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TROPISOILS

EXTERNAL EVALUATION

1981-1984

TropSoils is a collaborative research program whose goal is to develop improved soil management technology for developing countries in the tropics.

Primary funding is provided by the U.S. Agency for International Development through Grant DAN 1311-G-SS-1083-00. This action is in support of Title XII "Famine Prevention and Freedom from Hunger" of the Foreign Assistance Act.

The formal collaborators in the program are:

- Agency for International Development-USA
- Center for Soils Research-Indonesia
- Cornell University-USA
- Empresa Brasileira de Pesquisa Agropecuaria-Brazil
- Institut National de Recherches Agronomiques du Niger-Niger
- Institute d'Economie Rural-Mali
- Instituto Nactional de Investigacion y Promocion Agraria-Peru
- International Crops Research Institute for the Semi-Arid Tropics-India
- North Carolina State University-USA
- Texas A&M University-USA
- University of Hawaii-USA

Table of Contents

Synopsis of Recommendations and Actions Taken	3
External Evaluation Role and Process	9
Evaluation Report on Overall Activities	11
Evaluation Report on the Administrative Management	19
Evaluation Report on the Humid Tropics Program (Indonesia)	23
Evaluation Report on the Humid Tropics Program (Peru)	41
Evaluation Report on the Semi-Arid Tropics Program	59
Evaluation Report on the Acid Savannas	81

Synopsis
of
Recommendations Made by the External Evaluation Panel and
Actions Taken by the Soil Management CRSP

1. Administrative Management

1.1. Recommendation: Add two to three members to the Board of Directors from nonparticipating institutions; elect the Chairman from the nonparticipating institution members.

Action: This recommendation is quite recent; there has not been sufficient time for consideration.

1.2. Recommendation: Add an additional member to the Technical Committee from a nonparticipating institution; this member would serve as Chairman of the Committee.

Action: This recommendation is quite recent; there has not been sufficient time for consideration.

1.3. Recommendation: Hold more frequent meetings of the Technical Committee and conduct workshops with cooperating scientists to enhance the development of a unified program.

Action: The Management Entity has assumed responsibility for implementation of this recommendation and some positive actions already have been undertaken.

2. Overall Activities

2.1. Recommendation: Provide CRSP-funded senior scientist positions posted overseas with the same opportunities for tenure, promotion and remuneration as campus-based scientists.

Action: This issue has been brought to the attention of the participating university administrators, and it has received an understanding response. Continued attention will be given to this major problem.

2.2. Recommendation: Encourage more administration and campus-based faculty assistance to field-based CRSP-funded senior scientists in program development, publications and other activities which will enhance their professional development.

Action: This need has been brought to the attention of university administrators and favorably received. Continued attention will be given to this issue.

2.3. Recommendation: Increase cooperation with International Research Centers.

Action: The Management Entity will initiate positive action; initial contacts will be with IITA and CIAT.

2.4. Recommendation: A number of the senior scientists should restrict somewhat the range of activities in which they are engaged to provide more time for in-depth attention to those selected.

Action: This subject has been discussed with the Program Coordinators and positive action is anticipated.

2.5. Recommendation: Give more attention to long-range plans and to the development of annual work plans.

Action: The recommendation is being implemented.

2.6. Recommendation: Program Coordinators should give more attention to conceptualizing and articulating research project proposals.

Action: This recommendation has been discussed with Program Coordinators; some improvements are noted.

3. Humid Tropics - Indonesia

3.1. Recommendation: The research program on land clearing should take into account not only its impact on the chemical constituents and physical properties of the soils, but also to means that will leave the soil in the best condition for farmer operations.

Action: Recommendation will be included in the treatments tested and experimental design employed in the land clearing research.

3.2. Recommendation: Solicit more assistance from other agencies in pest control and plant breeding.

Action: Efforts are being made and some progress has been achieved.

3.3. Recommendation: Include perennial crops, other than pastures, in the research program.

Action: Some actions have been taken; others are under advisement.

3.4. Recommendation: Pastures research should include work with "cut and carry" species, in addition to those predominantly for grazing.

Action: Under consideration.

4. Humid Tropics - Peru

4.1. Recommendation: Take appropriate actions to strengthen the laboratory support services at Yurimaguas, including the addition of some equipment and implementing procedures that will reduce the number of analyses requested.

Action: Some improvements have been made; others are under development.

4.2 Recommendation: Strive to obtain more INIPA input into varietal evaluation, pest control and other disciplines essential to the development of stable farming systems.

Action: INIPA has appointed personnel to the subject programs and collaborative work is in progress.

4.3. Recommendation: Strive for more INIPA input into socio-economic issues.

Action: INIPA has assigned an economist to work with the program at Yurimaguas.

4.4. Recommendation: Researchers should exercise more self-discipline in the selection and initiation of experiments so as to provide more time for data analysis and interpretation.

Action: Subject emphasized in discussions with Program Coordinators and research leaders.

4.5. Recommendation: The CRSP provide leadership in developing a training program that will enhance the development and extrapolation of technology, recognizing that such a program cannot be fully funded by the CRSP, and thus, other sources will be necessary.

Action: Proposal under development which would involve a joint program among SM-CRSP, INIPA, USAID missions and others.

4.6. Recommendation: Develop a long-range plan for the SM-CRSP program in Peru and prepare an annual Plan of Work.

Action: Both recommendations have been implemented.

4.7. Recommendation: Shift leadership for the paddy rice and the pastures program to INIPA.

Action: The paddy rice recommendation has been implemented; the pastures program is being phased out with anticipated INIPA takeover by 1986.

4.8. Recommendation: Recognize the international, regional and country-specific dimension of the work at Yurimaguas and develop appropriate collaborative relationships with other components of the SM-CRSP and international centers.

Action: Plans are being developed to expand the collaborative research through involvement with other components of the SM-CRSP and with IBSTRAM, REDINNA and a tropical soil management research network.

4.9. Recommendation: Increase collaborative work with IITA.

Action: The Program Coordinators for the Peru and the Indonesian programs are in communication with IITA scientists and discussing collaborative research on such projects of mutual interest as land clearing and acid soil tolerant cultivars.

5. Semi-Arid Tropics

5.1. Recommendation: Improve the statement of objective for many of the projects so as to enable one to ascertain the focus of the research.

Action: The subject has been discussed with the Program Coordinator and researchers have been advised to take remedial action. Some improvement has been observed.

5.2. Recommendation: Evaluate the total research program to determine if objectives can be met with available resources, since observations suggest it may be overextended for the number of field-based scientist involved.

Action: The Program Coordinator and Texas A&M University administration have been advised of this concern and presumably the research proposals for years 4 through 8 reflect positive actions.

5.3. Recommendation: Avoid duplication of administrative effort between the two senior scientists posted in Niger.

Action: The on-site program administration has been reorganized to minimize such duplication.

5.4. Recommendation: A more favorable response is needed from AID to requests for personnel engaged in the program to travel to Niger.

Action: The problem has been formally presented to BIFAD and an acknowledgment received.

6. Acid Savannas

6.1. Recommendation: The senior scientist on-site in Brasilia should develop and become personally involved in a research project to complement the collaborative and administrative role he plays in others.

Action: He has developed a project and actions have been undertaken on implementation.

6.2. Recommendation: The level of funding for the program should be increased to permit initiation of a broader range of research.

Action: The budget for the acid savannas program is being increased and additional research projects have been added.

External Evaluation Role and Process

Role

The CRSPs are reported to be unique among AID funded programs in that primary responsibility for the evaluation of the progress and contributions of an individual CRSP is delegated to the Grantee, i.e., its Management Entity. Thus, the document establishing and funding the Soil Management CRSP specifies that arrangements will be made for and such evaluations undertaken as determined necessary and useful. One component of the evaluation process involved establishing an External Evaluation Committee. Specific actions designated for the External Evaluation Panel^{1/} are:

1. Review the projects and program of TropSoils as requested by AID and/or the Management Entity, provide written evaluation reports to the Management Entity, the Board, AID and JRC/BIFAD.
2. Make recommendations for the addition, elimination or modification of component projects and overall objectives.
3. Make recommendations to the Management Entity on retention or elimination of overseas work sites and on the selection of new ones as necessary.

Process

Membership on the EEP is composed of experienced scientists with international agricultural development expertise and who are appointed by the Management Entity, in consultation with the Technical Committee and with the advice of the Board of Directors and JRC. Members are from institutions who are not active participants in the program. In addition to the regular members, the EEP is augmented with additional personnel for specific evaluations.

^{1/}The Soil Management CRSP has chosen to use the term "External Evaluation Panel" rather than "External Evaluation Committee" referred to in the grant document.

The following personnel constitute the EEP for the Soil Management CRSP:

Dr. John Coulter, Chairman
Agricultural Research Advisor
World Bank

Dr. Marlowe G. Thorne, Secretary
Professor Emeritus
University of Illinois

Dr. Peter E. Hildebrand
Professor, Food and Resource Economics
University of Florida

Valuable assistance has been provided on special projects by:

Dr. Tony Juo
Head, Farming Systems Program
International Institute for Tropical Agriculture

Activities to date of the EEP have been undertaken at the request of the Management Entity following consultation with and concurrence by the Board of Directors and Technical Committee. The reports and recommendations resulting from these studies are reported herein and are being utilized in planning current and long-term activities.

Evaluation is a continuing process. As the level of activity in TropSoils increases, there will be an increase in the request for assistance from the External Evaluation Panel.

Evaluation Report on Overall Activities
of the Soil Management CRSP

SUMMARY

This is the first evaluation of the Soil Management CRSP by the External Evaluation Panel. Programs led by four U. S. Land Grant Universities are underway in four tropical countries at sites representative of three major agro-ecological zones. At one location there are senior scientists from two of the Universities. One University has subsidiary sites in three additional countries representative of the agro-ecological zone of its primary site. One University will soon have a graduate student located at the primary sites of another University. All research is in cooperation with a counterpart institution or agency in the host country.

The three members of the External Evaluation Panel (EEP) completed on-site visits to the four programs in tropical countries and visits to the home campuses of three of the four U. S. Universities involved during the period from March through October, 1984. The EEP met with the Technical Committee, Board of Directors, and Director of the Management Entity November 13-15, 1984. The EEP had another meeting January 19-20, 1985.

The EEP finds that progress on the Soil Management CRSP is generally very good and accomplishments are well within expectations at this stage of the program. Usual start-up problems have been experienced at each location and some unusual ones have been encountered at some locations. Staffing of senior scientists at the research sites is generally complete and numerous graduate student research problems are also underway. Backstopping by faculty members at the home campuses has generally been good and most have had opportunity to make one or more visits to the field location involved. Field and/or laboratory and/or office equipment has been obtained for each location. Vehicles have been purchased for each research location and are in use.

All research projects underway have objectives in line with overall CRSP objectives and show little deviation from the objectives of the project proposals originally submitted. All projects show at least satisfactory promise yielding results which will contribute to the achieving of the CRSP objectives.

The evaluation report for each program gives the specific strengths of that program and gives some concerns of the EEP regarding that program. There are some concerns which are common to all programs under the CRSP. It appears appropriate to present them here. Effort is being made by those responsible for the program to correct these problems and some progress is evident. However, some of these concerns are occasioned by campus-wide policies which are beyond the ability of the CRSP researchers or administrators to change. Additional effort is needed to correct the situation if full benefit of the CRSP is to be realized.

Nearly all senior scientist positions at the field locations have been filled with persons not already on the faculty of the respective University and their positions are usually considered to be "non-permanent". While qualified persons have been hired for the program, the EEP feels that maximum benefits to the U. S. Universities will not result from the CRSP activities if these

persons do not return to the home campus after an appropriate period of service overseas. It is important to utilize their experiences and improved competences in tropical soil science in programs of teaching, research, and public service at home. They should be a source of guidance and inspiration to students (undergraduate and graduate) and to other faculty members having interests in tropical agriculture.

Most universities appoint to non-permanent (and non-tenure-track) positions those faculty members who are supported on "temporary" funds. This is understandable as administrators and faculties take certain risks in having a high proportion of faculty on "permanent" positions when funding is not assured. However, not even state or federal funds are absolutely guaranteed to be forthcoming each year. The EEP believes the probability is good that funds will be available for this CRSP for at least another five years. That should give adequate time to move the senior scientists on this CRSP to tenure-track positions if their services indicate they would qualify for such positions on the home campus or a state research/extension center.

All concerned with the CRSP recognize the difficulty involved in a faculty member's being able to produce many research publications while serving overseas on a program such as this. Additional consideration needs to be given to developing procedures and policies for appointment or promotion to tenured positions based on the overall performance of the staff member under conditions less than ideal. Many campus promotion committees and some administrators do not recognize the greater amount of time and effort involved in conducting field and/or laboratory research in a different country. Equipment, supplies, trained personnel, transportation facilities, and other logistical support services may not be readily available and surprisingly long delays may be encountered. Those who have not had such overseas experience may not recognize the differences in time involved.

They may need to be educated if they review or approve appointments and promotions.

A faculty member on a research appointment overseas may find that of necessity he or she is involved in institution building also. Likewise, he or she may be involved in training support people, in budgeting, purchasing, accounting, and many other duties which are time-consuming. These activities may be quite essential to the research program, but they are different from what is required for an equally important research project at home.

These differences between conduct of research at home and on an overseas assignment have generally precluded extensive involvement of younger faculty members who are on tenure-track appointments and who have a limited number of years to achieve tenure. Again, perhaps a change in policies and procedures for promotion could encourage their participation to a greater degree and they could make a greater contribution. In the meantime, they can be involved in short-term assignments to a limited degree and they can direct thesis research of students with interests in projects such as the Soil Management CRSP. They must be given opportunity to become familiar with the soils, agriculture, climate, and cultural characteristics at the research location. It is gratifying to note that most of the universities in the CRSP have shown evidence of such limited involvement of younger faculty members. Travel budgets have evidently been adequate to permit one or more visits to the research site by such involved faculty. It is hoped that their involvement will continue throughout the life of the CRSP and thereafter.

There appears to be opportunity for greater cooperation with International Research Centers. Some senior scientists and project coordinators have visited the appropriate Centers; others have not. All need to maintain close contact with the Center programs through correspondence, reading of publications, and

occasional visits. Cooperating host country scientists need these contacts also and effort should be made to promote such when possible. A visit by a Center scientist to the CRSP research location can be valuable and may be even more valuable if it coincides with the presence of the project coordinator or other backstopping person from the home campus.

Continuing effort should be devoted to extending results coming from research under the CRSP to countries other than the host. As pointed out in one of the evaluation reports, this can sometimes be a sensitive point with host country scientists and administrators if they assume a paternalistic attitude toward the program in their country. They should be convinced that while they have a real partnership in the research, it is the responsibility of the CRSP to extend research information to the whole agro-ecological Zone in which the research is done. Cooperative efforts with International Centers and other international organizations should help with the extension of CRSP research results.

There appears to be a tendency of some CRSP senior scientists to become involved in too many activities, both research and otherwise. While each activity is undoubtedly worthwhile and making a contribution, the effectiveness of the scientist may be reduced because he or she cannot devote adequate time and effort to each experiment or other activity. Both senior scientists and project coordinators should be sensitive to this possible problem. When reports and scientific publications are not forthcoming within a reasonable time after data have been collected, the coordinator should begin to ascertain the reason and proceed to correct it. Many young scientists find it difficult and confusing to write the first scientific paper and assistance and encouragement may be needed. What may be a slight problem at home sometimes becomes a major one in a more professionally isolated environment.

Additional effort should be devoted to long range planning of research programs and to development of annual work plans.

The exercise recently completed for the development of plans for the next five years of the CRSP may have taken care of deficiencies in long-range planning noted in the evaluation visits. In any event, this should be a matter of continuing effort. Planning sessions must be held with host country and other cooperators to keep all informed of progress and to develop truly cooperative programs.

Graduate student research supported under the CRSP must be an integral part of the total research program at that location. If it does not contribute to CRSP objectives, it should be supported with other funds. Proposed graduate student research should be discussed at the planning session and evaluated by all cooperators as is done for any other research project.

While there are many differences among the soils, climates and cropping systems at the four research sites, there are some common soil problems. For example, each program coordinator reports problems with acidic soils, low fertility, and high levels of exchangeable aluminum. It would seem advantageous for each University to take the lead in working on one or more major soil problem with concentration at its principal location but with cooperative work at other locations. At the Cornell review, it was suggested that university might take the lead role in the study of nitrogen availability in tropical soils. It has an excellent program underway both on campus and in Brazil. Cornell scientists involved might collaborate with scientists of the other three universities and their host country counterparts and do cooperative research at additional locations. Similarly other universities might take a leadership role in study of other soil problems common to all zones.

Some difficulty has been experienced by EEP members in understanding clearly the objectives of many of the projects. Some stated project objectives are really experimental procedures. In some cases it is difficult to visualize that hypothesis is

being tested in the research. As indicated in two of the evaluation reports, project leaders might profit from study of a good book on research philosophy and methodology. One such book was suggested. Perhaps the Management Entity could arrange to have a copy of such a book sent to each senior scientist, each project coordinator, and to some other researchers involved in the CRSP. Better stated objectives of the research projects would assist materially in the reader's understanding of the purpose and the aim of the project.

The EEP found that all four programs were progressing satisfactorily and that they should be continued with no major changes. Some minor changes have been suggested for each program. It is really quite early in the life of the CRSP for this detailed a review but the need for planning for the next five years mandated the review at this time. The EEP believes that the Collaborative Research Support Program is an excellent vehicle for stimulating and supporting research in soil management which will lead to increasing and sustaining agricultural production in the developing world, while conserving and improving the land research base.

Evaluation Report on the Administrative Management
of the Soil Management CRSP

1. Effectiveness of the Board of Directors

The Board was organized according to agreed procedures and has functioned effectively in carrying out the duties envisioned for such Board for this CRSP. One administrator from each of the participating U. S. Universities and from each host country institutions serve as the Board. The Board elects one of its members to serve as Chairman. There has been good continuity; only one change has been made in a U. S. university member and one in a host country institution member. Both changes were occasioned by changes in duties of the Board members.

The Board has met at least once each year. An Executive Committee of the Board has met at additional times as needed. The relationships of the Board to the Technical Committee, Management Entity and the External Evaluation Panel have been good; joint meetings have been held annually.

The Board has taken very seriously its responsibility to review budgets and expenditures under the CRSP as well as to review programs, progress, and accomplishments of the CRSP. There has occasionally been some lack of recognition that the Management Entity has fiscal responsibility for all grant funds for the Soil Management CRSP received from AID. No serious problems have been evident to the EEP, but it must be kept in mind that the role of the Board is to review and recommend and the ME has responsibility for approving projects and budgets.

Each U. S. Board member has a special interest in the program of his or her university's program under the CRSP, as might be expected. Similarly each host country member has special interest in the program in his country. While

the Board has exhibited as much objectivity as could reasonably be expected, the EEP suggests that the addition of two or three Board members from non-participating U. S. Universities or International Centers might be beneficial. Since being Chairman places a Board member in a particularly difficult situation at times, perhaps the Chairman should be elected from these additional members.

2. Effectiveness of the Technical Committee

Each member of the Technical Committee has had extensive experience in research in tropical soils and has been actively involved in the CRSP since its inception. While they have different backgrounds and viewpoints, they function well as a Technical Committee. Their relationships with the Board, the Management Entity and the EEP are very good. The EEP believes they have planned excellent programs of research and are generally administering them in a very satisfactory manner. Relationships with technical and administrative leaders in host countries is quite satisfactory. Competent senior scientists have been identified for location in the host countries and they have generally been given quite adequate backstopping assistance. The training aspects have been given attention and show promise of producing some excellent people with specialization in tropical soils.

The Director of the Management Entity reports difficulty in receiving reports from Technical Committee members on time. Since each one has other duties than those of the CRSP, some delays are understandable. However, in some cases delays have been excessive and greater attention must be given to timeliness if the reporting responsibility of the ME is to be met.

Since each member of the Technical Committee serves as Program Coordinator for his University, each is involved in considerable administrative duties. The number of administrative support positions on the home campus and in the

host country varies from a total of 0.5 FTE to 6.0 FTE amongst the four programs. It is interesting to note that there seems to be no direct correlation between the number of support personnel provided and the timeliness of reporting.

The Technical Committee is encouraged to meet as often as needed to exchange ideas and to keep each other informed of program plans and progress. It is suggested that more workshops be sponsored which would involve cooperating scientists as well as Technical Committee members. Some of the workshops could be held in connection with professional society meetings to reduce costs and travel time. Others might be held at research sites in host countries to involve host country cooperators as well as to give Technical Committee members an opportunity to observe programs at the location.

The Technical Committee is encouraged to plan a global program of soil management. Preliminary discussions have been held and detailed planning must follow. It will require even closer collaboration amongst U.S. universities and host countries and must utilize the strengths of each.

The EEP suggests it may be beneficial to have as chairman of the Technical Committee a soil scientist who is not from one of the participating universities. The Technical Committee members might nominate one or more persons to the director of the Management Entity, who would ascertain availability and willingness to serve. The costs associated with this person's service with the Technical Committee would be met from the Management Entity budget.

3. Effectiveness of the Management Entity

The officials of North Carolina State University who carry responsibility for the Management Entity have been most supportive of the CRSP and of the Director of the ME. One or more has met with the Board, Technical Committee and EEP at the annual meetings and have contributed substantially to the discussions and deliberations.

The Soil Management CRSP is fortunate in having as Director a soil scientist with vast professional and administrative experience and who has been involved in the CRSP since its inception. He has visited all the research sites and all home campuses at least once since becoming Director. He works effectively with AID representatives, Board of Directors, Technical Committee, EEP, senior scientists, graduate students, and all others connected with the CRSP. He is a most capable Director and a significant portion of the success of the CRSP thus far is due to his efforts and his fine working relationships with all others.

A need was recognized for better communication among those directly involved with the CRSP and with governmental bodies and others interested in its progress. An editor has recently been added to the staff of the Director and it is believed that this will result in greatly improved communications. The editor has been given opportunity to visit two of the research sites and two home campuses and other visits will follow.

Evaluation Report on the Humid Tropics Program
(Indonesia) of the Soil Management CRSP

SUMMAPY

The SM-CRSP in Indonesia, under the leadership of the University of Hawaii and North Carolina State University, is off to a good start. It has made a strong effort to integrate the Indonesian agronomists into the team and this should have good impact, not only in training them in a variety of aspects of field experimentation for soil fertility management, but also in training them to work as part of an integrated team trying to identify problems from the farmer's point of view. The team is faced with many challenges in developing economic management systems for these soils. It cannot tackle all of the problems alone but it forms an excellent focal point to which other research programs could be attached. The team should be encouraged to seek help from some of the other institutes in AARD in the form of small teams on pasture, tree crops and cultivar selection work on annual crops. The project could thus be used to build up a strong capacity in the search for improved agriculture for these soils which are representative of large areas of Sumatra, particularly those being used for transmigration schemes.

Evaluation Report on the Humid Tropics Program (Indonesia)
of the Soil Management CRSP
John K. Coulter^{1/}

Introduction

This project is a joint program of the Center for Soils Research in Bogor (one of the AARD institutes) and the Soil Management CRSP (SM-CRSP) funded by USAID and executed by the University of Hawaii and North Carolina State University.

The project is planned to provide guidance for soil management of the oxisols and ultisols, commonly referred to as the red yellow podzolic soils, of the humid tropics. The first stage of this long term program began in July 1983 at Sitiung, a transmigration site in West Sumatra, with a team consisting of two agronomists and an anthropologist from the two universities and seven agronomists and support staff supplied by the Center for Soils Research.

I visited this research program March 25 - 30, and was accompanied by Dr. McCants of the Management Entity, Dr. Nicholaides of the N. C. State University research component and Dr. Uehara from the University of Hawaii. Dr. Draper of the RSI joined me towards the end of the mission.

Indonesian institutions, more specifically the Crops Research Institute and the Agricultural University in Bogor, have been involved in research on similar soils in Sumatra and Kalimantan for some time but the improvement of the fertility of these soils and the development of annual cropping systems that are technically and economically viable pose many difficult problems. However, the development of such systems is crucial for the transmigration programs supported by the Indonesian Government and the World Bank, as long as such programs include annual upland crops as a major segment of the farm model.

^{1/}Based in part on a visit to the research site at Sitiung, West Sumatra, March 25 - 30, 1984.

Though the team has been in the field for less than a year it has made excellent progress in developing a good research program and in identifying the important problems facing transmigrant farmers on these soils. The innovative feature of having a social scientist as a member of a soil management research team is already helping the team to develop a sharper focus on priorities for these farmers.

The ongoing research program is summarized in the Appendix and this report will, therefore, focus on some of the implications of the program for the future.

Land Clearing

This has been a controversial topic for several years. The argument often centers around the damage done by machine clearing viz-a-viz that done by manual clearing. It is proposed to start a fairly large scale experiment on this topic but, because of the long term nature and expense involved, much thought needs to be given to the objectives of such an experiment. It is worth emphasizing, however, that many of the problems with both manual and machine clearing are due to the fact that they are badly done. In manual felling in Sitiung V, for example, felling of both small and large trees has not been properly done and the burn has been poor, leaving the transmigrants to cope with an enormous quantity of logs and stumps. Many of the trees have been felled into the drainage ways.

One obvious answer, of course, is better supervision of contractors to ensure that the job is done properly. However, the farmers still need help in clearing the land. Chainsaws are one possible answer but it appears worth exploring the use of cross cut saws with the concomitant instruction in their maintenance. Another aspect of manual clearing in this scheme, and several others, is that the settlers are expected to fell and clear their second hectare themselves, yet these settlers from Java have absolutely no experience of jungle felling and (quite

rightly) regard it as dangerous. There is obviously a need therefore for some kind of scheme which will train a nucleus of settlers in jungle felling and burning.

The second important aspect of manual clearing for annual crops is the condition in which the soil is left. Unlike the local farmers, who, after felling and burning, dibble the seeds into the soil, the Javanese settlers prefer to hoe their land, tilling the topsoil completely. Indeed this is necessary if lime is being added and is probably useful for phosphate dressings also. However, the topsoil of these jungle areas is full of roots and the traditional Javanese hoe is not suitable for dealing with these. Worn and broken hoes of the farmers demonstrate this only too well. The farmers would probably be saved considerable effort if they had a differently designed and stronger hoe.

Regarding machine clearing, the areas that have remained completely sterile, even of weeds, several years after bulldozing demonstrate only too clearly the impact of such clearing. However, no one advocates the use of bulldozers for clearing for agriculture and the question is, what are the advantages and disadvantages of land clearing properly done by machine, e.g., by using a properly operated KG blade? However, this method of clearing still leaves open the question of what to do about the roots in the areas designed for annual crops.

An experimental program looking at land clearing has therefore to take into account not only the impact on the chemical constituents of the soils and such physical factors as can be measured experimentally, but also must look at what the farmer needs in the way of soil conditions, after clearing, to give him the best start in his farm operations.

Soil Acidity and Liming

Most of the soils are extremely acid, having up to 80 percent Al saturation and very little exchangeable Ca and Mg.

Consequently, only a few annual crops, of which upland rice is one, can survive without liming. Government has now started a liming program to encourage farmers to grow soybean (of which there is an Indonesian import for food of 400,000 - 500,000 tons). Ground limestone at the rate of 3-½ tons/ha (and at a cost to the government of about \$210 per ha.) is being delivered free to the farmers. However, there is inadequate field experimentation to determine optimum rates of liming and to link liming responses with soil analyses. The first year's results of the experiments being done by the SM-CRSP team would indicate that 2 tons lime/ha is adequate. The residual effect is also quite considerable.

The program in the Sitiung areas has demonstrated that government can, at a price, organize a ground limestone industry that delivers high quality material to the farmer and that the farmer is capable of spreading such quantities by hand very efficiently. It is indeed unfortunate that such a large investment program does not have a better agronomic and economic basis than that presently available. The problems comprise not only the correct amounts, but also the method of application, e.g., the advantages of hoeing into the soil deeply and the impact on the trace element status, e.g., zinc, in these poorly buffered soils. It must be emphasized that these farmers have no experience in the use of lime and the readiness with which they adopt liming must be attributable not only to the fact that it is free but also that they are prepared to try many things in order to improve their production. It follows, therefore, that the series of liming experiments now under way by the TropSoils team should help considerably in determining how to use this soil amendment efficiently.

Plant Pests and Diseases

Pests and diseases present major hazards for the settlers. The problem of vertebrate pests, rats and wild pigs, are well

known but there seem to be few concerted efforts to deal with them. The wild pig problem lessens as the jungle disappears but rats remain a problem and in the absence of some form of well managed poisoning campaign are likely to continue so.

Plant diseases also cause considerable difficulties, one of the most serious being blast of upland rice. The project has tested IRRI varieties but none of these, so far, show particular promise. The effects of disease on rice are well demonstrated in the SM-CRSP trials and in the farmers crops. In the trials the best grain yields have been in the range of 2.5 tons/ha but straw yields are up to 10 ton/ha which suggests that much larger yields of grain are theoretically possible if disease resistant varieties could be found. Yields in the farmers' fields are much lower, probably not more than 700 - 800 kg/ha on average. The effects of disease, particularly blast, are exacerbated by adverse soil and climatic conditions and it remains to be seen whether the attacks can be reduced by improving the soil fertility.

Pest and disease problems of crops are difficult for the team to cope with as it has no specific expertise on these topics. It has received help from the research center at Sukarami but progress in developing good cropping systems will require considerably more input from plant breeders and pathologists and it is hoped that such support can be increased in the future, perhaps through the station at Gunong Medan. It would indeed be a pity if the development of improved farming systems failed for lack of that most traditional of research activities, plant breeding.

Farming Systems Research

The farming systems program is designed to support the work on soil fertility management, thus ensuring that it is relevant to the farmers problems and at the same time attempting to define more clearly the major problems of the farmers. The program has

made a good start and is closely interlinked with the agronomic program. Indeed all of the agronomic work is being done on the farmers' lands, though the degree of farmer participation varies from nil to quite large. Like all programs of this nature, the major challenge is the maintenance of a balance within the overall project so that the research can be confined to a relatively few but important areas.

The work with 20 farm families operating on recently cleared land has given the team a good insight into the problems confronting the settlers, as previously described. By working with the farmers on their preferred rotations, information is also being collected on the labor input and the role of women in the farming systems. The anthropologist is also doing other research among the settlers, which includes determining the division of agricultural labor, the amount of time devoted to livestock, the amount of off-farm wage earning activity (which is large).

The research on farming systems with a soil management focus is providing much useful information for the project. The interdisciplinary nature of the research should keep the farming systems work from becoming too diverse and at the same time provide the soil management research with essential backup in its work for the settlers.

Perennial Crops

The issue of perennial viz-a-viz annual crops is one that has persisted since the major transmigration programs started. The question usually raised is, is it possible to develop systems of sustained annual cropping which are socially, technically and economically acceptable? Stated another way, the question is, given the poverty of the soils, the problems with pests and diseases, the periodic intra-seasonal droughts and the shortage of labor (in the absence of animal cultivation) can the farmer on these soils, depending only on annual crops, rise above the subsistence level? It may be possible to answer this question

in four to five years, though, given the experience of some of the other settlement projects and the problems encountered in growing good crops at even the experimental level, I am inclined to the view that it is going to be very difficult and, in many areas, perhaps impossible. Consequently, it would be wise to include some experiments with perennial crops in the program, in particular on some of the areas with slopes above eight to ten percent. This might be done by involving the Rubber Smallholders Research Institute at Sembabwa in some experiments, intercropping food crops with rubber and with other tree crops, particularly coconuts. Such work, involving the farmers as the other experiments are now doing, could provide good information on how to integrate perennial crops and annual crops on these poor soils.

Similar considerations apply to pasture; there is already a small trial of grass species (for grazing) provided by CIAT but as the farmers are interested in stall feeding, it would be worthwhile trying other species suitable for "cut and carry". The survey carried out by the anthropologist shows that the farmers have major interest in ruminant livestock and already put a considerable effort into cutting and carrying the very poor quality roadside and wasteland grasses. Such grasses are low in nutrients, including minerals.

Conclusions

The SM-CRSP is off to a good start. It has made a strong effort to integrate the Indonesian agronomists into the team. This approach should have a good impact, not only in training them in a variety of aspects of field experimentation for soil fertility management, but also in training them to work as part of an integrated team trying to identify problems from the farmer's point of view. The team is faced with many challenges in developing economic management systems for these soils. It cannot tackle all of the problems alone but it forms an excellent focal

point to which other research programs could be attached. The team should be encouraged to seek help from some of the other institutes in AARD in the form of small teams on pasture, tree crops and selection work on annual crops. The project could thus be used to build up a strong capacity in the search for improved agriculture for these soils which are representative of large areas of Sumatra, particularly those being used for transmigration schemes.

Appendix
Soil Management CRSP Activities^{1/}
1983 - 1984

The Soil Management CRSP (SM-CRSP) is a joint endeavour of the Indonesian Government (specifically the Center for Soils Research in Bogor) and the AID, through grant funded support. The goal of the project is to provide information and, ultimately, guidance for soil management in the humid tropics. There is a specific concern, in Indonesia, that the project address the problems of these ultisol-oxisol-entisol soils so common in Indonesia's Outer Islands. The first stage of this long term project has begun in Sitiung, a transmigration site in West Sumatra. For the immediate future, our goals are twofold: to rehabilitate lands that have been adversely affected by the land clearing methods used; and to develop soil management strategies that will render sustainable agriculture feasible in the area.

One of the important characteristics of this project is its upfront recognition that the ultimate beneficiary of this kind of research should be the people who live on the soil. We also recognize that there has traditionally been a gap between what scientists learn from their research on the one hand, and what farmers and community members on the other are willing and able to practice. In this project, we are explicitly trying to bridge that gap, recognizing a) that the people have valuable information about their own environment, preferences, goals, and constraints, and b) that we need to attend to those concerns in deciding what to investigate.

Our research to date can be seen to fall into four main categories. The first represents the most traditional, perhaps, from a soil science point of view. Previous scientific work had been done in the area before we came. Problems of soil variability, acidity, infertility, and erosion had all been identified

^{1/}Prepared by on-site personnel at Sitiung for the Program review.

beyond a shadow of a doubt. The following experiments were devised to follow up on our preliminary information and establish these environmental parameters firmly.

Soil Variability

It has been observed both on farmer fields and in experimental plots that there often exists extreme micro variability of soil productivity, i.e., great differences in plant growth within a few meters difference. It is not uncommon to see dead or dying plants (barren soil) within one or two meters of healthy, vigorous crop plants. This study, therefore, was established to determine or correlate soil chemical and physical properties most influential in causing the extreme crop growth and yield variability. An area 20 x 20 m in Sitiung IIE was chosen and intensively sampled in a non-random fashion suitable for making geostatistical analysis of the variability of soil and crop parameters. A total of 121 samples/observation sites were selected. Upland rice, peanuts and cassava will be grown in succession with the goal of determining which soil factors are responsible for the variation.

Soil Acidity

Soil analysis, field observation and previous experimentation have shown the soils of Sitiung to be extremely acid, and few crops grow well without liming. Two lime experiments have been established: One concerns lime rate and maintenance with the main objectives being to determine (1) initial rates of lime necessary to achieve a desired level of acidity (Al saturation) and (2) rate and frequency of lime applications to maintain the desired level. The second is a lime source and method of application experiment comparing two sources of lime, namely burned Ca(OH)_2 and ground CaCO_3 in combination with five methods of application, including surface (no-till), hand hoe (15 cm.), cattle-drawn plow (15 cm.), rototiller (15 cm.) and spading fork (30 cm.)

Soil Nutrition

Several experiments have been established dealing with individual soil nutrients. These include:

1. Mg experiment with 2 sources and 5 rates of Mg,
2. P experiment with 4 rates and 5 methods of application,
3. N experiment with 4 rates and 4 sources,
4. Set of three IFDC experiments,
 - a. lime x P
 - b. N source and rate
 - c. P rate (as TSP) and rock phosphate (partially acidulated)
5. a graduate student from NCSU will be coming in 1984 who will investigate K fertilization, i.e., rates, sources, time of application.

Erosion

Soil erosion on the sloping lands of Sitiung is severe. Gullies, exposed subsoil, and red, murky rivers are telltale signs of the effects of annual crop farming rolling and steep hillsides under the intense rainfall climate of Sitiung. A large experiment with walled plots and soil and water collectors has been installed. Treatments include no control, bunds (contour terrace) and bench terraces. Further treatments include leaving the above terraces bare or planted to Bahia grass and mulching or not mulching the channels in order to catch the eroded soil. These plots will be cropped with an annual rotation of rice, soybeans, and cowpeas.

The second major category of investigation has a close connection to agronomy. Because of concern that findings be immediately applicable, we have instigated a number of experiments aimed at specific crops. Rice, as can be seen, is important in almost all of them, since it plays such a vital role in the Indonesian diet and marketplace. Over 40 varieties and lines of upland rice were obtained from IRRI and planted in two locations.

This experiment is the acid upland screening nursery from IRRI. The 40 lines and varieties were planted under four fertility situations:

- a. no lime, no P
- b. no lime, 60 kg P/ha
- c. lime = $\frac{1}{2}$ exch Al, no P
- d. lime = $\frac{1}{2}$ exch Al, 60 kg P/ha.

It will be continued each year with IRRI upland rice group supplying materials.

A similar experiment will be established with 15 varieties of soybeans in 2^2 factorial, i.e., no lime, lime and no inoculant, inoculant.

As germplasm is identified from screening for acid and/or P tolerance, varieties of additional crops will also be utilized, e.g., peanuts, corn, cowpeas, as well as local strains of dryland rice.

Two more experiments have been undertaken in direct response to our findings since we came here. The new governmental emphasis on palawidja crops has included a planned pilot program for increasing soybean production. The team's recognition that the planned package may be deficient in certain essential nutrients (notably P and K) and fear that the entire program could fail for lack of same has resulted in a series of experiments on soybeans in Sitiung I.

Three locations in Sitiung Ia and three in Sitiung 15 were selected for experimentation. The treatments included a control (no lime or fertilizer), the government recommendation (3.5 t/ha lime and 50 kg TSP/ha) and various combinations of higher rates of TSP and KCl with the government supplied lime rate (3.5 T/ha). The purpose of these experiments is to determine if the recommended 50 kg TSP was adequate fertilizer for the limed soybeans. Lime is being supplied free of charge to the farmers but at great expense to the government (Rp 200,000/ha). It was hypothesized that with lime and insect control, higher rates of P and K fertilizer would be very profitable for the farmers. (Although lime

is supplied by the government, the farmers are to buy their own fertilizer.) It was hoped these experiments could demonstrate to the farmers the profitability of using fertilizers in connection with the generous subsidy of lime by the government.

Our interest in pasture experiments has increased since we have been on site, because of our observation that, besides having the potential of adding fertility to the soil and serving as a cover crop minimizing erosion, the people are currently spending a considerable amount of time in pursuit of grass for their animals (in Sitiung I and II). This suggests that pasture may be something of interest to them. We have obtained 21 kinds of pasture seed from CIAT, and planted them in Sitiung II.

This experiment is also known as the CIAT Trial B. It has been successfully established, although only one grass seed was still viable and the remaining 16 entries are legumes. The interest and desire by the farmers and suitability of this climate and landscape for pasture development all point to this work's being expanded to include more grasses and to test grass-legume mixtures. This will be done as seed is obtained.

Our third category of experiment derives from our commitment to seek cheaper methods than chemical fertilizers for enhancing soil fertility and productivity. One route is to seek substitutes like the residue from biogas plants or the possibly hormonal effects of worm casts for enhancing plant growth.

A few grams of worm cast material added to each seed hole produced dramatic responses in the greenhouse in Bogor, and is now being tested in the field here in Sitiung. Also various rates of residue (effluent) from a functioning biogas generator in Sitiung II are being tested solely and in combination with manufactured fertilizers as a soil amendment.

We are also interested in the use of green manure or cover crops as a soil improvement. Although we do not yet have an experiment dealing exclusively with green manure, it is a component

of a reclamation experiment (to be explained next) and our farming systems research (to be explained later). Also a graduate student from UH plans to come in September 1984 who may work on green manuring and/or alley cropping with legume trees.

A final component experiment that is underway in Sitiung Ile is a reclamation experiment. A very severely degraded, barren hillside was chosen for the site. It was cleared in 1978 by a dozer and was denuded of topsoil and vegetation. It has been essentially sterile since then. An experiment (to be the Ph.D. dissertation research of Karim Makarim) was implemented with both soil chemical and physical treatments aimed at determining what inputs might be required to bring this back into production.

The fertility treatments are:

main plots

1. no lime or fertilizer
2. low levels (to achieve critical value soil test levels) of lime, N, P, K, Mg, S, Ca, Zu,
3. high levels (to achieve optimal values of soil test levels) of lime, N, P, K, Mg, S, Ca, Zu.

split plots

1. hoe
2. hoe with post-emergence mulch (Calapagonium)
3. hoe and incorporate green manure (Calapagonium)
4. spading fork (deep tillage to 30 cm)
5. strip fork (deep till only alternate 20 cm strips)
6. rototiller

These treatments were installed on refurbished bench terraces that had been previously constructed by the farmer.

Our fourth and final category of research is the most atypical component for a soil management project. This research is designed, not to be a separate component, but rather to feed into all the components and to help us determine our research priorities so as to be maximally consistent with the interests,

constraints and opportunities that exist in the communities where we work. We began this process in Sitiung V (discussed at length in "Farming Systems: The Process in Sitiung"), working closely with 20 transmigrant families on their own land. The following experimental design was created in collaboration with these farmers, and is being implemented by them with informal help from TropSoils personnel.

Each farmer has four 10 x 20 m plots which received the following treatments:

- a. no fertilizer
- b. the government subsidy (100 kg urea, 100 kg TSP/ha).
- c. 800 kg/ha rock phosphate plus the above government subsidy.
- d. 2.5 T/ha lime + 100 kg/ha urea and 200 kg/ha TSP.

The yearlong cropping system used on these plots follows (planted consecutively):

- a.* Plant half red and half white rice in each plot,
- b.* When rice is two months, relay plant rows of cassava every 5 m.
- c.* Plant 3 rambutan trees per plot.
- d.* Plant chilis after harvesting white rice; and peanuts after red rice.
- e. Plant a vegetable combination consisting of tomatoes, chilis, eggplant, and long green beans, after the chilis; and mucuna been after the peanuts.
- f. Next wet season, plant rice again to determine impact of cover crop on yields.

In conjunction with these experiments, frequent communication with farming families was maintained to ascertain problems and opportunities that emerged. Additionally, a time allocation study and a series of interviews with our 20 cooperator families and 20 other randomly selected families were undertaken.

*Starred items are already accomplished.

In Sitiung I, we have undertaken another time allocation study and a study of cows and goats (in collaboration with the Small Ruminants (CRSP) because of our interest in pasture as a possible TropSoils activity.

A food consumption study has been planned to take place in April and May in Sitiung I and V. This will provide us information to help select experimental crops that will be most acceptable and to provide baseline data for nutritional assessment of community eating patterns in the two locations.

Farmer record keeping data have been collected from 14 farming families in Sitiung IV, by Dr. Doug Perry of the Food Crops Institute. We just received permission to analyze these economic data and plan to start in April.

Evaluation Report on the Humid Tropics
Program (Peru) of the Soil Management CRSP

SUMMARY

This component of the Soil Management CRSP is conducted by North Carolina State University and is administered by the Soil Science Department. There is an excellent administrative structure, with a highly competent and experienced support staff. Technical backstopping of the program is good for there are a large number of the faculty who have had overseas experience and, therefore, an understanding and empathy with research in the tropics. The quality of the research is good and all the personnel involved in the project, both in the field and on campus, are dedicated to their work.

A problem facing management of the program is the question of staff tenure. University policy is not to employ tenure-eligible faculty on grant funds. Building a strong capacity for work in the developing countries requires some solution to this problem. A related problem is promotion, which is based heavily on the traditional approach of research accomplishments as evidenced by publications. An objective system that rewards all-around performance under the less-than-ideal conditions which prevail in overseas research is encouraged.

The wide-ranging series of programs conducted at Yurimaguas over the years has built up a wealth of information about long term annual cropping of these soils, on the effects of land clearing and the management of different fertilizer regimes. The experience thus gained has raised a number of very interesting issues of a technical, economic and management nature. Serious consideration of the impact of these issues on the future

strategy of the SM-CRSP and program planning is warranted.

The review team's opinion is that the country-specific, regional and international dimensions of the work centered at Yurimaguas need to be taken into account in designing the future strategy of the program. The country component could concentrate on the selva area in which the SM-CRSP would serve a lead role in generating soil management technology and a subsidiary role in working with INIPA in testing commodity technology and in developing improved production systems.

The review team is strongly of the view that the SM-CRSP provides an excellent opportunity to develop a strong international network on management of soils in the humid tropics. This should include closer collaboration with IITA, cooperation with REDINNA and structuring the Indonesia program so that it is regarded as a full partner.

Evaluation Report on the Humid Tropics
Research Program (Peru) of the
Soil Management CRSP
John K. Coulter, Peter E. Hildebrand and
Anthony S. R. Juo^{1/}

Introduction

This report presents the findings of a review team comprising John R. Coulter, (Team Leader) Peter E. Hildebrand and Anthony S. R. Juo which visited N. C. State University (NCSU) and Yurimaguas, Peru, during the period May 4 - May 12, 1984. During the course of the review, they were accompanied by John L. Malcolm, AID/W; Charles B. McCants, SM-CRSP Director; Manuel Arca, INIPA; Adolfo Jurado, USAID/Lima and Pedro A. Sanchez, NCSU.

The team spent one day (May 4) at NCSU meeting officials of the university, attending presentations by a number of NCSU staff and graduate students on their program and discussing the support services being provided by NCSU. It then proceeded to Peru on May 5 and left there on May 12.

This report does not attempt to cover in detail the research that is being done at Yurimaguas and by staff at the NCSU campus in support of the program since this is well covered in the excellent publications of the project and in the material prepared for the review team. However, we would like to record our impression that the quality of the research is good and that all of the staff involved in the project, both at NCSU and Yurimaguas, are very dedicated to the work. We were particularly impressed by the enthusiasm and energy of the staff and graduate students at Yurimaguas and by their determination to develop a center of excellence in tropical soil research under less than ideal

^{1/}Based in part on a visit to the N. C. State University campus on May 4, with collaborating country personnel in Lima on May 7 and 12 and the field research site at Yurimaguas on May 8 through 10, 1984.

working conditions. We should like to underline this and to emphasize that while the report concentrates on those areas where changes might be made it does so in full acknowledgement of the overall quality of the program.

In this context we would like to note that the USAID mission and the Instituto Nacional de Investigacion y Promocion Agropecuaria (INIPA) were very supportive of the program. As noted later, they regard the Selva region as one presenting great opportunities for agricultural development, and the TropSoils program as having a major input into that development.

We would like to take this opportunity to acknowledge our indebtedness to all of those who made the arrangements for our visits at NCSU, INIPA, Lima and Yurimaguas. We would particularly like to thank Dr. R. H. Miller, Chairman of the Soil Science Department at NCSU and Dr. C. B. McCants, Director of the SM-CRSP Management Entity, Dr. Victor Palma, Director of INIPA and Dr. Dale Bandy, Dr. J. R. Benites and Dr. R. E. McCollum and their colleagues at Yurimaguas.

Background of Soils Research at Yurimaguas

The NCSU started research on the management of humid tropical soils at the Yurimaguas site in 1971. The soils are highly acid with the exchangeable Al often exceeding 70% of the exchangeable ions (typic paleudult). The station, situated in the tropical rainforest (selva) belt of Peru, has an annual rainfall exceeding 2000 mm with May, June and July the driest months, though 50 - 60 mm of rain falls in these months. The average mean temperature is about 26^o C. The station has about 100 ha under cultivation and is situated in an area where there is a substantial development of agriculture, mostly shifting cultivation except in the valley bottoms where paddy rice recently has been developed.

Early research examined the effect of land clearing by manual methods and by machine (bulldozer). This work demonstrated the deleterious effects of clearing by bulldozer. A series of

long-term trials with crop rotations and normally 3 crops per year was set up and by 1980, 21 consecutive crops had been harvested from these plots; the soil nutrients were monitored through soil analyses and lime, N, P, K, Mg and trace elements applied accordingly. In the rotations, yields of rice, corn and soybeans have been about 2 ½ tons/ha with peanuts somewhat higher.

Other research included liming rates supported by studies of movement of calcium down the soil profile, rates and times of application of potassium fertilizer, methods of reclamation of bulldozed areas, and effect of different methods of mechanical clearing, bulldozer, KG blade disking, rotavating, etc. and the effects of local and Florida rock phosphates.

These experiments were designed to maximize yields on these soils but in 1980 a series of trials using "low input" technology was started. Essentially these were designed to develop technologies that would produce acceptable yields with minimum or absence of soil amendments (lime) and comparatively low levels of nutrients by using species and varieties that were particularly well adapted to acid soil conditions. These trials have shown that upland rice and cowpeas are very tolerant of acid soil conditions and that there is a strong varietal difference in peanuts in their tolerance of acidity. Soybeans showed considerable sensitivity to acidity as well as suffering severe insect attack.

From the beginning, the program has also had to carry out crop selection trials. These have included upland and lowland rice, cowpea, soybean and peanut variety trials and also a series of trials of grass and legume species for pastures. This was essential as there were no major commodity development programs for the region.

Support Programs at NCSU

International projects at NCSU are administered at the departmental level except in the cases where they are multi-disciplinary groups requiring multi-departmental participation. The SM-CRSP is administered by the Soil Science Department. There

is an excellent administrative structure, with a highly competent and experienced staff which supports not only the work on tropical soils but, on occasion, other international efforts at the University.

Technical backstopping of the program is good for a large number of the staff in the department have had overseas experience and therefore have an understanding and empathy with research in the tropics.

One of the problems facing management of the program is the question of staff tenure; only one of the NCSU faculty staff in Peru holds a tenured position. This is because the university policy is not to hire tenured staff on grant funds. Building a strong capacity for work in the developing countries requires some solution to this problem. Both the University and USAID, which depends on the ready availability of a cadre of experienced and dedicated scientists willing to work overseas in postings which pose hardships for both staff and families, could benefit.

A further problem related to promotion and tenure is the traditional assessment of research capability based on publications. Unless such assessments take account, not only of the quality of the publications, but also of the conditions under which the research was carried out as well as the individual scientist's contribution to other major objectives of most overseas projects, e.g., training of local staff and institution building, such scientists may be strongly penalized viz-a-viz their colleagues working on the home campus. An objective system that rewards all around performance under the less-than-ideal conditions for overseas research work is to be encouraged and would be strongly supported by the review team.

Ongoing Research Programs at Yurimaguas

As indicated in the introductory section there has been a wide ranging series of programs at this station from its earliest days. Some of these experiments have continued and the

liming, mulching and fertilizer trials have built up a wealth of information about long term annual cropping on these soils.

i. Stability of Fertilizer-Based Continuous Cropping Systems

One of the interesting projects in this program is the work on weed populations and the investigation of various methods of controlling weeds in a number of cropping systems. Weed problems are a major limiting factor in annual crop cultivation on these soils; they limit the area that can be cultivated and lead to serious labor constraints at critical times. The team was impressed by the quality of this work on weed control and its high priority.

ii. Minimum Input Crop Production Systems

In the early stages of settlement of the forest areas, farming systems that will provide reasonable yields with low inputs are highly attractive. Consequently the work in selecting species, e.g., upland rice and cowpeas or cultivars with high acid tolerance is important. These trials, together with weed control experiments, should point the way for low-input, stable farming systems for these areas and the team strongly supports their continuation.

iii. Legume Based Pasture Production System

These trials include a large scale grazing trial with five grass legume mixtures, a pasture germplasm adaptation trial (CIAT regional trial) and disease and insect resistance evaluations. These trials are providing a considerable amount of information useful for pasture development in the selva and suggest that in these areas of ample availability of land, the programs have quite a high priority. However, the team considers that INIPA should be able to take over this kind of program in the not-too-distant future.

iv. Tree Based Production Systems

One of the interesting trials in this program is that on Pijuayo (Peach Palm) fertilizer responses. The trial on alley cropping has a variety of tree and bush species

including Leucaena, Cajanus (Pigeon Pea), liming and phosphate treatments and spacing. A large number of soil samples are being taken to monitor changes in chemical and physical properties. The team has no doubt about the important role of perennials in the development of farming systems for these soils, but considers that careful review of their potential role and likely adoption by farmers is needed before embarking on a large program. The soil sampling program needs to be looked at carefully to see if it cannot be more sharply focused and the numbers of soil samples reduced.

v. Management of Alluvial Soils

This program is essentially aimed at the development of flooded rice technology, mainly concerned with varietal trials, fertilizer requirements and water management. This work has had a strong impact on the development of paddy rice farming in the nearby villages. It has reached the stage where INIPA should be able to take it over.

Support Services

Yurimaguas has an adequately equipped and well managed laboratory able to address most kinds of plant and soil analyses. It does, however, have two problems to cope with - the difficulty in buying sulphuric acid (because of Government controls) and the overwhelming number of samples. At the time of the Review Team's visit, 3000 soil samples had been received in the previous three months.

The review team has the following suggestions for strengthening the laboratory performance.

- i. Institute a control system on soil sample numbers; in the absence of this, numbers will continue to grow far beyond the capacity of the laboratory;
- ii. There is a need for plant tissue analyses; to start a program on this, one additional technician would be needed;

- iii. The purchase of an EEL or new model Coleman flame photometer with laminar flow type burner using butane, would enable the laboratory to do K and Na analysis and relieve the load on the atomic absorption equipment;
- iv. Some minor items of equipment need replacement (custom sampling cups and trays);
- v. NCSU has the equipment (block digesters and Technicon auto-analyzer) for doing large numbers of N analyses on plants and soils whereas Yurimaguas does not. Some arrangements to do these analyses at NCSU would be desirable.

Off Site Research

The program has several projects off the Yurimaguas site, such as soil survey at Puerto Maldonado, and a study of alluvial soils in the Selva region. A network of cooperative on-farm and on-station trials has been established in collaboration with INIPA, at Alto-Huallaga, Pichis Palcazu and Alto Mayo. These trials started in early 1983 and are planned to run for 2 - 5 years. The review team did not visit the trial sites but during the course of our visit the work was described by those involved in the program.

The discussion on this extensive research program showed that over the years the program has developed a very large amount of information on the management of humid tropical soils, on the effects of land clearing, the management of different fertilizer regimes, the testing of a wide variety of crops and cropping systems, the control of pests, particularly weeds, and the support from laboratory services.

The experience with this long term program has raised a number of very interesting issues of technical, economic and management nature.

These include:

- i. Development of improved farming systems

The soil management research program can be seen as a major component of research to develop more productive,

probably more intensive and stable farming systems for soils of the humid tropical areas. The project demonstrates very clearly that soil management research cannot proceed in isolation and thus it has had to become involved in a range of activities, such as testing species and varieties, weed control, which are obviously an essential part of any farming system development. However, the SM-CRSP project, per se, does not have the resources to do all the work that is needed in the crop sciences and must depend on INIPA. The review team recognizes that INIPA is just starting on its reorganization but considers it essential that, over time, the SM-CRSP/INIPA collaboration strengthen the support in this field. As this collaboration develops the SM-CRSP program should be able to concentrate the major part of its resources on soil management aspects.

ii. Socio economic issues

As the program expands beyond soil science and becomes involved in farming, the need for more social and economic sciences input becomes greater. INIPA is in the process of establishing an agro-economic unit which will have quite a large staff and will be involved in both macro- and micro-economic research. About 60% of its resources will be devoted to policy and institutional support, but the unit is expected to be able to provide support at the micro-economic level to the program at Yurimaguas. Some of the work will involve ex poste analyses of profitability and risk of new technologies.

iii. Collaborative research

There is a need to develop more collaborative research with other institutions particularly IITA. Collaboration in low-input, soil-management systems, through alley cropping, mixed cropping, cover crops and live mulch systems would be useful. Exchange of graduate students, workshops, etc. would promote this cooperation.

iv. Research programming

The scientists, including the graduate students, are under great time pressures because of the policy of planting 3 crops per year. This results in little time for analyses of research results and for planning. There would be many advantages in growing only 2 crops per year and insisting that experimental results are properly analyzed at the end of each experiment. Each scientist should be provided a small programmable calculator if necessary. There is also a need to minimize the ad-hoc type of student program, funded out of the SM-CRSP budget. Graduate students have a major role to play in the research programs, but their work should be part of the longer term research plan.

Training

Training needs are very great and training is, in fact, one of the most efficient ways for the SM-CRSP to extend its influence, so that the additional facilities being constructed at Yurimaguas have a high priority.

Three forms of training needs have been identified:

- i. Short term in-service training for Peruvian scientist (mainly INIPA personnel)
- ii. Up to six months training programs for international participants (which could also include INIPA personnel)
- iii. Training of junior scientists working on dissertation or thesis research

Yurimaguas can perform two major aspects of training, the first being soil management research and its extension into farmers' fields. The second would deal with farming systems research because the ultimate objective of the Yurimaguas or other programs of this nature is to provide the technologies for improved farming systems. The station can provide the physical facilities and the SM-CRSP personnel the expertise for a strong training program in soil management research. While it is outside the role of a soil CRSP, there are, nevertheless, good opportunities

and a need for training in farming systems research and the USAID funded Farming System Support Program (FSSP) could provide expertise and training materials for this kind of program.

The training program deserves high priority but there is a limit to what existing TropSoils personnel can do. Otherwise, the training requirements place an increasingly difficult burden on the staff. If the training program is to be expanded, the review team considers that the appointment of a full time training coordinator will be essential. The TropSoils program does not have the funding for such a coordinator but it should be possible to utilize a combination of the funding sources which are available in one form or another in Peru. The training program should be self-sustaining in that fees and per diem charges would cover all the costs and overheads except the salary of the training coordinator.

The appointment of such a coordinator would relieve the scientist of much day-to-day routine activity on behalf of trainees, thus allowing them to concentrate on the scientific and technical aspects of the training, while at the same time the students would be better served by having a full time staff member to deal with all the other aspects.

Future Strategy for the SM-CRSP

Introduction

In the preceding section the team has made recommendations for some changes in the program and this section will therefore concentrate on some of the major issues that should be taken into account in the future. These issues are: (1) research program planning; (2) the role of the project in Peru; (3) its relationships with INIPA; (4) related to this the question, how can a soils research project effectively mobilize the needed support on crop research; and (5) its relationships with international and regional programs in the humid tropics.

Research Program Planning

Financial support through the SM-CRSP provides an excellent opportunity to develop a long range (say 5 year) plan for the project. To suggest this is not to ignore the amount of discussion and thought that has gone into the program. Neither is it to suggest that longer term planning will bind the researchers to a predetermined program regardless of the ideas and results that emerge during the course of the program. The goals of the SM-CRSP have been quite clearly stated and these goals: (1) in-depth soil management research to support the development of low input and high input cropping systems; (2) legume-based pastures, (3) agro-forestry; and (4) soil classification are endorsed by the team. The long range plan would, therefore, set out in detail how these goals could be reached, taking into account the funds that are likely to be available and the priority of each. Indeed, it is the planning of a program within likely available funds, rather than planning what would be done if more funds were added from the CRSP, that the team feels is the essential part of the process. This would not preclude a strategy, of course, to seek additional resources in staff or money from outside the project.

Another aspect of the research program is the development of an annual work program based on the results of the previous year. As noted earlier, the intensive cropping program with 3 crops per year does not give sufficient time for analyzing the results of the experiments and for designing the next year's program, based on these results. The necessity of developing student thesis projects also tends to give an ad hoc complexion to some of the work. The team considers that a combination of a long range plan and annual work programs would minimize this tendency. An important input to obtaining analysis of data would be the provision of a number of small calculators.

The Role of the Research Program at Yurimaguas and its Relationship with INIPA

The review team are well aware that the long standing, good relationships between the NCSU soils program and the Ministry of Agriculture in Peru present both an excellent opportunity and yet at the same time a sensitive area of collaboration. Furthermore, INIPA, which is both a collaborator with the SM-CRSP program and a customer for its output, is a very new organization still in the process of developing its program. Thus, the SM-CRSP work has to be of practical value to Peru. At the same time it has to service a much wider audience and so cannot be made subservient to the needs of Peru. This is complicated by the NCSU involvement in the Research, Extension and Education Project of which the Selva development is a part. Obviously, compromises will be necessary. The team regards the work on paddy rice and tropical pastures as two areas where the research forms a solid base from which INIPA can develop its own programs. The somewhat complex situation in Peru, therefore, induced the mission to set out in some detail its views on how the collaboration in the future might operate.

The Role of Yurimaguas

The soil management program at Yurimaguas forms an integral part of an international program, the two major parts for the humid tropics being those conducted there and in Sumatra. The other major program with similar objectives is that at IITA in Nigeria and its satellite activities in other parts of Africa. The work is also linked into other work, as yet fairly small, in the Amazon basin through the REDINAA network.

Thus, there is an international, a regional, and a country specific dimension to the work at Yurimaguas. The review team is of the opinion that all of these need to be taken into account in designing the future strategy of the program. All of the major programs seek to obtain a better understanding of the physical and chemical properties of humid tropical soils. Such knowledge

is freely transferable and useable in all regions with such soils. However, the application of this knowledge to the design of better farming systems is site-specific to a considerable degree because the applicability of such systems depends upon social and economic conditions as well as the physical conditions. For example, pasture systems for grazing could have wide applicability in the Amazon area, but not in Africa because of disease or Indonesia because of farm size. Rubber and oil palm systems, highly developed in Malaysia, could not be applied in Peru because of disease (rubber) or marketing and processing factors (oil palm).

The review team considers that the work at Yurimaguas could thus be looked at from two different perspectives:

- i. The selva program in Peru
- ii. The international role

The Selva Program in Peru

The selva area of Peru covers 60% of the country but has only 10% of the population. Lack of infrastructure, distance from markets and infertile soils have been the major handicaps to its development. The road system is being developed so that access to the potential markets in the coastal areas will be improved and the Government of Peru now gives high priority to agricultural development in this region. Consequently, research to support these development objectives also has a high priority. Nevertheless, the government has to give immediate attention to the development of technology for the high population areas in the Sierra. Agricultural development in the selva region can alleviate some of that pressure but the development of more productive agriculture in the Sierra will still require a major portion of the research resources. It is probable, therefore, that international support for research will need to play a major role in the selva. It is in this context that the review team examined the SM-CRSP.

A number of research stations will be developed in the selva. Several of these will be commodity oriented - rice, tropical fruits, tropical pastures, etc. Yurimaguas will be the principal station for research on the development of the soil management component for the production systems of the various regions. It will, therefore, be the major center for the generation of new information and new technology in soil management in the region. However, soil management technologies cannot be generated in isolation; they need support from the principal commodity teams in developing better production systems and it is in this area that cooperation by INIPA will become increasingly important.

Thus the Yurimaguas station would have 5 roles:

- i. the lead role in generating soil management technology for the selva;
- ii. the subsidiary role of testing commodity technology for other stations;
- iii. the subsidiary role of developing improved production systems for that area of the selva;
- iv. soil management support role for the other research programs in the selva;
- v. fertility capability classification for network and on-farm work.

The Future Research Strategy for Peru

In this scenario the TropSoil program has to develop a strategy to fulfill roles i., iv., and v above. It has to do this within its own resources, which are limited, and with any additional resources it can attract from Peruvian or other sources. Clearly the first priority for work with its own resources is that of providing the lead role in generating new technology for the selva. Even to do this fully will need additional resources. These will include funds for station development and funds for Peruvian staff support for their program.

To perform the second role, i.e., support for soil management research at the other Selva stations, there will be a need to supply trained people and advice on the planning and design of research programs. As noted above, increased training programs will need additional staff and facilities. This should be one of the most cost effective ways of supporting development at other stations.

International and Regional Roles

The need for closer collaboration with IITA was noted previously. This should benefit both institutions. Although the Indonesian program is much more recent than that at Yurimaguas and has smaller resources, it too can contribute to the work at Yurimaguas (and vice versa) and should be regarded as a full partner in the overall program.

As part of regional cooperative work, the SM-CRSP is cooperating with REDINAA. This network for the Amazon area includes Brazil, Bolivia, Colombia, Ecuador and Peru. The program proposes to carry out research in soil management, on annual and perennial crops, and on pastures and livestock for the Amazon area. It will be funded by several donors. There will thus be a good opportunity for the SM-CRSP to utilize REDINAA as a mechanism for spreading its findings widely in these areas. On the other hand the Yurimaguas site can be utilized for some of the REDINAA organized cooperative research. A successful network will require programs of excellence which can form a focus for the research and Yurimaguas, together with IITA and the Sumatra program, will form the nuclei for this network.

In conclusion, the review team is strongly of the view that the SM-CRSP provides an excellent opportunity to develop a strong international network on the management of soils of the humid tropics.

Evaluation of Semi-Arid Tropics Program
of the Soil Management CRSP

SUMMARY

The Soil Management CRSP in Niger, under the leadership of Texas A & M University, is off to a good start. Two senior scientists are in the country and appear to be well adjusted to the climate and conditions of living. Both handle the French language satisfactorily. They are well trained, industrious, and are cooperating well with other expatriates and with local personnel. Much equipment has been purchased and is in-country, including a vehicle for each scientist. Local personnel have been hired for support positions and appear to be functioning well.

Linkages with INRAN, ICRISAT, USAID, CARE, IFDC, FAO, and the University of Niamey have been established. Favorable reactions were received from all these organizations.

Thirteen projects have been planned and some work has been started on each. Many have one year's data ready for analysis and use in further planning. The projects address the CRSP objectives and goals and appear capable of yielding results which will contribute to their achievement.

Some project objectives are not clearly written, making it difficult to ascertain the focus of the research.

The Texas A & M University scientists on home campuses seem to be meeting their commitment for assisting scientists in the field and for conducting supportive studies. Graduate students are involved and plans have been made to increase this training activity.

Some concerns must be noted in regard to the program. The number of projects planned and initiated may be excessive for two senior scientists in the field. Understandably, difficulty has been encountered in getting equipment in the field and in

keeping it operating properly. Ordering of equipment, arranging its clearance in-country on arrival, setting up and maintenance necessarily takes much time in developing countries. Some data have been taken which have not yet been summarized for lack of time. Caution must be exercised to avoid overextending the time and effort of the senior scientists such that the research is not conducted and reported properly.

The two senior scientists operate more independently than advisable. Some duplication of effort is involved when each keeps accounts, hires local employees, maintains a vehicle, and performs other semi-administrative chores. It may be more efficient to designate one as responsible for administrative matters and let him handle such for both.

USAID policies on travel into Niger appear to hamper the project somewhat. Decisions regarding travel of some graduate students and some of their advisors are being made by other than the senior scientists directly responsible for the graduate student research. The limitation on number of persons permitted to enter Niger for the project review seriously hampered the evaluation.

Since both field positions are filled with non-tenured faculty, there is serious question as to whether Texas will be able to utilize the expertise they develop in Niger. While serious efforts will reportedly be made to have them return to Texas in faculty positions, there may be difficulty in their qualifying for tenure and/or promotion on the basis of the overseas experience. Scientists generally have difficulty in producing sufficient research publications during an overseas assignment to qualify in competition with colleagues who work in-state for the same period of time. If they do not qualify for positions which are satisfactory to them at the end of their service in Niger, Texas will not achieve full benefit of the effort under the Soil Management CRSP.

Remedial Actions Suggested

1. Each senior scientist should limit the number of projects in which he is involved to those which he can handle well. Data collection, summarization and publication must not be permitted to lag.
2. Duplication of administrative effort should be avoided wherever possible. It might be better for one senior scientist to handle all administrative matters for the program in Niger.
3. USAID/Niamey restrictions on travel into Niger should not impede necessary visits by graduate students and by graduate student advisers and other collaborating scientists.
4. Objectives should be more clearly stated in some projects. Perhaps it would be well if each researcher is furnished a copy of the book by Andrew and Hildebrand entitled: "Planning and Conducting Applied Agricultural Research."

Evaluation Report on the Texas A and M University
and Texas Agricultural Experiment Station Program
in the Semi-Arid Tropics in Niger^{1/}

Marlowe D. Thorne

The field evaluation was conducted in Niger July 17 to 25, 1984. USAID/Niamey travel restrictions resulted in cancellation of the travel of Dr. Charles McCants, Director, Management Entity and Dr. Gene Ferrier, Soil Physicist, ICRISAT/Upper Volta, both of whom had intended to participate in the evaluation. Mr. Neil Caudle, International Editor, Management Entity, accompanied me to Niger to get information about the project for use in communicating with other scientists, administrators, legislators, and the general public about the CRSP objectives and accomplishments.

Dr. Frank Calhoun, Principal Investigator, was delayed in arriving in Niger by travel problems beyond his control. He participated in the field trips to research sites and in the later conferences. Since he had the most complete background on the project, it was indeed unfortunate that he could not participate in the majority of the conferences with cooperating organizations in Niger.

While many program technical reviews are made by only one person, a broader perspective will likely result from persons with the different viewpoints and who can interact during the review process. The program had been underway too short a period for an effective and fair review, but the schedule required that it be done at this time. Much of the review had to be confined to the plans for research projects because some had been initiated only recently and no results were yet available. At least one had not really gotten started.

^{1/}Based in part on a trip to Niger July 17 - 25, 1984 and to Lubbock and College Station, Texas, October 24 - 26, 1984.

A full schedule of conferences with cooperating organizations had been arranged and was followed, as indicated in the attached schedule. All cooperators gave favorable reactions to the TropSoils program in Niger. Brief details of these conferences follow:

USAID

Dr. Frederick ("Rudy") Vigil, Program Officer; Dr. James Lowenthal, Acting Agricultural Development Officer; and Mr. Peter Benedict, USAID Director, all indicated satisfaction with the progress to date. USAID is planning to put some funds into the program to support two people in the soils laboratory at INRAN for a two year period. FAO support for that lab is terminating and USAID will provide this support through TropSoils.

Director Benedict said that there will be fewer persons in the Niger mission during the next two years and that programs which seem to be able to run themselves more independently of AID will get preference. TropSoils is more independent than most in his opinion. The AID people were pleased with the TropSoils scientists and their good working relations with other personnel and projects and with INRAN.

Dr. Vigil was pleased with the practical nature of the TropSoils projects. Dr. Lowenthal indicated that he would like to see more backstepping of the program in Niger by TAMU and TAES. Mr. John Heermans, AID Forester, Forest and Land Use Project, has had substantial cooperative effort with TropSoils in the study of rejuvenation of crusted soils in the "Tiger-Bush" areas of Niger as typified by the Guesselbodi Forest near Niamey. Variables studied include hand tillage, mulching with small branches, and combinations of tillage and mulching. TropSoils is making detailed soil moisture studies and the INRAN soils laboratory is making soil chemical analyses. Working relationships are reported to be good and study is progressing well.

INRAN

All the INRAN officials and scientists contacted expressed very good satisfaction with the TropSoils program to date. The

dissatisfactions which were evident when there was only one TropSoils scientist who had to divide effort between INRAN and ICRI-SAT have disappeared with the coming of the second scientist who works mostly with INRAN. TropSoils projects were reported to contribute to INRAN objectives and the working relationships of INRAN and TropSoils were good. Soil physics studies by TropSoils in many INRAN experiments provide needed data for the benefit of all.

Mr. Mahamadou Gandah, Head of Soil Physics Section, expressed disappointment that TropSoils was not cooperating on irrigation studies as he felt this was a high priority need of his section. It was explained that in the planning of the TropSoils program irrigation studies were discouraged because of the limited personnel and funds available and of the high costs of irrigation research. TropSoils scientists are interested in irrigation studies and might be able to cooperate at some future time.

Mr. Mahaman Issaka, Chief, INRAN Soil Chemistry Laboratory, was most appreciative of TropSoils support of the laboratory and welcome the promised support of two technicians through TropSoils. Analyses are being run for the TropSoils project and TropSoils has purchased some laboratory equipment to expedite such analyses. The laboratory has need for additional support, with the FAO assistance phasing out.

Mr. Issaka Magah, Chief, INRAN Agronomy Division, is also interested in cooperative irrigation studies with TropSoils and the Soil Physics Section. He indicated the main constraint of his section is lack of resources and he would welcome more cooperative work with TropSoils.

Mr. Adam Abdoulaye, INRAN Statistician, works with both TropSoils scientists and is very pleased with the working relationships. He helps keep the TropSoils computers operating.

Mr. Mamadou Quattara, head, INRAN Ecological Research Department, was particularly pleased with the cooperative studies on phosphorus response, soil characterization and soil physics.

He is greatly concerned with the problem on increasing food production for the increased population, particularly in view of the continuing drought conditions. He welcomes additional support from and cooperation with TropSoils.

Mr. Moussa Saley, Director General, INRAN, said that TropSoils has come into an area of research where INRAN lacked adequate personnel, equipment and funds. He said that TropSoils was contributing to a well defined need in INRAN. In response to a question, he stated that if TropSoils could take on an additional study he would give top priority to establishing a base for sections in the INRAN organizational chart which are not yet activated. He would not set a priority amongst the sections which need to be activated. He hopes that the TropSoils program in Niger can continue for many years and will receive support.

Mr. Daouda Idrissa, Project Manager, Tapis Vert ("Green Carpet") Project cooperates with TropSoils in studies of low-input conservation practices on erosion losses, runoff, and soil moisture status on soils in the project. Standard "Wischmeier" plots are established and various treatments evaluated. As soon as instrumentation is complete Mr. Idrissa expects that they will obtain data which will be more complete and more reliable and which can better be interpreted for other field conditions.

ICRISAT

Dr. Tardiu, Regional Director, was very complimentary about progress made by TropSoils in a short period of time. He especially appreciated how rapidly Dr. Chase, who works most closely with ICRISAT, had initiated research, become acquainted with other scientists and had learned the French language. He said he is generally critical of U.S. projects because they have so much difficulty in purchasing equipment, send people who do not speak or understand French, and who must spend an excessive amount of time and funds in connection with visitors to the projects. While TropSoils had all these problems, he felt they had

handled them well and made excellent progress. He spoke highly of the soil survey made of the ICRISAT Sahelian Center and said ICRISAT scientists have used the survey effectively in locating research projects and in interpreting results.

Dr. Leslie Fussel, Agronomist with ICRISAT, indicated the water balance studies made in cooperation with TropSoils contributed greatly to his program. He also has cooperative studies with TropSoils in use of the Sandfighter to control wind erosion in sandy soils and studies of spacial variability of soils at the Sahelian Center. He was equally appreciative of these studies.

Dr. Sivakumar, Agrometeorologist, is studying how weather affects crop growth, particularly through soil temperature and soil moisture effects. TropSoils cooperation provides temperature and moisture data needed. Cooperative studies are also underway on effectiveness of windbreaks to prevent sand blasting of seedlings and to conserve moisture.

Dr. Michael Klaij, Tillage Laboratory, and his colleague, Dr. W. Hoogmood of Wageningen, Netherlands, have cooperative studies with TropSoils on use of the Sandfighter for erosion control and as an aid to plant establishment. Various planting patterns and fertility treatments are being investigated. A rainfall simulator is being used to study water erosion difference in treatments.

Dr. Andre Batiano and Dr. Bruce Christiansen, supported by the International Fertilizer Development Center and located with ICRISAT have many fertilizer studies in cooperation with TropSoils. Detailed studies are being made of the effectiveness of partially acidulated phosphate rock in these soils. Both fertility and moisture-holding changes following surface mulching with crop residues are also investigated. TropSoils cooperates in measuring soil moisture relationships in the experiment.

All the ICRISAT scientists listed above expressed strong support for TropSoils and indicated that working relationships were good.

CARE

Dr. Steve Dennison, Project Director, CARE Maggia Valley Project, has an extensive study of windbreaks in the Valley in cooperation with INRAN and TropSoils. The primary objective is to test effectiveness of windbreaks in increasing millet yields. TropSoils will cooperate in soil moisture balance and wind modification studies. Initiation of the TropSoils effort awaits arrival of equipment. CARE will provide some labor since the location is a day's drive from Niamey and TropSoils will provide supervision.

UNIVERSITY OF NIAMEY

Mr. Ambouta Karimou, Professor of Soil Science, expressed appreciation for assistance of both TropSoils scientists in providing opportunity for him and some of his students to do research. The University provides him little support for research but does encourage faculty research. Students may do research problems during their last year and some have already been involved in studies of runoff, of water movement and of computer use. He expects such cooperative efforts to increase.

USAID/Niamey

John Heermans, AID Forester, Forest and Land Use Project, has had substantial cooperative effort with TropSoils in the study of rejuvenation of crusted soils in "Tiger-Bush" areas of Niger as typified by the Guesselbodi Forest near Niamey. Variables have included handtillage, mulching with small branches, and combination of tillage and mulching. TropSoils is making detailed soil moisture studies and INRAN soils laboratory is making soil chemical analyses. Working relationships are reported to be good and the study is progressing well.

Soil Management CRSP

An excellent folder had been prepared for the review by the Lead Institution which was given to me just before departure from the U.S. It aided materially in the evaluation of the project. It lists collaborating institutions, personnel involved,

general research objectives, and individual project outlines. In addition to the work in Niger, it lists studies in Mali, Cameroon, Haiti, and Lubbock and College Station, Texas. Since it is presumed that copies of this folder will be available to any reader of this report, individual projects in Niger will not be listed. Dr. Chase is senior scientist on seven projects: six in cooperation with ICRISAT and one with USAID. All these projects were underway at the time of the evaluation. Dr. Persaud is senior scientist on five projects, all in cooperation with INRAN and one in cooperation with CARE also. Three are underway but two were not yet begun since Dr. Persaud had been in Niger only 3½ months.

Field visits were made to the ICRISAT Sahelian Center, Gues-selbodi Forest, and to Chikal, (site of the Tapis Vert Project). While the visits were brief, I believe I obtained a good feeling for the work underway and had good discussions with the TropSoils scientists and cooperators. Dr. Calhoun and Mr. Caudle were also along on each field site visit.

Visits were made to the Texas Agricultural Experiment Station (TAES) at Lubbock and to Texas A and M University (TAMU), College Station on October 24, 25 and 26, 1984. Dr. Frank Calhoun, Principal Investigator and Dr. Charles McCants were present for all discussions at both locations. In addition to a review of research projects which have involvement in the program in the semi-arid tropics in Niger, reviews of the backstopping support of TAMU and TAES and of the general organization and administration of the Texas A and M University System were presented. It is difficult for an outsider to understand the TAMU System as it relates to research, teaching, extension and international activities. Immediate responsibility for administration of research, both in-state and overseas, rests with the department head and with Superintendents (Directors) of involved research centers in Texas.

The program in Niger involves faculty members from the Lubbock Center and from the Department of Soil and Crop Sciences at College Station. Dr. Calhoun maintains liaison with the Department Head, Dr. Runge; with the Center Director, Dr. Ott; and with the various faculty members at College Station and Lubbock who are involved. This, of course, is in addition to the Senior Scientists in Niger and the graduate students involved in Niger and in Texas. It appears that the problems of coordination are more complex than in most states and probably account for the high proportion of Dr. Calhoun's time involved in this project. The system seems to work effectively. A good program is underway in Niger, considering the short time of involvement and the problems which have been encountered there. The backstopping seems to be effective and the Niger research is directly related to the research programs of TAMU and TAES.

The 1984 publication, Soil Survey of the ICRISAT Sahelian Center, was discussed. This was one of the early activities under TropSoils in Niger and provides a basis for interpretation of research at the Center and its extrapolation to other areas. Subsequent studies have established that the soils on the Center are typical of extensive areas of sandy soils on which cowpeas and millet are grown in Niger. The publication itself lacks a definite publication number which would be useful for reference and retrieval. Credit is given to all cooperating organizations, but one cannot tell just which one published it. Drs. Wilding, West, Landeck, Calhoun and their collaborators are to be complemented on the study and the excellent publication resulting from it.

Pedology studies have also been conducted in the Majjia Valley which contribute to the windbreak research there. Pedological studies are continuing in Niger. Brief presentations were also given of the research on vertisols in Cameroon and on steep-lands in Haiti.

Research conducted by J. B. Dixon and H. Shadfan on soil hardening and crusting should help materially to understand these processes and contribute to development of practices which will reduce their detrimental effects. Basic studies are underway at College Station with adaptive studies in Niger.

Soil physics, chemistry, and fertility studies for the Semi-Arid Tropics under TropSoils are conducted at Lubbock and in Niger. It was somewhat surprising to see the high interest in the TropSoils program on the part of the Director of the Center at Lubbock and a number of faculty members located there. They seem to have found areas of particular interest in the Niger program and have identified ways in which they can contribute and which will be of eventual benefit to their domestic research programs. It was also gratifying to find the high quality back-stopping in purchasing of equipment provided by Mike Gerst for the project. He has taken a personal interest in the program and has evolved procedures for expediting purchasing, testing, and shipping of equipment to Niger. He has obviously had good support from his superiors and all are complimented on this fine operation. Unfortunately Mr. Gerst is in the process of moving to another position, but it is hoped that the services he has provided can be continued.

Five research projects under TropSoils are underway at Lubbock dealing with soil physics (TAMU Projects 18 through TAMU 22). Charles Wendt and Robert Lascano are leading the studies and supporting the Senior Scientists in Niger in their soil physics work. The studies center around soil moisture; its measurement, distribution, conservation, and use by crops. Development of methodology, testing of appropriate equipment and measurement methods are being given attention. Dr. Wendt had visited Niger recently and assisted in planning and initiation of studies here.

The soil fertility studies under TropSoils at Lubbock are closely integrated with the soil moisture work. Dr. Onken has assisted Niger and has studies underway under the sorghum/millet

CRSP also. The acidity and aluminum problems of the low base-exchange capacity soils are his particular interests and he collaborates with plant scientists attempting to find aluminum tolerant crops of economic importance for the semi-arid tropics. He pointed out that much soil fertility work has been done in the region but little, if any, of it has had chemical analyses of soils needed to permit extrapolation of results to other areas. His studies do have the necessary soil chemical analyses.

The matter of returning the Senior Scientists to permanent positions at TAMU/TAES was discussed. All agree that this is desirable if they perform adequately on the Niger assignment. Tenure is not normally granted to the TAMU system unless the individual does some teaching. However, TAES faculty who have no teaching responsibilities can have appointments with good assurance of permanence. The Principal Investigator is determined to do his best to help them obtain positions in the Texas system so their expertise can be utilized in future years.

1. The TAMU/TAES project objectives, as stated in the folder, appear to be in line with the SM-CRSP objectives and goals. The objectives of individual projects in Niger are difficult to assess from the writeups in the folder. However, Dr. Chase prepared supplemental materials dividing his work into six subject areas. Under each subject area is listed one or more projects. These are:

Subject Area I: Spatial Variability in Niger Soils

Project A: Survey of factors causing suboptimal development of millet crops in farmers' fields in Niger.

Project B: Spatial variability of soils at the Sahelian Center.

Project C: Precision plot and variability study.

Subject Area II: Evaluation of the West Texas sandfighter on West African sandy soils

Project A: Evaluation of speed requirements for effective sandfighting (1983 project)

Project B: Sandfighting: Control of rainwater distribution

Project C: Evaluation of the effectiveness of a sandfighter II: Wind modification.

Subject Area III: Soil Temperature Profile and Water Balance in a Sahelian Dune Soil

Project A: Characterization and modification of the soil temperature regimes in Niger

Project B: Soil temperature regimes and their modification

Subject Area IV: Soil Water and Energy Balance

Project A: Water and energy balance of Nigerian soil

Subject Area V: Guesselbodi Forest Research/Agroforestry

Project A: Rejuvenation of crusted, barren forest soils in Niger

Project B: Spatial variability in soil chemical and physical properties in relation to barren and adjacent forested soils

Project C: Estimating percentage runoff from crusted forest soils

Subject Area VI: Student Work Projects

Project A: Water balance and millet growth in 4 soils at the ICRISAT Sahelian Center

Project B: Effect of phosphorus on the root distribution of pearl millet

Project C: Phosphorus movement and transformation in the soil

Objectives are listed for each project and these appear to be in line with both the TAES/TAMU program objectives and the CRSP objectives, although some lack clarity of statement.

2. There is very good probability that the research now underway and that planned will yield results that will contribute to achieving the program objectives. Some of the projects have produced data but little was summarized and available

for study. Computer problems and lack of adequate assistance have contributed to delay in analysis of data. Delays in arrival of ordered equipment have resulted in incomplete data being obtained on experiments underway and in the delay in initiation of some experiments. Such delays are not unusual and are to be expected in a project this new.

Graduate student research has apparently gone well and has produced valuable information. Much of the data from their research has been taken back to Texas for analysis and study and is not yet available in Niger in usable form.

Research underway and planned seems well thought out and designed. All indications at this time seem favorable for relevant research which will be managed properly. The soil survey of the ICRISAT Center, done by TAES/TAMU scientists was reported to be very valuable and being utilized in locating experiments and in interpreting data.

3. One change which has occurred since program inception has been to have two senior scientists in Niger with soil physics training instead of one with soil fertility and one with soil physics. The reasons reported for the change include: (A) the dearth of soil physics information in Niger. (It was reported that this is the only program which is doing detailed soil physics studies) and (B) the need to work closely with both INRAN and ICRISAT. Initially, it was planned that each senior scientist would work with both organizations on studies in his discipline. However, it appeared advisable to have one devote major effort to each organization in cooperative endeavors and soil physics studies were urgently needed by both. The FAO, IFDC, and CIDA cooperation has provided soil fertility and chemistry information. If those efforts can continue under the same or other sponsorship, I foresee no great problems resulting from the change in emphasis in the TropSoils program. On the other hand, there seems to be considerable advantage to the change made if the fertility effort continues under other sponsorship.

4. Evaluation of interrelationships with the Collaborating Institution

(a) INRAN: All INRAN personnel with whom I met, including Director General Moussa Saley, expressed high praise for the TropSoils program and personnel, as indicated previously. They indicated that TropSoils had begun to fill a gap in their program, had provided technical assistance in soil physics which was sorely needed, had provided some equipment, and TropSoils and INRAN scientists are working well together.

(b) Local mission: The three AID technical employees and the mission director all were complimentary regarding the TropSoils program. In view of budgetary and personnel limitations of the mission in the coming years, preference will be given to projects which require minimal monitoring from the mission. Director Bénédict said that TropSoils required little monitoring and was progressing very well for the short time it had been underway. AID proposes to support two persons in the INRAN soil chemistry and fertility laboratory through TropSoils. They could have put this additional input into another project but thought it would work best through TropSoils. There is some concern amongst the TropSoils personnel that USAID is making unilateral decisions regarding entry of essential short-term people on the project. It has been difficult to get approval for some graduate student advisors to visit the project to direct the work of their students. Also one graduate student was not permitted to enter and conduct a study because AID personnel were not convinced of the need for the study and did not understand how it would contribute. TropSoils personnel think that they are more capable of making such decisions.

I agree, but doubt that USAID can be convinced to give up authority for approving entry on the project, especially in view of criticism from Washington regarding the numbers program.

(c) Related USAID funded programs: The Forest and Land Use Project has good working relationships with TropSoils and John Heermans had high praise for the TropSoils Contribution.

(d) International centers: There is a good close working relationship with the ICRISAT Sahelian Center in Niger, as previously indicated. All ICRISAT Personnel contacted indicated the importance of the TropSoils contribution and expressed hope that it would continue. The regional director of ICRISAT was also highly complimentary regarding TropSoils. He indicated he was highly pleased at the rapidity with which Dr. Chase had become oriented to the semi-arid tropics, had learned French language and had developed working relations with personnel.

Cooperation with IFDC scientist also appeared to be very satisfactory.

(e) Other institutions and organizations: Relations with CARE and the University of Niamey are apparently very good. Cooperative programs are underway to a limited extent with them and more is contemplated.

5. Graduate student training is progressing well under the project. One graduate student from TAMU was in Niger at the time of the review and seemed to be well adjusted and making a substantial contribution. Other students have been in Niger and made studies under the project. Both TropSoils and cooperating scientists had praise for the students' contributions but no theses nor other publications are yet available as a result of their efforts in Niger. There are plans for additional graduate students to do research under the TropSoils program.

One good example of technology transfer under the project is the trials using the Sandfighter which was developed in the Texas high plains and brought to Niger under the project. Adaptations have been made to suit it better to local conditions. These include bullock-drawn and donkey-drawn models

and the addition of special tines to open holes for seed and fertilizer in a once-over operation. Other projects are using the implement and some are to be made locally. It appears that this had good promise for controlling wind erosion and sandblasting of seedlings in the sandy soils of western Africa.

ITINERARY FOR SOIL MANAGEMENT CRSP REVIEW

NIAMEY, Niger

Wednesday, 18 July 1984:

- 0830 Dr. Frederick ("Rudy") Vigil, Programs Officer (CRSPs),
Dr. James Lowenthal, Acting ADO, AID/NIGER.
- 1030 Peter Benedict, Director, USAID Niamey
- 1330 Mr. Mamadou Quattara, Head of INRAN's Ecological Re-
search Department
- 1430 Mr. Mahamadou Gandah, Head of the Soil Physics Section,
Ecological Research Department, INRAN
- 1500 Mr. Mahaman Issaka, Chief, INRAN Soil Chemistry Lab
- 1545 Mr. Moussa Hassane, Chief, INRAN Forestry Division
(unavailable)
- 1630 Mr. Issaka Magah, Chief, INRAN Agronomy Division
- 1730 Mr. Adam Abdoulaye, INRAN's Statistician

Thursday, 19 July 1984:

- 0800 Dr. Tardieu, Regional Director, ICRISAT
- 0930 Mr. John Heermans, Forester, Forest Land Use Project,
USAID
- 1100 Mr. Daouda Idrissa, Project Manager, Tapis Vert ("Green
carpet") Project.
- 1515 Dr. Andre Batiano, Dr. Bruce Christiansen, IFDC Soil
Fertility, ICRISAT
- 1600 Dr. Michael Klaij, Dr. W. Hoogmood, Tillage Laboratory,
ICRISAT
- 1645 Dr. Leslie Fussell, Agronomist, ICRISAT
- 1750 Dr. M.V.K. Sivakumar, Agrometeorologist, ICRISAT

Friday, 20 July 1984:

- 0830 Mr. Ambouta Karimou, Soil Science Professor, University of Niamey
- 1030-1750 Field trip to Sadore:
Meet Dr. Bationo, Dr. Christiansen
Dr. Fussell
Dr. Hoogmood and Dr. Klaij

Saturday, 21 July 1984:

- 0815-1400 Field trip to Guesselbodi Forest
- 0930 Meet John Heermans at Guesselbodi Forest
- 1600-2000 Reception, Chez Chase
- 1200-1800 Meetings, Chez Dr. Persaud

Monday, 23 July 1984:

- 0830 All-day field trip to Chikal

Tuesday, 24 July 1984:

- 0800 Dr. Steve Dennison, Project Director, CARE Maggia Valley Project
- 0900-1200 Visit Niamey town
- 1200 Luncheon meeting with TropSoils staff
- 1600 Mr. Moussa Saley, Director General, INRAN

Evaluation Report on the Acid Savannas
Program of the Soil Management CRSP
Marlowe D. Thorne

SUMMARY

The Cornell University component of the Soil Management CRSP is located in Brazil and is progressing well. The senior scientist on the project has been in the country approximately one year. He has competence in the local language and customs, having served in Brazil as a Peace Corps Volunteer. One Cornell graduate student is now conducting thesis research in Brazil under this project. Two Brazilian scientists are pursuing graduate studies at Cornell with their thesis research to be conducted in Brazil. A graduate student from Brazil, enrolled at North Carolina State University, will also carry out his thesis research in Brazil under the CRSP.

Participation of Cornell University faculty members in the program appears to be excellent. They have had cooperative research on these soils in Brazil for many years. At least four have made visits to Brazil since the initiation of this project. There are plans for involvement of other faculty members as appropriate. All who now have projects under the CRSP or who plan to have projects appeared to be enthusiastic about the research, about the cooperative arrangements in Brazil and about the training of graduate students under the program.

Linkages with EMBRAPA, CPAC, and IICA appear to be excellent.

Project and topic objectives appear to be in line with the overall CRSP objectives. The work underway is relevant to the problems of the Cerrado of Brazil and to acid savanna soils in general. There is great potential for development of valuable information.

Cornell University's program under the TropSoils CRSP has major emphasis on graduate student conducted research. Only one

senior scientist, Dr. Eric Stoner, is located in Brazil. He is headquartered at EMBRAPA's center for research, CPAC, at Planaltina, near Brasilia.

Facilities for laboratory and field research at CPAC appear to be excellent. A new laboratory building has recently been occupied with much equipment being provided by the Japanese government. TropSoils has provided some laboratory equipment. Collaboration between CPAC and TropSoils personnel appears to be very good.

Some concerns must be noted. The senior scientist on the project in Brazil had not developed a research project at the time of the site visit. While he has had the usual problems in settling in and has been occupied with administrative matters, he should develop a project in the very near future and become actively involved in research.

The Principal Investigator did not visit Brazil from the initiation of the project until the evaluation trip. While some project funds were saved and utilized for travel of other Cornell scientists, he would have been better aware of the lack of personal research involvement of the senior scientist sooner if he had visited with him personally.

Some project objectives are not clearly written, making for some difficulty in ascertaining exactly the focus on that part of the research.

Since the senior scientist in Brazil is not a tenured faculty member, it may be difficult to provide a satisfactory position for him to return to the home campus upon completion of his assignment. There is recognizable difficulty in producing sufficient research publications during an overseas assignment to qualify for tenure or promotion in competition with colleagues who work in-state for the same period of time. If he cannot qualify for a satisfactory position and leaves the employ of Cornell, the full benefit of the effort under the Soil Management CRSP will not be achieved by Cornell University.

In the conference at Cornell University, it was noted that involvement of younger staff members must be discouraged unless the activity can produce publications in quantity and quality comparable with those which could be authored by that faculty member in comparable time on campus. It very nearly prevents the use of younger faculty in long-term assignments. While this situation is not unique to Cornell, it does have some adverse effects on overseas programs such as TropSoils. Cornell University has done a good job in involving some younger faculty in short-term assignments in Brazil and in advising graduate students who do thesis research in Brazil under the CRSP.

Remedial Actions Suggested:

1. The senior scientist in Brazil should develop a research project in the near future and get personally involved in the conduct of research.
2. More frequent trips should be made to Brazil by the Principal Investigator. At least one trip per year is suggested.
3. Objectives should be stated more clearly in some projects. Perhaps each researcher should be provided a copy of the book by Andrew and Hildebrand entitled: "Planning and Conducting Applied Agricultural Research."
4. The level of funding for this program should be increased to permit initiation of other research initially planned for acid savannas.

Evaluation Report on the Acid Savannas
Program of the Soil Management CRSP^{1/}
Marlowe D. Thorne

This evaluation report will follow the format of the guidelines provided by the Management Entity, with each numbered item listed first and comments regarding that item following.

1. Assess the relationships of specific projects to program objectives and goals. Cornell University projects under the Soil Management CRSP (SM-CRSP) include:
 - A. Management of nitrogen from green manure. This is the thesis research of Walter Bowen with cooperation of W. Shaw Reid and David R. Bouldin of Cornell University; Eric Stoner of Cornell University posted at CPAC; and Allert Rosa Suhet, Joao Pereira, Jose Roberto Rodrigues Peres, and Euzebio Medrado da Silva of CPAC.

This project is certainly in line with the overall SM-CRSP objective "to develop, with national institutions, improved soil management technology to increase and sustain agricultural production in the developing world, while conserving and improving the land resource base." Through field and laboratory research, the project should add to our knowledge of the contribution of legumes to the production of non-legume crops. While information is of particular importance to developing countries, it has valuable implications for crop production everywhere.

The project was initiated in the summer of 1983 and the first crop of corn was viewed in the field plots during the evaluation visit.

^{1/}Based in part on a visit to the research site near Brasilia Brazil, August 20 - 23, 1984 and to the Cornell University campus, October 11, 1984.

- B. Morphological evidence of water table fluctuation in a Red-Yellow Latosol, its genesis, classification, and identification on satellite imagery. This is the thesis research of Jamil Macedo, CPAC staff member who is an M.S. candidate at Cornell University. Ray B. Bryant and Eric R. Stoner are Cornell collaborators and Jorge Adamoli is consultant from CPAC.

This project can lead to improved management of Red-Yellow Latosols which exhibit shallow water tables during the rainy season. The study seems well designed, sites have been located and detailed data collection begun. It should make an important contribution to crop production on these important soils.

Weekly observations of water table levels are made in observation wells 3 meters deep. Aerial photography and satellite imagery are to be utilized in determining the extent of areas with high water table and in researching methods of classification of these soils.

- C. Influence of soil texture on phosphorus fertilization and management of Cerrado Oxisols. This project will be the thesis research of Ibere Lins, a Ph.D. candidate at North Carolina State University. John J. Nicholaides III and F. Cox of NCSU, Eric Stoner of Cornell and Edson Lobato of CPAC are collaborators in the study.

The objective is to determine the effect of soil texture on phosphorus fertilizer management for various acidic Cerrado soils. Field studies will be conducted in Mato Grosso du Sul as well as at CPAC. The study can lead to better management of Oxisols and to improved crop production and it is in line with SM-CRSP objectives and goals.

- D. Evaluation of nitrogen mineralization capacity by laboratory incubation techniques. This is the thesis research

of Jorge Quintana, CPAC scientist who is a Ph.D. candidate at Cornell University. Advisory personnel include: David R. Bouldin and Eric Stoner, of Cornell and Allert Rosa Suhet and Joao Pereira of CPAC.

The study should contribute to understanding of the nitrogen cycle under cropping systems in the acid savannas. It is complementary to project (A) and part of the overall concentrated study of economical means to provide nitrogen needed for adequate crop yields.

- E. Movement of nitrogen using ammonium sulfate tagged with ¹⁵N. Elias de Freitas, Jr., CPAC soil physicist, is project leader with R. J. Wagenet, Cornell University, as collaborator.

Field data have already been collected at CPAC and data analysis will be undertaken in the summer of 1985 when the project leader is on a study tour of Cornell University. This is also a component study of nitrogen economy in the acid savannas. A computer model for nitrogen leaching in soils has been developed at Cornell which will be utilized in the study. The project should contribute to improved efficiency in nitrogen fertilization of these soils.

- F. Study of methodologies for transfer of research results to other acid tropical savannas. Plinio Itamar de Mello de Souza, Jose da Silva Maderia Neto, Djalma Martinhao Gomes de Souza, Eculides Kornelius, Wencelsau J. Goedert, and Walter Couto of CPAC; Eric Stoner; David R. Bouldin, Armand Van Wambeke, and Matthew Drosdoff of Cornell University are all involved in the project.

The objective is to define and characterize the soil classification information which may aid in the extrapolation of experimental results in soil management of acid tropical soils. Existing soil survey information

will be utilized to determine which soil properties are important in extrapolation to other areas of acid savannas.

In view of the large areas of relatively undeveloped acid savannas in the world, this project could make a most important contribution to increasing world food production. As research results become available from other projects, it will become increasingly important to have effective means for transfer of results to areas where they are applicable. This project is certainly in line with overall SM-CRSP objectives. One of the research components listed for all zones was "improved delivery systems, including data banks and a documentation center." CPAC has a data bank which will be expanded. This is an item of much interest to CPAC and IICA as well as to TropSoils.

2. Evaluate the probability of ongoing research yielding results that will contribute to achieving program objectives.

The probability is believed to be very good. Projects are underway, personnel are well trained and are enthusiastic regarding their work. Laboratory and field facilities are good and equipment appears to be adequate and well maintained. Cooperation is good amongst those in Brazil and with Cornell and NCSU scientists who are supporting the work.

3. Determine any changes in objectives, emphasis and operations since program inception and assess factors causing these actions.

The program initially envisioned for the acid savannas anticipated much greater financial support under the CRSP than is now available. Thus only part of the planned work can be conducted in the current phase of the CRSP. Initial plans called for one senior scientist and three junior staff scientists at the Cerrado center in Brazil, one senior scientist and one junior scientist in Peru, and one staff scientist (Research Associate) and three junior staff scientists

on campus at Cornell preparing for work either in Brazil or Peru. The work in Peru on acid savannas has not yet been supported and the staff scientist on campus is not funded. Cornell plans to have six graduate students supported under the project and that goal is nearly achieved.

There does not appear to be a change in objectives of the program, but little emphasis can yet be placed on some of them due to limited resources. Cooperation with CPAC on phosphorus fertilization problems will intensify with the arrival of Mr. Lins for his thesis research. Other work planned for cooperation by Cornell scientists will intensify efforts toward other initially proposed objectives.

4. Evaluate the nature and productivity of interrelationships with (a) collaborating institution, (b) local mission, (c) related AID funded programs, (d) international centers and (e) other institutions or organizations.
 - A. Centro de Pesquisa Agropecuaria dos Cerrados (CPAC) the research arm at Planaltina of Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) is the cooperating institution in Brazil. The senior scientist and the Cornell and North Carolina State University graduate students supported by SM-CRSP are located with CPAC and considered members of their staff. Relationships on both professional and personal levels appear to be excellent.
 - B. No representatives of the local mission were met during the visit to Brazil. It was reported that relationships were good but the AID representative did not make it a policy to meet with project visitors unless there was specific need. Apparently the mission has the enviable policy of letting projects handle their own affairs with minimum of monitoring but with adequate support when problems develop.
 - C. No other AID funded programs were visited nor any contact made with personnel on any such projects in Brazil.

- D. Cooperation with international centers was not apparent, although some CPAC scientists had visited CIAT, as has the principal investigator. The senior scientist expressed a desire for such visit, but it had not yet been possible.
 - E. Cooperation with the Instituto Interamericano de Cooperacao para a Agricultura (IICA) is good. IICA supports some persons located with CPAC and they are actively involved with CPAC and TropSoils scientists. Dr. Elmar Wagner, previously Head, CPAC, is now with IICA, located at Brasilia.
5. Evaluate the contribution of the program to personnel training and technology transfer.

The Cornell program under the SM-CRSP has concentrated on training of personnel. Graduate students complete their course work at Cornell University and their thesis research in Brazil. The goal is to have six students supported under the project with at least two being Brazilian. CPAC staff members are being given the opportunity to undertake graduate training for an advanced degree with research relevant to the project objectives.

Non-degree training is also being provided for some CPAC staff through short-term study tours to Cornell University.

Transfer to the acid savannas of Brazil of technology developed elsewhere is being effected in the projects underway. Adaptation of that technology to Brazilian conditions is required and is given attention. Five senior faculty members of Cornell have visited Brazil and one from North Carolina State University will visit soon. They assist in the technology transfer and the research of the graduate students.

6. Evaluate the actual and potential impact of the research on (a) SM-CRSP goals, (b) collaborating country institutions

and (c) farmer practices.

- A. The projects underway contribute to each of the six research components enumerated for all zones in the planning document which resulted from the first meeting of the external panel for planning the CRSP. The projects also contribute to the specific research components enumerated for the seasonal, acid tropics. While the program is still too young to have made major contributions toward those research components and hence to CRSP goals, the potential is certainly there for such impact as the program progresses.
 - B. There is evidence of favorable impact on CPAC in the research underway and in the training of staff. There is potential for continued beneficial influence on research intensity and quality and on training and experience of the staff.
 - C. Low soil fertility, soil erosion and lack of available soil moisture are three of the constraints to production in the Cerrado listed by CPAC administrators in the briefing for the evaluation. Research underway or to be initiated will contribute toward alleviation of these constraints. CPAC research, with assistance from Cornell University and NCSU, has already contributed much toward improved fertilization of these soils. Agricultural development is progressing steadily in the Cerrado utilizing improved fertilization practices developed for these acidic infertile soils. Some tillage, moisture conservation and irrigation studies are underway at CPAC and there are plans for Cornell scientists to collaborate through TropSoils.
7. Appraise the expenditure of CRSP funds for (a) domestic centered research, (b) collaborating country centered research, (c) backstopping, (d) CRSP related activities and (e) administration.

No analysis of expenditure of CRSP funds was made. It is apparent, however, that, since only part of the requested funds for this program were received, shifting of expenditures has had to be made in getting the program underway. At this time, this evaluator has no criticism regarding fund expenditure except as is commented upon in some other sections of this report.

8. Identify areas that need special attention with respect to (a) research projects, (b) research methodology, (c) research personnel, (d) research funding, (e) collaborating country relationships, (f) local mission relationships, (g) funding level, (h) funding utilization, and (i) program administration.
 - A. The major deficiency apparent in research projects is the lack of a project led by the senior scientist on the project in Brazil. He has been in country long enough to have developed a project and to have it in operation. He has allowed administrative and other duties to take precedence, which was inevitable in the early stages. For his own professional development, as well as for the advancement of program objectives, it is important that he soon develop a research project and get it operational.
 - B, C, E, H, I. No areas were identified as needing special attention. Progress seems to be quite satisfactory in each of these areas and the lead institution and the management entity are to be congratulated on the fine status at present.
 - D, G. Funding level needs to be increased to make most effective use of this research program for the acid savannas. Funding has been used mainly for graduate student research including costs of Cornell scientists traveling to Brazil to plan research and to supervise thesis research of graduate students. Additional costs will soon

be incurred in this connection as EMBRAPA funds which have been used to support travel and maintenance costs of CPAC staff during graduate study at Cornell have been severely cut. The research project(s) of the senior scientist will need financial support. In addition, project proposals have been submitted by Cornell scientists for collaborative research at CPAC on priority items. Additional funding would facilitate initiation of some of these projects. The principal investigator from Cornell had not visited CPAC since the initiation of the program, in order to economize on travel expenditures and to permit other Cornell faculty members to make visits there. Funding level should not preclude such a visit in the formative stages of the program.

Additional comments on changes in program necessitated by the initial partial funding and the need for additional funds have already been made under (3) above.

9. Recommend actions perceived to improve (a) quantity and quality of research, (b) relationships among collaborating parties and (c) recognition of program contribution toward achieving CRSP goals.
 - A. Additional funding for the project should improve the quantity of research as indicated under (8). Other projects have been written and can be initiated as funding and personnel will permit. Additional sub-professional assistance could probably be well utilized in the cooperative research now underway. For example, Mr. Bowen was running the irrigation system for his plots himself, a time-consuming operation. While he reported that a technician was available when needed, the person apparently did not work in the off-hours when irrigations had to be made while winds were low. While the hours Mr. Bowen is putting in may not be unusual for a graduate

student, his limited time in Brazil could probably be better utilized with additional technical assistance being provided.

The project is fortunate in being located with a cooperating institution with good laboratory and field facilities. TropSoils has provided some needed laboratory equipment and will need to provide more as additional projects are underway.

The program for the acid savannas could be expanded significantly if additional funding were available for employment of additional senior scientists and adequate support personnel, as already commented upon under item (3).

- B. Relationships with collaborating parties appear to be good. It was apparent that not much discussion of the planning for next year's work had taken place before the evaluation. In the reporting session, there was considerable discussion about plans which had, evidently, just been developed and had not been adequately discussed. The rush of getting ready for the evaluation and the lack of a visit of the principal investigator contributed to some of the lack of understanding of the work plans. If there was strain in relationships, it may have been avoided by having such a discussion session ahead of the review meeting. This is not a major matter but is one on which improvement might be made.
- C. Plans are underway to get better recognition of the contributions of the program. The presence of Mr. Caudle during the conferences at CPAC and on field trips is preparatory to his assistance with dissemination of information about the program. Greater attention is to be given to making information about the program and its contribution available to all who may be interested.

10. Assess the need for and recommend as appropriate addition, elimination or modification of component projects and overall objectives of the program under review.

No need was identified for elimination or modification of projects now underway. Need for additional projects, particularly one to be led by the senior scientist, was noted and has been already commented upon adequately.