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REPORT OF THE EXTERNAL EVALUATION

OF THE

TECHNOLOGY FOR SOIL MOISTURE MANAGEMENT PROJECT (TSMM)

Report Submitted under:

Contract PDC-1406-I-00-0034-00

Delivery Order No. 6

Clarence C. Gray III
Daniel B. Taylor

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ACKNOWLEDGMENTS

The External Evaluation Team thanks all who gave their time and who assisted in carrying out the evaluation during the months of February and March 1991.

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The EET thanks Dr. Raymond Meyer, TSMM Project Manager, for his enthusiastic and abiding support in making the enabling arrangements throughout the course of the evaluation and in supplying documents and information as were required. The EET is also indebted to Dr. Tejpal Gill for his support of the evaluation and helpful insights regarding the TSMM project.

Clarence C. Gray III
Daniel B. Taylor

PREFACE

The Technology for Soil Moisture Management Project is one of a set of projects developed and carried out over the past several decades by the Division of Renewable Natural Resources Management in the Office of Agriculture of AID's Bureau for Science and Technology. As a group, the projects represent a mutually-supportive, balanced approach to clarifying and better understanding critical policy, management and environment issues as they relate to soils, a basic natural resource. The approach is now beginning to pay dividends, to the credit of the officers of the RNR Division.

Funds for the TSMM project were obligated July 27, 1981, but the project did not get really under way until 1984 when Dr. James F. Parr was appointed Project Coordinator by ARS/USDA. This is the project's second and final external evaluation.

This evaluation has been limited to a review of documents and discussions with U.S. project personnel and did not include contacts with recipient nations or with the project's cost-sharing, international assistance collaborators; thus, this evaluation must be appraised in that context.

This external evaluation has been conducted through a contract with the International Resources Group, Washington, D.C.

LIST OF ACRONYMS

ACSAD	Arab Centre for Studies of Arid Zones and Dry Lands
ADAB	Australian Development Assistance Bureau
AID	Agency for International Development (U.S.)
ARS	Agricultural Research Service, U.S. Department of Agriculture
ASEAN	Association for Southeast Asian Nations
AVRDC	Asian Vegetable Research and Development Center
BARC	Bangladesh Agricultural Research Council
BSP	Benchmark Soils Project, of AID-UH (defunct)
CAB	Commonwealth Agriculture Bureau
CATIE	Centro Agronomico Tropical de Investigacion y Ensenanza
CAZRI	Central Arid Zone Research Institute, India
CGIAR	Consultative Group for International Agricultural Research
CIAT	Centro de Investigacion Agricola Tropical
CILSS	Comite Permanent Inter-Etas de Lutte Contre La Secheresse dans le Sahel
CIMMYT	Centro de Investigacion y Mejoramiento de Maiz y Trigo
CIP	Centro de Investigacion de la Papa
CNRA	Centre National de Recherches Agronomiques
CNRS	Centre National de la Recherches Scientifique
CRIDA	Central Research Institute for Dryland Agriculture, India
CRSP	Collaborative Research Support Program, of AID
CSIRO	Commonwealth Scientific and Industrial Research Organization
DLD	Department of Land Development, Thailand
EET	External Evaluation Team
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuaria
ERS	Economic Research Service, U.S. Department of Agriculture
FAO	Food and Agricultural Organization of the United Nations
FERRO	Far Eastern Regional Research Office, India
FFTC/ASPAC	Food and Fertilizer Technology Centre for the Asian and Pacific Region
FSR/E	Farming Systems Research and Extension Project, Mali
GTZ	Gesellschaft fur Technische Zusammenarbeit
IARC	International Agricultural Research Center of the CGIAR System
IARI	Indian Agricultural Research Institute
IBSNAT	International Benchmark Sites Network for Agrotechnology Transfer, UH
IBSRAM	International Board for Soils Research and Management
ICAR	Indian Council of Agricultural Research
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICOM	International Soil Classification Committee
ICRAF	International Council for Research in Agroforestry

ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IDRC	Internal Development Research Center
IFDC	International Fertilizer Development Center
IICA	Instituto Interamericano de Ciencias Agricolas de la OEA
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Centre for Africa
INRA	Institute National de la Recherche Agronomique
INRAN	National Institute for Agriculture in Niger
IRRI	International Rice Research Institute
IRAT	Tropical Agriculture Research Institute in France
ISCOM	International Soil Correlation Meetings
ISSS	International Society of Soil Science
JNADP	Jordan National Agricultural Development Project
JUST	Jordan University of Science and Technology
NASA	National Aeronautics and Space Administration
NCARTT	National Center for Agricultural Research and Technology Transfer, Jordan
NEBUTA	Netherlands Bureau for Technical Assistance
NiFTAL	Nitrogen Fixation of Tropical Agricultural Legumes, of AID-UH
NORAD	Norwegian Agency for International Development
OALS	Office of Arid Lands Studies, University of Arizona
OAU	Organization of African Unity
ODA	Overseas Development Administration
OICD	Office for International Cooperation and Development, USDA
ORSTOM	Office de la Recherche Scientifique et Technique Outre-Mer (Office of Scientific Research and Technology for Mediterranean Zone - France)
PARC	Pakistan Agricultural Research Council
PASA	Participating Agency Service Agreement
PCARRD	Philippines Council for Agriculture and Resources Research and Development
ROCAP	Regional Office for Central American Programs / USAID
RRAM	Ruhengeri Resource Analysis and Management Project, Rwanda
SAT	Semi-arid Tropics
S&T	Science and Technology Bureau, U.S. Agency for International Development
SCS	Soil Conservation Service / USDA
SECID	South-east Consortium for International Development
SMSS	Soil Management Support Services - AID/USDA
SPC	South Pacific Council
TSMM	Technology for Soil Moisture Management Project - AID/USDA
TROPSOILS	A Collaborative Research Support Program (CRSP) in Tropical Soils, AID
UH	University of Hawaii
UNDP	United Nations Development Program

UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UPR	University of Puerto Rico
USAID	United States Agency for International Development (also AID)
USDA	United States Department of Agriculture
World Bank	International Bank for Reconstruction and Development

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I. EXECUTIVE SUMMARY

A. The Project

Technology for Soil Moisture Management (TSMM) is an AID/S&T/AGR/RNR global research and development service project conducted by ARS/USDA and ERS/USDA through a PASA with OICD/USDA which provides technical assistance to developing nations to help them improve their dryland, rainfed farming systems. The technical assistance is provided directly to individual nations or groups of nations through USAID country programs and indirectly through various types of regional and global networks of nations and international assistance agencies. Through these two operational modes, the TSMM helps nations with agronomic and economic assessments of their soil, water and crop/livestock systems and with the formulation of national strategies and programs for increasing the productivity of such systems. As a U.S.-based project, the TSMM project also serves as a bridge linking the U.S. scientific community with those of collaborating nations through continual exchange of soil moisture management information for sustained agricultural production. The project is composed of two separate components operated by ARS and ERS.

B. Purpose

The purpose of this external evaluation is to assess the overall performance of the project, evaluate the project's success in achieving its objectives, and indicate lessons learned and expected impact of its objectives/purpose on agriculture in LDCs.

C. Findings

Funds for the TSMM project were obligated in July of 1981, but the project did not really get underway until 1984 when the present project coordinator was appointed. Since then, the project has made excellent progress and has carved out a role for itself in the evolving international agricultural research system. Its role--its special niche--in the present scheme of international assistance is in dryland agriculture in the semi-arid tropics. In this regard, TSMM has:

- Sponsored an international conference on dryland agriculture in Texas at which there were 400 participants from 52 countries and 36 U.S. states.

- Arranged four (4) international workshops on dryland agriculture topics in Africa, Asia and the Middle East attended by 350 participants from 40 countries.

- Sponsored three (3) international seminar/conferences in Asia and the Middle East that had 580 participants from 49 countries.

- Conducted four (4) Field tours for 100 LDC leaders and international assistance agency managers to observe dryland farming practices in the U.S.

- Conducted collaborative research projects with scientists/ institutions in Jordan, Niger, Morocco, Dominican Republic, Haiti, and India.

- Developed automated databases and information systems for rainfed areas of Niger, Mali, Cameroon, Benin, Syria and Jordan.

- Adapted and developed crop growth and soil and water balance models for use in dryland farming areas.

- Completed case studies in Mali and Niger that provide useful, decision-making information for farmers.

- Distributed 2,600 copies of the proceedings of five workshops/ conferences held in West Africa, N.E. Thailand, Jordan (2) and Texas.

- Provided technical assistance to developing nations as requested by USAID Missions.

- Provided informal training to more than a thousand participants in sponsored workshops and conferences.

- Conducted programs of mutual interest with several international agricultural research centers--ICRISAT, ICARDA and ILCA.

- Operated a dryland, sustainable agriculture information network linking LDC scientists, U.S. scientists and scientists/program managers of international assistance agencies.

Despite its slow, uncertain start, TSMM has done quite well and has been the means through which expertise in dryland agriculture in ARS and U.S. universities has been made available to developing nations.

Notwithstanding its excellent record of the past several years, the TSMM project could be improved through more structured arrangements that would provide for long-term, collaboration with selected nations in the semi-arid tropics.

TSMM's special capabilities in dryland soil and water management research and outreach and in economic analyses would be enhancing, upgrading features for all of S&T/AGR's CRSP projects currently operating in the semi-arid tropics.

Beyond the current PASA which terminates in mid-1991, it would be beneficial to the Soil Management CRSP, if TSMM's soil and water outreach activities and economic analyses capabilities were to become components of the Soil Management CRSP.

D. Recommendations

The External Evaluation Team recommends that:

1. S&T/AGR/RNR consider ways to utilize the services of TSMM's ARS and ERS components to upgrade the outreach and economic analyses capabilities of its collaborative research projects that operate in the semi-arid tropics for the purpose of increasing their impact on developing nations. Such projects include the Soil Management CRSP, the Bean/Cowpea CRSP, the Peanut CRSP, the Sorghum/Millet CRSP (INTSORMIL) and the Small Ruminant CRSP.

2. After the termination of the TSMM PASA, S&T/AGR/RNR consider arrangements to make TSMM a part of the Soil Management CRSP on a phased-in basis initially under an "umbrella arrangement," but eventually in a manner that would allow the ARS and ERS components to become full-fledged research and outreach components of the CRSP.

E. Lessons Learned

The very slow, uncertain start almost led to TSMM's termination. While it is not clear that the slow start that delayed project activities for several years was due mainly to the lack of an agreed project plan and operational strategy prior to project initiation, very likely this deficiency was a contributing factor. Thus, a lesson in this project is that a project plan/strategy should be developed and approved prior to project initiation.

The success of the project after it got underway reaffirms the lessons of the past that development projects are likely to succeed when guided and operated by experienced, knowledgeable, dedicated professionals assisted by interested, competent allies and hosted by highly receptive, responsive host countries.

There is a need in many countries to compile and evaluate research data generated by earlier and on-going projects. Such "databases" (research compendia) can be very valuable in identifying research gaps, needs and priorities for future projects, and to prevent duplication of earlier and on-going projects. The EET feels that this is an important activity which should be encouraged in future projects.

Data collected on all USAID projects should be made available to interested parties (following a reasonable time period for researchers on the project to complete their analysis) on PC diskettes in a format which can be readily understood. The analysis conducted under the ERS component of the project suggests that there is often much additional analyses which can be done on data collected by projects. Furthermore, data accumulated over time and many projects could provide an invaluable source of information and data for further analyses.

II. PROJECT DATA

Project Title:	Technology for Soil Moisture Management (TSMM)
Project Number:	936-4021
Date of Obligation:	July 27, 1981
Date of Completion:	July 26, 1991
PASA Number:	DAN-4021-X-AG-7021-02
Funding: Authorized:	$5,400,000
Obligated:	$4,721,000
Lead Scientists/Contacts:	Dr. James F. Parr, ARS Dr. John C. Day, ERS
A.I.D. Project Manager:	Dr. Raymond Meyer
Type of Evaluation:	Final Evaluation
External Review Team:	
Frank Alejandro Ex Officio	Ph.D., Systems Administration Program Office, S&T Bureau, AID
Clarence C. Gray III Member/Chair	Ph.D., Soil Science Retired Officer, Rockefeller Foundation Professor Emeritus, Virginia Tech
Daniel B. Taylor Member	Ph.D., Agricultural Economics Associate Professor, Production and Resource Economics, Virginia Tech

III. PURPOSE OF THE EVALUATION AND STATEMENT OF WORK

A. Purpose

The purpose of the external evaluation is to review progress in achieving program objectives and assess how program activity components contributed to overall goals. The goal of TSMM is to increase food availability and

income in developing countries by increasing the productivity of dryland farming systems while maintaining or enhancing the natural resource base.

B. Statement of Work

The contractor is responsible for assessing the overall performance of the project, evaluating the project's success in achieving its purpose, indicating lessons learned, and expected impact of project purpose/objectives on agriculture in LDCs. The evaluation team shall:

1. Assess the use of data and information generated by TSMM by developing countries. Are the technologies, methodologies and products of the project effectively available to developing countries? What is the scope of use?

2. Evaluate the effectiveness of TSMM's scientist and research linkages such as the India/FERRO projects, JUST (Jordan), and Washington State and Purdue Universities. Were the project objectives appropriate and significant to developing country needs?

3. Determine the amount of cost-sharing and support provided by international, regional, and national organizations and USAID missions.

4. Evaluate the effectiveness and appropriateness of the project's technical assistance and research activities.

5. Determine the progress of the project since the last evaluation in 1986 and determine the degree to which its recommendations have been addressed.

6. Determine if there was satisfactory progress on the project's major activities since 1986. Briefly describe outstanding accomplishments. Is it probable that all project outputs will be completed by the project's ending date?

7. Review the networking with other S&T projects as a means to help facilitate technology diffusion and to increase project efficiency.

8. Make recommendations as to future program directions with respect to anticipated requirements for assistance in dryland research information in LDCs.

IV. PLACE OF THE EVALUATION AND METHODS USED

The external evaluation took place in Washington, DC and Rosslyn, Virginia in the offices and conference rooms of USDA, IRG, and AID/S&T/AGR. Briefings, interviews, review of documents, and discussion and analyses of findings were methods used to evaluate the TSMM project.

V. PROJECT DESCRIPTION

The TSMM is an AID/S&T/AGR/RNR global research and development service project conducted by ARS/USDA and ERS/USDA through a PASA with OICD/USDA which provides technical assistance to developing nations to help them improve their dryland, rain-fed farming systems. The technical assistance is provided directly to individual nations or groups of nations through USAID country programs, and indirectly through various types of regional and global networks of nations and international assistance agencies. Through these two operational modes, the TSMM helps nations with agronomic and economic assessments of their soil, water, and crop/livestock systems, and with the formulation of national strategies and programs for increasing the productivity of such systems. As a U.S.-based project, the TSMM project also serves as a bridge linking the U.S. scientific community with those of collaborating nations through continual exchange of soil moisture control information for sustained agricultural production. The project is composed of two distinct components.

In terms of a PASA agreement, the TSMM Project operated from late 1983 through September 30, 1991. In 1985, an economics component was added to the project through collaboration with the Economic Research Service (ERS) of USDA, although work did not officially begin on the economics component until October 1, 1986.

A. Purpose

The purpose of the project was to provide technical assistance to AID projects which were working in dryland or rain-fed agricultural systems in semi-arid regions and which needed expertise for improving soil and water management practices in these systems. The work of the project focused on countries in the Near East (Middle East), Sub-Saharan Africa, and Southeast Asia. ARS activities focused on this technical assistance perspective while ERS activities had more of a research orientation. However, the products of the ERS effort do provide sound examples of how economic analysis can be applied to these systems, and could provide an excellent basis for training in economic analysis techniques which go far beyond a simple budgeting approach. Evaluating the efforts of both ARS and ERS, the

S&T/AGR/RNR project manager feels that TSMM consisted of about one-third research, one-third technical assistance, and one-third networking activities.

B. Objectives

The **overall objective or purpose** of the project was to assist developing countries in the assessment of their soil, water, and crop management systems under dryland or rain-fed conditions, and the formulation of national strategies for increasing their agricultural productivity through research and technology transfer.

The specific objectives of the project were:

1. To increase the productivity and stability of cropping systems under rain-fed conditions;
2. To increase the retention and storage of water from existing precipitation, thereby minimizing run-off, erosion, and evaporative losses;
3. To increase the efficient use of water by crops through proper crop selection and sequencing, and through the use of improved crop calendars;
4. To assess the economic impacts of improved rain-fed crop and livestock production practices;
5. To evaluate public policy and program options that would stimulate adoption and diffusion of improved rain-fed production practices; and
6. To determine the benefits and costs of additional investments in dryland or rain-fed production systems.

Objectives 1, 2, and 3 address agronomic issues, while objectives 4, 5, and 6 cover the economic components of the project.

C. Summary of Activities

A brief description of the project's activities would include what the project staff referred to as the formation of databases, but which might more properly be called research compendia. One of the fundamental activities of TSMM in some countries was to compile and publish research results of all relevant research activities in that country which could be located. Much of this information had never been published. In addition to providing an invaluable source of information, it was hoped that the compendia would prevent unnecessary duplication of past or current research in the future.

Workshops were held in both LDCs and the U.S. to discuss research priorities and to observe soil moisture management techniques. It is worthwhile to note that the U.S. has much more to offer dryland areas in terms of observing U.S. techniques than is generally realized. For example, the stress which plants are subjected to in much of the U.S. dryland production area is more severe than plants experience in much of the sub-Saharan dryland production area.

Finally, research activities were conducted in both LDCs and the U.S. on aspects of dryland production. This research generally involved collaboration among U.S. scientists and their LDC counterparts. Much of the U.S.-based research involved economic analysis of data collected in LDCs.

Some of the results of these activities include an international network among soil and water management specialists in LDCs and in the U.S. land grand universities, ARS, and ERS. Where data has been obtained for analysis it has been made available to others for use in their research. Crop growth simulation models have been developed for several countries and crops with the ultimate goal of developing models which are more tractable for use in LDCs than the complex models used in the U.S. Such models will be very important for assessing the viability of technology transfer in a cost effective manner.

VI. FINDINGS AND CONCLUSIONS

A. Project Planning

Discussions with TSMM project personnel and project documents revealed the project got under way without benefit of an approved project document and a guiding logistical framework. It seems that the urgency of providing improved AID assistance to help alleviate widely publicized dire conditions of famine or near famine in many low-rainfall, non-irrigated tropical areas prevailed without the usual review and approval process. The upshot of the situation was that after initial funding, AID and USDA had to spend an inordinate amount of time assessing the situation and setting a course of action. Thus, the project got off to a slow, somewhat uncertain start over the first several years (1981-1983). It wasn't until after ARS assigned Dr. James F. Parr to the project in 1984 that a program strategy and plan of action was developed. It involved assessing the state of knowledge, identifying problems, mobilizing available resources, and arranging solutions. Specific activities to be conducted included:

1. Establishing an information network comprised of scientist-to-scientist linkages among and between soil and water management specialists in U.S. land-grant institutions, ARS/USDA and ERS/USDA, developing country institutions, international assistance organizations, and in AID.

2. International workshops to outline and establish research priorities.

3. Research in developed and developing countries linked by common objectives for improved understanding and extrapolation to areas of need.

The EET noted above the slow start of the TSMM project and the probable causes. After prodding by AID, ARS took the necessary actions to get the project under way and developed what has been a rewarding program plan.

B. Project Inputs

1. S&T/AGR/RNR

This AID office provided the funding and overall supervision of the project. This supervision included evaluation and approval of annual plans of work as well as approval of project expenditures. The direction which this office provided for TSMM was particularly critical given TSMM's lack of an approved project paper or logical framework for guidance. The PASA developed for this project thus took on added significance as it served to guide the project. The S&T/AGR/RNR office also helped with some of the information dissemination activities and logistical support needs of TSMM.

While fostering interaction among S&T/AGR/RNR projects is as much the responsibility of the projects themselves as this office, the EET would like to have seen more initiatives to encourage linkages. More effort on linkages with other S&T/AGR/RNR projects should have been pursued, particularly with SMSS.

Some difficulty was encountered by the project in terms of a lack of a timely transfer of funds from AID to OICD. At times this meant that ARS and ERS activities, and those of their cooperators, had to be "carried" by OICD and others. This made some operations difficult. It should be noted that OICD is expressing reluctance to "carry" projects for very long, and this reluctance could lead to operational problems in future AID projects with USDA unless these timing problems are worked out.

Another factor which the EET would have liked the S&T/AGR/RNR project manager to pursue more vigorously was more integration between the ERS and ARS components of the project. The EET feels that these components operated independently more than would be desirable. Some of this independence may be due to the ERS component being incorporated after the ARS component was up and running. It would have been much more desirable for S&T/AGR/RNR to have had both aspects of the project on-line from the initiation of TSMM efforts.

2. USDA

a. OICD

Two roles were played by OICD. One was logistical and the other involved financial management. The logistical support included arranging for travel, obtaining visas and so forth. The TSMM project personnel indicated that throughout the duration of the project OICD's logistical support has been outstanding.

The financial management activities of OICD consisted of holding funds transferred from AID to USDA/ARS and ERS, dispersing the funds for approved project activities, and providing a periodic accounting of the project's financial status to USDA/ARS and ERS and S&T/AGR/RNR personnel. The financial reporting function of OICD did not operate adequately during the first few years of the project. In order to ameliorate this problem, OICD, with AID's help, made some adjustments. Once these adjustment were made, TSMM staff report that the financial reporting of OICD was good. However, the primary reason that TSMM became satisfied with OICD financial reportings is that TSMM hired its own OICD accountant to provide timely financial reports with project funds. That is, they paid for this service in addition to OICD's overhead charges.

In order to support the services it provides to TSMM as well as other activities, OICD charges overhead. At the start of the SMSS project, OICD charged 18 percent overhead. By the end of the project, OICD's overhead rate had increased to 36 percent.

b. Agricultural Research Service (ARS)

ARS provided personnel, including the project coordinator who is also the U.S. National Program Leader for Dryland Agriculture

and Soil Fertility in ARS. While the project coordinator and one associate project coordinator were based in Washington, DC, two associate project coordinators were located at research laboratories in dryland farming areas of the U.S. Development of and planning for the non-economic components of TSMM was the responsibility of ARS. Incorporating ARS in TSMM provided AID with direct access to the largest group of scientists in the world who are involved in research efforts on the soil and water management problems of dryland agriculture. Approximately 15 ARS scientists and engineers and 10 scientists from land grant universities have worked on TSMM efforts.

The administrators of ARS were supportive of the TSMM effort. Personnel based both in Washington, DC and throughout the U.S. were involved in ARS' work. Experienced senior personnel who were actively involved in research were usually sent on the overseas work. They, thus, had immediate credibility with their counterparts in LDCs. The ARS personnel who worked on TSMM generally felt that they had learned a lot and that the experience had enhanced their domestic performance.

c. Economic Research Service (ERS)

The project coordinator for the economic component of TSMM was provided by ERS. This individual was responsible for the development of and planning for the activities of the economic component of the project. Before going any further, it should be noted that ERS administrators are neither supportive of international work nor of the micro-level studies which TSMM worked on. ERS personnel, thus, did not view any formal involvement in TSMM as career enhancing. Other than the project coordinator's efforts, the other ERS inputs consisted of informal discussions by the project coordinator with approximately 15 other ERS personnel. The EET finds this lack of support for international work within ERS to be very discouraging, and would hope that they eventually could operate more like ARS and SCS does. If such a mode of operation requires a change in their legislative mandate, then the EET hopes that such a change is forthcoming.

Other than the work which the project coordinator could accomplish alone, the remainder of TSMM's economic analysis was conducted through cooperative agreements with U.S. land

grant institutions. In total, 31 faculty, senior researchers, and graduate students have been involved in this ERS effort.

3. Foreign Cooperators and Collaborators

A summary of TSMM activities which includes workshops, seminars, and cooperation with other agencies, is contained in Table 1. The TSMM project (both ARS and ERS efforts combined) worked with various domestic and international institutions. Other collaborating institutions include Asia-Pacific Natural Agriculture Network, CAZRI, CRIDA, CSRS, FAO, FED, FERRO/Delhi, IBSNAT, ICAR, ICARDA, ICRISAT, IITA, ILCA, Indo-U.S. Sub-commission on Agriculture, INRAN, IRAT-CIRAD, IRDC, JNADP, JUST, Kasetsart and Kohn Kaen Universities in Thailand, NCARTT, ONAHA, ORSTOM, Punjab Agricultural University, the Rodale Institute, Rockefeller Foundation, SAFGRAD, SCS, SMSS, TROPSOILS, U.S.-India Fund, University of Jordan, and The World Bank.

The collaboration and cooperation of the above institutions with TSMM included cost-sharing, logistical support, participation in workshops, and collaborative research.

4. U.S. Land Grant Institutions

The cooperative agreement mechanism between ERS and the land grant institutions was a very effective mechanism for operating the economics component of TSMM for several reasons. First of all, cooperative agreements could be initiated without going through an RFP/Competitive bidding-type of process. Second, universities do not charge any overhead on these cooperative agreements, thus saving project funds for other activities. Finally, the salaries of the principal investigators at the universities were generally contributed to the TSMM project as cost-sharing funds.
Due to the limited budget of the project, funds were not available for primary data collection. Thus, the input of land grant institutions was generally elicited when they either had access to data from appropriate LDCs or when they could obtain such data. Purdue University and Washington State University were the institutions with which TSMM had cooperative agreements. The land grant institutions provided personnel and facilities, including computers, to conduct the analyses of the data.

TABLE 1. Some Institutions That Have Cooperated With The TSMM Project And The Nature Of Their Cooperation

Institution	Country or Location	Cooperative Activities
APNAN	Japan	Kyusei Nature Farming Network
CAZRI	India	Symposium
CRIDA	India	Training
		Monograph
FAO	Italy	International Conference
IBRD	U.S.	International Conference
		Study Tour
ICAR	India	International Conference
		International Workshop
ICARDA	Syria	International Workshop
		Training
		Workshop Proceedings
ICRISAT	India	International Workshop
		Training
		Workshop Proceedings
IITA	Nigeria	Training
JHADP	Jordan	International Workshop
		Training
JUST	Jordan	International Workshop
		Training
PUNJAB UNIV	India	Training
PURDUE UNIV	U.S.	Cooperative Research
ROCKFOUND	U.S.	International Conference
SAFGRAD	Africa	Training
TAES	U.S.	International Conference
		Conference Proceedings
TROPSOILS	Niger	Cooperative Research
UNIV JORDAN	Jordan	International Workshop
		Training
		Cooperative Research
WASH STATE UNIV	U.S	Cooperative Research

5. External Reviews

The TSMM project had an external evaluation November 17-18, 1986, by a team of three persons. While the evaluation was five years after the first funds were obligated, the project had really been under way operationally for approximately two years; thus, the project had not had time to build much of a record of achievement. The evaluation team gave the project overall good passing grades, with special citations for effective and efficient project management and for a set of activities consistent with LDC needs. The team made 10 specific assessments (really recommendations). The TSMM project leaders responded positively to the recommendations and have implemented or are in the process of implementing most of them. Several, such as recommendations on more work in Africa and more sensitivity to gender issues, have only been partially addressed for a variety of reasons, such as a lack of opportunities for effective operations (as is the case in many areas of Africa and elsewhere in the semi-arid tropics) and limited funds.

In terms of specific responses to issues raised in the 1986 review, the EET has learned the following:

- The ERS component conducted a dryland-irrigation case study in Niger in FY90. This case study was in response to the 1986 EET's observation that many dryland farmers allocate resources between irrigated and unirrigated land; TSMM could thus not focus on only dryland production.

- A new ERS-linked project in Burkina Faso will involve household analysis with special emphasis on the role of women. This project addresses the issue of lack of emphasis on women in development raised by the 1986 EET.

The EET concludes that there have been satisfactory responses to the 1986 external evaluation and that the project is progressing toward the accomplishment of its objectives. The EET has been quite impressed by the scope of TSMM's activities.

6. External Audits

No external audits were performed during this project. In a project of this length and magnitude, the EET finds the lack of an external audit to be a serious omission. Fortunately, internal audits were routinely performed through OICD's established internal auditing procedure.

C. Project Outputs and Accomplishments

1. Impact of the TSMM Project on LDCs

The TSMM project has conducted a variety of activities calculated to reach and influence agricultural scientists, specialists, administrators and policy makers. Such activities include:

a. Outreach/Extension

Major outreach activities are listed in Table 2 and are comprised mainly of seminars/conferences on dryland agriculture, workshops on specific dryland agricultural topics, and field tours or "traveling seminars." Through these activities alone, TSMM has been in direct contact with an estimated 840 individuals from many countries. There have been representatives at seminars/conferences and workshops from just about all developing countries in the semi-arid tropics (SAT). The TSMM has concentrated its outreach/extension efforts mainly in Asia and the Middle East.

The TSMM has been involved in two networks concerned with sustainable agriculture, with special concern for the SAT. One is a rather informal information network conducted by the TSMM Project Director through which interested researchers in developing countries are kept abreast of sustainable agricultural research and production practices and general information of common interest. The other is the Asian Pacific National Agricultural Network (APNAN) that grew out of the First International Conference on Kyusei Natural Farming held in Thailand in 1989. The purpose of the APNAN is to foster low-input, sustainable farming systems.

The Project Coordinator estimates that the TSMM project has had some measure of contact and influence with about 40 developing nations.

b. Research

Through its affiliated scientists and specialists in ARS and U.S. universities, TSMM has been engaged in a number of collaborative research projects with developing countries in the SAT. The projects involve both the ARS and the ERS components:

Table 2. Major Outreach Activities of the TSMM Project

Date	Activity and Co-Sponsor	Place	Participation Persons	Participation Countries/Agencies
1984	Field Tour	Pacific N.W. Texas High Plains	10	ICARDA
1985	Work Shop Khon Kaen Univ. USAID, ARS	Thailand	100+	5 Asian Countries
1985	Field Tour IBRD, ICRISAT ICARDA, FAO	U.S. Great Plains	35	10 Countries
1986	Workshop ICARDA	Jordan	70	11 Countries and GTZ, Australia, FAO
1986	Field Tour Plains	Southern Great	25	Assistance agencies- IBRD, USAID, USDA
1987	Workshop TropSoils	Niger	80	12 Countries and ORSTOM,ILCA,IRAT INRAN,ICRISAT ICRISAT, TropSoils
1988	Conference JHADP, INCARTT	Jordan	30	5 countries and ICARDA, ACSAD
1988	Conference RF,TAES, AID OICD/CSRS/USDA, FAO and SCS	Texas	400	52 countries and 36 U.S. states
1988	Travel Tour	Kansas, Nebraska and Iowa	30	Program mgrs. AID, IBRD, FAO, OICD
1989	Conference CAZRI, FERRO	India	150	19 Countries including Russia
1990	Conference ICAR, FERRO	India	400	25 countries
1990	Workshop ICAR, FERRO Rodale	India	100	12 Countries

The ARS has conducted collaborative research with

(1) The TropSoils CRSP in Niger on management of crop residues to increase soil water storage in Sahelian soils.
(2) Jordan University of Science and Technology (JUST) on determination of the agronomic and economic value of crop residues for water conservation versus feed for small ruminants.
(3) Rabat Institute in Morocco on wind erosion: management, characterization of sediments, effect of environmental factors, and an erosion control prediction system.
(4) Dominican Republic and Haitian scientists on water erosion and soil management practices.
(5) CAZRI and CRIDA of ICAR in India with modeling research on field water use and crop yield for maize-wheat farming systems in northern India.
(6) CAZRI, CRIDA and Punjab University on evaluation of soil water and nitrogen management practices for increasing water and nitrogen use efficiency.
(7) CAZRI and CRIDA on germplasm enhancement for drought tolerance and reclamation of wastelands.
(8) Indian scientists at Bellary, Agra, Bangalore and Indore on an integrated project for soil conservation and watershed management.
(9) Indian engineers at six sites on small scale mechanization for dryland agriculture.

The work conducted under the economics component of TSMM is of note from several perspectives. First, the work was multidisciplinary in nature with respect to the physical modeling of crop growth. Second, it developed a sequence of analytical techniques ranging from simple to more complex types of mathematical programming. Third, it has put together PC-based databases which others will find tremendously useful in their work. Fourth, through the case studies it has put together material which can become the core of an instruction program in LDCs on whole-farm analysis. Finally, the economic analyses conducted by this study demonstrate that there is a lot of very useful work which can be conducted with secondary data. While the researchers of the ERS component were sometimes frustrated by their inability either to fund primary data collection or obtain cooperation from on-going projects in this effort, the EET feels that the work they have been able to produce is commendable.

ERS has Cooperative Research Agreements with Purdue University and Washington State University and has conducted research in six categories:

(1) Automated Database Development and Information systems for technical information pertaining to soils, weather, agronomic practices, crop yield responses and farm characteristics in rainfed areas of Niger, Mali, Cameroon, Benin, Syria and Jordan. These databases consisted of secondary, non-TSMM generated data collected by WSU and PU personnel and others on prior assignments were used for these database systems. These databases are available to individuals who are interested in using them.

The nine databases are listed below:

- Niger Experimental Farm Trials. Collaborators: Purdue University and the National Institute for Agricultural Research in Niger (INRAN).
- North Jordan Farm Surveys. Collaborators: Washington State University and the International Center for Research in the Dry Areas (ICARDA).
- Northern Jordan Field Trials. Collaborators: Washington State University, Jordan University of Science and Technology (JUST), and ICARDA.
- The Niger Dryland - Irrigated Farms Database. Collaborators: Purdue University, the European Fund for Economic Development (FED), and the National Office of Irrigated Perimeters (ONAHA).
- North Cameroon Farm Trials and Farm Surveys. Collaborators: Purdue University and the Semi-arid Food Grain Research and Development Program in Cameroon (SAFGRAD/Cameroon).
- North Benin Farm Survey. Collaborators: Purdue University and the Semi-arid Food Grain Research and Development Program in Benin (SAFGRAD/Benin).
- Burkina Faso Farming Systems Database. Source institutions: ICRISAT, IITA, The World Bank, Purdue University, USDA, University of Hawaii (IBSNAT), and Washington State University.
- The Niger Phosphate Trials Database. Collaborators: International Fertilizer Center (IRDC), and ICRISAT Sahelian Center, Niamey.
- West Africa Literature Database. Purdue University.

(2) Crop Growth and Soil and Water Balance Models involving simple, minimal data sets have been developed or adapted for use by TSMM:

- Soil-Water Balance/Crop Yield Model

- Millet-Cowpea Crop Growth Model
- Linear Response and Plateau Model for crop response to fertilizer and other inputs
- Adaptation of EPIC (Erosion Productivity Impact Calculator) to barley, wheat, vetch and medic farming systems of northern Jordan
- Computer-based Linkage System for weather/crop/livestock whole farm systems

This work on the crop growth simulation models represents an effort which is vital if the economic impacts of alternative technology are to be assessed in a cost-effective manner. That is, good simulation models can eliminate the need for more extensive field trials (beyond model calibration) and allow risk to be assessed. The ERS project coordinator indicated that a good beginning had been made in developing LDC applicable crop growth models, but that more work needed to be done to make them less data-intensive and more usable under LDC conditions. The EET concurs with the assessment, applauds the progress made to-date, and encourages further work in this area.

(3) Whole farm models to develop/utilize methods for technology assessments that take into account as much as possible the interaction of soils, weather, farm resource base, farm production practices and the particular economic setting. Nine models have been developed as follows:

- A linear programming model of a typical rain-fed farming system in the semi-arid region of western Mali (800-1000 mm of rainfall, 120-150 day growing season).

- A discrete stochastic programming model based on a typical millet-cowpea intercrop farm model for the Sahelian agro-climatic zone in the Maradi region of Niger (400-600 mm of rainfall, 60-100 day growing season).

- A Target MOTAD linear programming model to assess sorghum technology for a typical rain-fed plus supplemental irrigation farm in southern Niger (300-500 mm of rainfall, 60-100 day growing season). The model is outfitted with two Expert Systems to facilitate its operation in a user-friendly mode.

- A dynamic programming intertemporal model of farm-level fertilizer decision-making in the Sahelian agro-climatic zone.

- A mixed integer whole-farm programming model of a representative barley-legume-livestock rain-fed farm in northern Jordan (300 mm of rainfall).

- A System of Linear Programming Models of Representative Traditional Farms in Northern Cameroon (600-1200 mm of rainfall, 120-180 day growing season).

- A Linear Programming Model of Representative Crop-Livestock Traditional Farming Systems in Northern Cameroon (600-1200 mm of rainfall, 120-180 day growing season).

- A Quadratic Risk Programming Model of a Typical Representative Farm in Northern Cameroon (600-1200 mm of rainfall, 120-180 day growing season).

- A Model of a Representative Farming System in Northern Benin.

As indicated above, the whole-farm modeling ranged from simple linear through complex dynamic programming. In many instances, the modeling employs the results of the simulation modeling, discussed above, for estimates of yields. Partial budgeting and other techniques which are frequently used to assess the potential of new technologies are not comprehensive enough to give a true picture of the impact of that technology on the whole farm system. The whole farm analysis is a systems approach to the analysis of impacts of alternative technology through which trade-offs among alternative uses of limited resources become clear, and the viability of alternative technologies can be comprehensively evaluated. The whole-farm approach is thus vital in order to accurately assess the potential of alternative techniques.

Since relatively simple through very complex analytical techniques were employed, a range of analytical techniques can be presented to scientists in LDCs which they can employ to conduct whole-farm analyses. The choice of technique will be based on the competence of the researcher and the availability of data. It should be noted

that any well-trained B.S.-level (by U.S. standards) agricultural economist should be able to use the linear programming approaches. Also, with two to four weeks of intensive training, all techniques except the most sophisticated ones could be taught to LDC scientists with a good background in agricultural economics.

The EET would like to suggest that a logical next step in TSMM is training LDC scientists in the use of these techniques. One important final point to bring out is that until a few years ago, due to software and/or hardware limitations, most of these analytical techniques were beyond PC capacity and thus beyond the reach of most LDC scientists. This is no longer the case and the EET thus feels that the ERS effort is well in tune with available technology.

(4) Development of procedures for handling risk, with special regard to technology appraisals. TSMM has been addressing the matter of proper procedures appropriate for rainfed farming systems. This work is under way, and is summarized below.

- Review of literature on approaches for handling risk and uncertainty in farm technology and research management decisions.

- Evaluation and comparison of procedures appropriate to rainfed farming systems analysis.

- Identification of operational approaches for incorporating risk and uncertainty into whole-farm planning for West Africa.

- Development of procedures for incorporating intertemporal impacts of soil erosion, reduced fertility, and conservation practices in static farm models.

- Development of an optimal control model for evaluating intertemporal dynamic relationships between soil and water conservation practices and productivity.

- Development of a simulation methodology (Soil Erosion Control Under Risky Environment [SECURE]) to evaluate physical and economic impacts of soil and water resource management under uncertainty.

The research on procedures for handling risk, uncertainty, and the dynamics of technology transfer builds upon the simulation and whole-farm analysis work. It attempts to synthesize the simulation models and the whole-farm planning models to develop a more realistic and flexible analytical tool. This effort represents the most analytically advanced work of the ERS component, and the EET encourages more work in this area.

(5) Expert Systems

As indicated above, one expert system for hybrid seed development and adoption for Niger based on one of the risk programming whole-farm analysis is under development. The expert system approach represents one way to bring the more sophisticated analytical techniques this project developed to the non-agricultural economist and/or the agricultural economist with only rudimentary training. The EET would like to encourage further work on this expert system, and the development of expert systems for other economic analyses employed in this project. We feel that expert systems are an outstanding mechanism to make the technology of evaluating technology transfer more transferable.

(6) Case Studies to illuminate important agricultural production issues have been carried out using the methods, data and computer systems developed or adapted in (1) through (5).

Six case studies were conducted in Mali, five in Niger, five in Jordan, one in Burkina Faso, three in Cameroon, and an unspecified number in Benin. More information is presented below:

(a) Mali Case Studies

- *Soil and Moisture Management in Mali: A Case Study Analysis for West Africa.* John C. Day and Marcel P. Aillery.

- *Water Conservation in Arid and Semi-arid Agriculture: An Economic Analysis.* John C. Day.

- *Crop Variety Selection in Response to Rainfall Variability in Dryland Agriculture: A West African Case Study.* John C. Day and Walter R. Butcher.

- *Data Base Integration for Agroclimatic Analysis and Planning.* E. T. Kanamasu, J. C. Day, and J. P. Milford.

- *Economic Analysis of Soil and Moisture Management on Marginal Croplands.* Walter R. Butcher and John C. Day.

- *An Economic Analysis of Farm Management Practices and Improved Technologies in the Sahel.* John C. Day, Walter R. Butcher, and David W. Hughes.

(b) Niger Case Studies

- *Stochastic Linear Response and Plateau Functions in Modeling Crop Response to Fertilizer in Niger, West Africa.* Patrick Jomini, Robert R. Deuson, Jess Lowenberg-DeBoer, and Andre Bationo.

- *Risk Sharing Systems for International Development: The Nigerian Case.* M. A. Krause, R. R. Deuson, T. Baker, P. Preckel, J. Lowenberg-DeBoer, C. K. Reddy, and M. Kadi.

- *A Simulation Model of Millet and Cowpea Intercrop (Case Study Analysis).* J. Lowenberg-DeBoer, M. Krause, R. Deuson, and K. Reddy.

- *Analysis of the Competition for Labor by Dryland and Irrigated Crops: The Case of Rice and Millet in Niger.* Ziyou Yu, Robert R. Deuson, and Jess Lowenberg-DeBoer.

- *Sorghum Technology Assessment for Southern Niger Using a Target MOTAD Approach.* Peter Ensink and Robert R. Deuson.

(c) Jordan Case Studies

- *Examining the Optimal Use of Cereal Grain and Straw in the Mafrag Region of Jordan with a*

Mixed Integer Programming Model. David W. Hughes, Walter Penaranda, Abdullah Jaradat, and Walter R. Butcher.

- *Economic Evaluation of Long-term Productivity Effects of Alternative Barley Farming Systems in Northeastern Jordan.* David Hughes, Walter Penaranda, Walter Butcher.

- *Costs and Returns of Crop Production for Dryland Farms in the Mafrag Region of Northeastern Jordan.* David W. Hughes.

- *Statistical Analysis of Farmer Livestock Survey Data in the Mafrag Barley Cropping Region of Northeastern Jordan.* David W. Hughes.

- *Costs of Producing Livestock for Dryland Farms in the Mafrag Region of Northeastern Jordan.* David W. Hughes.

(d) Burkina Faso Case Study

Employed the SECURE (Soil Erosion Control Under Risky Environment) methods of analysis.

(e) Cameroon Case Studies

- *The Impact of Farming Systems Research on Agricultural Productivity: The Case of North Cameroon.* D. Ngambeki, R. R. Deuson, and J. Lowenberg-DeBoer.

- *Integrating Livestock into Farming Systems in Northern Cameroon.* D. Ngambeki, R. Deuson, and P. Preckel.

- *Analysis of the Effects of New Agricultural Technologies in Northern Cameroon: A Risk Perspective.* E. Loehman, D. Ngambeki, Z. Yu, and R. Deuson.

(f) Benin Case Studies

No documentation provided to the EET.

If the economics component of TSMM continues in some form, further case studies are in the planning stages. As mentioned above, the EET feels that empirical examples of the analytical techniques contained in these case studies represents a tremendous education opportunity for enhancing the analytical capacity of LDC scientists. Intensive training workshops on the use of these techniques is now possible since they provide examples that LDC scientists can relate to. The EET would like to encourage such efforts in any continuation of the ERS activities. Ideally, the training would first involve learning the techniques using the case study data. Then scientists would apply the techniques to data from their own countries.

c. Training

All of the seminar/conferences and workshops conducted by TSMM and its cooperators involve training and upgrading the knowledge and understanding of participants on general and specific topics. Also, individual technical assistance consultations and collaborative research carried out by one or several TSMM scientists with LDC personnel involve to some degree informal training. TSMM has arranged on-the-job type training in USDA laboratories and U.S. universities for several LDC scientists via the visiting professor/sabbatical route.

While training has not been a separately-funded, discreet item for TSMM, informal training is a significant, lasting feature of the TSMM project.

d. Information dissemination

The TSMM project provided the EET with a TSMM publications list that has 170 entries relating primarily to ARS activities. The entries range from miscellaneous papers (69) through workshop papers (12) and conference proceedings to refereed journal articles (3).

The ERS component of TSMM has generated 63 research papers which have either been presented at professional meetings or published. One masters thesis and one Ph.D. dissertation have been completed as part of the ERS effort.

The likely distribution of useful materials, such as workshop and conference papers/proceedings to LDCs is of special importance. The Project Coordinator reported an estimated 2,600 copies of five workshops and seminars/conferences held in West Africa,

N.E. Thailand, Jordan (2) and Texas have been distributed worldwide; most of the copies went to LDCs. In addition, all TSMM publications were distributed through the normal USDA and AID distribution network.

It is clear that a large volume of useful, TSMM-generated materials have been made available for use by LDC scientists and technicians involved in dryland agriculture. The extent to which these materials have been translated, adapted to local conditions and made available to producers is not known; however, it is reasonable to assume that some of the practices and procedures suggested/recommended are being put to use.

The TSMM project has been engaged in a variety activities, largely with cooperating countries, international development assistance agencies and U.S. universities. It is the conclusion of the EET that through its outreach, research, training and information dissemination activities TSMM has reached leaders in LDCs concerned with dryland farming, managers of agriculture programs of major international assistance agencies and scientists in concerned IARCs. It is reasonable to conclude that such technologies and methods are now known in most countries.

The extent of use of such technologies and methods and their impact is not known. It is very likely that they have had or are beginning to have some impact on the agriculture of developing nations in the SAT regions of Asia and the Middle East and to a lesser extent in such areas of Africa and elsewhere. One could cite the very successful, productive relationship TSMM has had with the Jordan University for Science and Technology that has resulted in technologies and methods being put to use in Jordan, but this is just one country and a small one at that. One could cite the growing set of activities with India through the Indian Council of Agricultural Research (ICAR) and OICD/FERRO/New Delhi. These appear to be recent activities. In any case, it is hard to sort out the influence of a latecomer such as TSMM. For example, India has had programs and institutions dedicated to improving dryland agriculture long before TSMM was initiated. Further, ICRISAT, located in India, has had programs to help develop improved crop varieties for the SAT of India and elsewhere for nearly two decades. And of course, ICARDA has been active in the Middle East and North Africa for some years.

However along with others, the TSMM project has done things that needed to be done. For example, it opened up the vast dryland agricultural know-how and institutional capacity of ARS to developing nations, and it has helped to increase awareness on

the part of LDCs leaders and others as to what can be done to improve dryland agriculture. This is about as much as could be expected by the a project of the size and duration of TSMM. All things considered, TSMM has done a fine job with what it had, after getting off to a shaky, uncertain start.

2. Worldwide impact of the TSMM project

Certainly after sponsoring the 1988 international conference on dryland agriculture attended by representatives from 52 countries, 36 U.S. states and many international assistance agencies, the TSMM project is now known around the world. The conference was the occasion of celebrating 50 years of research at the Bushland, Texas experiment station (the TSMM coordinator estimated that TSMM raised $225,000 in cost-sharing funds for the conference). There is no question that conference and other TSMM international conferences and workshops held in various parts of the world have substantially heightened worldwide awareness of the potential for improving dryland agriculture. Beyond that, the worldwide impact of the TSMM project to date is hard to assess. It appears that through the publicity of the 1988 Texas conference and its successful experiences in Jordan, India and elsewhere with IARCs--ICRISAT, ICARDA and ILCA--TSMM may have found an effective niche--in the still evolving international agricultural research system. Considering that TSMM has been operating effectively for only about six years, that is quite a record. It should be noted that a number of the CRSPs with about the same or longer length of operation have yet to carve out a recognized, effective role in international agriculture. To the world, TMSS is another name for ARS/USDA and ERS/USDA, two of the world's premier, public, research organizations.

3. Impact of the TSMM project on the U.S.

The TSMM project has had a substantial positive impact on U.S. institutions and their programs. The bulk of the ERS effort was conducted through cooperative agreements with Washington State University and Purdue University. Faculty at these institutions and both domestic and international graduate students have undoubtedly achieved a high degree of professional enhancement from their involvement with TSMM. The ARS component also used university personnel in its activities. It should also be noted that the ARS personnel who are not based in Washington, DC generally collaborated very closely with their colleagues at nearby U.S. institutions. The experiences of these individuals will thus enhance the U.S. institution they work with. The ARS project coordinator noted that, without exception, the U.S. individuals who worked on ARS-focused activities found their experience to be career enhancing.

4. TSMM networking with AID/S&T/AGR projects

According to the project coordinator, attempts to collaborate with IFDC and APAP were rebuffed. SMSS personnel participated in one TSMM workshop. Informal exchanges of ideas and information with the staff of TROPSOILS was easily accomplished and productive.

The EET finds that TSMM networking with the S&T/AGR projects was inadequate. The project coordinators attempted to interact with little success, and perhaps should have devoted more time to this effort, particularly with SMSS. The S&T/AGR/RNR project manager should facilitate such interaction, and the EET hopes that such interaction will be stronger in future S&T/AGR efforts.

5. Progress towards the accomplishment of TSMM's major activities.

TSMM has been engaged in five major activities designed to achieve its objectives:

a. Establish an information network and scientist-to- scientist links among soil and water management specialists in the U.S. land-grant universities, the USDA/ARS and ERS, developing country institutions, international organizations and USAID missions.

   Progress: As described in preceding sections, TSMM operates such an information network.

b. Provide soil and water resource management scientists and economists for short-term technical assistance and consultations on special problems and proposed and ongoing research projects.

   Progress: TSMM with OICD help has done an outstanding job in providing technical assistance and consultations as requested.

c. Develop data and information systems that integrate agronomic, agroclimatic and economic data for comprehensive assessments of resource management options by both researchers and resource managers.

   Progress: Using secondary, non-TSMM data, TSMM has turned in an outstanding, unique (in terms of S&T/AGR/RNR projects), highly-productive performance with regard to this activity.

d. Examine case studies and other analyses of alternative agricultural production practices for their potential socioeconomic impacts.

Progress: TSMM has made excellent progress with regard to this activity through several very useful, enlightening case studies.

Overall progress in carrying out its program activities has been outstanding and has been due to the high caliber, highly experienced, knowledgeable TSMM program coordinators and their equally talented and dedicated ARS and U.S. university cooperators, and to fine support by international assistance organizations and collaborating host countries.

D. TSMM and AID Cross-cutting Themes

1. Cost sharing

Information on cost-sharing was only provided in detail for FY89 and FY90. Out of total regional expenditures, including overhead, of $485,495, TSMM obtained $487,000 in cost-sharing funds in FY89. Total expenditures in FY89 were $752,442, including overhead. Total expenditures, including overhead, were $557,767 in FY90. The TSMM project spent $439,242, including overhead, and obtained $407,500 in cost-share funds for regional activities in FY90. The EET views this level of cost-sharing as very substantial. It enabled both ERS and ARS to expand their operations far beyond what the core funding alone would have allowed. This level of cost-sharing is an indication of the tremendous value which TSMM clientele placed on the project. In addition, many in-kind contributions such as clerical support, technician help, and use of facilities were contributed to the project without accounting for them in cost-sharing funds. Thus, the actual level of cost-sharing which TSMM received is more than the reported levels.

2. Buy-ins

Information on buy-ins was not provided separately from the cost-sharing information to the EET. The S&T/AGR/RNR project manager indicated that some of the cost-sharing was provided by AID missions for the development of research compendia and conducting workshops and was thus analogous to buy-ins. Some research in Niger and India was also partially supported by AID missions. While the lack of buy-ins was discouraging, this problem does not appear to be unique to TSMM.

3. Sustainability

Two issues with regard to sustainability arise. One has to do with the future of the activities conducted by the TSMM project and the other with the relationship of TSMM activities to sustainable agriculture and the quality of the environment.

Should the TSMM project terminate, some TSMM activities will continue at a reduced level and in an unorganized manner and others will not continue. It is likely that the networks that TSMM is involved in will continue to some degree and it may very well be that other donors, such as Australia with outstanding capability in dryland agriculture, may take up some of the slack. The important consideration is that unless alternative arrangements are made to ensure ARS/ERS USDA's direct involvement in international dryland agriculture, TSMM's demise may deprive developing nations of a sorely-needed, unique resource.

The TSMM project is not the only U.S.-sponsored assistance effort concerned with soil management in the SAT and there are other major international and national dryland agricultural programs operating in the SAT. The point is that TSMM is not alone, but it is also a point in fact that the field is not crowded and TSMM appears to have found a special niche in the field--one that can bring the vast, unique resources of ARS/USDA into the mix. This is important.

With regard to sustainable agriculture, there is no conventional agriculture without soil. Soil resources, their extent and quality, are critical to permanently-productive national agricultural systems; thus, if their agricultural futures are to be made secure, it is imperative that nations and their farmers/producers understand how to use and manage their soil resources for a permanently, productive agriculture.

4. Women in Development

Responding to the 1986 external evaluation, an ERS-linked project has begun in Burkina Faso. It involves a household-level analysis with special emphasis on the role of women.

5. Peer Review

Many of the activities of TSMM contained aspects of peer review. Papers published in journals were subject to peer review. Papers published in proceedings of meetings and in other outlets were generally also subjected to peer review.

E. Lessons Learned

The very slow, uncertain start almost led to TSMM's termination. While it is not clear that the slow start that delayed project activities for several years was due mainly to the lack of an agreed project plan and operational strategy at project initiation, this deficiency was a contributing factor. Thus, a lesson in this project is that a project plan/strategy should be developed and agreed

upon prior to or at project initiation, that is, follow current project preparation guidelines.

The success of the project after it got under way reaffirms the lessons of the past that development projects are likely to succeed when guided and operated by experienced, knowledgeable, dedicated professionals assisted by interested, competent allies and hosted by highly receptive, responsive host countries.

There is a need in many countries to compile and evaluate research data generated by earlier and on-going projects. Such "databases" (research compendia) can be very valuable in identifying research gaps, needs and priorities for future projects, and to prevent duplication of earlier and on-going projects. The EET feels that this is an important activity which should be encouraged in future projects.

Data collected on all USAID projects should be made available to interested parties (following a reasonable time period for researchers on the project to complete their analysis) on PC diskettes in a format which can be readily understood. The analyses conducted under the ERS component of the project suggests that there is often much additional analyses which can be done on data collected by projects. Furthermore, data accumulated over time and many projects could provide an invaluable source of information and data for further analyses.

F. Status of the TSMM Project and Possible Future Options

Despite the fact that the TSMM project was a latecomer to international dryland agricultural assistance, the project appears to have established a good reputation and earned a niche in global assistance efforts for improved, sustained, dryland agricultural production in the SAT. The ERS has been quite productive and impressive in its contributions to technology evaluation and assessment. In fact, the ERS component has been strikingly noteworthy and exciting as an illuminating, compelling component to agronomic and soil management research in the SAT. Clearly, such analyses should be a part of all S&T/AGR research.
The TSMM project has established clearly what ARS and ERS can contribute to agricultural and economic development in the SAT. The question now is what arrangements are needed to ensure the continued input of ARS and ERS in effective, enduring ways?

From the experience of the past several years, it appears that a more structured arrangement for TSMM which assures long-term, ARS and ERS research and extension collaboration with host countries strategically located in high priority SAT regions would be the most rewarding course of action. Such a plan would free the TSMM project from its opportunistic, catch as catch can, current type of operation. It would enable the ARS and ERS

components to be directly engaged in national programs on a long-term basis and enable them to make highly specific, targeted contributions to national soil management activities and national agricultural development.

Given acceptance of the above approach to TSMM's future, it would seem appropriate for TSMM to join forces with one or several of S&T/AGR's global projects that have long-term operations in the SAT, namely, the Soil Management CRSP, the Bean/Cowpea CRSP, the Sorghum/Millet CRSP, the Peanut CRSP and the Small Ruminant CRSP. TSMM's operations are highly relevant to all the CRSPs listed.

A promising and practical arrangement would appear to be to join TSMM with the Soil Management CRSP (TropSoils). Such an arrangement would give TropSoils components it sorely needs and lacks, such as economic analyses and outreach, and give TSMM the structured, long-term involvement with SAT countries that it needs. Such a merger would certainly have important complementary and supplementary benefits; however, the magnitude of TropSoil's overseas operations is not reassuring with regard to its likely impact. This is a matter that needs attention. More interaction between TropSoils and the other CRSPs would appear to be part of the solution. Perhaps, a built in arrangement under the TropSoils CRSP for TSMM's ARS and ERS components to support INTSORMIL, the Bean/Cowpea CRSP and the Peanut CRSP would be desirable.

Such arrangements would have very attractive features, but the most important would be the potential for re-structuring the CRSPs and more effectively utilizing ARS and ERS resources and in the process increase the likely impact of all these resources on the SAT. Increasing the impact of the CRSPs in developing countries (and the overseas perception of the CRSPs) is not an unimportant consideration.

VII. RECOMMENDATIONS

The EET recommends that:

A. S&T/AGR consider ways to utilize the services of TSMM's ARS and ERS components to upgrade the outreach and economic analyses capabilities of its collaborative research projects that operate in the semi-arid tropics for the purpose of increasing their impact on developing nations. Such projects include the Soil Management CRSP, the Bean/Cowpea CRSP, the Peanut CRSP, the Sorghum/Millet CRSP (INTSORMIL) and the Small Ruminant CRSP.

B. After the termination of the TSMM PASA, S&T/AGR/RNR consider arrangements to make TSMM a part of the Soil Management CRSP on a phased-in basis initially under an "umbrella arrangement," but eventually in a

manner that would allow the ARS and ERS components to become full-fledged research and outreach components of the CRSP.

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APPENDIX B
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