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# **PROGRESS REPORT**

## **SOIL MANAGEMENT SUPPORT SERVICES**

**October 1, 1979 - September 30, 1982**

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A program of the Agency for International Development, implemented by the United States Department of Agriculture. The Soil Conservation Service, supported by the Office of International Cooperation and Development, provides international technical assistance in soil survey, classification, interpretation, and use and management of soils in the intertropical countries.

# SOIL MANAGEMENT SUPPORT SERVICES

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**Dr. Guy D. Smith (1907-1981)**

**This report is dedicated to Dr. Guy D. Smith, the father of *Soil Taxonomy*. He, more than anyone else, saw the need for a common language among soil scientists and worked not only to develop it but also to teach and assist everyone throughout the world to use it. SMSS owes much of its success to date to the privilege of his advice and guidance.**

# ACKNOWLEDGEMENTS

The achievements of SMSS to date have been due to the excellent cooperation of several organizations and individuals. The technical consultation component could not have been so efficiently run and responses to requests not so quickly met if not for the contributions and assistance of both the USAID country missions and the staff of the Soil Conservation Service, particularly the Office of International Activities. A significant contribution has been made by Dr. Steve Holzhey and his staff of the National Soil Survey Laboratory, Lincoln, Nebraska. Their prompt action on requests received for soil analyses enabled SMSS to respond quickly and provide quality data.

SMSS is also indebted to our international cooperators, particularly the chairmen of all international committees. The time and effort they have expended for SMSS is greatly appreciated. A special mention must be made of all the cooperating institutions, particularly Cornell University, the Benchmark Soils Project of the Universities of Hawaii and Puerto Rico, University of Ghent, Belgium, and the International Crop Research Institute for the Semiarid Tropics (ICRISAT) India. The individuals from these institutions who deserve mention are Professor A. Var, Wambeke, Professor Goro Uehara, Professor F.H. Beinroth, Professor R. Tavernier, and Dr. L.D. Swindale.

An important cog in the wheel of SMSS operations has been the staff of the Worldwide Programs of OICD, particularly John Hyslop, Bob Wack and, previously, Greg Garbinsky. These persons and their staff ensured the smooth operations of SMSS.

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# SUMMARY

## Background

To accelerate the wise development in the less-developed intertropical countries of land resources for agriculture and other uses requires detailed knowledge of soils and their potentials. The people of these countries generally have neither sufficient qualified personnel nor financial resources to acquire this knowledge on their own.

However, through taking advantage of various technical assistance programs offered them since World War II, many of these countries have achieved a level of sophistication, both in personnel and in organization, which allows them not only to accept assistance in a passive way but to actively seek out and adopt innovative technologies. Another development which has changed the world agrotechnology equation has come in the area of soil classification. Until recently there was no common international soil classification system. Different countries have used numerous and different soil classification systems, thereby preventing the exchange of soil research information (usually acquired at high expense) from one country to another, even though their soils may be the same or similar. A common and universal system has been established which, though not perfected, has the potential of serving as an international language for information exchange and technology transfer between countries.

In recognition of this changed situation, Soil Management Support Services (SMSS) was initiated in September 1979 to provide a program of interactive assistance designed to aid the less developed countries in developing modern soil science capabilities which can support their agricultural development while at the same time furthering worldwide progress in agricultural technology, especially in the area of soil classification. The SMSS program has had two components—*technical consultations* provided the target countries through use of U.S. Soil Conservation Service personnel on a temporary duty basis, and *technology transfer* activities aimed at creation of international mechanisms to promote successful transfer of agricultural technology.

Technical consultations have been provided on request by USAID Missions for assistance on specific problems involving soil survey, land use, land use planning, soil conservation, and soil fertility maintenance. The technology transfer component has dealt with the

perfecting of *Soil Taxonomy* as a universal system and its application in the tropical areas.

## Accomplishments— Technical Consultations

In three years of operation, SMSS provided 974 man/days of work to 22 countries, involving 49 consultants. The kinds of services provided under the technical consultation program include the following:

1. Technical assistance to countries in problem identification and solution on matters concerning soil surveys, soil conservation, soil fertility maintenance, and land use.
2. Reviews or evaluations of proposed or ongoing projects in soil survey, soil conservation, soil management, and land use.
3. Professional expertise to AID in formulating appropriate policies and programs relating to land use and land use planning for food and fibre production in the less-developed countries.

## Accomplishments— Technology Transfer

Four primary types of technology transfer activities have been carried out:

1. International linkages among scientists and organizations. The chief accomplishment here has been in the formation of eight international committees working toward refinement of *Soil Taxonomy*. SMSS also participated in several international scientific conferences on soil classification, and established working relationships with four major international organizations: FAO (Rome), ICRISAT (India), IRRI (Philippines), and ACSAD (Syria).
2. International workshops and training courses. A major international workshop was held in Rwanda in 1981, and two additional workshops planned. Training courses were held in Fiji and in Morocco, and additional courses planned.
3. Publications. A quarterly newsletter, *Soil Taxonomy News*, was established, and four issues distributed. Also, numerous technical articles, monographs and translations have been produced.

4. Creation of a soils data bank. Through soil analyses carried out in connection with technical consultations, workshops and training courses—21 pedons comprising 1,109 samples from 22 countries—SMSS has created an invaluable store of soil data.

## Utilization and Impact

Utilization of SMSS, in terms of technical consultations requested, participation in international committees, workshops and training courses, and demand for publications, has been extensive and shows signs of accelerating. SMSS has been a very active organization, and has clearly established its visibility and prestige on the international scene and its role with AID Regional Bureaus, USAID country missions, and personnel and organizations within the less-developed countries.

The impact of SMSS has been very significant, though difficult to summarize or quantify in an overall way. The technical consultations component has resulted in a large number of specific problem identifications and solutions in the target countries. And the technology transfer activities have resulted in raising levels of professional expertise among many scientists of the less-developed countries, as well as contributing to further refinement and acceptance of *Soil Taxonomy*. An indirect effect has been enhancement of the U.S. agro-science system through involvement of SMSS personnel in international activities.

The program has shown that major U.S. soil science resources can be tapped and channeled for international assistance in a manner both efficient and beneficial for all concerned. SMSS has established linkages and opened channels of communication which provide a firm basis for continued worldwide progress in soil science and in agricultural productivity.



Improving the productivity of the small farmer, such as these in Sudan, is the ultimate objective of SMSS.

# INTRODUCTION

## Background of SMSS

Food and fiber production in the less developed countries is still hampered by lack of funds and by lack of qualified people to plan and carry out modern agricultural programs. However, many of these countries have made real progress since World War II, largely through taking advantage of various technical assistance programs, and some have become agriculturally self-reliant. Worldwide, the level of improvement seen testifies to the effectiveness of foreign aid and the national developmental programs of the various countries.

In the last two decades, there has been a marked change in the kind of assistance sought by many less developed countries. An increased level of sophistication among their scientific and technical people, along with creation of appropriate organizational infrastructures, has enabled them not only to accept assistance in a passive way but to seek out and adopt innovative technologies. In other words, the spoon-feeding of the years immediately following WWII is being replaced by *interactive assistance*, as the less developed countries become more able to play participatory roles in world scientific and technological advancement.

It was in such a context of change in technical assistance programs that SMSS was established in September of 1979, with funding through October, 1982. A program of the Agency for International Development (AID) for technical assistance in soil classification, soil surveying, and use and management of soils, SMSS is implemented by the Soil Conservation Service (SCS) of the U.S. Department of Agriculture with the support of the Office of International Cooperation and Development (OICD). As the name indicates, SMSS is a program to serve or assist and not to develop, research, or implement. SMSS focuses on the soil as the basic natural resource of agriculture, and of course on its wise use and conservation, and on the soil scientists of the less developed countries as keys to successful transfer of agricultural technologies.

This report outlines the activities of SMSS in its initial phase, September, 1979 through October, 1982. These activities have on the whole been remarkably successful, as will be shown, and the project has re-

cently been extended by AID for another five years, through September, 1987.

## Statement of Objective and Methods

The ultimate goal of SMSS is increased food production in the developing nations of the tropics and sub-tropics. The intermediate specific objective of SMSS, through which this goal is to be achieved, is the development of modern soil science capabilities among these countries. They will then be able to exercise improved land resource management, including soil conservation and soil fertility practices, and to adopt successful agricultural technologies suited to their native soils.

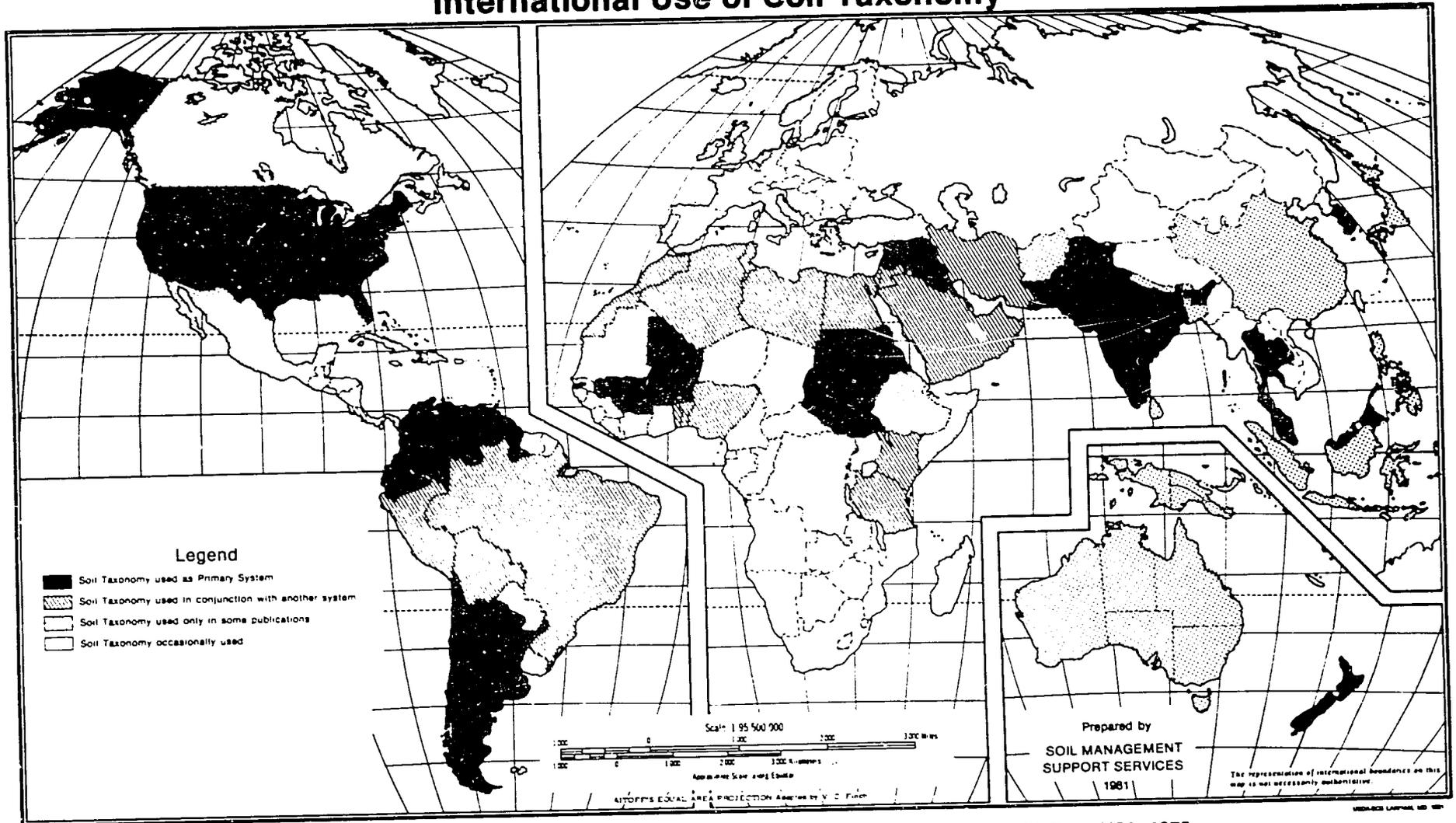
The methods by which this objective is to be achieved fall generally into one of two categories: (1) assistance in the form of technical consultation in response to specific requests from target countries; and (2) creation of international mechanisms to promote successful transfer of agricultural technologies. These categories are related, and overlap to some extent, but are usefully distinguished, and will be referred to in the rest of this report as *technical consultation* and *technology transfer* activities.

The basic element which is common to both these categories of activity, as will be explained below, is the use of the U.S. system of soils classification, embodied in *Soil Taxonomy*, as the fundamental tool of modern soil science. SMSS *technical consultation* activities involve primarily the dispatch of U.S. Soil Conservation Service scientists on temporary duty to countries requesting assistance relating to soils, with requests channeled through AID country missions. *Technology transfer* activities include, primarily, establishment of international linkages and international soil science committees working toward refinement of *Soil Taxonomy*; conducting of international workshops and training courses; sponsorship and distribution of publications, including the international newsletter, *Soil Taxonomy News*; and creation of a data bank on tropical and sub-tropical soils.

## Basis of SMSS in Soil Taxonomy

Every country in the world has some kind of soil resource inventory. However, the scales, the methodologies, quality control, and ultimately, the utility of

# International Use of Soil Taxonomy <sup>1/</sup>



<sup>1/</sup>Soil Taxonomy: A system of soil classification for making and interpreting soil surveys. U.S.D.A., USA, 1975.

these resource inventories show considerable variation. In the period following World War II and up to the early 1970's, many soil surveys in less developed countries were undertaken under bilateral arrangements with donor countries or international organizations, or, when funds were available, by private companies. A study carried out by Cornell University in 1978 under the AID grant program clearly showed that there was much room for improvement in the quality of these surveys.

During this same time span, there was being developed in the United States a new and comprehensive system for soil classification, published in 1975 as *Soil Taxonomy: A System of Soil Classification for Making and Interpreting Soil Surveys*. Developed chiefly within the Soil Conservation Service of the U.S. Department of Agriculture and under the leadership of Dr. Guy D. Smith, *Soil Taxonomy* represented more than 100 man years of scientific effort with contributions from scientists all over the world.

In 1974 and 1975 the Universities of Hawaii and Puerto Rico implemented an AID project—titled the Benchmark Soils Project—to test in the intertropical areas the concept of the soil family as defined in *Soil Taxonomy* as the crucial indicator of soil properties on which the success or failure of alternative agricultural technologies depend. The results of the Benchmark project support the concept and have lent additional impetus to the worldwide movement toward adoption of *Soil Taxonomy* as the international standard for soil classification.

Soil Management Support Services is, thus, a natural outcome of the confluence of continuing AID efforts to aid in the agricultural development of the intertropical countries and the rise of *Soil Taxonomy* as the essential soil science tool which will enable the developing countries to participate in international agricultural tech-

nology transfer. *Soil Taxonomy* is the basis for the work of the SCS technical consultants, whatever the specific project they are requested to work on; and teaching the U.S. soil classification system is the primary aim of the various international linkages set up to promote agro-technology transfer.

There are, however, two significant complicating factors in this program. First, although *Soil Taxonomy* has been tested and proven useful worldwide, its system has not yet been fully refined and perfected for application to tropical and sub-tropical soils. Therefore, as part of the *interactive* aspect of SMSS, the program involves not only giving but also receiving information in a continuing effort to refine *Soil Taxonomy*.

Second, for a country to apply the system efficiently for purposes of agricultural development, all related activities of soil resource inventory and evaluation must be exercised at a similar and corresponding level of precision. Therefore, SMSS projects involve not only teaching of *Soil Taxonomy* but also promotion of all related land resource inventory and management techniques, and especially soil surveys.

## Advisory Panel

An Advisory Panel composed of international experts and representatives of international and national organizations was constituted in January, 1980. The panel was chaired by Professor A. Van Wambeke of Cornell University and operated mainly through correspondence.

In December, 1980, an Advisory Panel meeting was held at the SCS office in Washington, D.C. Observers invited to this meeting included Dr. Guy D. Smith, Dr. F.H. Beinroth and staff members of SCS and AID. Minutes of this meeting are given in Appendix I.



SMSS Advisory Panel Meeting

# TECHNICAL CONSULTATIONS

Responding to specific requests for technical consultation has been a very significant part of the SMSS program, not only in providing an avenue for direct assistance in solving particular problems and furthering specific projects, but also in providing opportunities for disseminating understanding of the application of *Soil Taxonomy* and for its refinement with regard to tropical and sub-tropical soils.

Requests for both information and consultant services were received and responded to. Requests for consultant services originated in the less developed countries and were channeled through AID country missions or regional bureaus. In addition, SMSS has also served AID Washington.

## Requests Received

Table 1 lists the countries which have requested assistance, the number of man-days of work, and the number of consultants involved in the temporary duties (TDY's). During the three-year period, more than 30 requests were received, and a total of 974 man-days involving 49 consultants were provided. During the early part of the program, many of the consultations

Table 1. Number of consultants and man/days of work provided under the technical consultations program of SMSS.

Country	Man Days	No. of Consultants
1. Belize	6	1
2. Bolivia	17	1
3. Costa Rica	23	2
4. Djibouti	56	3
5. Ecuador	110	5
6. India	80	2
7. Indonesia	55	3
8. Jordan	24	1
9. Lesotho	30	1
10. Liberia	15	1
11. Mali	25	1
12. Panama	4	1
13. Peru	90	3
14. Philippines	30	1
15. Rwanda	40	2
16. Samoa	7	1
17. Senegal	144	7
18. Sudan	49	3
19. Suriname	7	1
20. Syria	62	4
21. Tanzania	7	1
22. Thailand	93	4
	974	49

were for assistance in soil conservation, while during the latter half there were increasing requests for activities related to *Soil Taxonomy*. This change may be partly due to the increased awareness of the possible uses of *Soil Taxonomy* resulting from distribution of *Soil Taxonomy News* and technical monographs, and the travels of SMSS staff. The SMSS efforts are directed to a balanced program, however, and USAID missions were encouraged to and did request assistance in almost all aspects of soil survey, conservation, use and management of soils.

Table 2 gives a list of countries which have requested technical information. These were provided directly by the program leader or the soil chemist. Most of the requests were for publications, while others involved answering specific questions related to *Soil Taxonomy*, soil survey and soil management. Table 2 does not list the letters received from individual scientists in the less developed countries. These were innumerable and relate to specific problems. Many of these letters were referred to the soils staff of SCS for action. Temporary duty personnel often, and at their own initiative, followed up on the requests from contacts they had established in the countries. These involved field and laboratory techniques, response to specific requests and publications. Correspondence related to these requests is on file with SMSS.

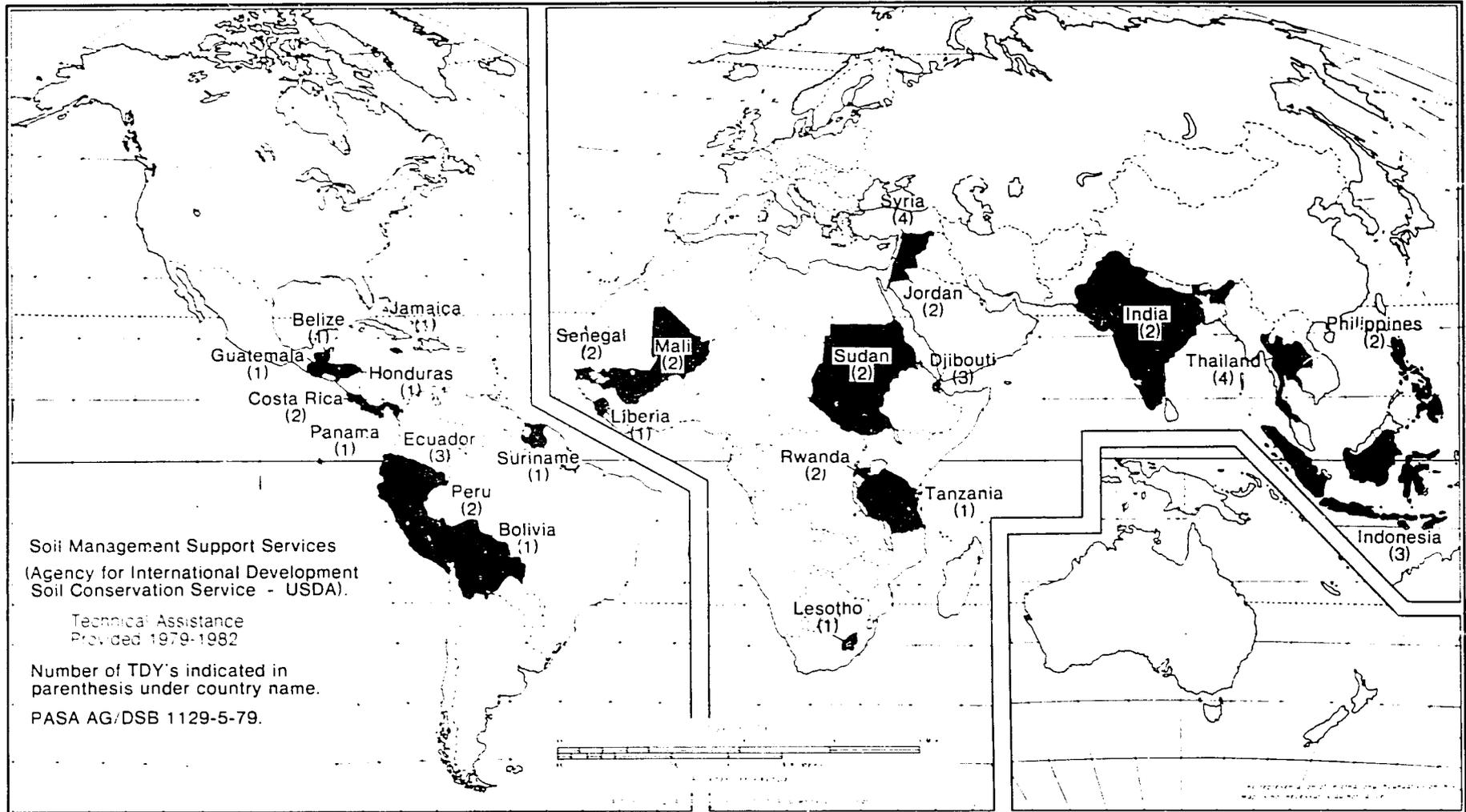
Table 2. List of countries which have requested technical information from SMSS through missions.

Mission	Country
1. USAID/Maseru	Lesotho
2. USAID/Kigali	Rwanda
3. USAID/Dar Es Salaam	Tanzania
4. USAID/San Salvador	El Salvador
5. USAID/Guatemala	Guatemala
6. REDSO/EA	Burundi
7. USAID/Tunis	Tunisia
8. USAID/Damascus	Syria
9. USAID/Rabat	Morocco
10. USAID/Suva	Fiji
11. USAID/Amman	Jordan
12. USAID/Djibouti	Djibouti
13. USAID/Jakarta	Indonesia

## Selected Technical Consultation Reports

During the three-year period, more than thirty requests were received and responded to. Appendix II

## Technical Consultation Activities of SMSS



Prepared by Soil Management Support Services October 1982

lists requests received and dates. Many of the reports of these consultations are summarized in the SMSS annual reports 1980 and 1981; detailed reports of all consultations are in the files of SMSS.

## 1. PERU

**Mission:** March 29 to April 27, 1980; 30 days.

**Purpose:** To assist Peruvian personnel to obtain information and develop written analyses on various aspects of soil conservation for use in the preparation of a project paper to be the basis for application to USAID for a grant.

**Cooperating Institutions:** USAID Mission in Lima and Peruvian Ministry of Agriculture and Food and General Directorate of Soil and Water.

**Consultants:** Ray T. Margo, Jr., SCS, New Mexico (Team Leader); Clayton Ogg, ERS, Washington, D.C.; Eugene S. Pope, SCS, Lincoln, Nebraska.

**Accomplishments:** Application approved; pilot project launched in Cajamarca area.

## 2. SENEGAL

a. **Mission:** May 18 to June 10, 1980; 24 days.

**Purpose:** To assist the Government of Senegal and USAID/Senegal in a soil survey for Phase I of the Senegal Fuelwood Production Project in the Bandia Forest. The primary goal was to identify and locate soils most suitable for the growth of various species of trees for the production of charcoal.

**Cooperating Institutions:** USAID/Senegal and Senegal Ministry of Water and Forests.

**Consultant:** James H. Brown, Assistant State Soil Scientist, SCS, Alabama.

**Accomplishments:** Development of a general soil map at scale 1:100,000; completion of approximately 500 hectares of very detailed soil survey at scale 1:5,000; soil interpretive tables; taxonomic classifications (French CPCS and USDA), and other sup-



David Gibson, Forester, Senegal, and James Brown, Soil Scientist, SCS, Alabama, examine soils suitable for fuelwood plantation in Senegal.

portive information. In addition, information was compiled for development of a base map and general soil map, both at scale 1:15,000.

b. **Mission:** October 25 to November 20, 1980; 27 days.

**Purpose:** Continuation of a soil survey for Phase I of the Senegal Fuelwood Production Project.

**Cooperating Institutions:** USAID/Senegal and Senegal Ministry of Water and Forests.

**Consultants:** James H. Brown, Assistant State Soil Scientist, SCS, Alabama; Donald McDaniel, Soil Scientist, SCS, Louisiana; and Lawson D. Spivey, Soil Scientist, SCS, Alabama.

**Accomplishments:** Approximately 2,800 hectares of the project area were mapped in detail. Pedons from three soil map units were sampled and forwarded to the U.S. National Soil Survey Laboratory for characterization data. Woodland productivity ratings and other related interpretive tables were developed, and revisions in past work accomplishments were made.

c. **Mission:** November 8 to November 20, 1981; 13 days.

**Purpose:** To provide additional soil survey interpretations by locating and identifying suitable areas for Phase I of the Fuelwood Production Project and to provide guidance for additional soil survey in other available areas of Senegal.

**Cooperating Institutions:** USAID/Senegal and Senegal Ministry of Water and Forests.

**Consultant:** James H. Brown, Assistant State Soil Scientist, SCS, Alabama.

**Accomplishments:** Field evaluations were completed of areas remaining in the Bandia and Thies Forests that may be feasible for fuelwood production. Areas were selected based on the soil survey for site preparation of fuelwood plantings. In addition, examination of available black and white and color-infrared photography for future surveys were conducted.

A presentation was made to USAID/Senegal personnel concerning the Universal Soil Data Base and Map Display System, and its availability and applicability for the Fuelwood Production Project and other projects in Senegal.

## 3. PHILIPPINES

**Mission:** May 22 to June 23, 1980; 30 days.

**Consultant:** Richard W. Arnold, Director, Soils, SCS, Washington, D.C.

**Purpose:** To assist in evaluating the soil classification program in the Philippines.

**Cooperating Agencies:** AID/Manila, PCAR, University of the Philippines-Las Banas, Philippines Bureau of Soils.

**Accomplishments:** The efforts of the Bureau of Soils, University of the Philippines-Las Banas, PCAR and other agencies were reviewed and several field visits made. Recommendations for activities to strengthen the national commitment were made, including training, research initiatives, and refinement of procedures. The concepts were presented to AID/Manila, PCAR, University of the Philippines-Las Banas, and the Bureau of Soils.

#### 4. RWANDA

**Mission:** May 31 to June 18, 1980; 19 days.

**Purpose:** Test *Soil Taxonomy* in the field as a reference system for the 1:100,000 scale map of Rwanda.

**Cooperating Institutions:** USAID/Rwanda; Institut des Sciences Agronomiques du Rwanda (ISAR); Faculte d'Agronomie, Butare.

**Consultant:** A. Van Wambeke, New York State



Mr. Venant Rutanca, Soil Scientist of ISAR, Rwanda, examines deformation of a quartz vein during the visit of Dr. A. Van Wambeke. Understanding the evolution of the landscape is critical to good mapping.

College of Agriculture and Life Sciences, Cornell University, Ithaca, NY.

**Accomplishments:** Scientists in charge of the Rwandese systematic soil survey were considering several alternatives for the preparation of the legend of the map. Previously, the INEAC system developed in Zaire twenty years ago was used. In order to broaden the scope of the national pedological classification, the USDA *Soil Taxonomy* and the FAO system were being considered for testing.

Twenty-eight profiles in different regions of Rwanda were examined and discussed with local soil scientists. A seminar was given at the Agriculture Faculty of Butare. Results indicated that the nomenclature of the U.S. system is informative of soil qualities that are important for plant growth and crop production. The Rwandese scientists and agronomists were very much impressed by the technology transfer potential of the U.S. system to attract innovative soil management practices to Rwanda. As a result, an International Soil Classification workshop was held in Rwanda in June, 1981.

#### 5. SUDAN

a. **Mission:** October 2 to 16, 1980; 15 days.

**Purpose:** To assess the needs of the Soil Survey Administration of Sudan (SSAS) and to make recommendations to develop and strengthen it; and to plan for an International Soil Classification Workshop in 1982.

**Cooperating Institutions:** Soil Survey Administration of Sudan, and State Ministry of Agriculture.

**Consultants:** H. Eswaran, Program Leader, SMSS-USDA/SCS, Washington, D.C. and J. Kimble, Soil Chemist, SMSS and USDA/SCS, Lincoln, Nebraska.

**Accomplishments:** The SSAS, responsible for the soil resource evaluation program for the nation, was found unable to perform efficiently due to a lack of equipment. A proposal for a 5-year project for USAID/Khartoum was developed to supply equipment needed along with a training component to strengthen the operation of the SSAS. Initial plans were also made for the 5th International Soil Classification Workshop to be held in Sudan in the fall of 1982, dealing with soils with high shrink/swell potential.

b. **Mission:** January 19 to February 8, 1981; 21 days.

**Purpose:** To sample Aridisols, Vertisols, and Alfisols for laboratory characterization in support of the Soil Survey Administration of

Sudan and in preparation for the 5th International Soil Classification Workshop to be held in Sudan in November, 1982.

**Cooperating Institutions:** USAID/Sudan, Soil Survey Administration of Sudan, International Soil Museum, Wageningen, the Netherlands.

**Consultant:** Wiley D. Nettleton, Research Soil Scientist, SCS, USDA, Lincoln, Nebraska.

**Accomplishments:** Twenty pedons were sampled in Sudan during the three-week trip and eight additional pedons sampled by the Soil Survey Administration of Sudan shortly thereafter. Analysis of five pedons from the southern region of Sudan was completed during 1981 and the data sent to Dr. Mohamed Ali, Director of Soil Survey Administration of Sudan, in time for him to present at the 4th International Classification Workshop, Rwanda.

A fairly complete sequence of Vertisols was sampled in the Kassala and Southern Kordofan Provinces. Two Ustalfs were sampled; one on the sugarcane scheme at Sennar and the other on a Nubian Sandstone outcrop near Er Roseires. At Khartoum, three Natrargids and two Haplargids were sampled. These soils form a sequence with increasing salt influence, paralleled by increasing influence of the Gezira clay on the underlying Nubian SS.

## 6. SURINAME AND BELIZE

**Missions:** January 5 to January 9, 1981 (Suriname); 5 days.

January 12 to January 15, 1981 (Belize); 4 days.

**Purpose:** To assess the agricultural potential of selected sites for settlement of refugees.

**Cooperating Agencies:** U.S. Agency for International Development, U.S. Department of State, governments of Suriname and Belize.

**Consultant:** Richard H. Gilbert, Soil Scientist, SCS, Washington, D.C.

**Accomplishments:** The U.S. Department of State wished to locate tropical countries that would accept up to 1,000 Indo-Chinese refugees for resettlement. In Suriname, two potential sites were seen by the consultant (one day at each location). Both were considered adequate, but detailed surveys would have to be made before resettlement could begin. A meeting with government officials and a refugee committee composed of private citizens indicated that the plan could be arranged for resettlement.

In Belize, one site was visited by the consultant

by air. Although it was in a remote location, the 1954 soil map of the country, prepared by the Imperial College of Tropical Agriculture, Trinidad, indicated that the area was suitable for agriculture. The consultant recommended that a detailed survey be conducted before relocation was considered.

## 7. THAILAND

a. **Mission:** February 9 to March 13, 1981; 33 days.

**Purpose:** To provide assistance in soil classification, soil mapping and soil interpretations.

**Cooperating Agencies:** USAID/Bangkok and Soil Survey Division of the Department of Land Development of Thailand.

**Consultant:** Gerald Latshaw, State Soil Scientist, SCS, Portland, Oregon.

**Accomplishments:** A detailed soil survey was being started for an irrigation project (Huai Aeng) in northeast Thailand near the city of Roi Et. The major purpose of the soil survey was to provide soil resource data to the Thais' Rural Irrigation Project. The Thais had used *Soil Taxonomy* in classifying soil, but wanted additional training in soil taxonomy, designing map units, and preparing soil interpretations for engineering and other non-cropland uses. Most of the five-week assignment was spent in the field looking at the soils in the irrigation project and in six other proposed projects which will have USAID financial support. Soil classification, mapping unit design, and soil related management and design concerns were discussed at each site with selected party leaders, correlators, and supervisory soil scientists from the Soil Survey Division.

The soil survey for the irrigation project area is to be done on aerial photographs at a scale of 1:10,000. Part of the assignment was spent in Bangkok working with soil scientists on guidelines for preparing soil survey interpretations and with soil scientists and extension specialists on the use of soil families for soil interpretations.

Recommendations included the suggested format for the soil survey report to be provided for the soil survey of Huai Aeng Irrigation Project. It was also recommended that the Thais propose a number of new subgroups in *Soil Taxonomy* to accommodate recognized soil series in the country. For example, additional subgroups are needed for the great groups Paleustults, Plinth-

quults, Plinthustults, Tropaqualfs, and Tropaquepts.

b. **Mission:** February 6 to February 21, 1982; 14 days.

**Purpose:** To assist in sampling 19 sites in support of the Department of Land Development, Thailand, and to be used in the 1983 Soil Interpretation Workshop.

**Cooperating Agencies:** Department of Land Development, Thailand, USAID, NSSL-SCS, Lincoln, Nebraska.

**Consultant:** M.J. Mausbach, Research Soil Scientist, National Soil Survey Laboratory, Midwest National Technical Center, USDA-SCS, Lincoln, Nebraska.

**Accomplishments:** Consultation provided technical assistance in sampling and characterization of soils to be used in the Soil Interpretation Seminar for Southeast Asia in 1983.

## 8. BOLIVIA

**Mission:** February 12 to March 10, 1981; 27 days total, including pre- and post-trip briefing with USAID and embassy staff in Washington, D.C. (21 days in Bolivia).

**Purpose:** Evaluate soil erosion and potential

erosion on the Chaco land clearing project in Southeastern Bolivia.

**Cooperating Agencies:** USAID/Bolivia, Land Tenure Center of University of Wisconsin, Bolivian Institute of Agricultural Technology (IBTA), Agricultural Bank of Bolivia (BAB), Committee of the Public Works and Development of Tarija (CODETAR), and Chemonics International Consultants.

**Consultant:** Van K. Haderlie, State Conservationist, Soil Conservation Service, Bozeman, Montana.

**Accomplishments:** In the late 1970's, with the support of USAID, a land clearing project was begun in the southern Bolivian province of Tarija, designed as an assistance program to help small farmers clear their land and put it under cultivation. Surface texture of soils in the project area is mainly loam, sandy loam, and loamy sand; slopes range up to 8 percent; and annual precipitation in parts of the project exceeds 100 centimeters. Under these conditions, there was concern for the accelerated erosion that could and does occur, not only through rainfall but by wind erosion as larger blocks of land are cleared. Recommendations were made regarding the land clearing and farming operations to minimize



Heavy rainstorms coupled with a lack of conservation practices contribute to severe erosion problems near Yacuiba, Bolivia. Ten centimeters of rain fell in one and one-half hours on this soybean field. The water flowed down the tractor and implement tracks, until it collected in drainage ways and began forming gullies. This is the way much of the rill and gully erosion begins. Contour farming, terracing, and crop residue management would reduce or eliminate much of this erosion.



USAID and Bolivian personnel measure the width of a developing gully as a third employee watches. Recent storms washed new seedlings from an otherwise good stand of soybeans (background), starting a gully. Storms will continue to enlarge this gully unless corrective conservation action is taken.

erosion. These included operating techniques, equipment changes or alternatives, farming systems, alternative crops and residue management, and structural measures for controlling erosion.

## 9. ECUADOR

a. **Mission:** January 19 to February 27, 1981; 6 weeks.

**Purpose:** Evaluate national soil survey and provide technical assistance in the use of soil surveys for conservation planning.

**Cooperating Agencies:** USAID/Ecuador and National Agrarian Regionalization Program (PRONAREG).

**Consultant:** Lewis A. Daniels, Soil Scientists, SCS, Montana.

**Accomplishments:** PRONAREG soil scientists have prepared soil maps for over 75% of the country at scales varying from 1:50,000 to 1:200,000. These soil surveys are adequate for general land use and conservation planning, but interpretation of soil surveys is minimal and lacks coordination and direction; there is no program of soil correlation; and there is no organized system of training. A serious erosion problem exists in the Sierra. The creation of a National Soil Conservation Program has been authorized

by the Minister of Agriculture. A national seminar on the use of soil surveys for planning soil use, management and conservation was planned and held during the consultation. Recommendations made as a result of the consultation were establishment of a comprehensive, country-wide system under PRONAREG of soil classification, correlation and interpretation; a comprehensive training program; plant materials centers to develop plants for soil conservation; conservation practices for problem soils; a multidisciplinary approach to solving land use problems; and a natural resource data bank.

b. **Mission:** February 26 to March 13, 1982; 16 days.

**Purpose:** To evaluate INIAP's soil conservation program; to train Ecuadorian technicians in the application of soil and water conservation practices; to advise farmers on soil conservation methods.

**Cooperating Agencies:** USAID/Ecuador, Ministry of Agriculture (MinAgric), INIAP-Instituto Nacional De Investigaciones Agropecuarias.

**Consultant:** John L. Caviness, District Conservationist, SCS, North Carolina.

**Accomplishments:** INIAP, through its soils

department is addressing the complex erosion problem in Ecuador. This mission involved the training of 26 Ecuadorian technicians in the planning, survey, design, and construction of conservation measures. Two days were spent giving lectures on soil and water conservation measures. The balance of the trip was spent in the field planning conservation measures, surveying and designing these measures and installing them. The work was performed on both small farms (campesinos) and large farms (haciendas).

10. **INDONESIA**

**Mission: May 8-28, 1981; 21 days.**

**Purpose:** To assist the Government of Indonesia in strengthening its internal capability to serve the agricultural and conservation needs of the country and to participate in a national seminar on soil and water conservation.

**Cooperating Agencies:** USAID, FAO, and Central Research Institute of Agriculture - Bogor.

**Consultants:** Gary Margheim, Environmental Coordinator, USDA/SCS, Washington, D.C., and Richard Duesterhaus, Assistant Chief, USDA/SCS, Washington, D.C.

**Accomplishments:** Visits were made to several field locations, including one to the Panawangan Pilot Demonstration Project in west and central Java and one to the Upper Solo Watershed Management and Upland Development Project in central and east Java. Consultants met with project personnel, observed project operations, field conservation measures, and agricultural conditions, and in addition, participated in the Seminar on Integrated Management of DAS (Watersheds) in Jakarta, May 26 and 27.

Review of the situation revealed that much remains to be done if an adequate level of soil and water conservation is to be achieved, including improvement in organizations, operational procedures, and communications between Jakarta headquarters and field center personnel.

The level of technology and research data for agriculture and soil and water conservation was found to be low to moderate when compared with many other countries. Recommendations made to substantially improve governmental capability to conduct a soil and water conservation program nationwide were: (1) a better definition of soil and water conservation problems, (2) assignment of additional soil and water conservation functions and goals, and (3) establishment of a decentralized delivery system.

11. **COSTA RICA, GUATEMALA, HONDURAS**

a. **Mission:** October 13 to November 19, 1981;

29 days.

**Purpose:** To verify soil classification or re-research and research validation sites to be used in technology transfer of alternative production packages in Central America and to suggest ways to identify analogous areas.

**Cooperating Agencies:** ROCAP/AID, Guatemala, and Center for Tropical Agricultural Research and Training (CATIE).

**Consultant:** Oliver W. Rice, Jr., Soil Correlator, Northeast National Technical Center, Soil Conservation Service, Broomall, Pennsylvania.

**Accomplishments:** CATIE, a regional agricultural research center, contracted with ROCAP/AID to carry out a Small Farmer Cropping Systems project, to identify and test alternative production packages suitable for use by small farmers, to identify analogous areas to which the production packages can be reasonably transferred, and to verify that the technology transfer to analogous areas can be successful. A necessary component of the analysis to accomplish this is use of soil characterization and soil classification at all stages of the work. During this consultation, expertise in soil classification was provided as follows: (1) reviewed soils data available at CATIE; (2) described, and recommended how to use it; sampled and classified soils at eight research sites; (3) consulted with SFCS project personnel on needed soil identification and characterization and how it might be accomplished in the current difficult working conditions in Central America; (4) trained project personnel in *Soil Taxonomy* and recommended reference material to them; (5) recommended suitable ways to use soil classification in identifying analogous areas in technology transfer.

b. **Mission:** October 26 to 30, 1981; 4 days.  
**Purpose:** Respond to request from ROCAP, Guatemala City, to assist CATIE, Turrialba, Costa Rica, evaluate status of soil-related research efforts in the Small Farm Systems program.

**Cooperating Agencies:** ROCAP/AID, Guatemala, and Center for Tropical Agricultural Research and Training (CATIE).

**Consultant:** Richard W. Arnold, Director, Soils, SCS, Washington, D.C.

**Accomplishments:** Discussions were held with staff members of CATIE and a short field trip made. Based on these observations, recommendations for short, intermediate and

long-range actions were presented to CATIE, ROCAP and Bureau representatives. Additional field sampling, expanded correlations, training, and staffing changes were among the suggestions.

12. **MALI**

**Mission:** October 22 to November 13, 1981; 21 days.

**Purpose:** Field review of Mali Land Use Inventory project—especially soils portion.

**Cooperating Agencies:** USAID/Mali, and TAMS/Bamako.

**Consultant:** Hubert J. Byrd, State Soil Scientist, SCS, Raleigh, North Carolina.

**Accomplishments:** TAMS is conducting a land resources inventory of Mali including both soils and vegetation. The contract specifies the soils of Mali be fitted into *Soil Taxonomy*. In a review of this project by outside consultants, March, 1981, some eight problem areas were identified where difficulties arise in placement of Malian soils into great groups of *Soil Taxonomy*.

The consultation provided assistance to the soils team in fitting the Malian soils into *Taxonomy*, sampled nine soils for laboratory study, and made eight recommendations to the soils team on (1) argillic horizon in sandy soils, (2) plinthite, (3) indurated petroferic layer, (4) soil moisture regimes, (5) low activity clay, (6) Alfisols and Ultisols, (7) Paleustalfs and Paleustults, and (8) names of soils used on soil maps.

13. **DJIBOUTI**

**Mission:** November 15 to November 27, 1981; 13 days.

**Purpose:** Evaluation of Water Resources and Soils Project 603001.

**Cooperating Agencies:** U.S. Agency for International Development/Djibouti and Government of the Republic of Djibouti, Ministry of Agriculture.

**Consultant:** Allen Hidlebaugh, National Coordinator of Soil Survey Research, SCS, Washington, D.C.

**Accomplishments:** The Water Resources and Soil Project is designed to institutionalize within

the Ministry of Agriculture the capacity to analyze ground and surface water quality as well as to compile, catalogue, and disseminate hydrologic information; and to classify soils, prepare soil maps and provide evaluation concerning the proper utilization of soils.

During the consultation, progress to date in achieving the objectives of the project was evaluated. Manuscript (unpublished) soil maps, slope maps, watershed maps, soil climate maps, and associated legends and descriptions were reviewed.

Three days were spent in the countryside inspecting present garden sites and areas with potential for agricultural development that have been identified. Various facets of the different types of soil surveys being used were examined during these field trips. These included examination of maps, soil descriptions, classification of taxonomic units, discussion of geology, and composition of mapping units. Time was also spent in the laboratory examining supplies and equipment.

Recommendations to assure successful completion of the project were discussed with E.M. Amundson, AID Affairs Officer, the contractor's representative, and the Djiboutian staff members.

14. **INDONESIA AND PHILIPPINES**

**Mission:** February 21 to March 7, 1982; 14 days.

**Purpose:** To assist Benchmark Soils Staff in sampling soils at their research sites.

**Cooperating Agencies:** Benchmark Soils Staff—University of Hawaii; Center for Soil Research, Bogor, Indonesia; Bureau of Soils, Philippines; USAID; and NSSL-SCS, Lincoln, Nebraska.

**Consultant:** M.J. Mausbach, Research Soil Scientist, National Soil Survey Laboratory, Midwest National Technical Center, USDA-SCS, Lincoln, Nebraska.

**Accomplishments:** Provided technical assistance to the Benchmark Soils Staff in sampling and characterization of soils at their experimental sites in Indonesia and the Philippines.

# TECHNOLOGY TRANSFER ACTIVITIES

The general strategy of SMSS is to focus, not on the small farmer as has been done in the past, but on the soil scientists of the less developed countries. Properly trained, and linked to international sources of current information on soil science and agricultural technology, these scientists will become able to recommend and oversee adoption of suitable technologies, and will help their countries avoid the costly mistakes which have been common in agricultural development in the past.

In support of the goal of optimal technology transfer, SMSS has carried on four primary types of activities, which will be discussed separately in this section:

(1) Establishment of international linkages among scientists and organizations, especially including formation of international committees working toward refinement of *Soil Taxonomy*.

(2) Conducting international workshops and training courses for educating personnel of the less developed countries in modern methods of soil survey and evaluation, including application of *Soil Taxonomy*.

(3) Sponsorship and distribution of publications, including notably the newsletter, *Soil Taxonomy News*.

(4) Creation of a data bank on tropical and subtropical soils, through soil analyses carried out incidentally to other activities, including technical consultations and the international workshops and training courses.

## International Linkages

The desire to improve the classification of soils in the intertropical regions has been an important driving force in this project, along with soil survey procedures and soil management practices. It is acknowledged in *Soil Taxonomy* that the classification of soils in the intertropical areas has lagged behind due to lack of data and studies at the time of development of the system. SMSS, in cooperation with the SCS staff on soil classification, has approached the problem in several ways. An important consideration in these efforts has been full participation of and communication among soil scientists in many countries and especially through international committees. It has also been found highly desirable to secure cooperation from and communication among a large number of national and international organizations.

## International Committees

Eight international committees (ICOM) were formed in the period 1979-82. An ICOM is developed when there are strong recommendations from leading soil scientists for a re-appraisal of the classification of a given group of soils. The Soil Conservation Service evaluates these recommendations, and after consultations, develops a charge for the committee and appoints a chairman. The international community is informed through scientific magazines and, recently through the newsletter of SMSS. Everyone interested is invited to contribute and discussions are held through correspondence, personal contacts and at international gatherings.

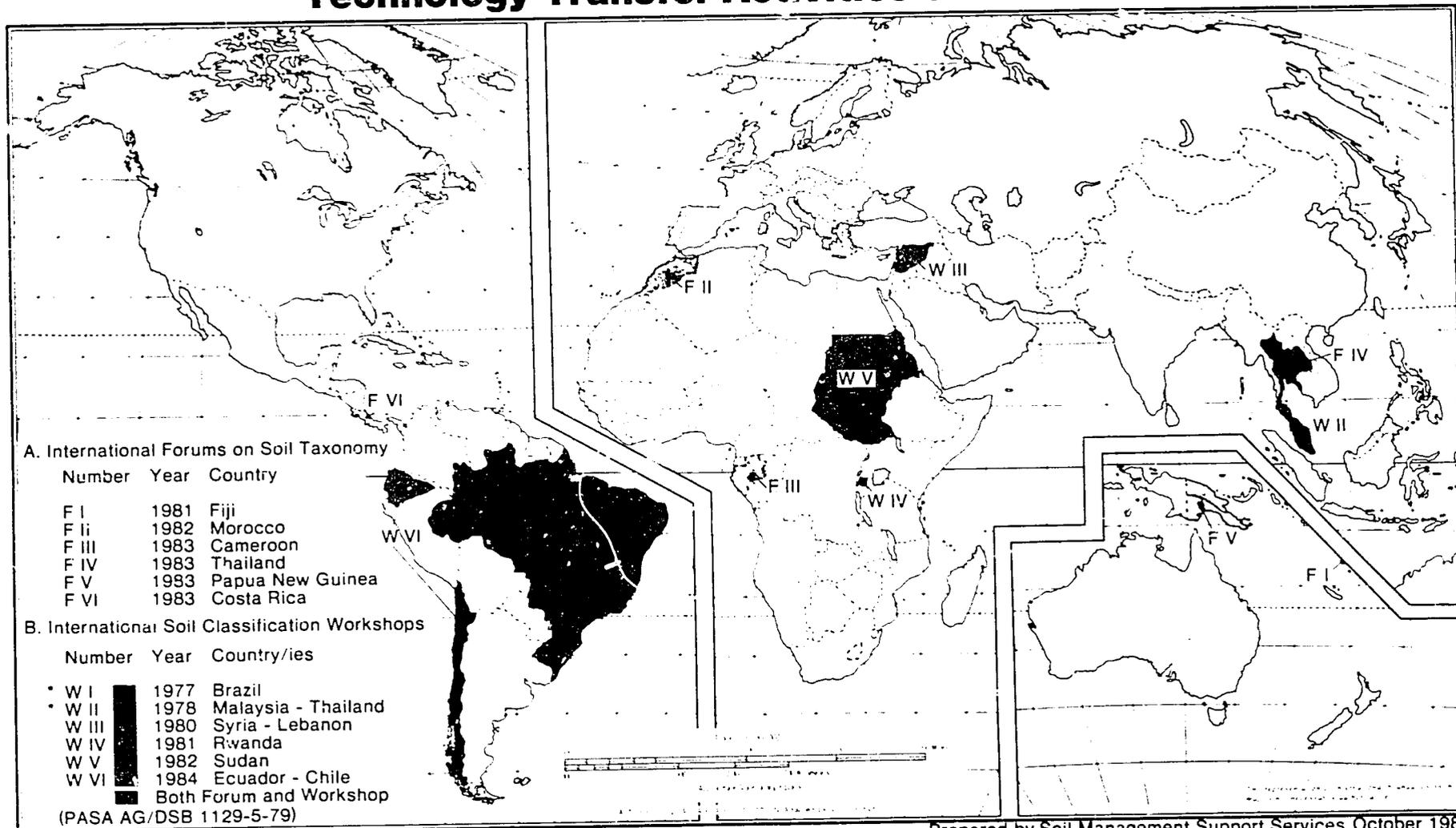
The eight international committees are:

- The International Committee on Classification of Soils with Low Activity Clays (ICOMLAC). Chairman: Dr. Frank Moorman (Netherlands)
- International Committee on Oxisols (ICOMOX). Chairman: Dr. Stanley Buol (North Carolina)
- International Committee on Soil Moisture Regimes in the Tropics (ICOMMORT). Chairman: Dr. Armand Van Wambeke (New York)
- International Committee on Andisols (ICOMAND). Chairman: Dr. Michael Leamy (New Zealand)
- International Committee on Vertisols (ICOMERT). Chairman: Dr. Juan Comerma (Venezuela)
- International Committee on Aquic Soils (ICOMAQ). Chairman: Dr. Frank Moormann (Netherlands)
- International Committee on Spodosols (ICOMOD). Chairman: Dr. Ted Miller (Pennsylvania)
- International Committee on Aridisols (ICOMID). Chairman: Dr. Ahmad Osman (Syria)

Summary reports of the work of the ICOMs are published in the newsletter of SMSS. At the end of 1982, two ICOMs were near completion of their assignment. ICOMLAC has submitted a proposal for testing and ICOMOX is expected to submit its proposal in 1984.

The proposals are submitted through SMSS to SCS. The National Leader for *Soil Taxonomy* arranges for the evaluation of the proposal primarily from the point of view of its impact on other parts of *Soil Taxonomy*. For this purpose, the whole of *Soil Taxonomy* is now on

# Technology Transfer Activities of SMSS



\*Organized by the University of Puerto Rico

Prepared by Soil Management Support Services October 1982

the computer, which is programmed to indicate all the changes which follow when an amendment is made. After this stage, the proposal plus the recommended changes are distributed to the national soil classification staff, participants of the National Cooperative Soil Survey, and to international collaborators. If, after a year, there are no serious objections, the approved amendment is published in the *National Soil Taxonomy Handbook* and also reported in *Soil Taxonomy News*. Guidelines for receiving and approving amendments have been established by SCS.

More than 100 international soil scientists are very actively involved in the work of the ICOMS. In order to develop certain criteria, chairmen of the committees frequently seek the assistance of non-soil classificationists such as chemists, physicists, mineralogists and climatologists. This interdisciplinary approach has been very fruitful.

## Summary of ICOM Activities

1. International Committee on Soils with Low Activity Clays (ICOMLAC).

Chairman: Dr. F.R. Moormann, (Netherlands)

ICOMLAC tested a formal proposal at the Rwanda workshop in June, 1981, and the chairman indicated that there were details to be worked out before the proposal could be submitted to SCS. More than 30 scientists of international reputation have worked for nearly 8 years to develop proposals. The chairman has sent out 13 circulars communicating developments. As ideas evolved, there was a convergence of opinion with the sister committee—ICOMOX. Once the boundary between the mandates of ICOMAX and ICOMOX is agreed to, the latter will also be in a stage for initial testing.

2. International Committee on Oxisols (ICOMOX).

Chairman: Dr. S.W. Buol (North Carolina)

The workshop in Rwanda in June, 1981, was organized mainly at the mandate of ICOMOX. Much of the initial work of this committee has been to improve the definition of the oxic horizon and to develop a definition for the order of Oxisols so that it does not overlap with the LAC soils. Seven circulars have been sent out communicating progress in this direction.

3. International Committee on Soil Moisture Regimes (ICOMMORT).

Chairman: Dr. A. Van Wambeke (New York).

ICOMMORT is in the final stages of developing firm proposals for making subdivisions of the current soil moisture regimes in *Soil Taxonomy*.

4. International Committee on Andisols (ICOMAND).

Chairman: Dr. M.L. Leamy (New Zealand).

Through the initiative of the ICOMAND chairman, a special conference on soils with variable charge was organized by the New Zealand Soil Science Society and the International Soil Science Society (ISSS) from February 10-19, 1981, in Palmerston North, New Zealand. The conference addressed *Soil Taxonomy* and was perhaps the first ISSS conference with a focus on *Soil Taxonomy*. The organizers provided time for the discussions, not only of ICOMAND, but also ICOMOX. SMSS was also invited to present a paper on the project. In addition, one whole day was devoted to the work of the Benchmark Soils Project of the Universities of Hawaii and Puerto Rico, during which Dr. Richard Arnold presented a paper on "Internationalization of *Soil Taxonomy*."

ICOMAND and the Soil Bureau of the Department of Scientific and Industrial Research (DSIR, New Zealand), have produced a series of flow charts for easy use of *Soil Taxonomy*. Together with SMSS they will be producing a computer program based on these flow charts.

ICOMAND has developed proposals for the new order of Andisols. An initial discussion was held in Rwanda during the 4th Workshop and plans are underway to have a full workshop in 1983 or 1984.

5. International Committee on Aridisols (ICOMID).

Chairman: Dr. A. Osman, (Syria)

Formed late in the first phase of the SMSS project, this committee will develop criteria for recognizing the order of Aridisols, particularly in the Middle East. These soils have excessive accumulation of carbonates and gypsum that strongly influence their use and management. ICOMID will be generating a considerable amount of data on these soils, which is necessary for a rational classification.

6. International Committee on Vertisols (ICOMERT).

Chairman: Dr. J. Comerma (Venezuela)

Also formed late in the first phase of the SMSS project, ICOMERT will obtain information from the Vertisol areas of the world, such as the Tir Noir of Morocco, the Grumsols of eastern Europe, the Black Cotton soils of the Deccan Plateau, India, the Gezira clays of Sudan, and the shrinking soils of Australia. These data will be helpful to refine the lower categories in the classification of the Vertisols.

7. International Committee on Classification of Soils with Aquic Soil Water Regimes (ICOMAQ).

Chairman: Dr. F. Moormann (Netherlands).

ICOMAQ, another late-formed committee, will consider primarily the rice growing soils of the

world. At a later stage they will look at other soils with natural or induced perched water tables (paddy soils). The treatment of such soils in *Soil Taxonomy* has been considered unsatisfactory by many soil scientists in Europe and Asia.

8. International Committee on Spodosols (ICOMOD).

Chairman: Dr. Ted Miller (Pennsylvania).

The mandate of ICOMOD is to evaluate current Spodosols problems and criteria and to propose changes that will improve the classification of these important soils. Committee charges are:

- Evaluate chemical criteria for defining spodic horizons. Chemical criteria exclude from Spodosols many soils which are spodic by morphology. This is causing considerable difficulty in retaining the traditional Podzols in the northern United States as well as elsewhere.

- Evaluate thickness requirements. Thickness requirements (12.5 cm) where soil temperature regime is frigid or warmer result in changes in classification when soil is disturbed by cultivation, logging, or even by windthrow.

- Improve classification of Aquods. *Soil Taxonomy* does not provide for adequate separation of Aquods with appreciable amounts of aluminum from those with only traces (Aquods of the cool, humid climates vs. Aquods in the warm and hot, humid climates).

- Propose criteria that will adequately distinguish Spodosols from Andepts and the proposed Andisol order.

- Recommend changes in the classification of Spodosols and define appropriate taxa as well as the diagnostic properties required for the definition of the taxa.



SMSS staff meet with staff of National Bureau of Soil Survey (India) and International Crop Research Institute for Semi-Arid Tropics, to discuss cooperative activities.

## International Meetings

Advancement and refinement of *Soil Taxonomy* through international cooperation has also been furthered by participation in international meetings sponsored by other groups. *Soil Taxonomy* was the basis for technical communications at two international meetings convened by the International Soil Science Society. The first was the Conference on Soils with Variable Charge, cosponsored by the Soil Science Society of New Zealand in 1981, and the other was the 12th International Congress of Soil Science held in New Delhi, India, in 1982 and organized by the Indian Soil Science Society. In addition, the Fifth International Working Meeting on Soil Micromorphology (London, 1981) had a special symposium on micromorphological properties of diagnostic horizons. The Second International Symposium on Acid Sulfate Soils (Bangkok, 1981) and the Conference on Aridic Soils (Israel, 1981) also had discussion sessions on *Soil Taxonomy*.

SMSS also participated in the FAO-sponsored Fourth Meeting of the Eastern African Sub-committee for Soil Correlation and Land Evaluation, held in Tanzania in October-November, 1980. At this meeting, leaders in soil survey from various African countries discussed alternative soil classification systems; SMSS participants presented the case for *Soil Taxonomy*.

## Linkages With National and International Agencies

In the first three years of its work, SMSS has established considerable linkages with international organizations and national institutes. The personal contacts established are very useful to SMSS, as the success of many of the activities depends on the enthusiasm and goodwill of our cooperators abroad.

The relationships which have been established are being molded into cooperative efforts which are mutually beneficial. The four international organizations with



SMSS poster at 12th International Congress of Soil Science in India.

which SMSS has or will be developing joint activities are:

Food and Agriculture Organization (FAO), Rome.

International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), India.

International Rice Research Institute (IRRI), Philippines.

Arab Centre for the Studies of Aridzones and Dry Lands (ACSAD), Syria.

The national organizations with which (SMSS) has had joint activities include:

Institute Science Agronomique Rwanda (ISAR), Rwanda

National Bureau of Soil Survey and Land Use Planning, India

Land Development Department, Thailand

University of South Pacific, Fiji

Department of Agriculture, Fiji

Department of Primary Industries, Papua New Guinea

University of Ghent, Belgium

Institute National Recherche Agronomique, Morocco

Soil Survey Department, Jordan

University Pertanian, Malaysia

Soil Survey Department, Philippines

Centre for Soil Research, Indonesia



SMSS - IBSNAT Meeting at University of Hawaii. (From left to right, Dr. Goro Uehara, Dr. Fred Beinroth, Ms. Cynthia Garver, Dr. Gordon Tsuji, Mr. Dick Kover, Dr. Hari Eswaran, Dr. H. Ikawa and Dr. James Silva).

On the domestic front, SMSS has worked closely with several organizations whose support to SMSS activities has been very gratifying, among them the Benchmark Soils Project, University of Hawaii, Benchmark Soils Project, University of Puerto Rico, and the Agronomy Department, Cornell University.

In addition, SMSS also plans to develop linkage with North Carolina State University, which provides management for another USAID supported program—the Soil Management Collaborative Research Support Program.

## Workshops and Training Courses

The workshops are a series of international meetings geared to developing a fuller understanding and refinement of the U.S. system of soil classification, *Soil Taxonomy*, with respect to the soils of the lower latitudes. The international soil classification workshops were initiated by the University of Puerto Rico, which organized and conducted workshops in Brazil in 1977, Malaysia and Thailand in 1978, and Syria and Lebanon in 1980. Beginning with the Rwanda workshop in June, 1981, the activities were incorporated into the program of SMSS.

A prime purpose of the workshops has been to provide an opportunity for members of the relevant SCS-established international committees on *Soil Taxonomy* (ICOMs) to discuss their committee charges in a country where critical examples of the soils under study can be seen in the field. Participation at the workshops was soon expanded to include soil scientists from countries of the region in order to familiarize them with *Soil Taxonomy* and to motivate them to use the system. All workshops were partially funded by AID and organized in collaboration with host country institutions, without whose technical, organizational and monetary inputs they would not have been possible.

### Fourth International Soil Classification Workshop, Rwanda

The Rwanda workshop, June 2-12, 1981, was a joint venture of SMSS, the Institute des Sciences Agronomiques du Rwanda (ISAR), the Algemeen Bestuur voor Ontwikkeling Samenwerking (ABOS) of Belgium, the University of Puerto Rico (UPR), and the University of Ghent (UG), Belgium. ABOS and ISAR were in charge of all logistic arrangements in Rwanda, and UPR handled the invitation of non-Rwandese participants and the ticketing and per diem payments of participants supported with AID funds, and assisted in the preparation of the program and publishing of the proceedings. SMSS provided the analytical data for the soils studied during the field trips and compiled the tour guide. UG supplied micromorphological information. The overall responsibility for the workshop rested with SMSS.

Most of the workshop funds came from SMSS, but ABOS contributed \$25,000 for local arrangements, bus transportation, travel support for two participants, and for the printing of the proceedings. The actual contribution of ABOS, however, was at least twice that amount as it placed all of the local resources and technical staff at the disposal of SMSS during the preparation and conduct of the workshop.

**Objective.** The objective of the Rwanda workshop was to resolve issues on the classification and manage-

ment of tropical soils of high altitudes. Some of these soils, particularly Oxisols and Ultisols, exhibit unique features, such as the sombric horizon, which have not been studied in detail and whose importance to soil classification needs to be established. The mentioned soils and Andisols are extensive in the highlands of east-central Africa in a region comprising Rwanda, eastern Zaire, Burundi, and parts of Tanzania, Kenya and Uganda. They are well represented in Rwanda at elevations between 1,500 and 2,500 m above sea level.

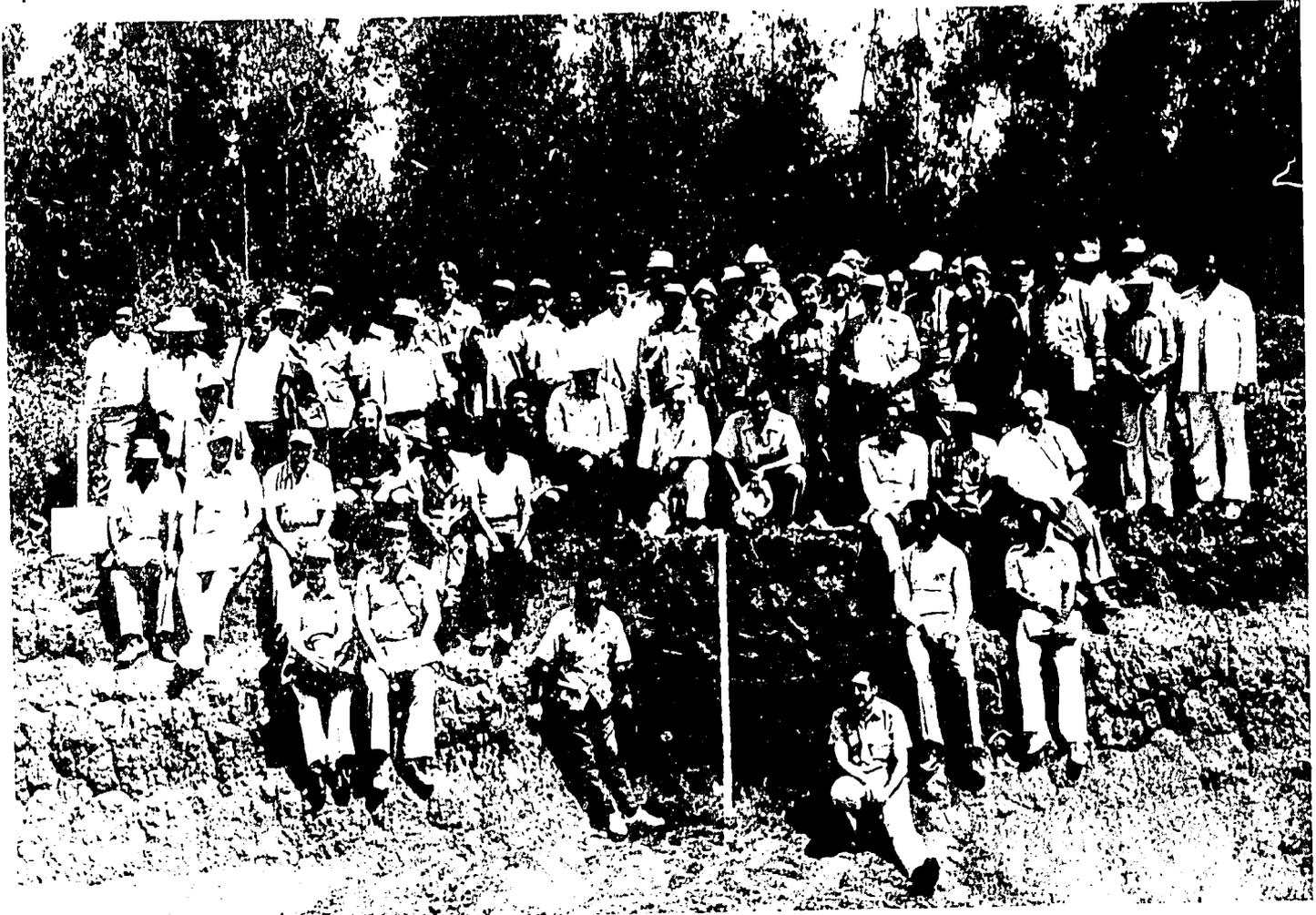
In holding a workshop in Rwanda, SMSS acted upon a recommendation of the Malaysia/Thailand meeting, at which the participants urged that a workshop be organized in Africa for the International Committee on the Classification of Oxisols (ICOMOX). For the reasons stated above Rwanda appeared a logical choice for the workshop, especially since contrasting soils can be found in relative proximity. Moreover, Rwanda is currently initiating a national soil survey program in which *Soil Taxonomy* will be used as the official system.

In addition, Rwanda exemplifies the enormous development problems of the region. It has the highest population density of Africa with 185 persons per square kilometer of arable land, and soil productivity

under traditional systems of management is low except in the area of Andepts and other soils influenced by volcanic ash.

**Participants.** Sixty-one scientists participated in the workshop; 21 came from Rwanda and 40 from 23 other countries. The participants represented various government agencies involved in soil survey and agriculture; the International Agriculture Research Centers (CIAT, CIP, IITA); the International Soil Museum; FAO; the International Society of Soil Science; the bilateral technical assistance programs of Belgium (ABOS), Norway (NORAD) and West Germany (GTZ); and numerous universities. Forty-two of the 61 participants were fully or partially supported with funds from AID.

**Conference Sessions.** There were five days of conference sessions during which 40 technical papers and 5 short communications were presented in nine technical sessions. All papers were invitational and designed to address the general theme of the workshop and the mandates of ICOMOX, ICOMAND and ICOMMORT in particular. Four papers dealt with soil management, and the five short communications concerned international activities related to soil classification.



Participants of the IV International Workshop in Rwanda.

Two technical sessions were dedicated exclusively to the discussion of issues concerning ICOMOX and ICOMAND. In addition, four evening discussion periods were arranged in response to participant interest.

**Field Tours.** Sixteen key soils were studied during six days of field trips that led to various ecological regions of Rwanda and covered a distance of 1,360 kilometers. At each profile there were about two hours of explanation and discussion regarding soil classification, land use and soil management. The discussions benefited greatly from the availability of complete and reliable soil characterization data provided by the National Soil Survey Laboratory of the SCS at Lincoln, Nebraska. In addition, mineralogical and micromorphological analyses were supplied by the University of Ghent. The soil moisture and temperature regimes were computed by Dr. A. Van Wambeke at Cornell and the University of Ghent.

**Proceedings.** All of the technical papers presented are included in the workshop proceedings, together with the profile descriptions and analytical data of the soils studied during the field tour. The proceedings also contain the discussions that followed the presentation of papers and discussions held in the field, both of which were taped and transcribed.

**Evaluation.** The Rwanda workshop was a combination of ICOM meetings and training given soil scientists of the less-developed countries, who were invited to participate fully in all phases of the workshop. Because of the widely different levels of technical expertise, compromises were inevitable. The technical quality of papers presented varied from excellent to mediocre. Discussions at the pits were probably more confusing



The Soil Survey Administration of Sudan are the hosts to the Fifth International Soil Classification Workshop—Nov. 2 to 11, 1982. From left to right: Dr. M. Hassan (Director, SSAS), Dr. A. Osman (Director, Soils Division, ACSAD), Dr. F.H. Beinroth (University of Puerto Rico), Dr. M. Ali (Director of Agriculture, Sudan) and Dr. H. Eswaran (Program Leader, SMSS).

than enlightening to some of the participants.

On balance, however, the workshop must be judged a complete success. One of the prime objectives of SMSS is to bring the practice of soil science in the less-developed countries up to international standards, and this is best done by giving the soil scientists of these countries opportunities to meet face-to-face and discuss



Telephone poles tilt due to shrink-swell behavior of Vertisols.



Dr. F.H. Beinroth (University of Puerto Rico) discusses properties of Vertisols with colleagues from the Soil Survey Administration of Sudan. On the extreme left is Dr. M. Hassan, Director of SSAS.

problems with their Western counterparts. In Rwanda, this process worked very well.

On the other hand, the discussion sections of the ICOMs were of high professional standards and characterized by rigorous argumentation reflecting not only pedologic competence but also a genuine desire to improve *Soil Taxonomy*. The workshop had significant impact in particular on the work of ICOMOX and ICOMAND. The proposals advanced by various ICOMOX members generated extensive discussions, and although a general consensus could not be reached in all matters, important agreements and compromises were achieved. The ICOMAND-related topics were less controversial, and good progress was made toward the development of a key for the new order of Andisols.

In addition, the workshop made a very substantial contribution to the ongoing soil survey program of Rwanda, providing complete characterization data from some 20 benchmark pedons and accurate placement of these soils in various systems of classification.

**Other Planned Workshops.** Other workshops planned are the Fifth International Soil Classification Workshop, on Vertisols and Aridisols, scheduled for Sudan from November 2 to 11, 1982, and the Sixth International Workshop, on Andisols, scheduled for Chile and Ecuador in January, 1984.

## Training Courses

The International Soil Classification Workshops are not primarily designed for training of scientists in less developed countries. The purpose of the training courses is to reach a large number of soil scientists in developing countries and to inform them of recent developments in soil survey, classification and use and management of soils. This program addresses the new

generation of soil scientists who have not had the benefit of a western education.

In the first phase of the program of SMSS, the emphasis was on regional training programs, as opposed to national programs. This gives an opportunity for scientists in a geographical region to meet and exchange views—and greatly facilitated by the support and cooperation of the South Pacific Regional Development Office of USAID/SUVA.

The participants of the forum quickly recognized the importance of using *Soil Taxonomy* as a basis for making soil survey in the region. They realized that a great deal of research was being conducted on the same soil and climate in virtually every island nation in the South Pacific. For the first time, some of the administrators realized that a great deal of duplication of effort could be avoided and that research stations of the region could work as a network of cooperating stations. This realization was expressed in a recommendation for a network of benchmark experimental stations to enhance sharing of agrotechnology. The recommendation suggested that the nations of the South Pacific approach funding agencies such as the European Economic Community and the Asian Development Bank for financial support for such an effort.

SMSS received many letters from many officials in the region, including one from the Permanent Secretary, Ministry of Agriculture, Fiji, addressed to Mr. Robert Craig, Director of USAID/SUVA, congratulating SMSS for the forum and emphasizing the need for more such courses in the region.

**Morocco Training Course.** The Second International Forum in *Soil Taxonomy* was held in Morocco and conducted in French. The participants came from the North African Countries—Algeria (3), Tunisia (8) and Morocco (26). These three Arab countries are preparing a soil map of their countries at a scale of 1:1 million using *Soil Taxonomy*. This effort is part of the



Participants of the Second International Forum on Soil Taxonomy, Morocco, discuss classification and management of a Haploxeralf.

Arab Soil Map Project of the Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD) which, with SMSS and the Institute National Recherche Agronomique (INRA) of Morocco, were the sponsors. The major source of funding was the Near East Bureau of AID. The forum was similar to the one in Fiji, but more attention was given to soil survey, mapping, and interpretations.

Preparation for a training program requires a lead time of one to two years. Two courses were conducted during this phase of SMSS, and plans made for three more in 1983:

Country	Serving the Region	Date
Fiji	South Pacific	November, 1981
Morocco	North Africa	April 13-26, 1982
Cameroon	Cameroon	Jan. 6-15, 1983
Malaysia	ASEAN	Feb. 7-25, 1983
Papua New Guinea	South Pacific	April 25-May 6, 1983

**Fiji Training Course.** This course, referred to as an International Forum on *Soil Taxonomy*, was held on the campus of the University of the South Pacific, Suva, Fiji. All of the major countries of the South Pacific (Fiji, Tonga, Western Samoa, Papua New Guinea, New Caledonia, Solomons and French Polynesia) were represented in the Forum. Most of the representatives were high ranking scientists or administrators of the ministries of agriculture. The Forum consisted of a training session on *Soil Taxonomy*, discussion session among participants and resource staff, field tours to examine soils in the field, and a final day of formulating recommendations for future action.

Although the forum was made possible by the support of SMSS, it was a success because of the large inputs and long term commitment of the New Zealand Government to use *Soil Taxonomy* for its technical assistance and agricultural development program in the region. The New Zealand Government has published a soil survey of the Cook Islands, has completed the soil survey of Tonga and is currently doing the soil survey of Fiji. The objective is to promote the adoption of *Soil Taxonomy* in the South Pacific so that the efficiency of its technical assistance program will be increased. This



Participants of the first International Forum on Soil Taxonomy held at Fiji.



SMSS and Cornell University team makes movie in Puerto Rico.

training course was also informed on the French classification and the French approach to soil survey. As a result, they had great difficulty in appreciating the approach advocated by *Soil Taxonomy*. The very frank discussions that ensued were a clear indication that they were interested to learn. The staff of the University of Ghent must be congratulated for the excellent course they provided and for the efforts they made to teach *Soil Taxonomy*. SMSS consultant B. Arville Touchet, State Soil Scientist, SCS, Alexandria, Virginia, provided an introductory course in *Soil Taxonomy*, translated and taught in French.

**Other Planned Activities.** SMSS has received several requests for similar training courses. Some of these have been planned and others are pending:

Country	Date
Cameroon	January 1983
Thailand	February 1983
Papua New Guinea	April 1983
Costa Rica	Pending
India	Pending
Malaysia	1984
Zaire	1984

A very specific request was received from Malaysia which wanted a course designed for teachers of *Soil Taxonomy* at universities in the Association of South East Asian Nations (ASEAN).

For these training courses, SMSS has developed training packages which include lecture notes, 35 mm color slides, and 16 mm and 8 mm color movies.

## Publications

Because of the need to provide up-to-date information to soil scientists in the developing countries, a program of publishing and distributing technical materials has been a very important part of the work of SMSS. Universities and research institutions in the less developed countries generally do not have foreign exchange to buy books. Library shelves are bare, and

as a result students and researchers do not have the opportunity to improve themselves. International technical assistance programs have seldom considered this as sufficiently important to warrant attention. The only time many of these institutions receive books is when a religious mission or a foundation donates them. SMSS publications attempt, therefore, to supply this need. The need, however, is far too great to be satisfied by the limited funds available to SMSS.

A resume of some of the publications that have been produced and a few which have been planned is given below.

### **Soil Taxonomy News**

This is the semi-technical newsletter of SMSS, which is published quarterly, beginning in October 1981. The newsletter is designed to attract a range of readers. Emphasis is of course on *Soil Taxonomy* including technical details of the system, amendments if any, and international use. The newsletter is not designed for pedologists alone but also for other workers in soils and for USAID Mission staff; short notes are prepared for these persons.

Currently SMSS produces about 1,000 copies of each newsletter, most of which are distributed to people in less developed countries. At the end of 1982 requests exceeded the supply by twofold. Many of the requests have come from within the U.S. and the western countries; SMSS is searching for a mechanism to respond to these.

### **Soil Resource Inventories and Development Planning**

National, regional, and even local planning for agricultural purposes requires accurate information on soil resources. This monograph is written not only for the decisionmakers but also for the scientists. It evaluates the current status of resource inventories and discusses the methodologies adopted in different countries. It also looks into the aspect of presentation of soil information to planners and suggests means to improve communication between decisionmakers and planners. Quality and quality control are critical aspects of developing soil inventories, and means to evaluate these are presented.

### **Soil Taxonomy and Technology Transfer**

The guiding principle of SMSS is that *Soil Taxonomy*, the U.S. system of classification, is the vehicle for international agrotechnology transfer. Recently two articles on this subject were published in the journal *Advances in Agronomy*. As the circulation of this journal is limited and as the two articles are semitechnical and deserve a wider audience, SMSS, with permission

of the publishers and jointly with BSP, has reprinted the articles for free distribution.

The two comprehensive evaluations give an excellent account of the international use of Soil Taxonomy and its potential for agrotechnology transfer. The monograph will be a useful information material for USAID Missions, national planners, and scientists alike.

### **Soil Taxonomy Keys**

The International Soil Museum in Netherland published in 1980 a "Field Extract for Soil Taxonomy." This contains the keys, up to the great group, and the book is designed to be small enough to be carried in the field. SMSS has developed a similar booklet called "Soil Taxonomy Keys" which contains all the keys up to and including the family category. In addition, the "Soil Taxonomy Keys" carries the most recent approved amendments. Now that *Soil Taxonomy* is on computer and SCS has the software to transfer the information directly to a typesetter, it is possible to publish amended keys whenever desired.

### **Soil Moisture Regimes in South America**

Written by Professor A. Van Wambeke, Cornell University, this monograph uses a model developed by the Soil Conservation Service to calculate the soil moisture and temperature regimes. The monograph also includes a map giving the distribution of the soil moisture and temperature regimes.

A companion monograph on the soil moisture and temperature regimes in Africa has been prepared but not yet published and those for Asia and Middle East are being considered. These monographs give some of the basic information necessary for technical assistance and technology transfer.

### **Guidelines for Soil Resource Inventory Evaluation**

Soil resource inventories vary greatly in methodology, quality and manner of presentation. Previously, few procedures were available to evaluate these inventories. This was the subject of investigation of the Agronomy Department of Cornell University. Published by Cornell University and SMSS, this monograph discusses methods of evaluation, and highlights areas in the operational aspect of an inventory which need attention and indicates how quality control can be maintained at each stage of the development of an inventory.

### **Soil Analysis for Soil Taxonomy**

This monograph, in preparation at the end of 1982, deals with the kinds of analyses needed for soil classification. It is a companion document to the one entitled

"Methods of Soil Analysis" published by the Soil Conservation Service.

### Scientific Articles

Staff of SMSS have also published a number of technical papers in scientific journals. A list of these is presented in Appendix III.

### Bibliography of Soils of the Tropics and on Soil Taxonomy

This Bibliography was compiled for USAID by Dr. A.C. Orvedal as Technical Series Bulletin No. 17 of the Agency for International Development. The succeeding volumes are published by SMSS. Volumes I, II, III and IV have been published and Volume V is under preparation.

There have been several requests to compile a bibliography of all articles published on *Soil Taxonomy* between the years 1970 and 1980. SMSS is working on this bibliography.

### Translations

*Soil Taxonomy* is now widely used all over the world. To date, the GPO has printed 19,000 copies. Under an agreement between SCS and Soil Survey of India, an Indian edition has been published and about 3,000 copies sold. About 1,000 copies of an Italian edition published in Rome by Italian soil scientists is being circulated in Ethiopia and Somalia. A private publishing firm in Great Britain has reproduced *Soil Taxonomy* for sale. The Arab Center for Studies of Arid Zones and Dry Lands (ACSAD) has published a summarized version of *Soil Taxonomy* in Arabic. Finally, the International Soil Museum has produced a field extract of *Soil Taxonomy* which only gives the keys.

There have been several requests to translate at least the diagnostic horizons and the keys of *Soil Taxonomy* into Spanish and French. The Spanish translation is under way and the French translation is being planned.

### Soil Analyses and Data Bank Activities

The various activities of SMSS are supported and complemented by the development of a soil data bank. SCS soil scientists on temporary duty in developing countries are urged to use the opportunity to describe and sample soils. The intent of SMSS is to develop a set of pedons described, sampled and analyzed in the same manner as the soils of the U.S. A voluminous amount of data exists in all the countries, but cannot be used for SMSS purposes due to poor characterizations or unreliable results. Consequently, SMSS has adopted the procedure of describing, sampling and analyzing all the soils that it needs, particularly for its workshops and training courses. The information is fed to the ICOMS for use in their deliberations. The SMSS analysis pro-

gram also serves as an interlaboratory test mechanism to determine the extent of variability in results from different laboratories.

Soil analysis support services are provided by the National Soil Survey Laboratories (NSSL) of SCS (Head, Dr. Steven Holzhey) and the activities are coordinated by Dr. John Kimble, Soil Chemist of SMSS. The work done falls under two general areas: soil characterization, and testing and development of methods.

### Soil Characterization

In this program of analysis of soils of the tropics, no missions specifically to collect samples have been made, as this was too expensive and does not meet the overall objectives of SMSS. In the course of sampling and analyzing soils, SMSS also wishes to assist less developed countries in their soil characterization program. Consequently, such sampling has only been done during technical consultations when SMSS consultants have traveled for other related objectives. The exception to this has been that soils have been sampled and analyzed specifically for workshops and training courses.

During the three-year program, SMSS analyzed 210 pedons comprising 1109 samples from 22 countries (see table 3). The data on the soils employed in the workshops and training courses are published in the proceedings of these activities.

Data are sent to the countries for evaluation and comparison with the data from the local laboratories. Some laboratories, such as that of the Institute National Recherche Agronomique (Morocco), show excellent agreement while for many others, there is no agree-

Table 3. Soil Analyses Performed by SMSS

Country	No. of Pedons	No. of Samples
Syria	27	120
Senegal	3	15
Rwanda	16	90
Syria	11	39
Thailand	2	5
Malaysia	3	8
Brazil	1	4
Sudan	5	35
Senegal	4	19
Gambia	5	34
Sudan	28	193
Mali	10	49
Morocco	4	16
Thailand	19	107
Yemen	3	14
Philippines	3	20
Indonesia	4	32
Costa Rica	8	34
Jordan	14	70
Indonesia	20	100
Papua New Guinea	15	100
India	5	30
Total	210	1,109

ment. When possible, SMSS tries to indicate the possible sources of error and assists in improving the quality of the results.

The limited experience of SMSS has clearly shown the need for more inter-laboratory comparisons. If a laboratory is not capable of producing reliable, reproducible results, all its recommendations are subject to error, the classification of the soils is incorrect and recommendations for technology transfer may be faulty. Reasons for poor analyses often are: lack of trained personnel, lack of equipment, and a laboratory environment not conducive to good work. In most cases, equipment and the laboratory environment are the prime reasons. The Soil Survey Administration in Sudan, for example, has good chemists, but facilities are inadequate. This laboratory has the potential to produce excellent results if it can be strengthened.

The reports received from SMSS consultants have continually stressed the need for strengthening soil survey and soil testing laboratories. SMSS, however, does not have the funds, nor is it its objective to venture into this. On the other hand, SMSS will be organizing training programs to improve the quality of the technicians.

## **Testing and Developing Laboratory Methods**

A simple procedure for the use of KOH extractable

aluminum as a field criterion for classification of Spodosols and Andisols, was written up in the first *Soil Taxonomy News* of SMSS. The method is very simple, requiring a minimum of equipment, and it can be run in the field. In field testing, it shows a great deal of promise. Along with the paper on the development of the method, a paper evaluating its use for Andisols is being prepared, with Kimble, Holzhey, and Holmgren as authors. It compares favorably to other methods used for characterizing andic properties and is much simpler to run than many of other methods.

Extensive testing has also been done using ethylene glycol monethyl ether (EGME) for the measurement of surface area of soils. Surface area measurements on all foreign samples are being run. Estimations of the clay mineralogy and activity of the clays can be made from these measurements. This allows the stratification of low activity clays from other types. This method can be used in most laboratories as very minimum equipment is required, making it a useful method for developing countries with poorly developed laboratories. In conjunction with R.E. Nelson, work has been done on the characterization of aluminum in soils. Al is measured in saturation extracts made using a modified Richard's type extractor. The method was written up in the second *Soil Taxonomy News* of SMSS. Work is continuing on development of a method to measure Ca and Mg in the same extract so that an estimation of the percent Al saturation can be made.

## UTILIZATION AND IMPACT

As documented in the Technical Consultations section, SMSS has received numerous requests from USAID missions and less-developed countries for technical consultations in its three years of operation. SMSS has responded to *all* requests and in every case made great efforts to search for and select the most appropriate person for the task. In addition, SMSS was usually able to respond within six to eight weeks, this short response time making the program more effective and accelerating demand for it. The fact that SMSS was called on to provide nearly 1,000 man/days of direct technical assistance testifies to a very high level of utilization of the SMSS program.

Evidence of utilization of the SMSS program in the area of its technology transfer activities is also impressive. Many hundreds of soil scientists of both developed and less-developed countries have taken advantage of the scientific opportunities provided by SMSS workshops, training courses, and international committees. The demand for SMSS-sponsored publications has at times seemed insatiable. By the end of 1982, SMSS was producing 1,000 copies of the newsletter *Soil Taxonomy News*, but requests exceeded that supply by twofold. Acceptance of the program is also seen in the establishment of working relationships with other major international and national organizations.

In its three-year life, then, SMSS has been very active. It has clearly established its visibility and prestige on the international scene, and its role with AID Regional Bureaus, AID Country Missions, and personnel and organizations within the target countries.

The impact of the program of SMSS is difficult to

summarize or quantify in an overall way, but it is very clear that this impact has been very significant. The large number of letters in the SMSS files from AID Mission and from target country personnel testify eloquently to this. A scanning of the summary reports of technical consultations shows a large number of problems identified and solved in the less-developed countries that would not have been addressed if SMSS had not existed. The records of the ICOMs document specific progress in the refinement of *Soil Taxonomy*. Through SMSS publications and through participation in its workshops and training courses, many scientists of the less-developed countries have not only been brought into contact with their western counterparts and with the system of *Soil Taxonomy*, but have been able to secure acceptance of and even contribute to this system as an international soil classification language. It should also be mentioned that the U.S. scientists of SCS and the land grant universities who have participated in SMSS activities now constitute a pool of expertise on international agriculture within the U.S., which will contribute to broadening the U.S. agro-science system.

In summary, then, SMSS has shown that major U.S. soil science resources can be tapped and channeled in a manner that is efficient and is beneficial both to the target countries and to U.S. interests, and which contributes significantly to worldwide progress in soil science and therefore in agricultural productivity. And SMSS has established linkages and opened channels of communication, all in a spirit of confidence and cooperation, which provide a firm basis for continued progress in this vital work.

## Minutes of SMSS Advisory Panel Meeting held in Washington, D.C.; December, 1980

1. USAID expressed its satisfaction with the first year of operations of the SMSS program as it provided rapid availability of a large group of experts from USDA to be of assistance to LDC's.
2. It is felt that a large amount of soil and crop information is already available at numerous sites in LDC's but that more effective mechanisms are needed to facilitate the exchange of this information. Hence the importance of *Soil Taxonomy*, which provides a common scientific language to stimulate more efficient use of this technical knowledge.
3. The panel considered that SMSS should develop stronger linkages with existing or with planned agricultural experimental networks, and that it could play a more active role in promoting coordinated soil management research programs. SMSS can also participate in institution building programs in LDC's especially by strengthening soil correlation activities. In certain geographical areas SMSS may also assist in the identification and mapping of specific soil constraints which would become the focal points of agricultural research to increase food production in farmers fields.

Active cooperation with International Board of Soil Resource Management (IBSRAM), with FAO and ISSS in order to promote an International Soil Classification Reference System, and with agricultural research networks (i.e., Soil Conservation in Africa) was recommended.

4. Dr. R. Arnold explained the staffing and personnel aspects of SMSS. Most requests for assistance come from USAID Missions and agencies involved in the planning of agricultural development in less developed countries. The SMSS program has prepared a list of readily available individuals.
 

It was pointed out that short-term assistance runs the risk of contacting only a small number of institutions in the LDC, and that for this reason it was difficult to avoid bias. The final consensus was that well prepared and precisely described short-term assignments can be useful, especially to remove bottlenecks in development operations.
5. It was recommended that SMSS also serve as a mechanism for quality control on the use of *Soil Taxonomy* in soil surveys conducted by contractors for AID field programs.
6. The second component of the SMSS program relates to the improvement and the promotion of *Soil Taxonomy* in less developed countries.

The discussion dealt with the search of an appropriate mechanism to identify the need of the changes, to test the approved modifications, and include the proposals in *Soil Taxonomy*. Without this mechanism there is little use in proposing changes.

It was pointed out by the Soil Conservation Service Director of Soils that proposals originating abroad could be accepted in *Soil Taxonomy* even if they would cause changes in the classification of the soil series in the United States.

The panel recommended that guidelines be developed indicating the criteria for approving proposals for their introduction in *Soil Taxonomy*.

The shortage of personnel to keep up with the incoming proposals and the enormous task to sort, evaluate, and incorporate them into *Soil Taxonomy* were pointed out. A recommendation to computerize *Soil Taxonomy* was approved.

7. It was felt that the specialized international committees to solve particular classification problems in *Soil Taxonomy* have been very successful in promoting *Soil Taxonomy*. The seminars they organized brought people from different countries and backgrounds together to study soil classification problems in the field. However, the panel considered that precise description of the mandates of the committees was necessary and that the decision mechanisms within each committee should be clearly defined. Potential problems of authorships of members are to be recognized and given due consideration.

An excessive number of new committees, however, may erroneously give the impression that *Soil Taxonomy* needs complete and drastic revisions. Therefore, its effectiveness as a stable transfer mechanism may be reduced and users may lose confidence. Equal consideration should be given to the positive aspects of *Soil Taxonomy*. Increased activities which would emphasize the correct use of *Soil Taxonomy* as it now stands were advocated.

Several participants insisted that soil properties which are important for land use be given higher priority in the taxonomic system.

8. The SMSS program has the capability to advise AID on laboratory equipment needs in LDC's. The importance of training people to use modern analytical equipment and to make correct interpretation of the results was also stressed. Sound sampling methods are considered a prerequisite for obtaining representative data both for mapping and soil management recommendations.

It was pointed out that exaggerated requests for soil analyses were often included in soil survey budgets. A good understanding of soil genesis and the relationships between soils and landscapes can considerably reduce the need for soil analyses. The panel indicated that the training of field personnel knowledgeable in the use of *Soil Taxonomy*, as well as in the supporting sciences, may be more important than the purchase of very specialized laboratory equipment.

SMSS was asked to place high priority on analytical methods of physical properties of surface horizons, rather than on chemical characteristics of deeper layers.

9. The panel considered that short training courses can favorably complement the consultancy activities. They would address a larger group of people from one region to be

informed about new methodologies for using and applying *Soil Taxonomy*. The panel thought that short term training sessions are effective provided the students have reached an adequate level of experience, and that the instruction focuses on specific problems. Most drawbacks in the past were due to improper selection of candidates. It was also recommended that the short-term courses include an intensive field training program in an LDC.

Training was considered a necessary component of future operations of SMSS. It was suggested that these efforts not only address scientists and planners in the less developed countries but also be directed towards a more general audience, for example, staff in development agencies who are not familiar with the benefits that soil science can bring to agriculture.

10. SMSS should develop packages including audiovisual aids and tape recorded explanatory tests for use in short-term training sessions. SMSS was also asked to accelerate the publication of monographs and other teaching materials.
11. The members of the Advisory Panel formulated several commendations and recommendations. These are given below with a brief note on the actions taken to date.

#### Commendation

1. The Advisory Panel commends the SMSS for the excellent progress made since project initiation and expresses its appreciation to the Agency for International Development for supporting the program.

#### Recommendations

2. Noting that *Soil Taxonomy* is being increasingly used in AID-supported programs but realizing that if incorrectly used it can be counterproductive, it is recommended that the SMSS assist in the evaluation of the competence of the AID contractors. It is further suggested that SMSS be involved in such evaluations and that it provide quality control in such projects.

Although the evaluation of the competence of the AID contractors may be desirable in some instances, this depends on requests from AID.

3. The Panel recommends that SMSS establish viable linkages with the International Agricultural Research Centers and the International Service to National Agriculture Research (IS-NAR) of CGIAR, regional organizations such as the Association of South East Asian Nations (ASEAN) and the Arab Center for Studies of Arid Zones and Dry Lands (ACSAD), and AID-supported programs such as the Benchmark Soils Project (BSP) and the proposed International Benchmark Soils Network for Agrotechnology Transfer (IBSNAT) and the Soil Management Collaborative Research Program (CRSP) and other relevant institutions including the International Soil Museum.

These linkages have now been established and several joint activities have been initiated as reported later.

4. The Panel recommends that SMSS strengthen its training component, develop audiovisual teaching aids on *Soil Taxonomy*, and also prepare technical and nontechnical pub-

lications on soil management and management implications of *Soil Taxonomy*. The Panel endorses the efforts of SMSS to document the rationale and concepts of *Soil Taxonomy* and the translation of the latter into Spanish and French.

Audiovisual teaching aids, technical, and nontechnical publications are being prepared.

5. The Panel recommends that SMSS continue to pay major attention to the application of *Soil Taxonomy* to soil management and research on the relationship between soil characteristics and the requirements of crops. More specifically, the diagnostic criteria used in *Soil Taxonomy* should be investigated in terms of their significance for various types of land use. From the point of view of refining *Soil Taxonomy*, the study of these relationships could lead to adjustments in the separation of taxa or in the definition of diagnostic criteria. It is suggested that the international committees consider the management implications of the modifications which they propose.

The international committees have been informed of this recommendation.

6. As computerized *Soil Taxonomy* would facilitate the integration and testing of proposed amendments, the matching of taxonomic criteria with management properties and the clustering of taxa into specific interpretative groupings, the Panel, therefore, recommends that the key of *Soil Taxonomy* and the definitions of diagnostic differentiae be stored in a computer retrieval system.

A computer program is being prepared for this purpose.

7. The link between *Soil Taxonomy* and soil management is still not well appreciated by many agronomists. Although the Benchmark Soils Project of the Universities of Hawaii and Puerto Rico and the SMSS have already made important contributions on this regard, the Panel recommends that a symposium be organized by SMSS in collaboration with BSP on the subject "Matching Crop Requirements with Soil Conditions." This symposium should attempt to examine the role of *Soil Taxonomy* in evaluating crop performance and response to management. The symposium should preferably be held in an LDC.

Plans are already underway to hold this symposium. The Benchmark Soils Project of the Universities of Hawaii and Puerto Rico is taking the leadership to organize the symposium. The symposium will be held in India in 1982 and cosponsored by the International Crop Research Institute for the Semiarid Tropics, Hyderabad, and the Soil Research Institute of India.

8. By virtue of the design and nature of the SMSS, this excellent program cannot be expected to achieve its objective on a short-term basis. The Panel, therefore, strongly recommends that the program be extended for 5 years beyond its termination of 1982. This extension would enable SMSS to have measurable and lasting impact of consequence to the agricultural development in tropical and subtropical LDC's.

AID/Washington has now extended the project for a five-year period (until September 20, 1987).

## Activities of SMSS (TT and TC Refer to Technology Transfer and Technical Consultation Components, Respectively)

September 1979	Establishment of Soil Management Support Services.	July 1980	Hari Eswaran appointed as consultant to SMSS 75 days.
October 1979	Richard L. Guthrie appointed as Acting Director. Conference on Soil Information Systems. Ottawa, Canada.	August 1980	USAID/Thailand. Evaluation and upgrading of soil, water, and conservation organizations, projects, and practices.
January 1980	Richard L. Guthrie. 5 days ASIA TR ARD. Review Proceedings of ASEAN Workshop on Watershed Conservation and Management.	September 1980	Victor Link and W. Austin. 14 days USAID/Jamaica. Soil survey, land use, and soil classification training.
March 1980	Richard Guthrie and Robert Hartung. 4 days USAID/El Salvador. Information on Soil Conservation Practices.	TC September 1980	Richard Guthrie and Arnold King. 14 days Mailing of Proceedings of 2nd International Soil Classification Workshop to international co-operators (250 copies).
TC April 1980	Richard Guthrie and Arnold King. 4 days DA AGR. Review small farm Soil Conservation Project in Guatemala, Project AB/Bua 233.	October 1980	USAID/Mali. Information on resource inventory and soil classification to GOM official.
April 1980	W.M. Johnson and T.S. Gill. 7 days USAID/Senegal. Soil Survey for fuelwood production. Project AG SEN--685-0219.	October 1980	John Witty. 1 day Symposium on Paddy soils, Nanjing PRC.
April 1980	James Brown. 14 days SMSS Brochure published.	October 1980	Klaus W. Flach. 11 days USAID/Sudan. Evaluating training and laboratory equipment needs for soil survey and classification.
April 1980	Followup meeting of 3rd International Soil Classification Workshop, Athens, Greece.	October 1980	Hari Eswaran and John Kimble. 14 days DS/AGR. Expert consultation on soil correlation and land evaluation, FAO, in Tanzania.
April 1980	R.W. Arnold and K.W. Flach. 6 days Conference on International Reference Base for Soil Classification, Sofia, Bulgaria.	November 1980	F.T. Miller. 7 days Hari Eswaran appointed as Program Leader of SMSS.
April 1980	R.W. Arnold and K.W. Flach. 7 days USAID/Peru. Assist USAID Mission and the Government of Peru in the preparation of a bilateral project related to the development and institutionalization of a soil conservation program.	November 1980	USAID/Senegal. Soil survey for fuelwood production project.
May 1980	Ray T. Margo, Eugene S. Pope, and Clayton Ogg. 30 days USAID/Senegal. Soil Survey for fuelwood production.	November 1980	James Brown, Lawson Spivey, Donald Mc-Daniels. 27, 18, 18 days, respectively Rwanda. Planning meeting for 4th International Soil Classification Workshop.
June 1980	James Bower and James Brown. 21 days USAID/Rwanda. Develop legend of national soil map.	TT December 1980 December 1980	Hari Eswaran and Fred Beinroth. 14 days Annual meeting of Advisory Panel of SMSS. Guy D. Smith commences interviews on <i>Soil Taxonomy</i> .
June 1980	Armand Van Wambeke. 10 days USAID/Philippines. Review national Soil Classification Program.	TT December 1980 TC December 1980	USAID/Liberia. Assistance in soil conservation. William Hance. 15 days Annual meeting of Agronomy Society of America.
June 1980	Richard Arnold. 30 days REDSO/EA. Scientific review of soils information and translation of French data of Kajondi Seed Farm in Burundi.	TT January 1981	John Kimble. 5 days USAID/Ecuador. Develop long-term soil management (soil erosion) program.
July 1980	Richard Guthrie. 4 days John Kimble appointed as Soil Chemist in SMSS.	TC January 1981	Luis Daniel. 32 days USAID/Swaziland. Request for soil management publications.
July 1980 TC	USAID/Tunisia. Provide LANDSAT imagery. Richard Guthrie. 4 days	TC January 1981	Richard Guthrie. 1 day USAID/Syria. Review possible technical assistance to ACSAD in soil survey and classification.

TC	January 1981	fication. Klaus Flach. 7 days USAID/Sudan. Assist in soil sampling for Soil Classification Workshop.	TC	October 1981	Jack P. Kanalz. 25 days USAID/Damascus. Assistance to ACSAD on soil map of Syria.
TC	January 1981	W.D. Nettleton. 21 days USAID/Ecuador. Develop long-term soil management program.	TC	October 1981	Roy M. Smith. 27 days ROCAP/CATIE. Application of Soil Taxonomy in ROCAP region.
January 1981	TT	Jesse Hicks, Paul Britt, and Jerry Dutchober. 17 days each Veracruz, Trinidad.	TC	October 1981	Oliver W. Rice. 17 days ROCAP/CATIE. Application of Soil Taxonomy in ROCAP region.
January 1981	TT	Guy Smith consultations. 14 days	TC	October 1981	Richard W. Arnold. 6 days USAID/Bamako. Assistance in soil survey project.
January 1981	TT	John Kimble. Sampling trip to Puerto Rico.	TC	October 1981	Hubert J. Byrd. 25 days Thailand, Indonesia, Malaysia. Mission to organize training course.
January 1981	TT	Symposium on Acid Sulfate Soils. Thailand, Malaysia.	TT	November 1981	Hari Eswaran. 15 days Fiji. Training Course
February	TC	Hari Eswaran, John Witty, Warren Lynn. 14 days each USAID/Bolivia. Evaluate soil erosion.	TT	November 1981	Richard W. Kover, Goro Uehara and Hari Eswaran. 15 days each
February 1981	TC	Van K. Haderlie. 17 days USAID/Thailand. Assistance in soil conservation.	November 1981	TC	USAID/Dakar. Assistance in soil survey of fuel wood project.
February 1981	TC	Gerald Laishaw. 40 days Conference on soils with variable charge, New Zealand.	TT	November 1981	James H. Brown. 11 days USAID/Djibouti. Evaluation of soil survey laboratory
February 1981	TT	Hari Eswaran, Richard Arnold. 17 days each Three chapters of new Soil Survey Manual mailed out to international cooperators (350).	TC	December 1981	Allen R. Hidlebaugh. 12 days Morocco. Planning meeting for training course.
March 1981	TT	Soil Classification in United States. M.G. Cline. Mailed to international cooperators (350).	TT	January 1982	Hari Eswaran. 12 days USAID/Panama. Evaluation of national soil survey and conservation program.
March 1981	TT	Conference on Aridisols, Israel.	TC	January 1982	Reuben Nelson. 30 days Technical Monograph No. 1 entitled "Soil Resource Inventories and Development Planning" mailed out.
April 1981	TT	Richard Guthrie. 14 days National Work Planning Conference. Washington, D.C.	TT	February 1982	Thailand. Sampling of soils for training program.
April 1981	TT	Frank Moormann invited by SMSS. 4 days Special symposium on international technical assistance.	TT	February 1982	Maurice J. Mausbach. 30 days India. 13th International Congress of Soil Science.
May	TT	Micromorphological evaluation of soils of Rwanda.	TT	February 1982	Klaus W. Flach, Richard L. Guthrie, Steven C. Holzhey, and John M. Kimble, Hari Eswaran. 12-25 days each
May 1981	TT	Ghent, Belgium H. Eswaran. 7 days USAID/Samoa. Training course.	February 1982	TT	Indonesia, Philippines. Sampling of Benchmark soils.
May 1981	TT	James Silva. 7 days USAID/Indonesia. Assistance in evaluation of transmigration program of GOI.	February 1982	TT	Maurice J. Mausbach. 10 days USAID/Quito. Assistance in soil conservation program.
June 1981	TC	Gary Margheim and Rich Duesterhaus. 10 days each 4th International Soil Classification Workshop, Rwanda. 28 out of 62 participants funded by SMSS.	TT	March 1982	Eddie Wood and John Caviness. 12 and 25 days, respectively
June 1981	TT	Richard Arnold, John Kimble, and Hari Eswaran. 15, 15, 21 days, respectively.	TT	March 1982	Jordan. Sampling of soils for training course.
June 1981	TC	USAID/Syria. Training course on erosion under arid conditions, organized by ACSAD.	TT	April 1982	Eddie Spencer. 24 days
July 1981	TC	Gordon Stroup and Steve Rawlings. 14 days each USAID/India. Assistance in irrigation project of GOI.	TT	April 1982	Morocco. Training Course in Soil Taxonomy.
August 1981	TC	Ray Meyer. 45 days USAID/Sudan. Assistance in planning workshop.	TT	May 1982	Arville Touchet and Hari Eswaran. 16 days each
August 1981	TT	Hari Eswaran. 10 days International Working Meeting on Soil Micromorphology. London	TT	May 1982	Thailand, Papua New Guinea. Planning meeting for training course.
October 1981	TT	Hari Eswaran. 8 days USAID/Bangkok. Assistance in developing soil conservation program.	TT	May 1982	Hari Eswaran. 25 days Orlando, Florida. Participation in S. Regional Work Planning Conference.
			TT	June 1982	John Kimble. 5 days USAID/New Delhi. Assistance in characterizing benchmark soils of India.
			TC	June 1982	Dewayne Williams. 35 days
			TT	June 1982	Puerto Rico. To make movie on Soil Taxonomy.
			TT	June 1982	Hari Eswaran. 7 days
			TT	June 1982	Sudan. Planning meeting for V Workshop
			TT	June 1982	Fred Beinroth. 10 days
			TT	June 1982	North Carolina. Discussion with Indonesian delegates on soil management project.

TT	Hari Eswaran. 7 days	TC	Darwin L. Newton. 35 days
July 1982	Brazil. Conference on laterites.	August 1982	Papua New Guinea and New Zealand. Preparation of training course.
TT	Steve Holzhey. 15 days	TC	John Kimble. 30 days
July 1982	USAID/Djibouti. Project evaluation.	August 1982	Washington, D.C. SMSS expert consultation meeting on Soil Fertility.
TC	Allen Hidlebaugh. 21 days	TC	
July 1982	USAID/Djibouti. Training staff on lab analyses.	August 1982	Technical Monograph No. 4 entitled, "Guidelines For Evaluating the Adequacy of Soil Resource Inventories" mailed out.
TC	George Holmgren. 30 days	TT	
July 1982	Hawaii. Discussion on IBSNAT-SMSS Cooperation.	August 1982	Costa Rica. To develop cooperative program with CATIE.
TT	Hari Eswaran. 10 days	TC	Hari Eswaran. 7 days
July 1982	Technical Monograph No. 3 entitled "Soil Moisture and Temperature Regimes - Africa" mailed out.	September 1982	Ecuador and Chile. Planning meeting for the 6th workshop.
TT		TC	Hari Eswaran and Fred Beinroth. 20 days
August 1982	USAID/Kigali. Assistance in geomorphological evaluation.	September 1982	Washington, D.C. End of Soil Management Support Services Phase I.
TC	Robert Ruhe. 30 days		
August 1982	USAID/Jakarta. Assistance in soil survey evaluation.		

## Papers Published by SMSS Staff

- Ali, M., H. Fadul, T.D. Cook, W.D. Nettleton, and J.M. Kimble. 1982. Vertisols in Central Sudan: Udic, Ustic, Xeric, or "Monsoonal" Moisture Regime. To be presented orally at the ASA Meetings, Ahaheim, California, November 28-December 3, 1982.
- Eswaran, H., A. Osman, and M. Iliawi. 1982. Mineralogy and micromorphology of Aridisols. Proc. 3rd International Soil Classification Workshop, Damascus, Syria.
- Paramanathan, S., and H. Eswaran. 1980. Morphological properties of Oxisols. In: Soils with Variable Charge (Ed. B.K.G. Theng). Publ. New Zealand Soil Science Society 35-44.
- Eswaran, H., and R. Tavernier. 1980. Classification and genesis of Oxisols. In: Soils with Variable Charge (Ed. B.K.G. Theng). Publ. New Zealand Soil Science Society 427-442.
- Eswaran, H. 1981. Scanning electron microscopy as applied to soil research. Proc. VI International working meeting on Soil Micromorphology, London. In Press.
- Eswaran, H. 1982. Research priorities for the tropics. Submitted to the 12th International Soil Science Society Congress. New Delhi, India.
- Fedal, H.G. Borst, and W.D. Nettleton. 1982. Role of Lithologic Discontinuities in Gilgai Formation in Sudan. To be presented orally at the ASA Meetings, Anaheim, California, November 28-December 3, 1982.
- El Hassen, M., T.D. Cook, H. Fadul, and W.D. Nettleton. 1982. Evidence of Increasing Aridity in Holocene Time in Sudan. To be presented orally at the ASA Meetings, Anaheim, California, November 28-December 3, 1982.
- Flach, K.W., and O.W. Rice. 1980. Principles of classification as applied to paddy soils. Conference on Paddy Soils, Nanjing, China. 381-386.
- Flach, K.W., C.S. Holzhey, F. de Coninck, and R.J. Bartlett. 1980. Genesis and classification of Andepts and Spodosols. In: Soils with Variable Charge (Ed. B.K.G. Theng). Publ. New Zealand Soil Science Society 411-426.
- Guthrie, R.L. 1980. Analytical requirements for placement in *Soil Taxonomy* and methods used. Proc. 3rd International Soil Class. Workshop, Syria 199-204.
- Guthrie, R.L. 1981. Classification of Aridisols in *Soil Taxonomy*. Proc. Int. Conference on Aridisols. Israel. In Press.
- Guthrie, R.L. 1982. Classification of Vertisols in *Soil Taxonomy*. Submitted to the 12th International Soil Sci. Soc. Congress. New Delhi, India.
- Kimble, J.M., and C.S. Holzhey. 1982. An evaluation of KOH extractable aluminum in Andepts (Aridisols). Submitted to the 12th International Congress of Soil Science, New Delhi, India.
- Kimble, J.M., R.E. Nelson, and H. Eswaran. 1981. Relating observable characteristics and laboratory properties in some soils of Rwanda. Submitted to the Annual Meeting of the Agronomy Society of America, Atlanta, Georgia.
- Kimble, J.M. 1981. Analytical techniques for soils with variable charge. Presented at 4th International Soil Classification Workshop, Rwanda.
- Kimble, J.M., C.S. Holzhey, and G.S. Holmgren. 1982. An evaluation of KOH extractable aluminum in Andepts (Aridisols). Presented orally at the 12th Congress of the International Society of Soil Science, New Delhi, India, February 12, 1982.
- Kimble, J.M., R.H. Jordan, and C.S. Holzhey. 1982. Standard Laboratory Methods and "Soil Taxonomy" Terms Specifying Methods. To be published as a Soil Management Support Services Monograph.
- Eswaran, H., R. Guthrie, and S. Holzhey. 1982. The Place of Laterites in *Soil Taxonomy*. To be presented at the II International Symposium on Lateritisation Processes in Brazil, July 4-12, 1982.
- Lynn, W.C. and J.E. Witty. 1981. Are Sulphhemists and Sulfohemists Valid Classes in *Soil Taxonomy*? Presented orally at the Secnd International Symposium on Acid Sulfate Soils, Bangkok, Thailand, January 19-24, 1981.
- Nettleton, W.D., R.B. Grossman, B.R. Brasher, and T.D. Cook. 1982. Application of Pedology of Plant Response Prediction for Tropical Vertisols. To be presented orally at the Fifth International Soil Classification Workshop, Sudan, October 31-November 11, 1982.