient to achieve purpose. 1. Coordination meeting convened. 2. Site preparation and selection initiated. 3. Information dissemination and training start.	1. Annual review reported. 2. Committee reports printed. 3. Technical reports published. 4. Personnel trained. 5. Scientific, private, and public sector informed.	Affecting output-to-purpose link: 1. Qualified individuals from agencies and institutions identified. 2. Sufficient number of stations available. 3. Support facilities exist. 4. Skilled personnel required.
	Inputs: Activities and Types of Resources 1. Network sites identified. 2. Areas of training identified. 3. Infrastructure for services and information system established.	Level of Effort/Expenditure for each activity. Coordinating body: Training consultants Support for training workshop Support for communication systems.		Affecting input-to-output link: Financial assistance provided. Government interest exists.

DEVELOPMENT HYPOTHESES

MANAGEABLE INTEREST

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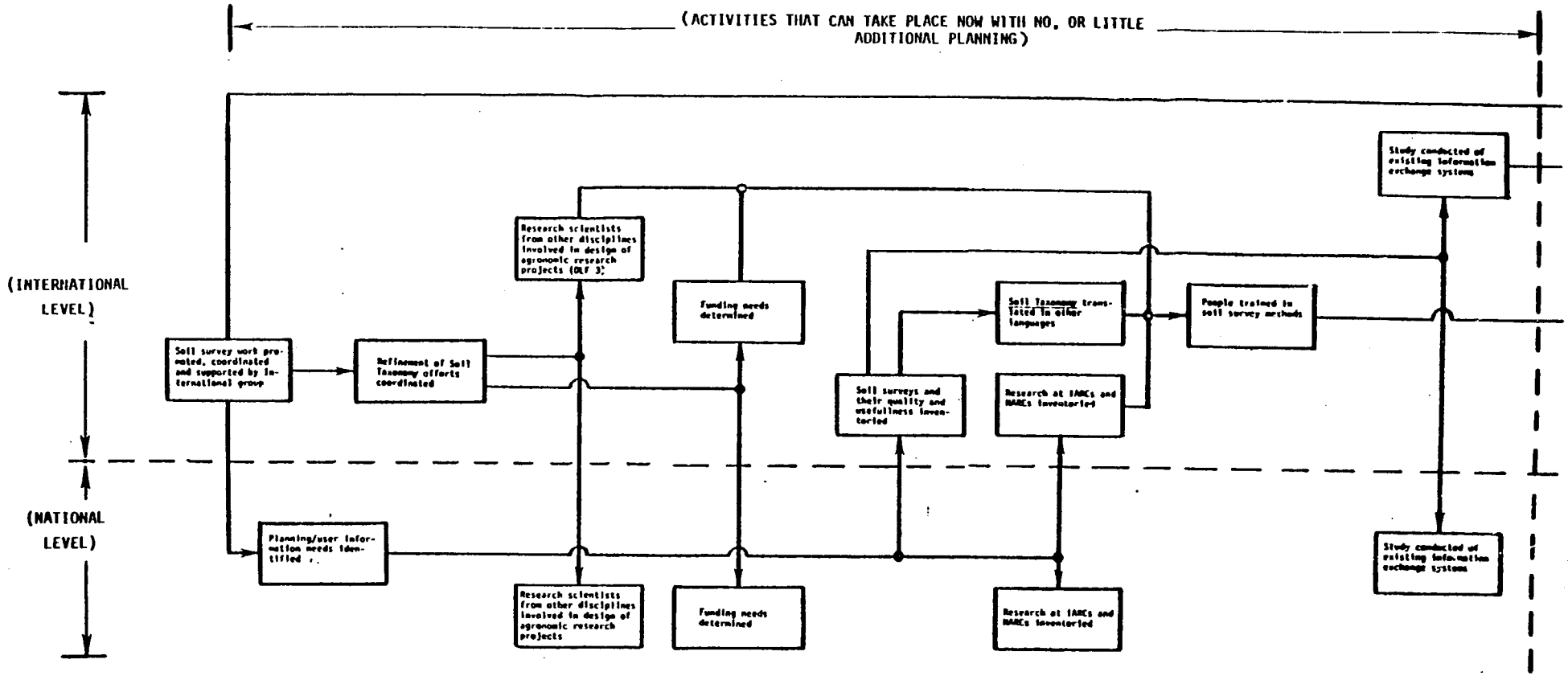

Figure A-9

FLOWCHART

LEGEND

Boxes ▭ : Represent major activities to be undertaken

Arrows ⟶ : Show direction of relationships

Triangles ▷ : Serve as connectors from different pages

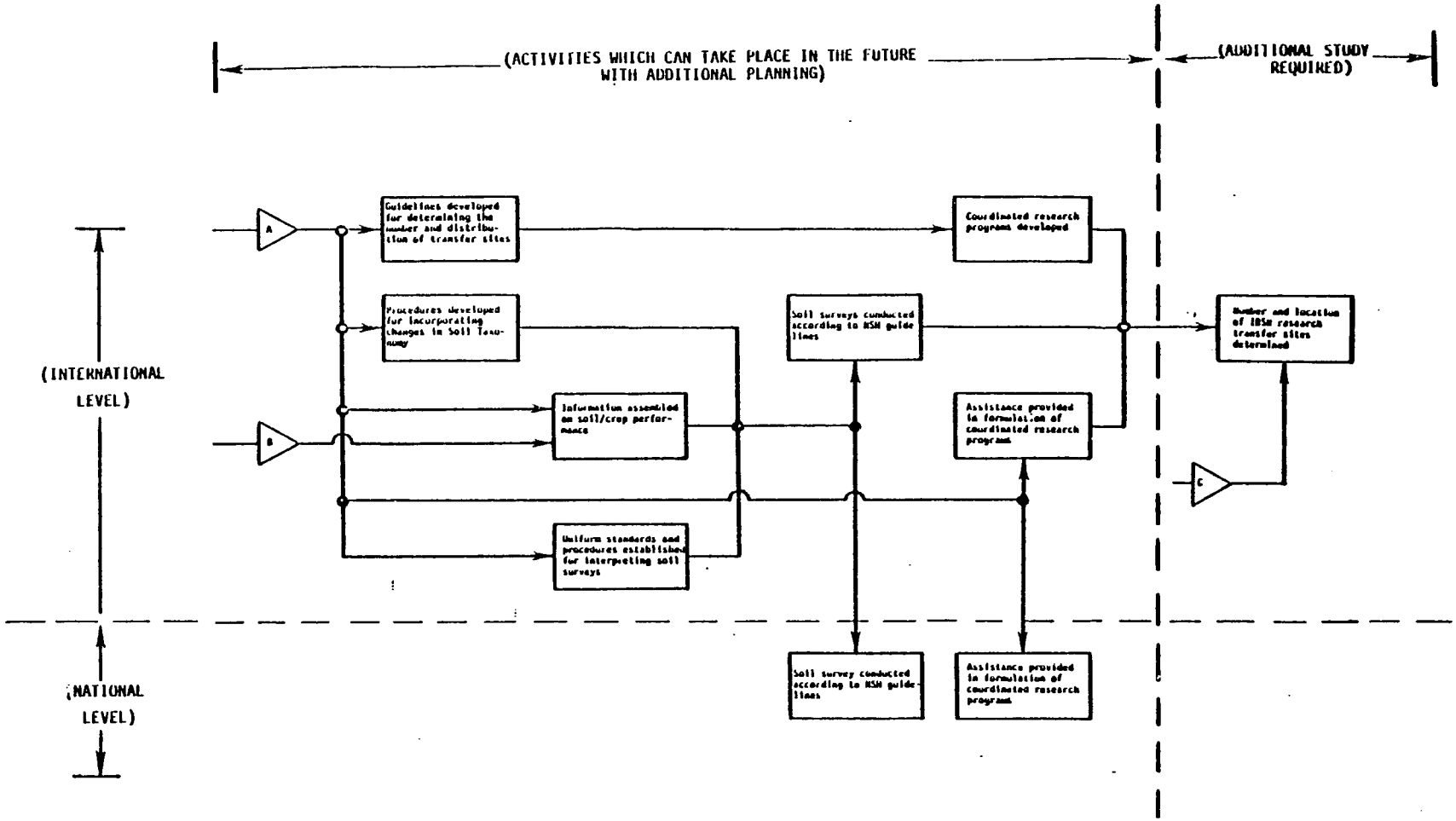

Figure A-9 (cont.)

LEGEND

Boxes ▭ : Represent major activities to be undertaken

Arrows → : Show direction of relationships

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