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MOROCCO DRYLAND AGRICULTURE APPLIED RESEARCH

MID-TERM EVALUATION

Prepared for:

USAID/MOROCCO

June 1991

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LIST OF ACRONYMS

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ACCT	Agence de Cooperation Culturelle et Technique
ACSAD	Arabic Centre for Studies of Arid Zones
AIRC	Agricultural Information Resource Center -- Settat/Centre de Conjuncture
ANAFID	National Association for Land Consolidation, Irrigation and Drainage/Association Nationale des Ameliorations Foncieres, de l'Irrigation et du Drainage
ARS	Agricultural Research Service of the United States Department of Agriculture
ASAL	Agricultural Sector Adjustment Loan [executed between the Government of Morocco and the World Bank in 1987 for the period 1987 to 1992]
BYVD	Barley Yellow Virus Disease
CABO	The Center for Agro-Biological Research at the University of Wageningen
CDN	National Documentation Center/Centre de Documentation National
CDSS	Country Development Strategy Statement
CGIAR	Consultative Group for International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CIDA	Canadian International Development Agency/Agence Canadien pour le Developpement International
CIRAD	International Center for Agronomic Research and Development/Centre International pour la Recherche Agronomique et le Developpement
CMV	Development Center/Centre de Mise en Valeur
CNCA	National Agricultural Credit Bank/Caisse Nationale de Credit Agricole
CRCA	Regional Agricultural Credit Bank/Caisse Regionale de Credit Agricole
CT	Extension Center/Centre du Travaux
CRSP	Cooperative Research Support Project
DAARP	Dryland Agriculture Applied Research Project
DDR	Division of Development Resources/Direction du Development Rural
DPA	Provincial Agricultural Office/Direction Provincial d'Agriculture
DPAE	Planning and Economic Analysis Department/Direction de la Planification et des Analyses Economiques (MARA)
DPV	Department of Plant Production /Direction de la Production Vegetale (MARA)
DVRA	Department of Extension and Agrarian Reform/Direction de la Vulgarisation et de la Reforme Agraire (MARA)
EDI	Economic Development Institute (of the World Bank)
EGS	Equipement General et Special/General and Special Expenses
ENA	National Agricultural College/Ecole Nationale d'Agriculture (Meknes)
FAO	Food and Agriculture Organization of the United Nations
FCAR	Fonds (Quebecois) de la Concertation des Actions de Recherche
FMTE	Farmer Managed Trials and Evaluation
FSI	Foreign Service Institute
FSIP	Farming Systems Infrastructure and Policy
FSR	Farming Systems Research
FSR/E	Farming Systems Research/Extension

FY	Fiscal Year
GDP	Gross Domestic Product
GOM	Government of Morocco
GNP	Gross National Product
HF	Hessian Fly
IANR	Institute of Agriculture and Natural Resources
IARC	International Agricultural Research Center
IAV	National Agronomic and Veterinary Institute/Institut National Agronomique et Veterinaire Hassan II
IBRD	International Bank for Reconstruction and Development (The World Bank)
ICARDA	International Center for Agricultural Research in Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDMC	International Development Management Center (University of Maryland)
IDRC	International Development Research Centre (Ottawa)/Centre pour la Recherche sur le Developpement International (Ottawa)
IMF	International Monetary Fund
INRA	National Agricultural Research Institute/Institut National de la Recherche Agronomique
IPS	Institutional Planning Specialist
IQC	Indefinite Quantities Contract
ISNAR	International Service for National Agricultural Research
IST	Institutional Sustainability Team
LOP	Life of Project
LDC	Less Developed Country
LSI	Large-Scale Irrigation Scheme/Perimetres de Grande Irrigation
MARA	Ministry of Agriculture and Agrarian Reform/Ministere de l'Agriculture et de la Reforme Agraire
MIAC	MidAmerica International Agricultural Consortium
MIS	Management Information System/Systeme d'Information pour la Gestion
MOU	Memorandum of Understanding
OFT/E	On-Farm Technology Evaluation
ORMVA	Regional Agricultural Development Office/Office Regional de Mise en Valeur Agricole
PACD	Project Assistance Completion Date
PE	Professional Engineer
PID	Project Identification Document
PIL	Project Implementation Letter
PBO	Planning By Objectives/Planification par Objectif
PT	Participant Trainee
SAL	Structural Adjustment Loan
SCS	Soil Conservation Service
SR/CRSP	Small Ruminant Cooperative Research Support Project
SRD	Service de Recherche et du Developpement/Research and Development Service of INRA

TA	Technical Assistance
TDY	Temporary Duty
TPM	Team Planning Meeting
TRC	Technical Resources Center
UNL	University of Nebraska, Lincoln, Nebraska
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

PREFACE

This evaluation report is the product of a team evaluation of the Morocco Dryland Agriculture Applied Research Project (DAARP) (Project No. 608-0136). The project is funded by the Governments of the Kingdom of Morocco and the United States of America. The principal agencies charged with the design and implementation of the project are the Agency for International Development (AID), as represented in Morocco by the United States Agency for International Development Mission (USAID) in Rabat; and the Ministry of Agriculture and Agrarian Reform (MARA), as represented by the Institut National de la Recherche Agronomique (INRA). The primary technical assistance contractor for the project is the MidAmerica International Agricultural Consortium (MIAC). MIAC is a consortium composed of the following American land grant universities: the University of Nebraska, the University of Missouri, Kansas State University, Oklahoma State University and Iowa State University. The University of Nebraska at Lincoln serves as the lead institution in execution of all USAID/MIAC contractual obligations under the project.

The purpose of the mid-term evaluation was to assess progress in achieving project purpose and outputs and to assess the impact of the technologies developed and disseminated. The project was initially conceived in 1975/1976 and designed in 1978. It underwent two significant redesign efforts and project expansions in 1984 and 1988. Effective project implementation has been underway for approximately ten years. It was, therefore, deemed timely to assess project achievements to date and to determine what actions should be taken to ensure project sustainability after the scheduled termination of AID assistance in August 1994. The specific objectives of the evaluation were to:

1. Assess and document progress, achievements, and the impact of research carried out to date;

2. Assess progress in technology transfer, measure the rate of adoption among the target farmers and determine the impact of this technology dissemination;

3. Measure progress in institution building including the institutionalization of research functions to insure sustainability and progress in staffing, facility construction, management and budgeting·

4. Measure progress in the transition to Moroccan leadership at the Aridoculture Center and at satellite centers; and

5. Make and prioritize recommendations to enhance the sustainability of the project following termination of AID assistance. [See Annex 1 for Evaluation Statement of Work].

The mid-term evaluation of the Morocco Dryland Agriculture Applied Research Project (DAARP) was conducted in two phases. Due to evacuation of USAID Mission and MIAC

personnel from Morocco as the consequence of hostilities in the Persian Gulf, the first interviews of the evaluation were conducted by evaluation team members -- J.H. Eriksen, J.W. King and F.E. Brusberg -- with MIAC staff and DAARP personnel at the University of Nebraska in Lincoln, Nebraska [11-27 February 1991]. Subsequent to these interviews, Eriksen and King held interviews with staff and faculty members from the University of Minnesota in St. Paul, Minnesota and with MIAC personnel in Minneapolis, Minnesota [27-28 February 1991].

On the basis of their interviews and reading of DAARP documents, evaluation team members Eriksen, King and Brusberg wrote sections of a preliminary draft evaluation report. This report was finalized by Eriksen as team leader in Ithaca, New York [1-20 March 1991].

Subsequent to the lifting of the ban on travel to Morocco in April 1991, DAARP staff returned to Settat, Morocco. The second phase of the evaluation started on 6 May 1991 when team members Eriksen, King, Aronson and Ouattar met with USAID Mission staff in Rabat, Morocco. The team proceeded to the DAARP Headquarters in Settat, Morocco on 7 May 1991. Interviews with INRA and MIAC project staff and visits to observe project activities on research stations and farmers' fields took place between 7-22 May 1991.

An evaluation team debriefing for INRA and MIAC personnel was held in Settat, Morocco on 22 May 1991. The evaluation team then spent the subsequent period [23 May-7 June 1991] conducting supplementary interviews in Rabat, Morocco at INRA national headquarters and at Institut National Agronomique et Veterinaire Hassan II [IAV] in debriefings at INRA and USAID, and in finalizing the evaluation report.

The evaluation team wishes to express its appreciation and gratitude to the many persons in Lincoln, Nebraska; St. Paul, Minnesota; and in Morocco who endured many long interview sessions, spend time searching for project documents, and made other efforts to facilitate the progress of this evaluation.

EXECUTIVE SUMMARY

I. INTRODUCTION

This report is the product of a team evaluation of the Morocco Dryland Agriculture Applied Research Project (DAARP) (Project No. 608-0136). The project is funded by the Governments of the Kingdom of Morocco and the United States of America. The principal agencies charged with the design and implementation of the project are the Agency for International Development (AID), and the Ministry of Agriculture and Agrarian Reform (MARA), represented by the Institut National de la Recherche Agronomique (INRA). The primary technical assistance contractor for the project is the MidAmerica International Agricultural Consortium (MIAC). MIAC is a consortium composed of the following American land grant universities: the University of Nebraska, the University of Missouri, Kansas State University, Oklahoma State University and Iowa State University. The University of Nebraska at Lincoln serves as the lead institution for the project.

The purpose of the mid-term evaluation was to assess progress in achieving the project goal, purpose and outputs, to assess the impact of the agricultural technologies developed and disseminated, and to provide USAID/Morocco with guidance for the life of the project.

A. Project History

The DAARP was initially conceived in 1975/1976 and designed in 1978. The project underwent major redesign efforts and expansions in 1984 and 1988. The original project included a USAID contribution of $ 4,500,000. The 1984 project amendment raised the USAID contribution to $26,500,000 and the expansion in 1988 raised USAID life-of-project funding to $ 50,000,000. The 1988 project amendment extended the project activity completion date to August 31, 1994.

Although the original project agreement was signed in September 1978, the technical assistance contract with MIAC was not signed until 1980. Project work, other than the selection of the first four participant trainees, began in earnest only in 1982. Even then, effective project implementation did not begin until the project was expanded in 1984, after a new project assessment was done by MIAC, which forecast substantial potential for major advances in dryland agricultural technologies and which led to a doubling of the resident technical assistance team.

By 1984, the worst drought in recent Moroccan history had ended and the first Moroccan researchers had returned from their participant training in the United States. Between 1984 and 1987, there was a rapid evolution in the project activities and accomplishments. Much of the construction at the INRA center headquarters and laboratories in Settat was completed. Progress was made on developing initial technologies under the DAARP and a resident staff of American and Moroccan researchers was in place.

On the basis of these accomplishments and an estimate of further potential, the Winrock International project evaluation in 1986 recommended the second major expansion of the DAARP. The elements for this second phase expansion were designed in 1987 and formalized in a second project amendment in 1988. This mid-term evaluation, then, covers the period of actual DAARP performance from 1988 to May 1991 and also analyzes the potential and problems facing the project through its projected completion in 1994.

B. Project Goal, Purpose and Project Outputs

From the beginning of the DAARP, the project goal and purpose have remained constant. The projected outputs have changed as new elements have been added as project activities. The goal of the project is to increase food production in order to meet the needs of Morocco's fast growing population and to improve the income of farmers with small and medium-sized land holdings. The purpose is to establish a sustainable applied research capacity relevant to the dryland farming systems and natural resource constraints of the 250 to 450 millimeter rainfall region of Morocco and capable of providing technologies to improve farmer productivity. According to the latest statement of projected DAARP outputs in the March 1988 revision of the Project Agreement, the seven major outputs projected from this project are:

1. A functioning and sustainable Regional Research Station at Settat (the Aridoculture Center);

2. A functioning and sustainable network of supporting satellite research substations for the Center;

3. A functioning management system in place to carry out effective research programs and develop budgets, accountability and evaluation;

4. Agronomic technologies and farming systems practices developed that are appropriate to small and medium-scale dryland farmers;

5. Farming equipment developed that is suitable for small and medium-scale farmers;

6. A functioning and sustainable technology transfer unit that is transmitting new technology information to clients; and

7. Direct links between researchers and representative farmers established that provide (a) basic understanding of targeted farming systems, (b) baseline information for evaluation and feedback of research programs, and; (c) a model for evaluating the economic and social viability of alternative technologies.

The center in Settat is meant to serve areas of ten provinces in Morocco, a wide zone stretching from Casablanca eastward to Khouribga, south almost to Marrakech, and west to Essaouira on the coast. The designated project zone covers approximately 35,000 square kilometers. In 1988, the project zone had an estimated population of 6,409,000 persons -- or about 27 percent of Morocco's total population and 50 percent of its rural population.

II. SUMMARY OF MAJOR FINDINGS AND CONCLUSIONS

The DAARP has made substantial progress toward the achievement of some of the seven project outputs established in the 1988 project amendment. It has made less progress toward others and very little toward certain of the others. In particular, there will be a functioning INRA center, with very good physical facilities when the project ends. The DAARP will have met -- or exceeded -- its participant training objectives by 1994. And, a number of new agricultural technologies for dryland farming will have been developed. A number of these technologies -- i.e. improved cereal and food legume varieties, farm machinery, and new farming practices -- may have important impacts on agricultural production in the project zone. There is little doubt that the DAARP in 1994 will be deemed to have accomplished most of the project outputs related the development of new technologies and establishment of a research capacity in Settat -- in fact, most of these outputs have already been accomplished to a major degree.

On the other hand, there is much still to do to achieve two other dimensions of the project purpose and outputs. First, there is a question of the DAARP's focus on the needs of its stated clients -- above all the farmers in the project zone but also agents of other agricultural services and private sector agricultural suppliers and processors. The report finds that the DAARP has not yet demonstrated exactly how the research and technology development it has been conducting has been and will continue to be appropriate to its milieu and especially the degree to which high priority local needs being addressed.

Second, there is a major question with respect to the sustainability of many of the activities of the DAARP after 1994, as called for in the project's purpose and several of its expected outputs. The evaluation report analyzes program sustainability at several different levels and recommends a number of actions be taken to ensure that the INRA research center and its affiliated field research stations will be able to carry the high level of present research activities when the project formally ends.

The major finding of the evaluation report is that, although much has been accomplished to date, the INRA center in Settat is still a fragile creation. Much work remains to be done if its promise is to be realized within Morocco's national system for agricultural research. Moreover, a major reorientation in project activities and participant thinking is needed now to focus on the institutionalization of major planning and management systems within the INRA structure and on serious issues of institutional sustainability.

This mid-term evaluation report, therefore, concentrates in large part on the work that remains to be done to guarantee the survival of a relevant and sustainable INRA research program in

Settat. It does so in part because neither MIAC nor INRA management have given enough thought to these issues to date. If the evaluation report -- and indeed the discussions with all parties during the evaluation effort -- therefore have a critical tone, it is because the team is convinced that the project is worth saving and that appropriate remedial actions, if taken now and sustained over the remaining life of the project, will go a long way toward achieving those elements of the project purpose and expected outputs that have been relatively neglected until now.

A. Project Accomplishments

1. Physical Facilities

The INRA regional center complex on the outskirts of Settat is well-planned and nearing completion. When the remaining buildings are finished, there will be adequate office, laboratory and utility space for the full complement of agricultural scientists, technicians and support personnel. In addition to buildings at the center, construction is proceeding on an INRA guest house and recreational facility in downtown Settat across from a new university complex. If not for delays in working with local contractors, nearly all the research buildings at the center would be ready for occupancy in 1991.

Development of the four field research stations affiliated with the center has been seen by INRA as clearly secondary to the development of the central headquarters infrastructure in Settat. While the stations are relatively generously endowed with the farm equipment necessary to the research trials, farm buildings and basic infrastructure -- i.e. access roads, electricity and water supplies -- are still lacking or inadequate in their present state.

2. Participant Training

The development of Moroccan agricultural scientists under the project participant training component has been one of the most important accomplishments of the DAARP to date. This enhanced human resource capacity within INRA may well be the greatest single legacy of USAID/MIAC assistance.

As of May 1991, nine participants had received M.S. degrees and eleven had finished their Ph.D.s. Four M.S. candidates have completed their course work in the United States and are working on their thesis research in Settat. Two more candidates are in the United States and the remaining four will leave for training in 1991.

Eleven doctoral candidates have finished their programs and received their degrees. Seven more have finished their course work and have returned to Morocco to complete their dissertation research. Seventeen candidates are completing their course work in the United States and two more candidates will probably leave for course work in 1991.

Short-term participant training has been made available to scores of people under the project. In addition to English language training, courses averaging one month in duration have covered such skills as basic and more advanced computer training, in vitro breeding methods, forage analysis, soil testing laboratory techniques, program management, field station operations, maintenance of electronic equipment, seed multiplication procedures, desk top publishing and audio-visual techniques, and even driver education for bus and tractor operators.

3. Center Operations

Returned Moroccan researchers, together with others hired directly for the center, constitute a professional agricultural research staff of 32. This staff is supplemented by a MIAC technical assistance advisory group of 14 expatriate scientists and supported by a staff of over 200 technicians and laborers. Researchers from seventeen different disciplines are organized into six research "sub-programs". Research is planned and carried out using a series of planning and organizational sessions. The research program at the four field stations is very active and individual researchers are linked to colleagues in the same fields at other Moroccan institutions and abroad. Though there are many serious management, financial and organizational problems at this young research institution, it is certainly to the credit of INRA, USAID and MIAC that the center is up and running in a serious fashion.

4. Development of Agricultural Technologies

The daily work of both MIAC and INRA researchers at Settat is the search for improved agricultural technologies for the farmers of dryland Morocco. Some of this work began before there was an INRA center in Settat, when plant breeders were working out of the national agricultural laboratories in Rabat. Other work was focused on local adaptation of ideas and technologies developed at the international agricultural research centers or by American universities. Whether technologies were actually developed in Settat or only adapted there, there is now a substantial list of agricultural technologies that are available for Moroccan farmers as a result of the work of INRA center researchers.

The cereal improvement researchers have led in project achievements. Annex 7 Table 1 lists 29 new crop varieties toward the development of which the DAARP can claim to have made at least a partial contribution. The most widely publicized of these new varieties has been Saada bread wheat that was brought from South Dakota to take advantage of its resistance to Hessian fly. Although it had an immediate success in some niche areas challenged with major infestations of this fly, it has not enjoyed widespread adoption in the countryside. Many of the other varieties developed by INRA plant breeders may have much more important overall impacts.

Other work on yield losses from insects and diseases is producing interesting results. Working together with plant breeders, pathologists will be releasing Septoria-resistant food legume varieties between 1992 and 1994, and work has been done on a number of hard wheat, soft wheat and barley diseases.

In 1984, an early planting and weed control experiment using 2-4D showed that grain yields could be increased by 30 to 40 percent. Publicity by the Moroccan extension service is said to have resulted in at least 20 percent of the wheat farmers using this new package technology on 300,000 hectares by 1986.

Recommendations from Settat on appropriate timing and quantities in fertilizer applications and on varietal tests for specific local areas form part of the information available from the center. Center agronomists have also been important participants in local adaptation of technical packages being promoted at the national level -- i.e. early planting dates, insecticide use, and improved cereal varieties. Finally, scientists and the Settat regional agricultural extension services are engaged in the first full collaboration in the country to help marry the two agencies that have formerly been working in mutual isolation.

Other improvements are also underway at the center. Food legume varieties brought from ICARDA in Syria are being adapted and tested for larger seed size, improved disease resistance, and applicability for winter planting. In soil management, no-till cultivation methods, using herbicides and a special seed drill in place of tillage, may represent a dramatic advance in moisture conservation for crop production.

B. Major Problems to be Addressed

1. There are serious contradictions in the parallel mandates of the DAARP as a project and the INRA Center in Settat

Project planning and operations within the DAARP have suffered from the constraints imposed on the project mandate -- i.e. to serve only farmers with small and medium holdings having dryland crop enterprises -- as compared with the pre-existing and legal mandate of the institution it is charged to help develop. The INRA center in Settat is charged by the Government of Morocco to serve the agricultural needs of all farmers in its zone of influence. While many DAARP activities have simply ignored the defined project mandate and worked on technologies irrespective of the likely client adopter group(s), other potentially fruitful areas for research and extension have either been neglected completely or complicated by researchers trying to postulate problems which may not really exist.

2. The DAARP has suffered from an inability or unwillingness to set priorities aimed at accomplishing all of the expected project outputs

The fundamental problem at the INRA center and in the DAARP is an inability to set priorities and to allocate resources in line with those priorities. This deficiency can be seen at many different operational levels. The problem originates with the lack of a clear and mutually agreed upon typology of client farmer groups and farming systems in the project zone. Despite the enormous emphasis in agricultural development on such analysis in recent years, the project and the center are still struggling in 1991 to precisely define the client groups they have been supposedly working to assist for the last decade.

Concretely, the annual integrated plan of work developed by MIAC and submitted to USAID as the basis for allocating project resources have virtually refused to prioritize either research topics to be addressed or other management issues. All research protocols presented are apparently accepted as of equal importance and all management issues are presented as equally critical. The issue of lack of prioritization also pervades INRA/MIAC choices on management issues, the possibilities for developing the field research stations, the choice of long-term participant training positions, the selection of technologies for transfer into the Moroccan extension system, and the lack of a sense of urgency in finishing crucial baseline studies.

The management vision of MIAC has been to replicate a long-term Title XII academic institution, rather than to accomplish a defined and relatively short-term mission with a clear completion date.

Given these deficiencies, major high priority tasks need to be seriously addressed in the remaining years of the project, particularly in institutional building and planning/management systems. In this regard, the evaluation team has serious doubts that the method of Planning-By-Objectives (PBO), which has raised such high hopes within INRA, can be expected to solve the problems. The appointment of an INRA research coordinator with a clearly-articulated mission, supported by a strong MIAC team leader/research planning specialist, would hasten progress toward defining priorities.

3. A supplementary budget request presented to AID reflects the lack of priority-setting and demonstrates the lack of management insistence on a clear contribution to the overall mission from each element of the center

The evaluation team was asked to examine the "supplementary budget request" MIAC had submitted to USAID in 1990. Our conclusion was that the request was a confused document that reflected both a lack of vision and priority setting and an ignorance of USAID disbursement procedures. In our opinion -- confirmed by the budget projections of MIAC's own administrative officer -- there are sufficient funds in MIAC's existing contract to cover the costs of all the "supplementary" requests for payment for past activities covered by work plan approvals and for current work in technology transfer and socioeconomic baseline studies. Future activities listed in the "supplementary" request which make sense for USAID to fund could also be paid for from existing contract resources -- i.e. additional socioeconomic studies, technology transfer activities, and a soil and agro-ecological mapping exercise.

While there may be a need -- perhaps in FY 1993 -- for USAID to add funds to the MIAC contract to allow completion of certain project activities, there is no reasons whatsoever to hold current and critical project activities hostage to a contract replenishment at this time.

4. **Proposals for experimental station development also reflect the lack of priority-setting and control of organizational strategy**

A series of proposals for experimental station development suffer from a lack of prioritization and an over-eagerness to build up inventories of agricultural equipment without a clear plan for their utilization. Furthermore, over half the land of the stations is available for commercial farm enterprises, which could produce much of the income needed to support INRA center operations without resort to more external funding. The evaluation team, therefore, strongly recommends that INRA develop a strategic plan for supporting and operating its field research stations and show evidence that it is beginning to implement such a plan before any additional USAID funds for station development are provided under the DAARP.

5. **Additional participant trainee positions should be approved but only after a training agreement has been developed between INRA and the Institut Agronomique et Veterinaire Hassan II**

USAID approval of additional long-term participant training position would necessitate extending the DAARP PACD for up to three years. The evaluation team believes that this may be desirable for five of the eleven positions requested by INRA. In addition, the evaluation team suggests that two additional slots be created for M.S. training in statistics and biometry.

All but two of these training opportunities -- i.e. two M.S. level programs for which candidates are ready to depart in 1991 -- should be handled in collaboration IAV and the candidates should get their doctoral degrees from IAV.

Finally, serious problems in research planning and research program management exist at INRA and the evaluation teams believes there is a need to provide short-term post-doctoral training for up to six Moroccan scientists either through external short courses or instruction at the INRA center conducted by external consultants.

6. **New MIAC technical assistance staff are not likely to have substantial impacts if they arrive during the last two years of the project**

There are serious questions among INRA officials as to the utility of recruiting new MIAC technical assistance staff for the last two years of the MIAC contract -- or the necessity of extending contracts for several of the existing MIAC staff. The evaluation team has some of the same questions. We believe, for example, that the tasks of the proposed MIAC research coordinator should be combined with the job of the new MIAC team leader. Moreover, we feel that a new MIAC team leader is not likely to be effective unless he is recruited from within the ranks of the MIAC team resident in Settat. Finally, we believe that technical assistants in forages, entomology, agricultural engineering, and cereal agronomy may not be able to make the substantial contributions that would justify the expense of extending their contracts.

If all of the positions in question were to be eliminated, a total of 92.25 person months (7.69 person years) of budget resources could be freed up and shifted to other more important DAARP activities -- either within or outside the existing MIAC contract.

7. **INRA/Settat has serious management and control problems in the way it handles increasingly scarce resources**

INRA management needs to take serious steps to economize on available resources. Technical and support staff need to be more tightly managed, central stores and motor pool systems must be developed, certain laboratories should pool resources and serve as common resources for the whole center to avoid task duplication, and off-station field trials and demonstrations need to be grouped whenever possible. Together with various other more routine matters, these tasks probably justify the appointment of a deputy director for administration at INRA/Settat.

8. **To sustain the operations of the center, INRA will have to increase the operating budget by over 70 percent for the next two years and by a further 42 percent in 1994**

Problems of financial sustainability threaten the substantial investments in human resource development at the INRA center made by AID and INRA over the last decade. The problems arise from two major sources. First, INRA's own budgets are inadequate to sustain center research at current levels. Second, MIAC has been supplementing the funds available for operations in order to keep the research work from slowing down and in some cases grinding completely to a halt.

To project the future of the center once MIAC involvement ends in 1993 and USAID contributions end in 1994, the evaluation team presents an analysis -- with somewhat more refined assumptions than those of the IDMC sustainability study in 1991.

Our first assumption was that INRA wants to maintain a level of support for researchers at approximately the FY 1991 level. Three scenarios are presented in the report and our conclusions are as follows:

a. If the INRA operations budget continues to increase at current rates and DAARP contributions to center operations decline as planned, then only 28 researchers can be supported at the FY 1991 level in 1995.

b. If INRA expects to keep a "critical mass" of 40 researchers in Settat and support them at the FY 1991 level, then the GOM will need to increase the center's operational Settat budget by about 4,000,000 Dirhams per year starting in 1992 to even keep pace with needed expansion in nominal terms -- i.e. without including inflation effects.

c. If INRA wants to sustain all 57 researchers who will return to Settat after participant training, then the GOM will have to raise the center's operational budget by 4,000,000 Dirhams for 1992 and 1993 and by an additional 8,000,000 Dirhams thereafter.

The evaluation report makes several major suggestions as to how to some of the needed income could be raised.

9. **Within the research program, several disciplines will have to be guided to redefine their mission if they are to continue to contribute to technology development**

With respect to research programs, there are certain disciplines which need to have their work redefined. Both soil fertility and agricultural mechanization have yet to disseminate their first technologies to farmers, although there may be a niche market for the seed drill that is under development. Agronomy was an early contributor of technologies and continues to be a major participant in the technology transfer process but it does not have any prospects for delivering further technologies in the near future, unless work is extended by a change in the DAARP's mandate. Neglected themes at the center that are major issues with farmers in the region include crop storage techniques, livestock production and mixed agriculture, and enterprises using supplementary irrigation.

10. **There is a risk that linkages to the extension and production services of the Ministry of Agriculture will result in duplicated efforts**

INRA and the various Moroccan agricultural extension agencies have had and continue to have difficulties in defining the proper roles and linkages between agricultural research operations and agricultural extension services. The INRA Service de Recherche et Developpement must strive not duplicate the work of the Moroccan extension system now being rebuilt with World Bank assistance. It must plan its work with farmers more clearly. The outreach program must required more researcher involvement in publishing in local newspapers and journals, in developing instructional materials for dissemination to clients, and in training "Training and Visit" extension officers.

III. EVALUATION RECOMMENDATIONS

A. General Recommendations

1. Developing a Common Mandate for Program Planning and Sustainability

The zone of influence mandated by the GOM for the INRA regional center program based in Settat is defined in terms of three regions of Morocco -- Doukkala, Abda and Chaouia. These

regions do not correspond necessarily with the ten provinces defined as the current project zone. Second and more importantly, the INRA regional center is mandated to work with all farm households within its defined zone, not just with farmers having small and medium-sized farms. And, third, the INRA regional center is required to work with a broader array of agricultural enterprises within its zone than is currently the case in the DAARP mandate. Enterprises additional to the project mandate include, at a minimum, fruit, vegetable and specialty crops grown under dryland conditions and all crops grown under small-scale irrigation outside the large public irrigation perimeters -- e.g. Tadla and Doukkala.

The evolution of USAID's country development assistance strategy and the specific place of agriculture and the DAARP within it appears to have introduced some new elements into the institutionalization equation. USAID strategic orientations in agriculture appear to be shifting toward a broader and more inclusive view of agricultural problems in Morocco. There is more concern for establishing the proper -- and complementary -- roles of Moroccan public agencies and private firms in development of the agricultural sector. There is also more emphasis on allowing market forces to determine the evolution of agricultural innovations and enterprises within Morocco and on putting USAID resources in the service of this process -- rather than using funds to "tilt" sectoral development patterns a priori in favor of certain farmer groups, crops or technological innovations for reasons of internal policy or efficiency versus equity considerations.

At present, then, there are two different mandates at play in Settat. They are the "Aridoculture Center" program mandate as defined by the project and the INRA regional center program mandate as defined within the INRA national structure. This variance in mandates causes problems with respect to what elements should rightfully be in the present center research program and, more importantly, what elements are to be institutionalized in the future.

To remedy this situation, the evaluation team strongly recommends that USAID take steps to rationalize the points of conflict between the DAARP and INRA mandates so as to create a more solid basis for program planning in the present and discussions of center sustainability for the future. To make the mandates compatible, we specifically recommend that USAID take the following steps:

a. That the DAARP goal statement be revised to read "The goal of the project is to increase food production in order to meet the needs of Morocco's fast growing population and to improve the income of farmers.

b. That the zone of influence for DAARP activities be considered the same as for the INRA center -- i.e. the regions of Chaouia, Abda and Doukkala.

c. That, while research on problems of dryland agriculture continues to be the primary focus of the DAARP, scientific assistance to other types of agricultural enterprises also be considered as equally appropriate.

d. That the center being developed in Settat be formally referred to by its proper legal name -- i.e. the Centre Regional de la Recherche Agronomique de Doukkala, Abda et Chaouia at Settat -- and no longer as the "Aridoculture Center".

e. That full recognition in program planning be given to the fact that the center in Settat is and will continue to be a regional research center within the national INRA system of eight research centers -- and that the center has no accepted status in Morocco as a national center in and of itself with international linkages.

ACTION: USAID

2. **Program Focus and Prioritization**

Beginning with the INRA/MIAC work plan for FY 1992 due to October 1991, the MIAC and INRA work plans must include, at a minimum, the following sections:

a. A defined and well-articulated agro-ecological and socio-economic typology of project zone and its farmer-client groups;

b. A clear statement of how the research objectives including diagnostic trials and other SRD activities are linked to that typology and to a recognition of the potential impacts to be achieved from each project;

c. A concise recapitulation and assessment of the previous year's research work enumerating both the successes and the failures;

d. A discussion of the anticipated research to be carried out, in four categories: continuing work by non-degree candidate researchers, new work to be initiated by non-degree candidate researchers, continuing research by degree candidates (marked as to whether it is or is not research for the degree), and new work to be initiated by degree candidates;

e. A concise statement of general problems encountered in the project in the past year and proposed measures to alleviate those problems; and

f. A clear and unambiguous presentation of the state of program finances -- including both actual and projected disbursements from the MIAC contract budget and the INRA budgets. To help develop this plan and work in this area on a permanent basis, an INRA Deputy Director for research planning should be recruited.

ACTION: MIAC and INRA

3. Center Management

A range of center management problems require resolution. There are questions that bear directly on center sustainability. In the opinion of the evaluation team, they require the appointment of a deputy director for administration at the center. Key goals that must be achieved are:

a. Technical and support staff time needs to be allocated and managed much more efficiently;

b. A formal motor pool system needs to be established in order to reduce vehicle operating costs;

c. A central stores system is needed for all parts and disposable supplies;

d. To avoid task duplication, soils and quality analysis laboratories should serve the entire center and bill other sections for their services;

e. To reduce costs, attempts should be made wherever possible to group on-farm trials, evaluation trials, and demonstration plots within each relevant area.

In addition to these specific items, in order to maximize the utility to be derived from the capital expenditures on facility construction over the last decade, we strongly recommend that INRA priorities now shift to providing adequate financial and human resources for INRA center maintenance. In this regard, a common rule of thumb used in the United States is that one must anticipate annual maintenance costs on infrastructure to be between 10 and 15 percent of the total value of the buildings in question.

Maintenance and upkeep of capital equipment within the center is another source of increasing concern as the project moves towards 1994. Given that rapid replacement of costly pieces of equipment will be difficult due to INRA budgetary constraints, we recommend that INRA administrative personnel at both the national and center levels place a premium on developing and maintaining a capacity to properly operate and adequately service all of necessary capital equipment in place.

ACTION: INRA AND MIAC

4. Improvement of Field Research Stations

Field stations need improvement both in physical terms and with respect to their management systems. Evaluation team priorities are as follows:

a. One of the four stations -- Jemaa Riah -- is in need of almost total renewal of buildings and equipment. Erosion control work must be undertaken on some fields. Two other stations -- Khemis Zemamra and Jemaa Shaim -- need infusions of capital for new equipment and building repairs. All three stations need to be linked to the INRA/Settat by an effective communications system.

b. Before any investments are feasible, however, INRA must develop and begin to implement an operational plan for the cost-effective utilization and self-management of the four stations.

c. The plan must include a five-year strategy to:

(1) Manage land use for all field station cropland -- research and commercial activities;

(2) Manage technical staff and field labor -- permanent or seasonal -- much more efficiently;

(3) Provide operational budgets to purchase necessary inputs for both research and revenue-generating activities and to use them in a timely way; and

(4) Arrange for rational sales of commodities produced on the stations.

Most important, the operational plan must be reinforced by a legal guarantee and delegations of authority from the Ministry of Finance and INRA in Rabat that the annual revenues generated from the improved management of the field stations will be retained as part of the INRA center's operational budget for the following year.

Once it is independently confirmed that these conditions are met, USAID should make the further investments in the three field stations divided over a three year period (FY 1992-1994). Actual disbursements should be made commensurate with INRA presentation of evidence demonstrating progress in implementing the new field station operational plan.

ACTION: INRA AND USAID

5. INRA/SETTAT Financing for Sustainability

To carry on its research activities at FY 1991 levels, the INRA center in Settat will have to find between 3,300,000 and 4,300,000 Dirhams in additional budgetary support for 1992; between 3,000,000 and 4,000,000 additional Dirhams for 1993; and from 4,200,000 to 9,900,000 Dirhams for 1994 (not including international travel grants or short-term training. If funding is not found to fill the looming resources gap, then either researchers will have to be transferred

away from Settat to enable the remaining staff to get on with their work or researchers will find themselves without the means to continue their scientific activities.

To help fund the Center, four actions need to be taken:

a. INRA/Settat and its individual researchers need to ensure that the funding that is available is used more efficiently to support research.

b. The part of the strategic plan for the field stations having to do with increasing and retaining revenues from non-research activities must be developed and implemented. As well, INRA/Settat should be authorized to retain potential income that can be made from soil analysis, plant diagnosis, and agronomy consultations and tests for local farmers.

c. Scientists must be encouraged to discern and take advantage of these grant, consulting and contract work.

d. USAID should consider using part of the remaining money in the DAARP to cover the operating shortfalls being projected, provided that funding be tied to annual proof that the INRA total operating budgets for Settat (not including salaries) are rising in a manner to cover the full costs of sustainability by 1995 or whatever year the DAARP funds could be extended to cover.

ACTION: INRA AND USAID

6. Research Programs

There are disciplines which need to have their work redefined. Both soil fertility and agricultural mechanization have yet to contribute their first technologies to the DAARP, although there may be a niche for the seed drill that is under development. Agronomy was an early contributor of technologies and continues to be a major participant in the technology transfer process which exists at the Center but it does not have any prospects for delivering further technologies in the near future.

There are research areas that would serve INRA/Settat's regional mandate that have not up to now formed any part of the DAARP. These include research on storage losses, on the great importance of livestock and mixed farming within the total dryland agricultural system, and on small-scale irrigation -- with due regard to salinization. Agronomy, agricultural engineering, and soil fertility would quickly regain importance if irrigation work were added to the Settat program.

ACTION: INRA, MIAC AND USAID

7. On-Farm Technology Evaluation Activities

On-Farm Technology Evaluation (OFTE) trials are currently testing only one or two technical variables in each trial out of the sense that farmers cannot handle more complex packages. As a predictable result, many OFTE fields perform poorly in comparison to adjacent farmers fields. There is no sense planning for failure. OFTE should get its planning right by redesign of these trials wherever necessary.

ACTION: MIAC AND INRA

8. SRD and the Extension Function Outside INRA

The SRD activity within INRA must not duplicate the activities of the extension agencies now being redeveloped within other national institutions. At the same time, INRA scientists in an applied research institution like Settat should have more frequent and direct contacts with the extension agencies. SRD has a primary role to play in linking scientists to extension -- e.g. in providing scientists for the training aspects of the "Training and Visit" extension system being installed with World Bank assistance in the region. INRA/Settat management must ensure that SRD limits itself to the appropriate linking role with the extension system and that center scientists provide their information through SRD to farmers and the other elements of the GOM agricultural administration in the project area.

ACTION: INRA

9. Long-Term Participant Training

Of the supplementary long-term training positions requested, only five should be approved. In priority order, they are:

(1) MS in Research Station Management (1991)
(2) MS in Agricultural Mechanization (1991)
(3) PhD in Agricultural Economics with a minor in Agronomy (1992)
(4) PhD in Food Legume Pathology or Entomology (1992)
(5) PhD in Weed Science (1992).

In addition, INRA should consider presently an additional request to USAID for training of two biometricians to the Master of Science degree level.

In the interest of strengthening effective linkages between Moroccan institutions, the three Ph.D. opportunities in 1992 and the additional biometry posts should be handled as a collaborative

training effort between INRA and IAV. Under this arrangement, the candidates would be jointly selected and accepted as candidates for the IAV Ph.D. or M.S. degrees. They would proceed to do a tailored combination of course work at IAV and at an American university and return to Morocco to conduct their dissertation research. The candidates would then defend their work before a committee of IAV, American and INRA advisors.

ACTION: INRA, IAV, MIAC and USAID

10. Short-Term Participant Training

Short-term post-doctoral training should be provided in research program planning and management for up to six INRA scientists. In addition, we believe that other short-term training opportunities should have a major focus on developing planning and management skills among a broader spectrum of the research staff in Settat. In this regard, we have the following specific recommendations:

(1) Dr. Sefrioui be sent to the University of Missouri to work with Drs. Jere Gilles and Constance McCorkle on effective planning, design and implementation of rural sociology research.

(2) Mr. Hamel of the Technology Transfer/SRD unit should be sent to the University of Florida to work with Dr. Peter Hildebrand and his colleagues on matters related to rapid reconnaissance surveys and the process of technology testing and dissemination.

Finally, with respect to technical support services, we believe there is a great need to strengthen staff capacities in field station management, operations of technical library resources and computer maintenance and operations, central laboratory operations and maintenance, motor pool operations and vehicle maintenance, and desk top publishing techniques to improve the presentation and quality of INRA center publications, particularly for distribution within Morocco. While we cannot at this point define in precise terms the nature and contents for each of these training opportunities, we believe that INRA and MIAC project leadership should be directed to select INRA staff candidates and develop such short-term training programs as a matter of high priority.

ACTION: INRA AND MIAC

11. The Pending "Supplementary Budget Request"

The primary conclusion of the evaluation team as a result of its discussions with MIAC and INRA staff is in fact there are ample funds already in MIAC's existing contract to cover the costs of all of the requests we are recommending USAID accept. Phrased differently, MIAC, as a contractor, does not appear to us to be in any real danger of running out of contract funding in FY 1991, if it is authorized to disburse funds to cover all of the recommended activities in

FY 1991, FY 1992 and FY 1993. There will be a separate issue at some later point in the project of replenishing the MIAC contract -- probably in FY 1993 -- to add a final amount of funding to compensate for actual disbursements authorized by USAID but this is a completely separate issue and should be handled as such.

In addition to long-term and short-term participant training discussed below, the evaluation team would recommend that the following activities in the "supplementary budget request" be approved for implementation.

a. Socio-economic Studies

(1) USAID should issue a project implementation letter (PIL) specifically authorizing ex poste actual MIAC disbursements for baseline study activities incurred prior to FY 1991.

(2) USAID should authorize MIAC to expend up to a total of $ 126,000 in FY 1991 to complete all activities related to project baseline studies, with the stipulation that MIAC clearly demonstrate to USAID that a final report on the baseline studies has been completed in calendar year 1991 and that a typology has been developed from baseline study data and utilized as a management tool in development of the MIAC Integrated Plan of Work for FY 1992.

(3) Finally, USAID should consider authorizing funds for socio-economic studies up to a total investment of $ 167,000 in FY 1991 to 1994, either under the MIAC contract or by separate arrangement with INRA directly which is more convenient for USAID. Such authorization should be dependent upon further refinement of the proposals and the budgets.

b. On-Farm Technology Evaluation

The situation with respect to on-farm technology evaluation activities is much the same as that for the "baseline" studies and our recommendations are the same.

(1) USAID should provide ex poste authorization in a PIL for on-farm technology evaluation activities conducted prior to FY 1991.

(2) USAID should provide authorization FY 1991 on-going technology transfer activities.

(3) USAID should provide specific authorization for a program of technology transfer activities spending up to $ 323,000 in FY 1992, FY 1993 and FY 1994.

c. **Soil Mapping**

The revised mapping proposal for soils and agro-ecological zones contained in Annex 5 should be implemented as soon as possible under the existing MIAC contract.

None of these actions require that additional funding be added to the existing MIAC contract at this time.

ACTION: INRA, MIAC and USAID

d. **The In-Vitro Laboratory**

The evaluation team believes this request is completely outside the purview of research activities anticipated under the DAARP. We, therefore, see no merit in considering possible USAID funding for this unrelated activity so late in the DAARP.

12. **MIAC Staffing**

There are serious questions as to the utility of recruiting new MIAC technical assistance staff and/or extending the contracts of existing MIAC resident staff for the following positions: research coordinator, forage specialist, entomologists -- both the long-term and sabbatical positions, agricultural engineer, and cereal agronomist sabbatical consultancy. If the proposed technology transfer position is not be filled before the end of 1991, then it should be eliminated.

If all of the positions in question were to be eliminated, a total of 92.25 person months (7.69 person years) of budget resources could be shifted to other DAARP activity categories -- either within or outside the MIAC contract.

The MIAC chief of party and research coordinator positions should be combined after the departure of the present chief of party and a candidate to fill the combined position should be selected from within the ranks of existing MIAC technical assistants in Settat.

In line with efforts to improve field station program planning and management, two persons-months per year of consulting time should be added to the MIAC program. The consultant's primary task would be to help INRA administrators develop and implement the strategic plan for the stations discussed above.

In addition, consulting services should be provided to INRA under the MIAC contract in research program planning and management as a supplement to post-doctoral training for INRA scientists in this important area.

Finally, MIAC orientation sessions to date have apparently been wanting when it comes to explaining to MIAC scientists the need for them to play a broader role in communicating skills

to their Moroccan colleagues. We believe that every one of the specialists resident in Settat possesses a much broader array of skills -- e.g. skills in developing budgets for research protocols, in economizing on costs through common use of resources, in setting overall and daily priorities for work activities, and in evaluating and writing up research results -- that they could and should communicate to their colleagues in daily interaction. And, in this regard, we recommend that MIAC administrators be strongly urged to push MIAC technical assistants more aggressively to communicate these supplementary skills during their remaining tours of service in Morocco.

ACTION: INRA, MIAC AND USAID

13. Agricultural Chemicals Storage and Handling

The DAARP should design and implement a model program for the safe storage and handling of agricultural chemicals as a demonstration for all Moroccans involved with distribution and use of these products. In this regard, the agricultural chemicals storage facility at Settat should be completed and a strict policy on the use and safe handling of insecticides, pesticides, herbicides and other agricultural chemicals should be implemented.

ACTION: INRA AND MIAC

14. Development of Linkages

INRA/Settat linkages with an international network are diverse. They are all useful but there is a risk of diluting the focus of the research program and of diverting attention from the applied work for service to local agriculture. These networks should increasingly be focused on those activities which reinforce core research areas in Morocco and on those which actually have the potential for producing grant and contract funds for the center.

At the national level, INRA/Settat scientists have many roles to play in linking their work to the wider agricultural network in Morocco. The joint demonstration program with the Safi DPAs was a success that should be disseminated as a model to other areas of the country. Links with IAV have also been productive. Local publication of agricultural research results in Morocco and distribution of information leaflets and newspaper articles on those results in French and Arabic should also be increased as an essential part of each researcher's role.

ACTION: INRA

15. Budgeting of Remaining Authorized Funds

In line with our financial and staffing critiques in this report, we would like to present the evaluation team's tentative recommendations on the optimal use of the USAID project resources, net of the existing MIAC contract. To the best of our knowledge, these funds total $ 6,166,739

in May 1991 and the evaluation team suggests that these funds be spent in the following order of priority -- with the approximate levels of expenditures in brackets.

- Fund the balance of project activities included in the MIAC contract -- i.e. long-term participant training, socioeconomic studies, and the technology transfer program activities. [up to $ 1,000,000]

- Fund supplementary short-term participant training not included in the MIAC budget projections as yet -- i.e. post-doctorate training in research planning and program management, and other training in station management and specialized skills. [$ 250,000]

- Fund short-term consultant services -- Moroccan and external -- to INRA in Rabat and Settat in research planning and program management and other management skill areas as needed. [$ 250,000]

- Fund additional socioeconomic work, as needed, to evaluate technologies and develop other information on changing patterns of agricultural enterprises and market conditions in the project zone. [$ 100,000]

- Fund an end-of-project comprehensive evaluation. [$ 250,000]

- Fund support for development of INRA field research stations commensurate with INRA's development and implementation of an acceptable strategic plan for these stations. [$ 1,500,000]

- Fund operational costs of the on-going research program over the life of the project commensurate with evidence from INRA that it is increasing its own budgets -- capital and operating -- for the center. [$ 2,500,000]

- And, finally, fund structural modifications and replacement equipment in laboratories and other facilities at the center, as necessary. [$ 300,000]

ACTION: USAID

MOROCCO DRYLAND AGRICULTURE APPLIED RESEARCH PROJECT

MAIN REPORT

"Assessing priorities is difficult and uncertain in any context, particularly in the context of agricultural research. However, if there is to be effective use of scarce research resources, particularly in the public sector, it is not enough simply to leave the hard choices to individual scientists. Decisions about resource allocations have to be related not only to scientific possibilities but to national priorities within the broader policy setting. Thus there must be a dynamic and informed approach to resource allocations." [Davis et al, 1987, p.5].

Davis, J.S., P.A. Oram and J.G. Ryan. (1987). Assessment of Agricultural Research Priorities: An International Perspective. Australian Centre for International Agricultural Research, Canberra.

I. INTRODUCTION

This report is the product of a team evaluation of the Morocco Dryland Agriculture Applied Research Project (DAARP) (Project No. 608-0136). The project is funded by the Governments of the Kingdom of Morocco and the United States of America. The principal agencies charged with the design and implementation of the project are the Agency for International Development (AID), as represented in Morocco by the United States Agency for International Development Mission (USAID) in Rabat; and the Ministry of Agriculture and Agrarian Reform (MARA), as represented by the Institut National de la Recherche Agronomique (INRA). The primary technical assistance contractor for the project is the MidAmerica International Agricultural Consortium (MIAC). MIAC is a consortium composed of the following American land grant universities: the University of Nebraska, the University of Missouri, Kansas State University, Oklahoma State University and Iowa State University. The University of Nebraska at Lincoln serves as the lead institution in execution of all USAID/MIAC contractual obligations under the project.

The purpose of the mid-term evaluation was to assess progress in achieving project purpose and outputs and to assess the impact of the technologies developed and disseminated. The project was initially conceived in 1975/1976 and designed in 1978. It underwent two significant redesign efforts and project expansions in 1984 and 1988. Effective project implementation has been underway for approximately ten years. It was, therefore, deemed timely to assess project achievements to date and to determine what actions should be taken to ensure project sustainability after the scheduled termination of AID assistance in August 1994. The specific objectives of the evaluation were to:

1. Assess and document progress, achievements, and the impact of research carried out to date;

2. Assess progress in technology transfer, measure the rate of adoption among the target farmers and determine the impact of this technology dissemination;

3. Measure progress in institution building including the institutionalization of research functions to insure sustainability and progress in staffing, facility construction, management and budgeting;

4. Measure progress in the transition to Moroccan leadership at the Aridoculture Center and at satellite centers; and

5. Make and prioritize recommendations to enhance the sustainability of the project following termination of AID assistance. [See Annex 1 for Evaluation Statement of Work].

II. PROJECT BACKGROUND

This section of the report presents a brief statement of the goal, purpose, projected outputs and history of the Morocco Dryland Agriculture Applied Research Project (DAARP).

A. Project Goal

The goal of the project is to increase food production in order to meet the needs of Morocco's fast growing population and to improve the income of farmers with small and medium-sized land holdings.

B. Project Purpose

The purpose of the project is to establish a sustainable applied research capacity relevant to the dryland farming systems and natural resource constraints of the 250 to 450 millimeter rainfall region of Morocco and capable of providing technologies to improve farmer productivity.

C. Projected Outputs

According to the latest statement of projected DAARP outputs in the March 1988 revision of the Project Agreement, the seven major outputs projected from this project are:

1. A functioning and sustainable Regional Research Station at Settat (the Aridoculture Center);

2. A functioning and sustainable network of supporting satellite research substations for the Center;

3. A functioning management system in place to carry out effective research programs and develop budgets, accountability and evaluation;

4. Agronomic technologies and farming systems practices developed that are appropriate to small and medium-scale dryland farmers;

5. Farming equipment developed that is suitable for small and medium-scale farmers;

6. A functioning and sustainable technology transfer unit that is transmitting new technology information to clients; and

7. Direct links between researchers and representative farmers established that provide (a.) basic understanding of targeted farming systems, (b.) baseline information for evaluation and feedback of research programs, and; (c.) a model for evaluating economic and social viability of alternative

technologies.

D. Project History 1975 to 1990

The Dryland Agriculture Applied Research Project in 1991 is the longest running and most expensive agricultural project in the USAID/Morocco portfolio. As such it has a long and rich history which has been well-documented by USAID, the Government of Morocco (GOM), and the principal contractor, MIAC.

The DAARP was initially authorized in 1978 with an AID life-of-project (LOP) contribution of $ 4,500,000. Under this initial authorization, AID and the GOM agreed to construct, staff and equip a regional dryland research institution to be known as the Aridoculture Center. This Center was to serve an area of ten provinces in Morocco, including Safi, El Kelaa, Settat, Casablanca, El Jadida, Essaouira, Marrakech, Beni Mellal, Ben Slimane and Khouribga. The designated project zone covered approximately 35,000 square kilometers. [see Text Figures 1 and 2]

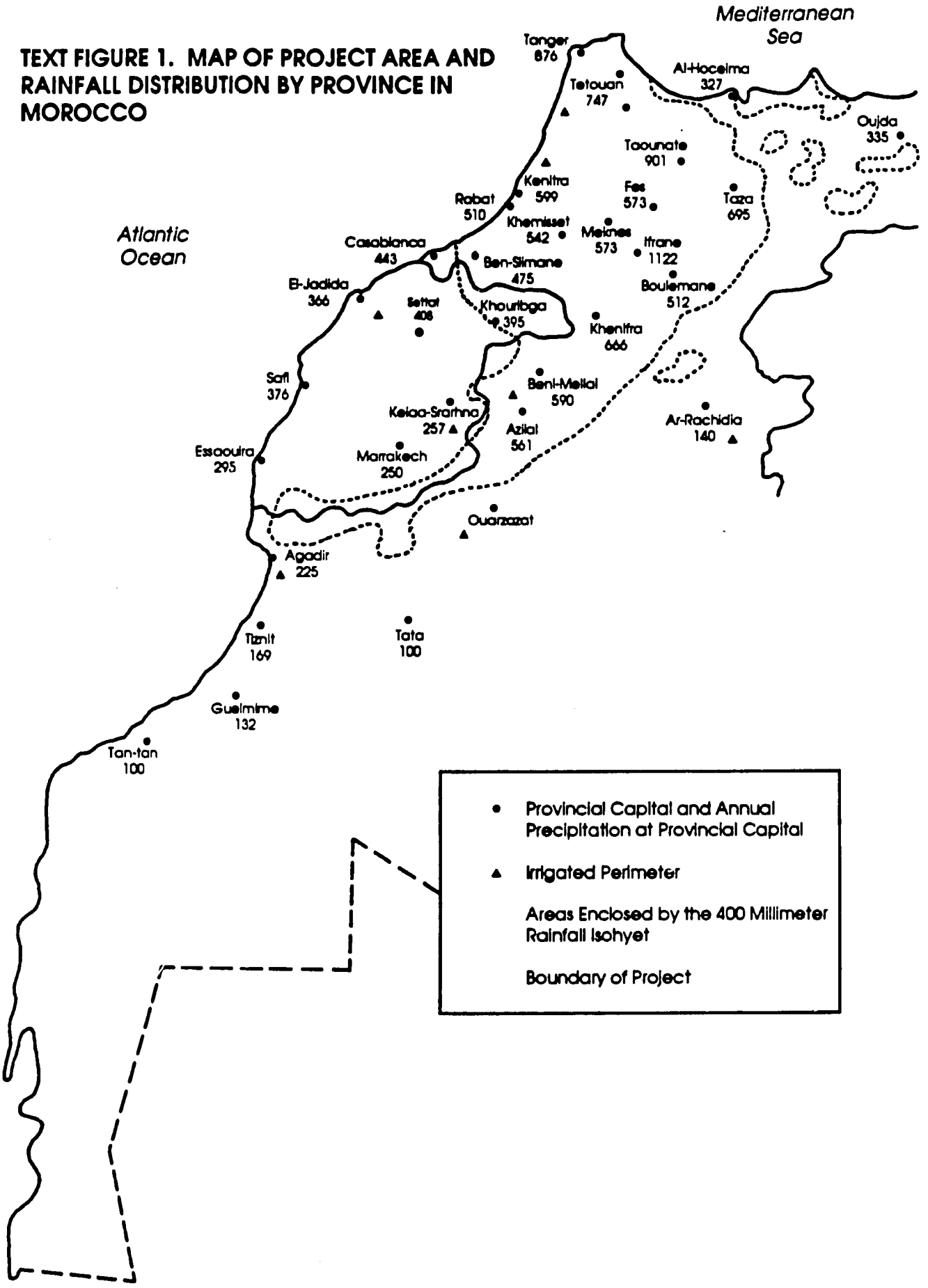
In an excellent End-of-Tour Report (Watts, 1987), the project evolution is described as passing through three early stages: an Early History Stage 1975-1982; a Transition Stage 1982-1984; and an Evolving Institution Stage 1984-1987. The Early History Stage was initiated with an invitation by USAID to MIAC to field a team of agricultural specialists. These specialists were charged with evaluating the status of the non-irrigated portion of the agricultural sector in Morocco. Their observations indicated that an applied research program in the semi-arid dryland region was required before very many successful steps could be taken toward improving the region's agriculture. An infusion of technology was deemed necessary and an applied research program was seen as the means to providing technology adapted to the region's needs.

The report of this team, therefore, was the basis upon which the major project design effort went forward in 1977 and 1978. The result of the effort was a Project Paper in early 1978 and a signed Project Agreement with the GOM in September 1978.

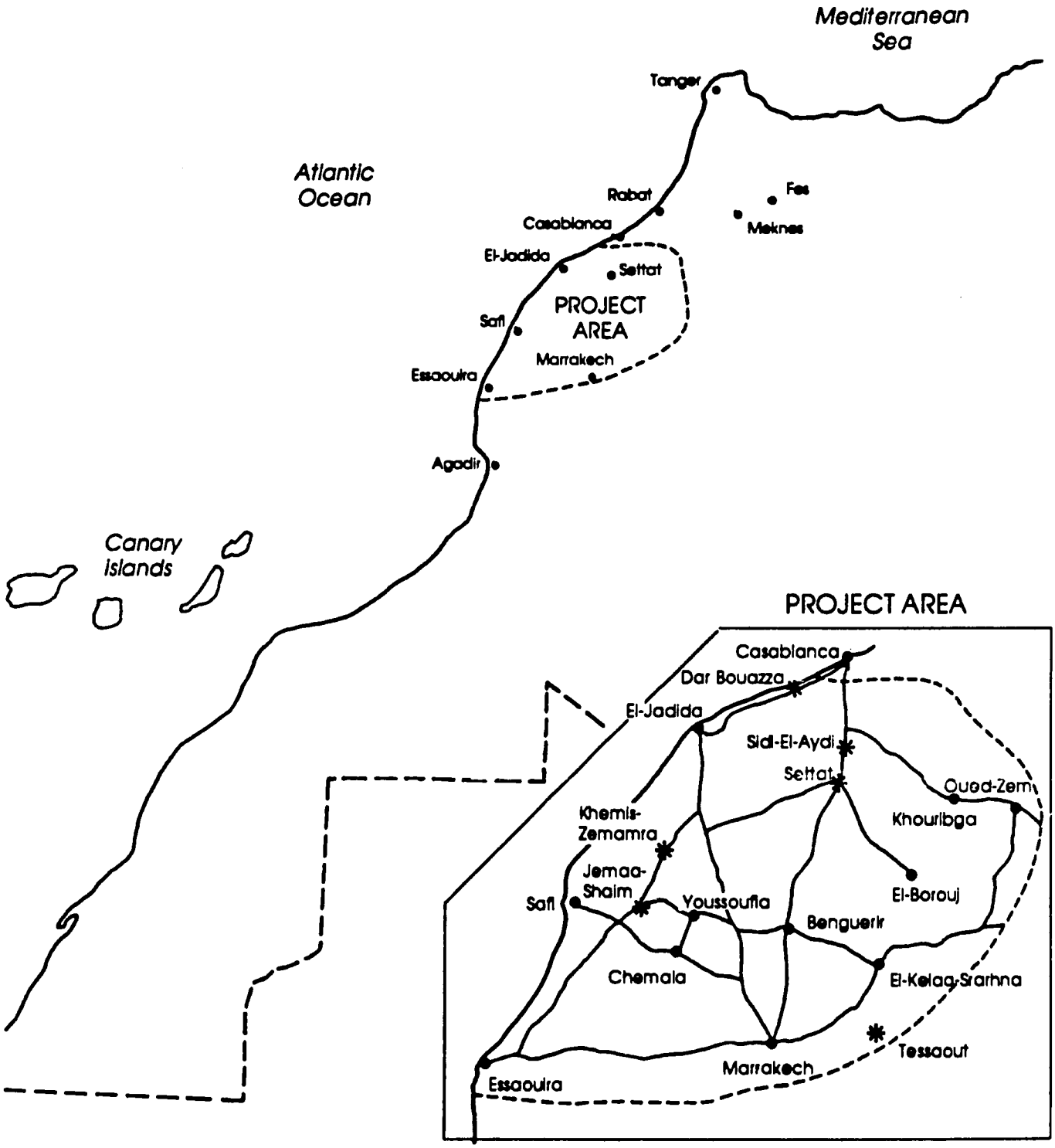
In 1980, MIAC was finally contracted under a collaborative assistance mode to field a team of American agricultural scientists to develop a multidisciplinary research program at the Aridoculture Center and to simultaneously train a cadre of Moroccan personnel in selected areas of expertise so that they could eventually assume full responsibility for Center activities.

By the admission of all parties, project implementation proceeded very slowly over the period 1978 to 1982 due primarily to organizational problems in Morocco, contractual problems between USAID and the prime contractor, and subsequent MIAC/GOM staffing problems. Perhaps the most interesting commentary on this period was as follows:

TEXT FIGURE 1. MAP OF PROJECT AREA AND RAINFALL DISTRIBUTION BY PROVINCE IN MOROCCO



TEXT FIGURE 2. DETAILED PROJECT AREA



✱ = research stations or centers

"It is important to understand that the entire project operation was considered by the Moroccan government to be an experiment. Up to that point agricultural research had been modeled along the lines of the French system. In Morocco this meant placing emphasis more on whatever interested the scientist instead of focusing an entire research team on a program that would get results directly applicable to the farmer. It was widely recognized that the American system was different but most people were doubtful that it would work well in Morocco. Accordingly, the project was to be, in effect, a trial to see if the American research system would work and bear fruit that the French system had not.

At the beginning of the project, and in fact for several years thereafter, the traditional Moroccan program was carried on in parallel with the MIAC project so that comparisons could be made in results, output, etc.. For these reasons the "Project" was considered by INRA and the Moroccan government to be a very distinct entity, quite apart from the normal INRA organization. It has been only since about 1985, with the return of a substantial number of Moroccan program participants, that this attitude has slowly changed within INRA and within other government circles." (Watts, 1987 pp. 18-19)

A second important commentary, also by Watts, was:

"INRA, as well as MIAC, also had major delays in recruiting personnel for the project. By the time the MIAC team leader arrived in Morocco (i.e. 1982), only two INRA participants had been sent to the U.S. for training. During 1981, only two more people were selected .... INRA staff were reluctant to sign up as project participants. At that time they were all stationed in Rabat and, while perhaps not being that productive, were at least comfortable with what they were doing and with their living situation. For them, the American system was an unknown. There was a language barrier to be overcome. Furthermore, they were advised that if they participated in the program, they would have to move from Rabat, a city of natural beauty with a cosmopolitan atmosphere, to Settat, which, at best was a backwards, overgrown village with few amenities. It was only in 1982 that an additional group of people was named and placed in language training." (Ibid, p. 19)

The Transition Stage of DAARP development encompassed the period 1982 to 1984. This period marks the beginning of full-time MIAC leadership of project activities with the arrival of Dr. Darrell G. Watts as team leader in September 1982.

At this point, according to Watts, "USAID was on the verge of canceling the Project. Apparently, they had been prepared to do so earlier in the summer of 1982 but decided to wait to see if changes might be forthcoming with the replacement of the team leader and the soil scientist." Moreover, he reports that:

"From the very beginning of my time in Morocco, there was tremendous pressure from both USAID and INRA to make quick progress. The reasons for their demands were quite understandable but equally frustrating. Both organizations had received scathing criticism as the result of past project deficiencies (imagined or real). In addition, there was active opposition to the project by some within the INRA bureaucracy. They perceived (correctly) that if it succeeded in training a new group of elite Moroccan scientists, the old generation would quickly be superseded by the new. Beyond this there was considerable doubt on the part of a number of people within the Moroccan Ministry of Agriculture and, for that matter, within some sections of USAID-Morocco, that the project would produce fruitful results." (Watts, 1987, p. 21).

It should be noted that at the point when Dr. Watts assumed the MIAC team leader's position, the project office was still located in Casablanca, although the Settat site had been selected. Moreover, the project technical assistance "team" consisted of one agronomist, one cereals breeder, one machinery maintenance specialist, one soil scientist and the previous temporary team leader who was to remain until March 1983 to help with participant training activities. This team was supported by a staff consisting of one American national who had been hired locally to manage the office and keep the books, two Moroccan secretaries and one general office worker.

Progress was made early in the period with respect to construction at the site of the Aridoculture Center in Settat, ordering commodities and equipment, preparing and sending additional Moroccan participants to the United States for training, and revising the MIAC agricultural research program. However, field operations were greatly curtailed by the effects of a drought which had begun in the Fall of 1980 and continued to plague the project zone through the harvest in the Fall of 1984.

By the end of 1982, it had become apparent to MIAC staff that the existing "team" in terms of absolute numbers and disciplinary areas was inadequate to deal with the scope of the research and institutional development problems facing it. Moreover, it was "discovered" apparently for the first time that the agriculture of the region was an integrated livestock and cropping system, in which production of forage or feed for animals was of prime concern to farmers. Moreover, it became apparent that water conservation and the associated tillage and management practices to achieve it were fundamental to the improvement of dryland farming and that weed control was another fundamental element in the evolution of a better system.

These concerns resulted in one of two major accomplishments for the project during this period. In November 1983, a new MIAC team arrived in Morocco to revise the project designed in 1978. This redesign proposed to increase project staffing to a total of thirteen expatriate positions, including an American administrative associate to support the MIAC team leader in project management. The effort culminated in the signing of amendments to the Project Agreement in 1984 and a new USAID/MIAC contract in April of that year. The total MIAC budget went from $ 3,800,000 to $ 22,500,000 under the new contract with USAID retaining approximately $ 4,000,000 outside the MIAC contract for project activities.

The second major accomplishment of the period was the return of the first Moroccan participant trainees from the United States. Four participants returned to the project between March and November 1983. These individuals joined an INRA staff consisting of two agronomists, one weed scientist and one soil scientist to form a team of eight professional staff members. This provided for the first time enough people to actually begin a significant research effort in the project zone.

This period also saw a major project failure in the development of a regional socio-economic program. Under the initial project design, it had been decided that all socio-economic research in the project zone would be conducted by staff from the Division of Rural Development at the Institut National Agronomique et Veterinaire Hassan II (IAV) in Rabat under a direct and separate contractual arrangement with USAID. According to Watts, "relationships between the combined INRA-MIAC Aridoculture program and the IAV sociology group was strained from the very beginning. Moroccans in both camps spent a great deal of time in acrimonious debate. In essence, the sociologists did not believe that what the researchers were doing was germane to the problems they perceived the farmer to face. The agronomists felt that there was little practical use for the information being gathered by the sociology group." (Watts, 1987 p. 25)

Moreover, in 1984, it became apparent that the socio-economic program was deficient with respect to quantitative skills in economic analysis, and with respect to risk analysis. Accordingly, USAID mandated the addition of a sociologist to the MIAC staff to provide for a resident social scientist in Settat for the first time. However, the situation between the IAV sociology group and INRA continued to deteriorate -- and did so more rapidly after the untimely death of Dr. Paul Pascon, the acknowledged leader of the IAV Sociology group, in May 1985. Ultimately, the evolution of a sociology component within the DAARP itself began to overshadow the efforts of the IAV group and in 1987 USAID canceled the IAV contractual relationship.

From that point on, the problems of the DAARP socio-economic component, which continued to exist within the project, were largely a function of personal characteristics of the sociologists and economist hired under the MIAC contract.

The Evolving Institution stage of the DAARP between 1984 and 1987 was characterized by Watts as a very rapid evolution. The DAARP operational structure was said to have been quickly and radically altered by the arrival of new MIAC personnel and the continued arrival of Moroccan participants after completion of their university course work in the United States. According to Watts, "it was not entirely easy to maintain the focus on long term objectives because of the constant struggle to develop lab, office and field plot space for new personnel. It was not only space at issue. There was a continual tug-of-war for all the support resources that would enable a scientist to function. Transport, technician help, laborers, field equipment and lab materials were all battled over on a daily basis." (Ibid, p. 27)

During this third stage in the Watts' characterization of project evolution, many trends and problem areas appear to have surfaced which continue to affect the project in varying degrees in 1991. The first of these problems was posed from the moment project and INRA regional staff

finally moved into the Aridoculture Center complex in May 1984. At that time, the INRA Director was faced with the choice of determining whether his own future lay in being a regional INRA headquarters director or the director of the Aridoculture Center, which had yet to attain any formal status within the INRA national structure and was in fact a creation of the DAARP. The INRA Director at the time, although nominally wearing both hats, chose to see himself first and foremost as the director of the INRA regional headquarters.

This issue of administrative authority and job perceptions was a major complicating factor in providing effective leadership in Settat. The MIAC team leader had the financial resources of the project but no administrative controls over the INRA researchers. The INRA regional director, on the other hand, found himself in the opposite position of having control over INRA personnel but having little or no direct access to the project funding which was the main support for research activities. This institutional arrangement created tensions which show every evidence of having been carried over to the present day.

During the period, the research program in Settat, according to Watts, expanded almost exponentially. The new MIAC staff was experienced and eager to get on with their research activities. The INRA participants were gaining experience and confidence. This led to a second trend which continues to some degree in 1991. That is the tendency of participant researchers to first want to work only on their individual thesis or dissertation problems and, having successfully completed that chore, to be inclined to work on another individual research problem. Watts comments that it was only toward the end of his tenure as MIAC team leader that "some truly interdisciplinary efforts began to evolve". He further states that "it should be understood that the evolution from individual research effort to joint work is quite a radical departure from Moroccan tradition. While the participants had seen this done in the United States, they struggled some to put it together in the Moroccan context". (Ibid, p. 29).

Another trend which appears in project documentation during this period is perhaps best summarized in the statement that "the heart of any institution is its human capital. MIAC has made a major investment in developing scientific and support personnel for the Aridoculture program. During the course of the Project we have sent 26 participants to the U.S. for graduate training. In addition, a larger number of people have been sent to the U.S., international centers or other locations for short term training or international professional meetings. Others have received short term training in Morocco. The impact of this training can be clearly seen in the improved quality and quantity of research output. Our primary thrust was and remains long term training of scientists." (Watts, 1987 p. 30).

A problem area mentioned in this period is the shortage of quality support staff for the Aridoculture research program. It was said that the rapid buildup of scientific personnel in Settat had outstripped INRA's ability to supply technicians. There had been severe hiring limits placed on that level of personnel for several years and those competent technicians who were settled in other locations, particularly where they were provided with government housing, were extremely reluctant to move to Settat, where housing was in short supply, was expensive and had to be paid for from their own pockets.

Early in the life of the project, it became apparent that the Aridoculture program had to develop strong linkages to other institutions if it was to prosper over the long term. Ties with the international centers such as ICARDA, CIMMYT and even ICRISAT were seen as important as were regional programs such as those carried out by ACSAD and even national programs in the Mediterranean area. In addition, there was a perceived need for linkages with other institutions in Morocco.

While linkages were established with several international and domestic research institutions, a problem apparently arose in dealing with the international centers. It was difficult to maintain a good level of interchange without, in effect, becoming a satellite of those centers. Watts (1987) observed that:

> "In spite of their protestations to the contrary, the international centers, particularly ICARDA and CIMMYT want to share in the credit for what is happening at Settat. They have good, aggressive scientists who are prepared to help Morocco improve its food situation and help the Aridoculture Center develop. They are, however, quite human and not infrequently let their loyalties to their own institutions override the needs of the Moroccan program."

Another positive aspect of the project's evolution in this period was the installation of an international scientific panel to obtain independent evaluations of the progress and quality of the work being conducted by the Aridoculture research staff on an annual basis. This innovation was originally requested by Mr. Faraj, the INRA National Director. He suggested that this be an annual review by the same scientists so that they could view the progress of the program and have a basis of comparison over time.

The review panel of six internationally respected agricultural scientists was duly constituted taking special care to preserve its independence from any MIAC involvement. The composition of the panel remained unchanged during the successive annual scientific program reviews during the period.

With respect to project financial matters, problems with INRA's operational budget were reported to be a continuous source of frustration for all project participants. The principal problem was that INRA was never able over the period to obtain more than a small fraction of its approved annual operating budget from the Ministry of Finance. Funds were very late in arriving, if they arrived at all and the rules for spending the money were deemed so cumbersome and inflexible that the INRA administration was extremely limited in its capability to use the funds effectively.

MIAC on several occasions attempted to ease the problem by providing funds from the USAID/MIAC contract as a cash buffer to make rapid short term purchases. The problem caused by this GOM/INRA financial situation apparently required inordinate amounts of INRA/MIAC staff time and energy to attempt to resolve. The problems were out of all proportion to the amounts of money actually involved in such transactions. It is claimed by MIAC project officials, however, that had MIAC not picked up much of the operating costs for the research work in

Settat during the period, the entire project would have simply ground to a halt.

On the official level, USAID is reported to have periodically advised the MIAC Team Leader that in principle project funding should not have been used to support the INRA budget. But, at the same time, USAID officials apparently agreed with MIAC staff that such temporary transfers had to be made in order to avoid wasting the very large investment made in personnel, time and equipment.

This stage of institutional development saw a major advance in facilities development in Settat. Between 1984 and 1987, fourteen laboratories were developed and equipped at the Aridoculture Center, in addition to a Technical Reference Center and a computing facility. Moreover, major renovations were undertaken at the Sidi El Aydi field research station and equipment was provided. Some renovation and equipping was also undertaken at the Jemaa Shaim field research station.

Beyond the actual construction, detailed planning proceeded for a headhouse for the Center's greenhouse complex and an agricultural materials processing and handling center, as well as the design of the greenhouse complex itself. The MIAC team was closely involved with additional work in the design phase of the agricultural mechanization center and the planning for a new seedhouse and one additional office and laboratory building at the Center.

Actual construction of facilities proved to be only part of the total task of building a functional research center. Considerable additional effort was expended after the initial contractors had completed their work in adapting the new facilities to actual research needs. This work entailed construction of cabinetry, installation of additional wiring and changes in plumbing fixtures. Unfortunately, this process was hampered from the Summer of 1986 to the Fall of 1987 by the complete collapse of the Center's water supply system due to faulty construction of the main underground distribution system.

The acquisition of adequate land area for research was reported to be an on-going issue throughout this period. Early on it became apparent that land immediately adjacent to the Center site in Settat was inadequate for research purposes being limited to three non-contiguous parcels with soils that suffered from extreme heterogeneity. Moreover, at the Sidi El Aydi field research station, new experiments had been installed on top of old ones for years without intervening uniform cropping to eliminate the effects of previous plot treatments. Experimental results were, therefore, confounded to the point of being useless for research analyses.

In the summer of 1984, a temporary arrangement was completed to lease twenty-six hectares of additional land immediately adjacent to the Sidi El Aydi station through December 1989. This provided enough space to accommodate experiments installed in the area by returning INRA participants and by MIAC staff but it did not provide a permanent solution to the problem.

The failure to adequately plan for the siting of the Aridoculture Center in an area immediately adjacent to sufficient hectarages of land appropriate for research purposes or to subsequently

secure additional land created the major problem of increased costs and lack of timeliness in field research activities due to transportation problems for researchers, support staff and necessary equipment and other experiment inputs. This situation had not resolved itself by the end of the period.

The Project Paper Supplement of 9 March 1988 proposed to extend the DAARP by six years until 31 August 1994. It also proposed to increase AID life-of-project (LOP) funding by $ 23,676,000 to a total of $ 50,000,000. The Government of Morocco (GOM) was to increase its contribution for the DAARP by the Dirham equivalent of $ 16,295,000 to bring its total LOP contribution to the equivalent of $ 28,231,400.

The project extension was to provide inputs to strengthen the on-going research program, focus and upgrade the technology transfer program, and ensure the institutional sustainability of the Aridoculture Center. The additional AID funding was: to add 72 person years of resident expatriate technical assistance; to provide for 26 additional participant training opportunities (7 Master of Science (MS) and 19 Doctor of Philosophy (PhD) degrees); to fund additional short-term training; and to provide commodities for the project.

Since the DAARP was the subject of a comprehensive evaluation in May 1986 (Winrock International, 1986) and the recommendations of this evaluation were incorporated into the project redesign exercise in 1987 and 1988, the present mid-term evaluation focused its attention primarily on the period from 1987 to 1991 and particularly on the period since the last major amendments to the project in March 1988. At the start of this period, the designated project zone had an estimated population of 6,409,000 persons. This population represented about 27 percent of Morocco's total population and 50 percent of its rural population.

III. EVALUATION FINDINGS AND CONCLUSIONS

Having reviewed the project goal, purposes and objectives and presented a brief history of the project through 1987, this section presents the evaluation team's findings and conclusions with respect to progress and issues in institution building and sustainability, in development of new technologies through agricultural research, in the development of a system of technology transfer, and in relationships with agribusinesses and the private sector. The periods of greatest importance for the present evaluation are the period of actual performance from 1988 to mid-1991 and the period of transition from mid-1991 to 1994.

A. Progress in Institution Building

1. Human Resource Development

a. Long-Term Degree Training

One of the principal activities of the DAARP since 1982 has been providing long-term training for Moroccan agricultural research scientists in the United States and Morocco. These participant training programs have been oriented toward producing competent Moroccan scientists in agricultural and social sciences at the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) levels. Both MIAC and Moroccan project personnel contend that development of this cadre of Moroccan agricultural scientists has been one of the most important accomplishments of the DAARP to date and that the existence of enhanced human resource capacity within INRA will be the greatest legacy of USAID/MIAC assistance after the project ends in 1994.

As of May 1991, nineteen Moroccans had been selected by jury to participate in M.S. level training programs. Two of these candidates participated in language training courses in Morocco but did not achieve adequate levels in English to continue with their anticipated studies. Both were dropped from the participant training programs and have since been reassigned to INRA posts in other parts of Morocco. Thirteen candidates have actually participated in M.S. programs at six American universities to date. Of these, nine have completed their program requirements and received their degrees. Eight of these graduates are still with the INRA Center in Settat and one has been reassigned to another post within the INRA system. Finally, four degree candidates are to leave for M.S. training during 1991.

At the Ph.D. level, forty Moroccans have been selected by jury for training, including seven who previously received their M.S. degrees under the DAARP. Of these candidates, thirty-seven were sent to nine universities in the United States for doctoral training. One candidate decided to leave the program after being selected and two others are preparing to depart this year.

With respect to the performance of Moroccan candidates in doctoral programs, two candidates failed to complete their coursework and were dropped as degree candidates by their universities. Both of these have left INRA employment. Of the remaining Moroccans, eleven candidates have received their degrees. Another seven have completed their coursework and returned to Morocco

to work on their dissertations. One of these candidates has subsequently discontinued his doctoral studies and has been reassigned to INRA responsibilities outside Settat. The remaining seventeen Moroccans are presently pursuing their studies in the United States. Finally, two Moroccan scientists, having received their Ph.D. degrees under the DAARP, have left Settat. One has been reassigned to another INRA Center as a department head and the other is no longer in INRA.

In addition to the Moroccan participant trainees already in degree programs, INRA and MIAC presented a request with the 1990/1991 Integrated Plan of Work to USAID for approval of eleven additional degree training positions. Candidates have already been selected for two of these positions. If the supplementary request were to be approved, nine additional participants would have to be chosen under the INRA jury selection procedure and, as necessary, receive English language training before departing Morocco. The additional degree training positions being sought are:

(1) MS in Agricultural Mechanization
(2) MS in Research Station Management
(3) MS or PhD in Food Legume Pathology or Virology
(4) MS or PhD in Agronomy
(5) PhD in Food Legume Entomology
(6) MS or PhD in Agricultural Economics
(7) PhD in Weed Science
(8) PhD in Agricultural Economics with a minor in Agronomy
(9) PhD in Cereal Pathology
(10) MS or PhD in Virology
(11) MS or PhD in Biotechnology.

The evaluation team agrees that the long-term participant training program for Moroccan scientists is the most uniformly successful element in the DAARP. By the end of the project, a cadre of well-trained, well-motivated Moroccan scientists will be in place within INRA. These scientists will have the capacity to carry on high quality agricultural and social science research into the next century. The evaluation team, however, noted three inconveniences in the long-term participant training program -- all of which should have been remedied or accommodated in the project design process.

The first problem is that degree programs have on average taken longer to complete and been more costly than anticipated by project designers. The M.S. programs appear to have taken about 4.5 years on average to complete and the Ph.D. programs are taking about 5.5 years. In a few cases, particularly at the M.S. level, the coursework portion of individual programs needed to be extended to include remedial courses; but, in most instances, the delays have been caused by the pressures to function as a full-time INRA researcher put on degree candidates after they complete their coursework and return to Morocco for thesis or dissertation research. At this time, the degree candidates as INRA researchers are in a quasi-student, quasi-employee status and must find ways of effectively responding to the demands placed upon them by both their graduate faculty advisors <u>and</u> their full-time employer. In most cases, the result is a significant delay in

completing a degree program.

The second problem is that the rolling design process for the long-term participant program has resulted in an uneven distribution of trained Moroccan scientists among the existing sub-programs and disciplines in Settat. Disparities are evident not only in the absolute numbers of scientists present at the Center but also in the levels of cumulative research experience between disciplines. This is so because several disciplines not only had greater numbers of candidates selected for degree training but because these candidates actually departed for the United States in the early and mid-1980s. The consequence is that these scientists not only have completed their degree programs but now have several years of post-doctorate research experience to their credit.

The disparities are well illustrated in comparing the relative strengths of the cereals improvement group, the soil sciences group, and the plant protection group at the Center with the relative weaknesses of the agricultural economics/rural sociology group, the food legumes group, the agricultural engineering/mechanization group, and the group charged with research support.

The first three groups between them contain twenty-one of the thirty-two trained scientists resident in Settat and ten of the twenty-five degree candidates still in the United States. By contrast, the agricultural economics/rural sociology group has three scientists in residence in Settat -- none of whom were trained under the DAARP -- and only two degree candidates in the United States -- one in each discipline. The food legumes group similarly has only two Moroccan scientists working in Settat and four completing their coursework at American universities. And, finally, in the cases of the agricultural engineering/mechanization and the research support groups -- i.e. specialists in biometry, library sciences, center administration, field station management, technology transfer -- there are no professional staff at the Center who have benefitted from long-term DAARP training specific to their present job responsibilities. Between them, these groups have only seven degree candidates in training in the United States or waiting to depart for training in 1991.

The third problem with the long-term training program is that so many of the degree candidates are still completing their coursework in the United States or waiting to initiate their coursework. At present, forty-four percent of all approved degree participants are still in one or the other of these categories with thirty-nine months left until the end of the project. There are two major consequences of the late scheduling of long-term training for the participants and the research program in Settat. The first is that many of these participants will not have any real opportunity to work with resident MIAC scientists when they return to Morocco because those scientists will have finished their assignments and departed for the United States. Second, the participants will be returning to Settat during a period when project resources to support research activities will be dropping off rapidly. This situation will inevitably lead to heightened competition for the remaining resources and increased tensions between experienced researchers trying to maintain their established programs in the new era of scarcity and the newly-arrived degree candidates trying to complete their thesis/dissertation research.

b. Short-Term Non-Degree Training

According to MIAC records, INRA Center staff have benefitted from seventy-seven different short-term training opportunities under the DAARP. In most cases, the training seems to have involved participation in specialized short courses or training programs of approximately one month's duration. The two discrete areas of heaviest concentration in short-term training have been in English language instruction and in basic computer literacy and more advanced skill training.

The rest of the short-term training opportunities break down into two categories: those which provided additional specialized instructional/observational experiences for Center scientists and those which provided to developed or enhance skills in Center support staff. In the first category, there have been opportunities for instruction in in vitro, forage analysis and soil testing laboratory techniques and other specialized training by disciplines. In the support category, training has been provided in areas as broad as program management and field station operations; as specialized as maintenance of electronic equipment, seed multiplication procedures, and desktop publishing and audio-visual techniques; and as mundane as driver education for bus and tractor operators.

This short-term training appears to have been carried out with professional competence and dispatch and has contributed to enhancing staff capacities within INRA.

c. Other Needed Human Resource Development

With respect to what additional staff training is needed for the INRA center in Settat, we believe that the imbalances between sub-program groups should be redressed with provision of a limited number of additional long-term training opportunities. However, the number and type of opportunities must be tempered by the realization that USAID assistance to the DAARP is projected to end in 1994. This means that if, at least, the United States coursework component of each supplementary degree candidate is to be finished before September 1994, then candidates must be in position to start their programs at American universities in 1991 and 1992. Even then, given the average length of the DAARP degree programs, an extension of the project completion date would be necessary specifically to allow degree candidates to finish their thesis/dissertation research in Morocco and defend their work before their graduate committees.Taking all these factors into consideration, the evaluation team feels that only the five additional opportunities listed below in priority order should be considered for approval:

(1) MS in Research Station Management (1991)
(2) MS in Agricultural Mechanization (1991)
(3) PhD in Agricultural Economics with a minor in Agronomy (1992)
(4) PhD in Food Legume Entomology or Pathology (1992)
(5) PhD in Weed Science (1992).

In addition, we believe that, in the interest of strengthening effective linkages between Moroccan institutions, the three Ph.D. opportunities in 1992 should be handled as a collaborative training effort between INRA and IAV. Under this arrangement, the candidates would be jointly selected and accepted as candidates for the IAV Ph.D.. They would proceed to do a tailored combination of coursework at IAV and at an American university and return to Morocco to conduct their dissertation research. The candidates would then defend their work before a committee of IAV, American and INRA advisors.

As will be discussed in succeeding sections of this report, the evaluation team is concerned about the general weaknesses displayed in research program planning and management and in the quality of technical support services available to researchers at the INRA center. On the one hand, while the Moroccan scientists involved in program planning and management appear to have excellent personal skills, they are few in number and overburdened with the diversity of demands on their time. On the other hand, many -- if not most -- researchers in Settat tend to neglect -- and in some cases to disparage -- the need for personal involvement in all aspects of program planning and implementation.

We believe, therefore, that short-term training opportunities between now and the end of the project should have a major focus on developing planning and management skills among a broader spectrum of the research staff in Settat. In this regard, we have several specific suggestions. We would, therefore, recommend that:

(1) Dr. Sefrioui be sent to the University of Missouri to work with Drs. Jere Gilles and Constance McCorkle on effective planning, design and implementation of rural sociology research.

(2) Mr. Hamel of the Technology Transfer/SRD unit should be sent to the University of Florida to work with Dr. Peter Hildebrand and his colleagues on matters related to rapid reconnaissance surveys and the process of technology testing and dissemination.

(3) Up to six senior Moroccan scientists having present or future roles in research program planning and administration be given opportunities for short-term training at the international research centers or elsewhere in program planning and administration.

With respect to technical support services, we believe there is a great need to strengthen staff capacities in field station management, operations of technical library resources and computer maintenance and operations, central laboratory operations and maintenance, motor pool operations and vehicle maintenance, and desktop publishing techniques to improve the presentation and quality of INRA center publications, particularly for distribution within Morocco. While we cannot at this point define in precise terms the nature and contents for each of these training opportunities, we believe that INRA and MIAC project leadership should be directed to select INRA staff candidates and develop such short-term training programs as a matter of high priority.

d. Other Training Issues

In the Evaluation Statement of Work, the question is posed as to whether or not INRA should be oriented in the future toward filling its personnel requirements with graduates from IAV and/or other Moroccan institutions. We have two responses to this question.

First, it should be noted that the majority of scientists in Settat are already graduates of either IAV in Rabat or ENA in Meknes at least at the Bachelor of Science equivalent level.

Second, we believe that IAV and ENA, as their programs develop and mature, will continue to provide excellent training opportunities for most of the personnel required in INRA research programs in the future. However, much more collaboration is needed between INRA at the national level and the two schools to develop specific position profiles for INRA researchers to be trained such that their local training is precisely tailored to the actual needs of the research programs within which they will work over their careers.

With respect to training in specialties for which no local training capacities are likely to exist in the medium-term, we would encourage that other institutional arrangements be exploited with a broad spectrum of external institutions. Some of these may be American universities but other opportunities should not be ignored -- i.e. research program administration at international centers or with USDA, equipment maintenance with specific equipment supplier programs. In our opinion, there is much value in diversifying training opportunities to include a broad spectrum of non-American institutions, including those in Europe -- e.g. CABO at the University of Waagenigen, CIRAD in Montpellier, and certain institutions in Germany and the United Kingdom.

The central point is simply that INRA should adopt a deliberate policy of seeking out and exploiting staff training opportunities of the highest quality available to it regardless of location in the world. This is essentially the policy followed by IAV in successfully developing and maintaining its present faculty and we see no reason why INRA should not seek to follow a similar strategy in its own staff development.

2. Infrastructure Development

a. INRA Regional Headquarters Infrastructure

According to the INRA Center Director, the development of physical infrastructure at INRA Settat will be complete when the buildings presently under construction are finished in 1992. The physical plan of the INRA Center in Settat appears to be well laid out. When all construction underway is finished, there will be adequate office and laboratory space for the full complement of agricultural scientists, technicians and support personnel envisaged by INRA. If budgetary constraints or other factors result in a permanent INRA Settat staff of more modest size, then the headquarters complex will provide even more spacious accomodations.

At present, INRA has six new buildings in various states of construction. These include: the biotechnology research building for which the shell is partially complete; an agricultural chemicals reception/storage receiving center (90 percent complete); an agricultural mechanization center and headquarters motor pool facility (75 percent complete); building for plant breeding research (80 percent complete); and a technology transfer building (80 percent complete).

In addition to buildings at the INRA regional center, construction is proceeding on an INRA guest house and recreational facility in Settat across from a new university. This complex is being constructed in response to the concerns of the INRA National Director for maintenance of good morale among INRA scientific staff in Settat. As explained to the team, INRA officials believe that social and cultural amenities available in Settat are not comparable to those found in other parts of the country and, therefore, there is a need for special measures to strengthen the long-term prospects for retaining staff in the local research program.

In general, the construction of research facilities in Settat has been slower than anticipated in project documents. There have been a number of problems to resolve between INRA and the various building contractors and, in some instances, contractors have had to be replaced with others -- often after significant delays. Given that Moroccan staff in Settat seem to consider the problems encountered as relatively normal for public construction projects in Morocco, one must wonder whether USAID/MIAC concerns expressed about the construction delays in Settat are not reflective of an overly optimistic initial appraisal of how quickly INRA would be able secure the considerable capital funding needed for the headquarters complex and to proceed with implementation of the physical plan, rather than any extraordinary circumstances with respect to this particular building project.

At this time, however, the question is moot since all construction envisaged is funded and underway and INRA officials repeatedly assured the evaluation team that, in their opinion, all construction would be completed by the end of 1992. Suffice it to say that there is evidence that the delays in construction have had some negative impacts on project implementation. One example is that of the Settat greenhouse facility, which finally went into service in late 1989 well behind schedule. This construction delay caused significant problems for implementation of a number of research protocols in plant breeding and varietal development. In addition the slow progress on several large office/laboratory buildings, like the technology transfer facility, has resulted in overcrowded office and laboratory conditions at present for existing center staff. Thirdly, since no financial provisions were apparently made for modifying some of the existing laboratories to accommodate the changing needs of the research program, INRA faces a continuing problem of how to accomplish these modifications, maintain existing buildings, and finish the construction underway.

Maintenance of physical plant at INRA headquarters is reported by both INRA and MIAC staff to be a chronic problem. The principal problem seems to be that the annual INRA budgeting exercise habitually makes less than adequate provision for plant and equipment maintenance expenses. Secondly, there appears to be a problem in setting clear priorities in capital and maintenance expenses on plant and equipment between INRA headquarters in Settat and the four

affiliated research stations, as discussed in the next section. And, finally, INRA currently does not have an adequate complement of trained staff to handle all the basic infrastructural maintenance and repairs.

The inadequacy of electric supply for the laboratory growth chambers has been remarked upon as a major problem and clearly a comprehensive upgrading of the headquarter's electrical service will be essential when construction of the new facilities is completed. Moroccan staff, when questioned about the problem, appeared to be fully cognizant of the need for changes and said that full rectification of the electrical supply with the physical plant will be accomplished by 1992.

The plumbing and waste disposal systems are also cited in MIAC reports as inadequate foı existing operations. Among other problems reported by MIAC staff are difficulties with the lighting in the greenhouses, the faulty operation of potable water supply pumps and lines, and the inadequacy of air conditioning and winter heating systems. On the positive side, the long standing problem with the water demineralization system for greenhouses and laboratories appear to have been solved with the installation of an adequate system in April 1991.

In the context of this evaluation, the apparent difficulties encountered with modifications to the physical plant in place raise serious questions in the present about the real capacity of the center to execute a research program as large and complex as that projected in planning documents. Clearly INRA, both in planning and operations, needs to pay greater attention to these problems if the research program is to be maintained even at its current level, much less at the activity levels projected for the future.

The principal conclusions of the evaluation team with respect to the Center's infrastructure are as follows:

(1) The Center complex is essentially well-planned and nearing completion. When construction is finished, the complex will be more than adequate to accommodate the staff anticipated for program operations.

(2) In order to maximize the utility to be derived from the capital expenditures on facility construction over the last decade, priorities must now shift to providing adequate financial and human resources for Center maintenance. In this regard, a common rule of thumb used in the United States is that one must anticipate annual maintenance costs on infrastructure to be between 10 and 15 percent of the total value of the buildings in question.

(3) Maintenance and upkeep of capital equipment within the Center is another source of increasing concern as the project moves towards 1994. Given that rapid replacement of costly pieces of equipment will be difficult due to INRA budgetary constraints, INRA administrative personnel at both the national and Center levels need to place a premium on developing and maintaining a capacity to properly operate and adequately service

all of necessary capital equipment in place.

b. Research Station Infrastructure

Until this year, INRA operated five field research stations in support of its total program. However, in 1991, the Dar Bouazza station was taken over by the municipal government for other purposes. Future research and revenue generating operations, therefore, will be carried out on the four remaining stations. These stations are described below.

The Sidi El Aydi Station is situated 15 kilometers from Settat. Although it is the smallest of the stations, it is the one most used by INRA and MIAC researchers. The station is well equipped with equipment and has the best complement of skilled laborers -- i.e. welders, carpenters and shop personnel -- but most of them are on contract to MIAC only for the duration of the project. The station has a capacity for supplementary irrigation on a portion of its 39 hectares of arable cropland. This irrigation capacity is particularly important for plant physiology studies.

The Jemaa Riah Station is 18 kilometers east of the Sidi El Aydi Station. This station was acquired by INRA at the behest of USAID to alleviate the crowding at the Sidi El Aydi Station. The station is said to have deep soils and appears to be an excellent research site. The entire 180 hectares of station land are fenced to prevent entry of local flocks and herds.

The station is, however, under-exploited at present and its physical plant is in serious disrepair. It has only a limited water supply and no electrical service. The only water supply is a well with water at 72 meters. If the station is to operate efficiently, even as a satellite of the Sidi El Aydi Station, a pump and water distribution system and an electric service are needed, as well as a facility for a small shop and equipment storage.

The Jemaa Riah station is situated at the base of a line of hills which are largely bare of vegetation and highly erodible. Flows of runoff water from these hills tend to channel through fields on the station causing serious local gully erosion. Erosion control measures need to be taken quickly to ensure that greater damage to valuable station land does not occur.

The Khemis Zemamra Station is located near the town of the same name about 120 kilometers southwest of Settat. It has an arable cropland of 267 hectares in two large pieces, of which 160 hectares are irrigable. This station is presently used primarily for seed multiplication -- i.e. cereal, food legume and oil crop seeds -- and for commercial crop production -- i.e. wheat and sugar beets -- to generate receipts for INRA. Italian financing under an FAO project provided the station with a modern seed cleaning, sorting and treatment plant in 1987.

The Jemaa Shaim Station is located 150 kilometers southwest of Settat and about 40 kilometers from the Khemis Zemamra Station. This station lies in the lowest rainfall area of any of the satellite field stations, with annual precipitation averaging 280 millimeters. Irrigation is not possible in the area and research activities are centered on rainfed cereals and food legume crops, as well as tillage methods to conserve soil moisture. Due to low rainfall, the station is also

important for work on moisture stress and drought tolerance with cereals.

In addition to the four field stations, there is a small amount of land directly adjacent to the INRA center in Settat which has been used for long-term ley-farming and soil management trials. The land is sloping with highly heterogeneous soils and a minimal value for other types of experiments. This land is not considered in further analysis.

The evaluation team has several concerns with respect to the four field stations. They are as follows:

(1) It appears that field station development has been seen by INRA as clearly secondary to the development of infrastructure at the Center in Settat. This priority is set irrespective of the fact that the field stations presently produce receipts from their commercial operations roughly equivalent to INRA/Settat's total core operational budget, exclusive of local salaries, and could be managed to produce considerably more revenue in the future to bolster prospects for program sustainability.

(2) There appears to be no well-developed INRA strategic plan for how to use the resources of these stations to best advantage of the on-going research program and to ease the transition from project resources to a self-sustaining INRA program in Settat. Clearly the field stations possess cropland and other resources far in excess of what is likely to be needed in the foreseeable future for strictly research purposes but we have seen little evidence that effective planning is underway to improve the utilization of station resources in contributing to prospects for sustainability of the total program.

(3) With respect to the use of the field stations for strictly research purposes, we must question whether these needs could not be adequately accommodated by having two well-developed and well-equipped field stations at Jemaa Riah and Khemis Zemamra for most of the on-station research trials and using the facilities at Jemaa Shaim for a limited number of experiments related to moisture stress and tillage conservation methods to retain soil moisture.

(4) After consulting the major reports on field station development [Muhtar, 1990;Croy, 1990] and discussing the issues with all concerned parties, we believe that, based on available resources, research and commercial production needs, and overall potential for future development, a clear priority ordering of the field stations with respect to any further USAID financial contributions to station development is evident. We see the highest priority being the full development of Jemaa Riah as an operational station. The second and third priorities are selected investments in Khemis Zemamra and Jemaa Shaim, respectively. We see no need for further investment in the Sidi El Aydi field station, given its small size and rather limited potential. In fact, if Jemaa Riah station was to be fully developed in the medium-term, we believe that the Sidi El Aydi station would be better seen in the future as a satellite of the Jemaa Riah station to be used primarily for farmer demonstrations of new technologies -- and not the reverse.

(5) If the field stations were to be managed as self-supporting units through increased sales of agriculture commodities -- e.g. seeds, wheat, sugar beets, oilseed crops, etc. -- the present serious problem of adequate station support and further development would be significantly resolved as an internal matter. Revenues from such sales retained directly or recycled through the INRA financial system -- would adequately finance the stations, in addition to contributing to general operating expenses at the Center.

The evaluation team's principal conclusions with respect to the INRA Settat field stations are:

(1) One of the four stations -- Jemaa Riah -- is in need of almost total renewal of buildings and equipment and, in addition, demands major erosion control work on a portion of its fields. Two other stations -- Khemis Zemamra and Jemaa Shaim need infusions of capital for new equipment and building repairs if they are to operate efficiently as sites for research trials and revenue-generating activities. And, finally, all three stations need to be linked to the INRA center in Settat by an effective communications system.

(2) Before any investment is feasible, however, INRA must actually develop and begin to implement the operational plan for the cost-effective utilization and self-management of the four INRA Settat field stations called for in the center's Plan de Travail 1991. (Centre Regional de la Recherche Agronomique de Doukkala, Abda et Chaouia, 1991, p.1)

[Note: Late in May 1991, the INRA center director sent the evaluation team a revised request for USAID assistance with field station development. While this new request displayed commitment and responsiveness by INRA, the request itself was wholly deficient in that it presented yet another list of equipment for USAID funding without any substantial evidence of a strategic plan to operate the field stations for both research trials and revenue-generating enterprises.]

(3) Such a plan to be effective must at a minimum rationalize the annual use of all field station cropland -- irrigated and non-irrigated -- by research trials and other cropping and fallow activities over at least a five year period. It must also provide a detailed plan for support of the field stations with regard to all necessary management and technical staff and field labor (permanent or seasonal), operational budgets to purchase necessary inputs for both research and revenue-generating activities, a crop management plan for the timely use of the inputs, and a plan for rational sales of station commodities. In addition, the operational plan would have to be reinforced by a legal guarantee from the Ministry of Finance and INRA in Rabat that the revenues generated from the improved management of INRA Settat's field stations would be retained as part of the INRA center's operational budget for the following fiscal year.

(4) If these conditions were to be met by INRA in the near future, we believe that USAID should be willing to assist INRA Settat in developing a system of more functional field stations before the end of the project. We also believe that any further

investments in these stations should be divided over a three year period (FY 1992-1994) and disbursed in direct proportion to INRA's demonstrated progress in implementing the new field station operational plan.

3. Center Planning and Management

a. Present INRA Program Planning and Management

To the credit of all DAARP participants, there is evidence that thought, time and effort have been expended since 1988 to formulate and institutionalize a rational process for identifying, addressing and funding elements of the annual INRA center research program. This process has been supplemented by efforts to begin to adopt a Planning-By-Objectives (PBO) management system in the research planning process.

In the project, this process is implemented within an organizational structure composed of six research sub-programs, which group INRA and MIAC scientists representing at least seventeen separate academic disciplines plus the outreach function of technology transfer ("Service Recherche/Développement" [SRD]). Grouping scientists into sub-programs was, according to Edwards (1990), a deliberate attempt to dampen the influence of the INRA disciplinary orientation using sections and departments, and he argues that it has begun to work.

Of the six sub-programs, four have commodity orientations -- i.e. cereal improvement and production, food legumes and forages. The remaining two programs are harder to classify. The technology transfer sub-program has a clear process orientation; whereas the socio-economics sub-program represents the two disciplines meant to serve definitional and evaluative functions.

Under the current project research planning system, most problem identification, prioritization and development of research protocols is supposed to take place at the level of the sub-programs. Under the guidance and coordination of each sub-program head, researchers are to determine sub-program priorities; develop and review research protocols; and group them as projects within their sub-program. The research is then presented to a senior management group, the Aridoculture Scientific Committee, which consists of the INRA Settat director, the MIAC team leader, and a group of four senior INRA and MIAC scientists. This committee is then charged with the final decision-making as to the appropriateness of the sub-program packages and the research projects and individual protocols within them.

Sub-program leadership is, however, a recent function. It is elected, it is subject to change, it is not rewarded (except by a marginal addition to the annual per diem allowance), and it is operating among scientists who are not yet very strongly differentiated by seniority and experience. As well, two of the sub-programs -- i.e. cereals improvement and cereals production are much larger than the others, while another -- i.e. socio-economics -- groups disparate personalities who do not seem to be very comfortable working together. In these circumstances, the INRA Director's wish to install a process of research management that will be close to the work but will exert real authority has yet to be realized.

Thus neither the sub-program leaders nor the Scientific Committee has played a significant role in relating budgetary limitations to clearcut research priorities. Far from it, in fact -- there has been virtually no link between any vision of priorities and the actual allocation of budgetary resources. Nor is any performance evaluation of work carried out in the previous year to help determine allocations for the current year's work. Instead, the allocation of resources at the center follows multiple lines which tend to allow every researcher at least to start all the research that is deemed manageable by him or her for the year. The system which generates full and equal funding operates as follows:

♦ First, nearly 50 percent of the INRA operational budget of the center goes to fund the center field stations, whose technicians and permanent laborers -- except those paid under MIAC -- are paid directly by INRA headquarters in Rabat. Field station managers do not need to refuse land or labor to researchers and have not really had the authority to do so. Thus core research resources have been essentially free to all comers, including researchers from outside the INRA center in Settat.

♦ Second, MIAC funds have substantially augmented the research funds available to INRA researchers, many of whom are doing thesis research and can demonstrate their need for research resources. While it is difficult to account for exactly how much MIAC funding goes to support INRA researchers, the current climate is one in which it is understood that MIAC can and should keep the full research program going, as per our preceding discussion on page 12.

♦ Third, a reserve of 30 to 40 percent of the disposable INRA funds -- after the fixed costs of center maintenance, lighting, telephones, etc. are paid and central functions, like accounting and the library, are covered -- is kept by center management to cover extraordinary needs and reward especially promising efforts. In effect, these funds are available to respond to individual needs for such things as costly inputs, unanticipated repairs and/or simply to oil the "squeaky wheels" of individual assertiveness.

♦ Fourth, the balance of disposable funds are then divided nearly equally among researchers. In particular, taking the current year as an example, each one gets allocated the services of two laborers or one technician. Researchers also get an equivalent number of vignettes for gasoline. And each gets the same allowance for per diem days, with sub-program leaders getting slightly more than the rest of the research staff.

Questions of sustainability of this system obviously arise, as more and more researchers return from overseas training and as MIAC resources begin to decline and then disappear. Those very grave issues are discussed below. In the meantime, funding now covers virtually every research protocol, project and sub-program presented for review.

The <u>timeliness</u> of research planning has been another serious problem for INRA management. Lead times to have work plans approved by both INRA and USAID have been long and the process is cumbersome. In past years, the project's research planning process was initiated in September with an annual Fall Planning Conference. The annual MIAC work plan, which is a

project document not an INRA document, was prepared in October/November. A draft plan was ready for review by USAID in December. A separate INRA work plan was prepared for INRA in Rabat and presented in January after the beginning of the major agricultural season. This plan usually was not approved until March or April. Tied to the GOM fiscal cycle -- which follows the calendar year -- INRA/Settat is not notified what financial resources it will actually have either for the INRA investment/equipment budget or its operations budget until the agricultural year is virtually over.

Recognizing that both planning cycles are out of synch with the exigencies of the agricultural year, the DAARP planning process was modified in 1990. It was agreed to start the DAARP planning process in March with submission of protocol titles and budgets to INRA/MIAC management. [Note: The 119 protocols for 1991 can be classified into four categories: continuing research (76 -- 64 percent), continuing thesis/dissertation work (19 -- 16 percent), new research start (21 -- 17 percent) and new thesis/dissertation work (3 -- 3 percent)].

Discussions were initiated between researchers and sub-program leaders to sort out priorities and estimate financial requirements. Several meetings occurred between the MIAC and INRA administrations and between researchers and sub-program leaders to evaluate preliminary estimates of inputs, needs for consultants and advisers, international travel to scientific meetings, long- and short-term training needs, laboratory and field equipment priorities, expendable commodities, and operational funding.

All these aspects of planning for the campaign were to have been finalized at the Fall Planning Conference in Marrakech. However, this edition of the annual planning conference was used for a wide-ranging discussion of the future of the INRA center and the aridoculture program, with a focus on sustainability issues, rather than to finalize the research agenda.

For 1991/1992 work plan, the process has again begun early, with one or two additional innovations. First, this year the preliminary plans and protocols have been sent to interested parties in the DPAs and other local government offices for their comments before the program gets set at the center. Second, the evaluation team has insisted that the sociological baseline study be finished, at least in draft, so that the typology of farmers can be presented to other researchers. The aim of both these efforts is toward collaboration to clarify the ways in which the technical researchers' work addresses the needs of discrete sets of "clients."

This last issue, about the "client-centeredness" of DAARP research, presents another major issue of ongoing INRA research management. The current process relegates the focus on the potential clients of DAARP research results to a low priority. This is so for at least four reasons. First, the primary activity of management has been internal rationality -- i.e. the setting up and evolution of ways to allocate financial and other resources made available by USAID and the GOM for the project. Second, a significant portion of the annual research program at present is dictated by the thesis and dissertation requirements of Moroccan participants finishing their degree programs. Third, many research protocols apparently reflect either the individual research interests of INRA and MIAC scientists or the extensions of research they have been doing for

years either at home (for the MIAC scientists) or under older, ongoing national programs at INRA. Fourth, and very importantly, the long history of unfinished social and economic baseline work leaves a void of systematic knowledge about the project zone which continues to inhibit project priority setting.

Certainly the designers of the project originally demanded that it determine and serve the specific needs of a well-defined clientele -- i.e. the small and medium farms in the drylands. The INRA center onto which the project was grafted has had a broader mandate -- i.e. to serve all agriculture in the geographic zone it covers. But whatever the mandate, farmers can only be served if there is a well-grounded planning process based on a detailed understanding of farmer groups and agro-climatic conditions in the project zone. American agricultural research institutions know this implicitly, and generate their research programs from the demands of producer groups, well-comprehended constraints, or well-defined opportunities. In the developing world, however, neither the external constraints nor the farmers' own conditions and systems of production are well known.

Recognizing this, the project called for baseline studies to, among other things, define a typology of farmers that would be the first multidisciplinary step toward developing a shared perception among all researchers as to who their anticipated clients are and how the clients' farming situations differ across the project zone. The contract with IAV to produce that typology was canceled in 1987, although nearly ten years of data had been collected with the same sample of 50 farmers in the central part of the project zone. The rural sociologists and economists who have come into the project since then have not yet produced the typology, either.

In the absence of such an agreed typology, it was extremely difficult for the evaluation team to see how researchers determined what technologies needed to be developed in Settat, whose needs specifically they were being developed to serve, and/or how they were to be most effectively transferred to the farming community. INRA researchers say that they know the farmers of the region, and design their research accordingly, but such personal knowledge varies by individual, and it is at best only a vague substitute for systematic social and economic analyses.

Lacking results from baseline research, more recently developed techniques of rapid rural appraisal might have sufficed to help define a common research program. These methods involve technical and social scientists in informal surveys across specific areas of the project zone, and have been a successful part of farm systems research elsewhere. Yet despite workshops given by MIAC consultants -- Drs. P. Hildebrand and C. Gladwin of the University of Florida -- on rapid appraisal and sondeo techniques, the project has yet to have try this approach to solving the fundamental constraint of lack of knowledge of its milieu.

The principal questions which, therefore, remain are: What role is provided for the farming community to influence the Settat research agenda? What mechanisms are in place to ensure that researchers receive direct and undiluted feedback from the local level about both the specific technologies being developed and the global directions and priorities of the research program itself?

INRA -- independent of the DAARP -- lacks a planning document which clearly lays out the long-term goal(s), purposes and objectives of the envisaged research institution in Settat from a Moroccan perspective. Its Plan Strategique de Recherche en Aridoculture, which was apparently drafted in 1989 with MIAC assistance, was never finalized and accepted by INRA. The PBO aridoculture program is to be finished by the end of 1991. According to the method, it will set out a list of priority projects for addressing the key constraints of the sector.

INRA/Settat has a long-term mission in the project zone. But to wait until three years before the end of the project to produce a prioritization of perceived sector research requirements seems, to the evaluation team, to be an unconscionably late response to the need to define where the organization is going. Later sections of this report review the Service Recherche/Developpement and DAARP technology transfer programs, which also should be playing a key role in connecting the work of the center to the farming community.

It is not just the evaluation team that finds the lack of definition of and contact with the farming sector so unacceptable. In his End-of-Tour Report (1991), Dr. R.L. Zimdahl, the most recent DAARP research coordinator, reviewed the research planning process and commented as follows:

> "The present planning process asks that each person submit protocols (research outlines) which are reviewed by the sub-program leaders. In my experience few submitted protocols are rejected or returned for explanation or substantive revision. The present system is not a scientific review and program integration. The system impedes the conduct of research, reviews little, and integrates almost nothing. It is a system that can be handled well by a competent clerk....
>
> Therefore, I recommend that PBO or something resembling it be implemented and given a change to work. PBO may work although I am skeptical of its success as a management system for scientific research. The Center needs a system to facilitate development of mutually agreed upon research goals. The administrative responsibility is to move research planning away from individual initiative without destroying each scientist's quest for excellence. The administrative challenge is to develop the Center staff as a true interdisciplinary group with shared objectives. The staff often acts as if they belonged to separate departments. They endlessly discuss budgets, vehicles, labor, capital equipment, and international travel and seek a bigger share for their program. They do not spend much time discussing small scale farmers or food production. They suffer from objective drift. I often wonder if we remember that our goal is to feed people and improve the situation of the small farmer in the project area. Our goal is not to do research, publish papers, attend meetings, or acquire equipment and vehicles. These are means to the end -- to the goal. Collective planning with clearly articulated, continual administrative guidance will assist the staff to remember the real objectives; to focus on the end not the means of achieving it."

The responsibility and the challenge for INRA research management thus remain to foster interdisciplinary work toward mutually agreed and clearly relevant objectives without undermining individual initiative. Since Zimdahl and INRA staff all agree that the PBO plan for drylands agriculture is the key to resolving the problems identified throughout this discussion, it is now necessary to turn directly to an examination of the PBO system and its evolution at INRA.

b. Planning By Objectives

Initial discussions on the management technique of Planning by Objectives (PBO) began between ISNAR, INRA and USAID in the early 1980s, after an initial ISNAR assessment of the newly-autonomous INRA organization had been completed. At present, there is still no comprehensive PBO plan, either for the agricultural sector as a whole -- at which level national objectives and priorities for the sector might obviously be set -- or for INRA as a national institution. Nonetheless, INRA has begun slowly to apply the logic of PBO to the rationalization of its diverse national research operations.

Since 1988, efforts to implement PBO more fully have been underway, involving INRA personnel (A. Kissi and M. Kohen) and ISNAR staff (P. Goldsworthy, M.-H. Collion and J. Sands). These efforts have focused on the implementation of planning processes and documents which will ultimately describe program priorities and needs for the development of all major INRA research programs. Full PBO plans include computer-based monitoring and accounting systems as well as collegially-designed objectives and program components. In full PBO implementation, budgets will flow according to PBO priorities. Detailed PBO documents for the National Olive and the National Forage and Red Meat Programs have been completed. These programs begin with the forecast demand for the commodity under consideration. They then project sources of supply from various sub-sectors and locations of production. Finally, they design the research activities from an assessment of constraints necessary to achieve the stated production and quality goals.

Aridoculture -- i.e. rainfed agriculture -- is itself designated as one of the PBO National "Programs". It is headed by the Director of INRA/Settat. No full PBO plan yet exists for this program -- one of the two programs, with Saharan agriculture -- that are systems, rather than commodity, based. However, the reorganization of the INRA center programs in 1988, away from disciplines into the six "sub-programs" was a partial move toward the interdisciplinary focus on objectives envisaged with full implementation of Aridoculture PBO program.

In moving toward implementation of a full PBO program at Settat, two workshops have already been held, and the full plan for the Aridoculture program is due to be completed by the end of the current calendar year. Recent PBO-related meetings have lasted up to three days, with several days of follow-up work required to complete the necessary documentation. These discussions involved heavy input from several agencies outside of the Center -- i.e. IAV, ENA, government ministries, INRA, MIAC, DPAs, DVRA and, to a limited extent, local farmers through the Chambre d'Agriculture.

PBO as a management tool has not yet revealed its potential. The PBO process has been deemed useful in some general way by Moroccan researchers at INRA/Settat, in that it has focussed INRA and MIAC attention on planning in the context of Moroccan needs and the contributions of other institutions. Researchers -- outside of a small group of PBO enthusiasts -- have three principal reactions to the system development efforts to date. First, there is a distinct feeling that the various national programs are simply being built up around the continuing work of the existing researchers -- i.e. it is a kind of administrative rationalization of efforts already on-going. Second, there is a growing wish, perhaps from fatigue at the planning meetings, that a more simplified and streamlined PBO installation process is needed so that the process does not interfere with research activities underway. Third, there is a strong sense that, while the "average" researcher spends a great deal of time in planning workshops, the PBO plan that is the interim end-product of the exercise will actually come from small committees of administrators and will not be truly "participatory" product at all. In short, researchers at the Center overwhelmingly shrug off PBO as superfluous to their ongoing work. It should be noted that at the national level this lack of enthusiasm for PBO is not deemed to be a serious handicap, as it is felt that the benefits of the system will take some time to manifest themselves.

There is an additional complication with PBO. As aridoculture is one of the national programs, it is organized largely around the work of INRA/Settat. But other, overlapping, national programs also involve Settat researchers in a major way. For example, two Settat researchers (B. Sakr and A. Amri) are the heads of the National Food Legume Program and the National Cereal Program, respectively. In addition, INRA researchers in Settat are expected to provide leadership as national coordinators in cereals breeding programs for durum wheat, bread wheat, barley and triticale. If INRA budgets were already following PBO organizational lines, severe contradictions might already have arisen in the commitments of various sub-programs and individuals. INRA will eventually have to resolve such overlaps and find ways to prioritize among its national programs if PBO is to be a lean, output-driven system.

Planning By Objectives is a methodology -- rather like the Log Frame Analysis used in USAID project documents -- that attempts to gear the organizational effort to the achievement of clearly-articulated goals, purposes and objectives. It bids for the collaboration of all those involved in mission accomplishment by participatory planning and periodic participatory reviews. It adds management tools for tracking the attainment of objectives. Like other systems, it can get rigid and top-heavy if it is not supple enough to reflect the contingencies of implementation, and it is subject to the imposition of strong wills in the definitional process. Most problematically, at least as so far designed at INRA, it does not help allocate priorities and resources between many individual programs in the overall strategy. So fundamental questions -- how big should an aridoculture research program be? Or, how much consultation with farmers is really needed to define a critical research program? -- will still be decided outside the PBO approach. So far, the fact that budgeting for research is not linked to PBO means that PBO, however useful or cost-beneficial -- and that assessment is not made here -- has a long way to go to be a meaningful part of INRA Settat program planning.

c. INRA Budgets and Financial Management

The INRA center in Settat has only partial control of its own budget and the budget itself is subject to substantial constraints imposed by GOM and INRA/Rabat budgeting procedures. Within the last two years, considerable progress has been made in relocating certain accounting functions in Settat and in improving the timeliness of replenishments to INRA accounts. But there are still major steps to be taken if the INRA center in Settat is to have the flexibility to respond fully to the needs of its researchers and to the vicissitudes of the agricultural milieu in which its activities take place.

(1) The Budget Calendar

Morocco's fiscal year corresponds with the calendar year, which has major implications for any public agencies with missions in dryland agriculture. The INRA center's budget proposal for the current budget year must be submitted to INRA in Rabat by October 15 of the preceding year. The INRA center budget proposal, in turn, is presented to the Ministry of Finance by the end of December each year. Official announcement of actual budget allocations is done segment by segment starting around March 15 of the current budget year and sometimes continuing into May. Replenishments of funds are in principle available by quarter throughout the budget year. But, until recent improvements were made, replenishments sometimes lagged well behind the theoretical schedule. Now that funds to pay accounts are available in Settat in a timely way, suppliers are less wary than before to deal with the center.

(2) Budget Categories

The INRA center works with an investment budget, a personnel salaries budget, and an operations budget. In fact, however, the major categories of these budgets overlap in ways that take some time to understand. First, the investment budget consists of two major categories: one for "équipement" that includes capital investment in buildings and equipment; and the other, called EGS, which actually serves as a supplement to the budgets for salaries and operations. Second, salaries for all permanent INRA staff -- i.e. titulaires -- are paid directly from Rabat. And, it is only within the last year that INRA/Settat has even been notified as to the running account of personnel salaries paid from Rabat. Third, the official operations budget is a small part of what Settat gets for operations because the EGS component of the investment budget actually contributes up to 75 percent of the actual sums used for operating the center and its four field experiment stations.

While the larger operations budget -- i.e. including EGS component -- pays for all INRA's contributions to the ongoing research work -- including those at the field stations but excluding salaries of tenured INRA staff, it also pays for the considerable field station activities that go to farm production and other commercial services that earn revenue for INRA. Indeed, the smaller operations budget -- without the EGS component -- is at rough parity with income generated by the center's field stations -- although the two sums are said not necessarily to be related to one another. In any case, a good deal of the equipment, inputs and labor at the stations is not directly

used for research but rather for activities to produce an operations budget for the following year.

(3) The Evolution of INRA/Settat Budgets

One major line of evidence for examining INRA intentions for the long-term development of Settat is to look at the budgets that have been supporting the center during the DAARP. Unfortunately, it has not been possible for the evaluation team to trace the evolution of all budget categories over the last few years, chiefly because comprehensive salary records were not available in Settat. With the rapid increase of professional staff and their departures to and return from the United States and with research expenditures being partially hidden in budgets that cover field station commercial production activities, it is not easy to analyze precisely which researchers have been using what portions of the various budgets.

Three partial analyses of INRA budgets cast some light on the current level of support of Settat within the INRA system. First, the overall operations budgets -- i.e. including EGS -- for the last four years can be broken down by administrative section and sub-program to show INRA /Settat budgeting. (Text Table 1) This table represents all the direct costs of INRA research -- i.e. materials, maintenance, inputs, light, phone, administration, temporary labor, etc. -- other than the salaries of the permanent researchers, technicians and other support staff. It also includes the costs of non-research farm production at the field stations, however, so it covers more than the research itself.

To this record of costs can be added salary data for personnel but only for 1990. Text Table 2 breaks down global salary and benefit costs to all Settat personnel (including those away in training -- who continue to receive their salaries -- and those assigned to Settat for only some portion of the year.

The ratio of researchers to technical and support -- currently about 1:1:2 -- will be discussed below under sustainability issues. Both the temporary staff -- including some researchers -- paid by MIAC and the temporaries paid for by the EGS portion of the INRA operations budget augment the numbers shown in Text Table 2 and change the ratio somewhat. For 1990, EGS-paid temporary workers added 800,000 Dirhams to the INRA wage budget. Counting these people, as well as the titulaires, the total INRA wage budget to non-researchers was 3,992,656 Dirhams.

We can compute the total INRA budget per permanent researcher present at Settat for 1990. Give a 1990 operations budget as per Text Table 1 of 4,191,900 Dirhams -- grand total minus temporary salaries of 800,000 Dirhams -- and salaries for non-researchers of 3,992,656 Dirhams -- grand total minus researcher salaries plus the 800,000 Dirhams in temporary salaries -- the true INRA research operations support budget for 1990 totals 8,184,556 Dirhams. This budget divided by the 32 INRA researchers actually present in Settat in 1990 amounts to an average operations allotment per researcher of 255,767 Dirhams.

TEXT TABLE 1
OPERATIONAL BUDGETS FOR THE INRA CENTER IN SETTAT
1988 to 1991 in Dirhams

Unit / Year	1988	1989	1990	1991(est)
Administration	376,000	290,000	233,400	586,248
Common Charges	429,400	825,372	983,150	1,174,050
Experiment Stations	2,097,300	2,391,847	2,536,900	2,580,696
Accounting	--	--	--	81,300
Research Sub-Programs				
Cereal Improvement	642,000	493,691	322,800	321,472
Cereal Production	48,400	50,900	309,950	410,122
Forages	107,500	101,952	147,150	136,551
Food Legumes	72,700	78,600	106,700	107,825
Socio-Economics	--	--	95,850	106,275
Technology Transfer	191,300	251,000	256,000	187,461
TOTAL	3,964,600	4,485,565	4,991,900	5,692,000

TEXT TABLE 2
SALARY AND BENEFIT PAYMENTS TO INRA/SETTAT PERMANENT STAFF
1990

Staff Category		Number of staff in category	Total Gross Paid
Researchers	Ingenieurs d'Etat (M.S., Ph.D.)	35	3,161,346
	Ingenieurs d'Application (B.S.)	21	1,224,543
Technicians	3 Grades (ADT,ATP,ATS)	49	1,473,957
Support staff	8 grades (AP,ASP,AGE,AGS,AGT,-SEP)	94	1,718,699
TOTALS		199	7,578,545

We can go a step further and deduct the expenditures allocated to non-research-related farm production enterprises at the field stations. To do so, we can assume conservatively that 12.5 percent of the support staff labor costs (50 percent of all support workers, temporary and permanent, are at the field stations and we assume 25 percent of their time) and 25 percent of the operations budget for the field stations goes to run the non-research operations. The total budget for research support is then reduced by 215,000 Dirhams (permanent workers x .125), 100,000 Dirhams (temporary workers x .125) and 634,000 Dirhams (operations) respectively, or by a total of 949,000 Dirhams. The actual budget available for research support, therefore, is reduced from 8,184,556 Dirhams to 7,235,556 Dirhams.

The 1990 INRA research support budget per INRA researcher declines to 226,111 Dirhams -- the equivalent of $ 28,264 at U.S. $ 1.00 = D 8.000. While this calculation is exclusive of the additional substantial MIAC contribution presently available under the DAARP, it must be taken as the starting point of any relevant discussion of prospects for sustainability of the research program of the center within the INRA system.

The third record of the INRA financial contribution to the Settat center that is available is the equipement budget -- i.e. the INRA investment budget less the EGS component. This budget has evolved shown in Text Table 3.

TEXT TABLE 3
THE EVOLUTION OF INRA/SETTAT EQUIPEMENT BUDGETS
1988 to 1991 (in Dirhams)

Budget Category	1988	1989	1990	1991
Construction	1,917,377	4,354,800	6,391,000	2,600,000
Office Furnishing	384,000	320,000	200,000	--
Special Materials (including farm equipment)	2,484,000	2,043,862	800,000	250,000
Vehicles	400,000	1,096,665	300,000	550,000
Livestock	180,000	24,000	--	--
TOTAL	5,365,377	7,839,327	7,691,000	3,400,000

The four years of support shown in the Table represents about $ 3,000,000 in construction and equipment for the center -- a commendable level of support even if one subtracts the funds committed to the construction of the Centre d'Accueil, which is not a research building. In addition, INRA has officially engaged -- Notification # 295DACF/1 of 8 April 1991) a further substantial sum of money to the équipement budgets for 1992 and 1993. These engagements include 10,350,000 Dirhams for construction, 3,542,000 Dirhams for special materials -- mostly

farm equipment -- and 350,000 Dirhams for vehicles for a total of 14,242,000 Dirhams -- or $ 1,780,250. (Note: Excluded from the engagements undertaken are the sums earmarked for the experimental station at Dar Bouazza which is no longer in INRA hands). Thus, the GOM has committed itself to redress the sharp reduction in the INRA équipement budget for the current year by spending over the next two years at about the levels of 1989 and 1990.

(4) Accounting Procedures and Controls

The secondment of a Ministry of Finance accounts officer to Settat in 1990 has considerably eased financial processes and reduced the delays in settling Settat's accounts on a periodic basis. In addition, some payments can now be made with ex poste documentary justifications, instead of the old system of detailed pro forma invoicing.

Some researchers freshly returned from the United States unknowingly order materials that are not available in Morocco and delays occur as well for larger purchases that still do require three formal quotations and various certifications before the transaction can be authorized. For very small purchases that could -- and are, in the end, routinely be bought from regular suppliers -- and for unusual needs that arise urgently during the agricultural year, accounting requirements can pose significant constraints to efficiency and sometimes to the continuance of field experiments.

Overall, however, there is a sense among INRA center managers that their accounting problems are being reviewed and steps are being taken to reduce bureaucratic bottlenecks over time. MIAC has been giving some help to computerizing INRA accounts and procedures and takes seriously its mission to help transfer skills wherever possible.

(5) Summary

In the view of the evaluation team, the major issue in the INRA/ Settat budget and accounting process is sustainability -- not current management. At the national level, INRA is very seriously handicapped in being bound to the GOM calendar year fiscal process -- a problem we assume manifests itself across all government functions in the agricultural sector. It is well beyond the capacity of the DAARP to effect changes in national government operations on this issue. We can only note that the timing of the GOM budget cycle poses serious constraints to INRA/Settat research planning and implementation because neither administrators nor researchers can count on financial resources being available well in advance of the start of the agricultural year.

d. INRA Personnel Management

INRA personnel at Settat are there only partially as the result of clear strategic design. Staff management is a combination of INRA history, the evolution of DAARP staff thinking, the vicissitudes and requirements of academic progress toward graduate degree completion, and the constraints of Moroccan government policy and budget. Now that the Center is moving toward completion of its full staff complement and preparing to live on its own budget, there is much

to do to stabilize management techniques to set the patterns by which INRA/Settat professionals and junior staff will live.

The first researchers were recruited to INRA/Settat from elsewhere in the INRA system. ISNAR had recommended a decentralization of the existing INRA research system, the USAID project was in operation, and Settat offered the prospects and resources of a major project that included graduate degree training opportunities in the United States. Members of different disciplines got to Settat in different ways. INRA decided to put all its plant breeders in Settat, but people from other disciplines went not because of a long-term INRA center development plan but because of the MIAC project development plan, or the recommendations of a scientific panel, or from some other perceived need. Rural sociology and agricultural economics, for example, had not existed as disciplines within INRA before, and the first candidate for agricultural economics training had previously been an INRA research station director in Agadir, with no prior professional or academic background in agricultural economics.

Some other degree candidates had long years of experience doing standardized research trials with their primary Ingenieur d'Application degree from ENA in Meknes or the Ingenieur d'Etat earned at IAV in Rabat. Others were new or recent graduates recruited by INRA/Rabat on the basis of short job descriptions to go to Settat to become specialists in forages, plant pathology or some other specialty according to the needs of the DAARP. Very recently some of this recruitment has involved juries that sifted through multiple candidacies for each position.

No job descriptions for the posts at INRA Settat had been defined at the beginning -- first, because INRA had worked only with the dual classification of "engineers" and assignment to particular offices and their directors (this system of "affectation" applied as well to technicians and laborers); and, second, because the staff being recruited was on its way into student status, with work to be defined by academic programs, not particular INRA program needs at Settat. New recruits began working on English and on preparing their candidacies for American universities. Salaries were at INRA scale levels, which are a relatively simple combination of academic qualification, years of experience, and certain supplements for family status. Salaries continued while students were in the United States. Researchers signed a contract with INRA agreeing to stay with the organization -- presumably in Settat -- for eight years in return for the external participant training they received.

Research work at the INRA center has been defined and judged primarily in terms of degree requirements. Researchers have returned from the United States to do their thesis/dissertation research. Built into their programs is a return trip of three months at their universities to complete the writeup of their research and to defend their theses/dissertations. For many degree candidates, visits from their major advisors have been scheduled during the research and MIAC advisors have also been available to consult on research. The work of technicians and laborers in Settat was also primarily at the disposition of the researchers in their capacities as students. Finally, performance has been judged by achieving the degree being sought.

Until recently, therefore, the primary sources of motivation and performance for most staff have

been internal, from personal ambition, and external, from training programs. There have been no job descriptions, no performance evaluations, no salary awards or other recognition of superior performance. Technicians and laborers have job permanence as titulaires -- i.e. tenured staff -- in their positions and can neither be fired nor induced to superior performance by salary bonuses. Besides, INRA acquired a surplus of tenured laborers and technicians in certain categories -- e.g. secretaries -- as a result of closing down many of its smaller experimental stations. This is a further constraint on INRA's being able to hire additional staff with skills more germane to the work being conducted in Settat or, for example, converting the skilled labor at the Sidi El Aydi from MIAC contracts to permanent INRA employment.

Now that many researchers are completing their degree programs, INRA Settat is moving into a second stage of management requirements. Individual capacities of the researchers to self-motivate, researchers' perceptions of new paths for their work, and working relationships in different sub-programs and disciplines all vary considerably. While about half the researchers are still single, family situations and attachments distinguish different commitments to work and life in Settat.

INRA management is just beginning to try to cope with these second stage adjustments. It is the INRA center director's intent to delegate authority to sub-program leaders to judge the merit of junior colleagues' work; but for reasons described in the last section, these intentions have been difficult to translate into reality. The INRA director has also been negotiating with INRA/Rabat for more flexibility with and control over the work of technicians and laborers, but the negotiations have borne little fruit to date. INRA job descriptions are beginning to be put together. Ways will have to be found quickly to gain these basic management tools because without them rational management, quality research, and effective planning are not fully achievable.

Staff morale is already a major problem at the center. This problem arises from two sources: professional questions of salary and status, on the one hand; and personal questions of living conditions, on the other. Of these two, salary levels are by far the most important issue. INRA, as yet, has established no system for recognizing any academic degrees beyond the old French-style engineering degrees. These degrees are presently the highest academic levels which relate directly to salary grades within the INRA system and no formal researcher designations exist in the present salary structure.

The problem is that INRA Settat staff now have academic degrees and job responsibilities comparable to those of their contemporaries who teach and conduct research within Morocco's university system. For a new Ph.D. recruit, the existing discrepancy in salary structures means he or she could expect to have an average starting salary of 4,660 Dirhams in INRA versus an initial salary of 8,900 Dirhams at IAV in Rabat or ENA in Meknes. This is a differential of (-) 48 percent in salary for persons with comparable academic credentials. Moreover, the average workload of the faculty member is lighter and staff policies encourage the professor to supplement his or her total income through external grants or consulting work. There has been much discussion over several years within the Moroccan government about correcting these gross

anomalies in salary structures between the two communities of researchers and giving INRA researchers a series of salary grades comparable to those in universities but so far no changes have been formalized.

Staff housing has also been a problem in Settat. Settat is a young city with few amenities and is seen by INRA staff as a difficult place to live. It is not a location that in itself helps to retain the loyalties of professional INRA staff. Rents are lower than in Rabat, but researchers had hoped for actual subsidies on building plots or apartment purchases as a further special compensation for the lower salaries they receive.

The salary and living conditions issues for INRA researchers impact with at least the same intensity at lower staffing levels. There have been a number of reports of well-qualified technicians in the other seven INRA centers refusing transfers to Settat because they would not have access to the same housing and other amenities they were currently enjoying. At the field stations, managers and other staff do not have access to adequate on-station housing. Moreover, at least two stations lack potable water systems and electricity, and none have reliable communication linkages by either telephone or radio. Together, then, the salary and living conditions issues threaten the effectiveness of INRA management at Settat in fundamental ways.

In a recent study of researchers' social situations at Settat by Dr. F. Nassif (Annex 4), 64 percent of the researchers said that INRA headquarters' attitude toward them was either very negative or negative and a further 25 percent considered INRA indifferent to the researchers' needs. An overwhelming majority declared INRA administration and the INRA Director in Rabat to be responsible for blocking improvements to the situation. Senior scientists -- i.e. those who have completed their Ph.D.s -- voiced particular frustration both in the survey and to the evaluation team. As issues for long-term sustainability of the center, these questions will be raised again in subsequent sections of this report.

e. Other Management Issues

A range of other management problems, both at the macro- and micro-levels require resolution. They are questions for INRA to resolve, <u>not</u> the DAARP. But they are questions for which the <u>project</u> leadership has some responsibility to suggest management solutions <u>and</u> point out the consequences of not getting INRA's house in order by the time MIAC assistance and DAARP funding disappear. These management matters include:

- Labor is not closely managed at the center. Labor assignments to particular researchers often means that some laborers and technicians are underemployed, while others are heavily burdened. If, in the course of the year, individual researchers do not fully utilize their assigned laborers, they should be reassigned to more active colleagues. Likewise, if active researchers encounter unexpected and significant down time in their research, technician and labor allocated to that researcher should be made available to others who might usefully employ it.

♦ A motor pool system would significantly reduce vehicle expenditures. Dispatching systems would ensure that shuttle vans or carpools to the experimental stations were scheduled to carry all those who needed to go on any particular day. This would eliminate the current practice of sending multiple vehicles to the same site half full. While personal use of project vehicles is presently tolerated as a means of compensating researchers for their low INRA salaries, it will be increasingly difficult to continue this practice as the DAARP financial contributions which currently allow such expenditures end.

♦ There are serious problems concerning the internal management --i.e. allocation and billing -- of parts and supplies. A central stores system with inventory controls is needed to handle the consumption and resupply of office and computer supplies, laboratory chemicals and supplies, tools, and the like. This system should charge supplies to individual researchers, sub-program heads or center administration as appropriate. Costs for supplies would be lowered under such a system, particularly if purchases were grouped and secured in bulk shipments. A central stores office should also have charge of catalogues and equipment manuals which are now dispersed around the center. It will be increasingly important, as personnel shift over time, not to lose track of the manuals and other informational materials necessary to operate and maintain center equipment.

♦ To gain efficiencies in center planning and administration, it is essential that several laboratories be managed as centerwide facilities since they will support most research activities. The soils laboratory and a quality control laboratory for specialized analyses could bill the sub-programs internally for services rendered and, thereby, reduce the costs of duplicating laboratory work.

♦ Finally, there may be some efficiencies to be gained by grouping certain on farm trials and evaluation work with demonstration trials to reduce travel and monitoring costs. There may be good arguments to the contrary, but at least the locations should be discussed as part of the annual management plan just as the organization of trials at the experimental stations needs to be well-planned for maximum effectiveness.

The current INRA Settat director functions formally as the Director of the INRA Centre Regional de la Recherche Agronomique de Doukkala, Abda et Chaouia based in Settat, the Moroccan head of the DAARP aridoculture program, the head of INRA's national Department of Agronomy, and the head of the DAARP's sub-program on technology transfer. It is clear, therefore, that Dr. El Mourid has heavy -- and, perhaps, unreasonable -- responsibilities for several different levels of research and management within INRA and the DAARP. Without a deputy center director for administration, we feel it is unlikely that the long list of resource-saving management reforms cited above will ever be fully elaborated and set into place -- the best intentions of the INRA center director notwithstanding.

f. MIAC Planning and Management

Although there were no questions in the evaluation team's Statement of Work specifically related

to an assessment of MIAC's performance in general project planning and management, we believe some comments are warranted.

In the first instance, the evaluation team would like to say, on the basis of all available evidence, that MIAC administrators in Lincoln, Nebraska and Settat appear to have acquitted themselves in an exemplary manner with respect to the sheer mechanics of day-to-day project management. In this regard, the DAARP administrative officer (R. Cartier) should be especially commended for designing and implementing a financial accounting system within the project which appears to meet the USAID Controller's requirements for financial reporting and accountability in a competent and timely manner.

Second, the evaluation team would like to point out that, although we have detected and reported a number of significant deficiencies and weaknesses in the DAARP, we do not believe all of these problems can or should be attributed a priori to the MIAC administrative personnel presently residing in Settat.

To the contrary, much of the burden for the existing problems in our opinion rests with the project designers -- and particularly those people who participated in the design of the DAARP project amendment in 1987/1988. In this regard, we have discussed many of the problems that we believe have their origins in the 1987/1988 design exercise elsewhere in this report. We believe that, given the accumulated experience of USAID, INRA and MIAC with the DAARP prior to the last major design effort, the final product was remarkably narrowly focussed in its approach to and impacts on the final phase of the project and that the design itself failed in significant ways to effectively lay out the ground rules for addressing many of the questions that were subsequently posed in the Statement of Work for this mid-term evaluation. The key problems we would cite in this regard are those related to:

- The lack of a comprehensive and well-articulated INRA strategic plan for development of the center in Settat which was developed with full recognition that the center must evolve within the context of a national system for agricultural research in Morocco -- and not as a separate entity outside that system.

- The lack of adequate and detailed measures in the design addressing the sustainability issues likely to impinge on the continued functioning of the INRA Settat program after project activities ended in 1994.

- The apparent lack of recognition of the need for MIAC technical assistance personnel to be much more than simply adjunct scientists in the implementation of the Settat research program.

- The lack of appreciation for the real need to provide for a more rapid transition to genuine Moroccan leadership in setting the course for development of the INRA Settat program at all levels -- including having a real and decisive participatory role in deciding how project resources were to be apportioned.

If there are specific criticisms of the resident MIAC staff in Settat and their post-design activities -- and we believe there are -- we see them as revolving around the following issues:

♦ There was until May 1991 a persistent tendency on the part of MIAC administrators to present the INRA center in Settat as a quasi-independent national center for rainfed agriculture with extensive linkages to the international network of agricultural research centers and certain American universities. This vision was promoted with a certain tacit disregard for realities in Morocco, as is well documented in various MIAC reports and in a videotape presentation of the DAARP.

In this regard, some departed USAID personnel must also be held responsible for tacitly -- if not explicitly -- subscribing to the same vision of the future when they should have known better and thereby greatly complicating the prospects for center sustainability. A more modest vision of the future more in keeping with the real constraints on center expansion and survivability within the Moroccan national system for agricultural research would have been much more appropriate.

The INRA role in promotion of the more grandiose version of the center is somewhat more ambiguous. On the one hand, INRA administrators appear to have had no serious compunctions about demanding that USAID fund and support several activities within the DAARP that they either had no intention or capacity to initiate themselves. On the other hand, present INRA administrators in Rabat clearly articulated their doubts to evaluation team members that the scope of DAARP activities could be sustained at current levels after 1994 in the context of a national agricultural research system with all the competing demands of the six other INRA research centers.

♦ There appears to have been an unfortunate tendency on the part of MIAC administrators to over-emphasize certain of the seven principal outputs anticipated from the DAARP -- i.e. participant training and specific research results -- and to under-emphasize others. Specifically, while we recognize and sympathize with the natural tendencies of contractor personnel under pressure to play up those project activities in which they perceive the most success, we believe that there has been a collateral tendency until very recently to downplay the lack of progress on other activities. Specifically we include in this category the issues related to development of an efficient system for setting research program priorities, a system for linking the actual allocation of project resources to those priorities, an effective mechanism for transferring research results to farmers as clients, and the issues of program sustainability after 1994.

♦ MIAC appears to have done a relatively poor job of preparing its resident technical assistance personnel for what we perceive to be the full dimensions of their assignments in Morocco. First, the majority of MIAC personnel resident in Settat still have poor to non-existent communications skills in French -- and only one or two have any command of Moroccan Arabic. These language deficiencies in our opinion have prevented the technical assistance specialists from overcoming their natural isolation as outsiders in Morocco and from deepening their personal relationships with many of the Moroccan staff, not to mention Moroccans outside the

center. Language deficiencies also have had a parallel effect on MIAC scientists' abilities to accumulate information on events happening in Morocco outside the project per se and to assess how these events might impact on their own activities.

Second -- and perhaps more importantly -- MIAC orientation sessions have apparently been wanting when it comes to explaining to MIAC scientists the need for them to play a broader role in communicating skills to their Moroccan colleagues. The evaluation team, for example, was surprised in interviews with MIAC scientists to find that most of them thought that they would be performing adequately in the project if they only succeeded in communicating technical skills within the narrow confines of their individual scientific disciplines. We, on the other hand, believe that every one of the specialists resident in Settat possesses a much broader array of skills -- e.g. skills in developing budgets for research protocols, in economizing on costs through common use of resources, in setting overall and daily priorities for work activities, and in evaluating and writing up research results -- that they could and should communicate to their colleagues in daily interaction. And, in this regard, we must fault MIAC administrators for not pushing them more aggressively to do so during their tours of service in Morocco.

♦ And, finally, there is the issue of the contents and layout of successive MIAC Integrated Plans of Work. We found these documents inadequate to their assumed purpose of clearly laying out what the project was to be about in any given year. Even when evaluation team members read the Work Plans in conjunction with the MIAC's Annual Research Reports, we found it very difficult to establish the current status of work in progress within the research sub-programs, to determine how priorities were being set between sub-programs, to ascertain the relationships between research activities and the allocations of resources within the DAARP, or to determine how much of the research being carried out was related simply to necessary thesis/dissertation research and how much was work by non-degree candidate researchers.

With a view to simplifying and improving the Work Plan presentations, we would suggest that they be reorganized for FY 1992 to include, at a minimum, the following sections:

♦ A clear statement of the research program's overall objectives linked to a defined and well-articulated typology of project zone and its farmer-client groups.

♦ A concise recapitulation and assessment of the previous year's research work enumerating both the successes and the failures.

♦ A presentation of the anticipated research to be carried out in the current year broken down and discussed in four categories: continuing work by non-degree candidate researchers, new work to be initiated by non-degree candidate researchers, continuing research by degree candidates, and new work to be initiated by degree candidates.

♦ A concise statement of general problems encountered in the project in the past year and proposed measures to alleviate those problems.

♦ And, finally, a clear and unambiguous presentation of the state of program finances -- including both actual and projected disbursements from the MIAC contract budget and the INRA budgets.

g. MIAC Staffing Through FY 1993

The latest MIAC contract with USAID (1988) provides resources for up to 888 person months of technical assistance through FY 1993. During the evaluation, MIAC reported that, as of the end of April 1991, 512.75 person months of this total had already been expended on MIAC technical assistance personnel in place or departed. Finally, MIAC presented its projection of how 361 of the remaining 375.25 person months of technical assistance should be allocated through the end of FY 1993. Under this projection, 14.25 person months allocated for technical assistance would not be used.

As can be seen in Text Table 4, the MIAC projection, which has not yet been approved by either INRA or USAID, is broken down into two categories of technical assistance: long-term resident advisor positions and "other allowed" positions. The latter category is a mixture of short-term consultancies, academic sabbaticals, and two resident advisors (Bansal and Riddle). Between May 1991 and the end of the contract, MIAC projects 301 person months of long-term resident advisor positions and 60 person months of "other allowed" positions.

When the MIAC staff projection was discussed with INRA center staff, the need for several technical positions over the last 28 months of the MIAC contract was questioned. The long-term residence positions questioned were the proposed research coordinator (24 person months), the forage specialist (12 person months), the entomologist (16 person months), and the agricultural engineer (12 person months). Among the "other allowed" positions, the Moroccans questioned the need for and/or actual availability of persons slotted for the cereal agronomist sabbatical consultancy (2 person months) and the entómologist sabbatical (12 person months). If all of these questioned positions were to be eliminated in the final MIAC staffing plan for the DAARP, a total of 92.25 person months (7.69 person years) of budget resources could be shifted to other DAARP activity categories -- either within or outside the MIAC contract.

The evaluation team has carefully reviewed the MIAC staff projection and the Moroccan comments on it. In the first instance, we seriously question the feasibility of bringing any new technical assistance personnel to Morocco to assume resident positions to the last eighteen months of the DAARP. We simply do not believe that American scientists with no previous experience in Morocco could acclimate to their new environment quickly enough to produce sufficient results to justify the costs of establishing and maintaining them. This judgement would affect the prospects for replacing the forage specialist (Tiedeman), the entomologist (Buschman), and the agricultural engineer (Monroe).

With respect to the other long-term positions projected, we support the recruitment of a technology transfer specialist for the DAARP if a qualified candidate can be identified and put in Settat before the end of 1991. If the current slow pace of recruitment were to drag on beyond

the end of this year, however, we would have serious questions about the viability of this position.

The research coordinator position is also problematic in our minds. First, we do not believe that any American scientist should be appointed to this position unless a Moroccan research coordinator is in place within the center. Even then, we question the feasibility of bringing in an outsider for this position. This is so because such a coordinator, in the best of cases, would have an opportunity to affect the formulation of only two annual work plans -- those to be presented in the Fall of 1992 and the Fall of 1993 and then only as an advisor to the INRA research coordinator.

Given this situation, we will recommend that the MIAC positions of team leader and research coordinator be combined in one position after the departure of Dr. D. Keith in August 1991. Moreover, we believe that the replacement candidate for the combined position should be selected from among the technical assistance personnel already in place in Settat.

With respect to the "other allowed" positions projected, we agree with Moroccan questioning of the need for the cereal agronomist and entomologist sabbaticals in the last months of the MIAC contract. However, based on our assessment of the needs for better field station program planning and management, we would suggest that the consulting time allocated to this subject be increased to include, at least, two person months of consulting time in each of the remaining calendar years of MIAC contract. We see this consulting time being used to assist Moroccan administrators in formulating and periodically evaluating and revising a strategic plan for the field station operations. The consultant, however, should not simply serve as a compiler of lists of capital equipment to be financed with DAARP resources but someone who can offer critical advice on overall planning and operations over a series of visits.

Text Table 5 presents the evaluation team's revised projection of how DAARP resources should be utilized to supply technical assistance personnel under the MIAC contract.

h. Project Budgeting Through FY 1994

According to financial data provided by the MIAC Administrative Officer, MIAC has disbursed a total of $ 12,677,823 on project activities in FY 1989, FY 1990, and FY 1991 through April 1991. MIAC projects additional disbursements for planned project activities of $ 1,792,993 through the balance of FY 1991 -- i.e. total FY 1991 disbursements of $ 4,349,152. To this total, one should add "supplementary" expenses in FY 1991 for supplemental training activities ($ 7,850), on-farm technology evaluations ($ 115,646) and baseline study activities ($ 125,489) for an FY 1991 total of $ 4,598,137.

If disbursements in FY 1991 track according to current projections, MIAC will have disbursed a total of $ 14,719,801 on project activities. This would leave a total of $ 5,000,660 in the existing MIAC contract for project activities in FY 1992 and FY 1993 through August 1993 -- i.e. the end of the present contract.

TEXT TABLE 4
MIAC PROJECTION OF TECHNICAL ASSISTANCE -- MAY 1991 TO AUGUST 1993

Advisory Position	FY 1991	FY 1992	FY 1993	Total Person Months
Long-Term Resident Technical Advisors				
Team Leader	5	12	11	28
Administrative Officer	5	12	11	28
Research Coordinator	1	12	11	24
Cereal Breeder	5	11	0	16
Cereal Agronomist	5	12	3	20
Soil Fertility Specialist	5	9	0	14
Forage Specialist	5	12	11	28
Entomologist	5	11	0	16
Food Legumes Specialist	5	11	0	16
Agricultural Engineer	5	12	11	28
Agricultural Economists	10	12	11	33
Rural Sociologist	5	12	9	26
Technology Transfer Specialist	1	12	11	24
Sub-Totals	62	150	89	301

"Other Allowed" Positions				
Station Management Specialist	0	2	0	2
Cereal Agronomist Sabbatical	0	2	0	2
Agricultural Economist Sabbatical	2	0	0	2
Electronics Specialist	2	0	0	2
Agricultural Machinery Specialist	5	12	3	20
Rural Sociologist	5	3	0	8
Entomologist Sabbatical	0	1	11	12
Sub-Total	14	32	14	60
Total	76	182	103	361

In addition to the funds projected to be available in the MIAC contract after FY 1991, there are two additional sums of money available for DAARP activities. The first is the carryover funding available from the USAID project allocation prior to 1988 which amounts to $ 2,210,200 (authorization of $ 26,323,000 less actual disbursements of $ 24,112,800 prior to 1988). The second sum is the difference between total funds authorized as the total projected USAID DAARP contribution of $ 23,677,000 as per the 1988 project grant agreement and the total allocated to the existing MIAC contract of $ 19,720,461. This total amounts to $ 3,956,539.

This means that, given current projections, there is a total of $ 11,167,399 available for DAARP activities from now until the end of the project. Of this total, $ 5,000,660 is in the existing MIAC contract and $ 6,166,739 is currently outside that contract.

Evaluation team commentary on the optimal disposition of these funds over the life of the DAARP is presented below under sustainability issues.

TEXT TABLE 5
REVISED PROJECTION FOR MIAC TECHNICAL ASSISTANCE PERSONNEL
MAY 1991 TO AUGUST 1993

Advisory Position	FY 1991	FY 1992	FY 1993	Total Person Months
Long-Term Resident Technical Advisors				
Team Leader/ Research Coordinator	5	12	11	28
Administrative Officer	5	12	11	28
Cereal Breeder	5	11	0	16
Cereal Agronomist	5	12	3	20
Soil Fertility Specialist	5	9	0	14
Forage Specialist	5	12	11	28
Entomologist	5	2	0	7
Food Legumes Specialist	5	11	0	16
Agricultural Engineer	5	11	0	16
Agricultural Economists	10	12	11	33
Rural Sociologist	5	12	9	26
Technology Transfer Specialist	[1]	[12]	[11]	[24]
Sub-Totals	61 [60]	128 [116]	67 [56]	256 [232]

"Other Allowed" Positions				
Station Management Specialist	0	4	2	6
Agricultural Economist Sabbatical	2	0	0	2
Electronics Specialist	2	0	0	2
Agricultural Machinery Specialist	5	12	3	20
Rural Sociologist	5	3	0	8
Sub-Total	14	19	5	38
Total	75 [74]	147 [135]	72 [61]	294 [270]

i. The Supplemental Budget Request for FY 1991

In late 1990, MIAC submitted a Budget Analysis and Request as an accompanying document to the MIAC Integrated Plan of Work 1990-1991. The supplementary budget request was composed of six separate requests for additional funding to be put into the MIAC contract in 1991 to cover "additional work that was not included in Contract No. ANE-0136-C-00-8019-00 or that was underestimated or not sufficiently forward-planned for the Center and its satellite stations." (MIAC, 1990, p.1)

As an integral part of the evaluation team's Statement of Work, we were asked to investigate and comment on each of the six proposals put forward by MIAC in its supplementary budget request. This section summarizes the evaluation team's conclusions on the proposals. Individual proposals are also discussed in somewhat greater detail elsewhere in this report.

(1) The Station Development Request

This request was discussed in a preceding section of the report on infrastructure. The evaluation team believes that the need to improve conditions at three of the four INRA field stations is obvious. However, further USAID investments in station development in the absence of any INRA strategic station management and operations plan and without concrete evidence that INRA is itself moving decisively to install better management systems for these stations would be rash and premature.

We will recommend, therefore, that any further USAID investment in station development be strictly tied, first, to the development by INRA and approval by USAID of a strategic plan for improved utilization and management of INRA field station resources and, second, to annual presentations by INRA -- attested to in writing by MIAC management -- of evidence that the agreed plan is being fully implemented. Moreover, we believe that any further USAID investments in station development should be spread over the remaining fiscal years of the DAARP to ensure that investment is commensurate with demonstrated INRA performance.

(2) The Baseline Activities Request

The evaluation team discovered in its discussions with MIAC and INRA staff that this proposal is in fact comprised of three separate items. First, there is a MIAC request for "recovery" of $ 82,919 from the MIAC contract for expenditures already incurred for DAARP baseline survey activities. Second, there is a request for $ 126,000 to cover the FY 1991 costs of completing the DAARP baseline survey, producing a final report on this exercise, and developing a typology of client farmer groups and discrete agro-ecological zones in the project area. Thirdly, there is a request for $ 167,000 to carry out an integrated socio-economic studies program in Settat over the remainder of the DAARP.

The first evaluation team conclusion with respect to this request is that there are ample funds already in MIAC's existing contract to cover the costs of all of these requests. Phased differently, MIAC as a contractor does not appear to us to be in any real danger of running out of contract funding in FY 1991 if it is authorized to disburse funds to cover all of the above activities in FY 1991, FY 1992 and FY 1993. Having said this, however, we believe there remains the completely separate issue of replenishing the MIAC contract -- probably in FY 1993 -- to add a final amount of funding to compensate for actual disbursals authorized by USAID.

With respect to the first item requested, we believe that there is ample documentary evidence to justify MIAC's claim that baseline activities were authorized by USAID but not specifically funded in the existing MIAC contract. We would suggest, therefore, that USAID issue a project implementation letter (PIL) specifically authorizing ex poste actual MIAC disbursements for baseline study activities incurred prior to FY 1991.

With respect to the second item, we recommend that USAID authorization be given to expend up to $ 126,000 in FY 1991 to complete all activities related to baseline studies. This authorization should include the stipulation that MIAC clearly demonstrate to USAID that a final report on the baseline studies has been completed in calendar year 1991 and that a typology has been developed from baseline study data and utilized as a management tool in development of the MIAC Integrated Plan of Work for FY 1992.

With respect to the continuing need for an integrated program of socio-economic studies in the DAARP through FY 1994, we believe that substantial progress was made during the evaluation in defining and developing such a program. The initial presentations of anticipated socio-economic work are contained in Annex 5 of this report. We believe the ideas are of sufficient

merit to warrant USAID consideration of an authorization to fund the studies up to a total investment of $ 167,000 in FY 1991 to 1994, either under the MIAC contract or by separate arrangement with INRA directly which is more convenient for USAID. Such authorization should be dependent upon further refinement of the proposals and the budgets.

(3) The On-Farm Technology Evaluation Request

The situation with respect to on-farm technology evaluation activities is much the same as that for the "baseline" studies. The first item is simply a MIAC request for formal line item authorization to "compensate" the existing contract for $ 25,000 MIAC claims it actually disbursed prior to FY 1991 on on-farm technology evaluation activities authorized in principle by USAID but not specifically funded. The second item is for specific funding authorization for $ 115,000 in FY 1991 for on-going technology transfer activities. And, the third item is to provide specific authorization to spend up to $ 323,000 in FY 1992, FY 1993 and FY 1994.

With respect to the first two items, we suggest that USAID formally authorize these activities ex poste.

The third item -- i.e. on-farm technology evaluation activities in FY 1992 to FY 1994 -- is more problematic. Although the evaluation team feels that some progress was made in designing and developing a revised program request during the evaluation period, we are still not fully convinced that the technology transfer/SRD activities in Settat are on the right track. We believe that much more work needs to be done with respect to the presentations contained in Annex 5. And, we convinced that this program activity badly needs input from the MIAC technology transfer specialist scheduled to arrive in Settat in September 1991 before USAID authorizes additional funding starting in FY 1992.

We will, therefore, recommend that additional work on the technology transfer program be done in 1991, with the assistance of the new specialist, and that any decision on USAID funding in FY 1992 and beyond be deferred until the revised program can be presented.

None of these actions require that additional funding be added to the existing MIAC contract at this time.

(4) The Request For Modifications in the Long-Term Training Plan

The evaluation team will recommend that up to five additional long-term training slots be approved by USAID basically to compensate for present imbalances in INRA center staff capacities. Taking all factors into consideration, the evaluation team feels that only the additional opportunities listed below in priority order should be considered for approval:

- MS in Research Station Management (1991)
- MS in Agricultural Mechanization (1991)
- PhD in Agricultural Economics with a minor in Agronomy (1992)
- PhD in Food Legume Pathology or Entomology (1992)
- PhD in Weed Science (1992).

In the opinion of the evaluation team, provision of these additional training slots can be accommodated within the existing MIAC contract without provision of additional funding at this time.

(5) The Soil Mapping Project Request

After considerable discussion with evaluation team members, center staff withdrew the original soil mapping project proposal in the supplementary budget request. They then presented the alternative proposal presented in Annex 5 of this report.

The alternative proposal has the twin virtues of being much more focussed in objectives and much less costly to implement. The evaluation team believes that the proposal merits consideration for USAID funding. The mapping project could be implemented either as an additional activity to be authorized under the existing MIAC contract or as a separate contract between USAID and IAV to fund the needs of the IAV Ph.D. candidate who is expected to do the actual mapping work.

In the opinion of the evaluation team, provisions for this additional activity can be accommodated within the existing MIAC contract without provision of additional funding at this time.

(6) The In-Vitro Culture Laboratory Request

The evaluation team believes this request is completely outside the purview of research activities anticipated under the DAARP. We, therefore, see no merit in considering possible USAID funding for this unrelated activity so late in the DAARP.

4. Development of External Linkages

The DAARP envisioned the Settat Center as an applied research center that would be nourished by strong links to national and international sources of technology, advice and collaboration. These links would also enable INRA's well-trained researchers to take prominent roles in the future of dryland research both in Morocco and on the international scene, and would keep the researchers at the forefront of their own fields. There are potential contradictions within this vision, to be discussed below. Nonetheless, it is worth examining the kinds of linkages that INRA/Settat researchers are building and maintaining with research and researchers elsewhere. Even excluding those of the MIAC staff, there has already been a commendable growth of such

linkages at the institutional and individual levels.

a. IAV and Other Moroccan Institutional Linkages

Obviously the link between basic and applied research within Morocco itself must over the long run be very strong if research is to play its full role in national development. Until recently, linkages between INRA/Settat and Morocco's main agricultural teaching and research institution, IAV, have not all been easy. Early in the project, USAID contracted with IAV to provide initial social and economic baseline data but the contract was canceled in 1987 with no useful output having been acquired to serve project needs -- nor have project staff yet succeeded in filling this void. IAV was also blocked from accepting INRA researchers who did not present the formidable qualifications necessary for the IAV Master's degree equivalent program -- even though some had received their initial degrees from IAV.

More recently collaboration is growing. New accords between IAV and INRA in Rabat may permit some of the final project participant trainees to attend IAV. At the time of writing, four IAV students are at Settat, three for short-term exercises and one for M.A. research. INRA staff have lectured at IAV and serve on thesis committees, while IAV personnel have trials running at INRA/Settat field research stations and have served on several of the INRA scientific panels.

A large variety of relationships link Settat to other institutions in Morocco. The Domaines Royaux have sought help from the staff for training and for particular agronomic problems. Private sector chemical companies have sought evaluations for labelling of their products. The Ecole Nationale d'Agriculture (ENA) in Meknes and the Faculty of Science in Rabat have sent students to Settat for training.

b. National Agricultural Programs

INRA Center staff stress that even more important than links to individual institutions are the roles that they play in the overall activity of Moroccan agricultural research. After all, nearly half of INRA's total researchers are at Settat. Three of them chair their respective national programs of research. One has led the development of the national program of SRD and another is studying the social situation of the researchers themselves, on behalf of INRA's directors. One Settat scientist was transferred to the INRA Center in Kenitra to head the national plant pathology program. As one INRA scientist put it, he is the national program in his field and any national program such as Planning By Objectives or policy reform must be built around his own work.

c. International Linkages

The DAARP has established a wide range of linkages with international research centers in the North African and Mediterranean regions, in the wider group of international agricultural research centers (IARCs) and with American institutions. Examples of these linkages are as follows:

(1) ICARDA is the most important of the IARCs for Settat research. Work at Settat in barley, food legumes, forage agronomy, ley farming, plant pathology and climatology has been done on behalf of -- or in collaboration with -- wider ICARDA programs. Annual Hessian fly surveys, begun at Settat, have been adopted across the ICARDA network. Work on winter chickpeas at Settat has been identified by ICARDA as an important new topic. ICARDA has also provided some station management training.

(2) CIMMYT has been supplying germplasm for wheat since the 1960s and aid in triticale production more recently. It is also supplying aid in small-scale farm mechanization. ISNAR is supplying key assistance to the elaboration of the Planning by Objective framework for INKA.

(3) Regional organizations are also very important. The Arab Council for Semi-Arid Development (ACSAD) has supplied materials and micro-elements for trials and work on farm systems analysis. A new Maghrebian grouping -- the ACCT -- is developing exchanges for triticale and drylands research under the initiative of INRA staff. One of the plant pathologists is a member of the scientific committee of the Mediterranean Phytopathological Union. Individual work on specific problems with INRA (France) in cereal diseases and forages and with the European Community on barley will also have benefits in both directions of the collaboration.

(4) Moroccan researchers' connections with their former universities and advisors in the United States have broadened to include links to other organisms. The United States Department of Agriculture laboratory at Kansas State, grain alcohol researchers at Iowa State, the Science and Technology Office of AID in Washington, D.C., and the International Development Management Center (IDMC) at the University of Maryland are all aiding work at Settat in continuing relationships.

d. Future Linkages

The minor grants that a small number of INRA/Settat researchers have won from non-Moroccan organizations are a hopeful sign for the future. At IAV, one-third of the time of research staff is left open for individuals to supplement their income and research opportunities through contracts and consultancies. INRA managers realize that similar opportunities for their staff will take some of the edge off the invidious comparisons of working conditions that the staff makes and, importantly, reward the best of the researchers and keep them at the leading edge of their fields. Settat is, of course, rather out of the way of the flow of international contacts that Rabat enjoys. There are also two administrative issues to resolve, since INRA staff are civil servants -- all of whose time should be devoted to their jobs -- and since, under current procedures, grants are administered through INRA/Rabat, which is said to extract a substantial proportion of the moneys before they reach Settat.

Part of Settat's future obviously lies in encouraging links that can produce grant and contract income for the Center, while simultaneously enhancing the research objectives of the center, not

detracting from them. The best chances for such constructive linkages will be with the Rockefeller Foundation, the International Development Research Centre (IDRC) and perhaps CIDA (ACDI) in Canada, and joint applications with American colleagues to the National Science Foundation and other research supporting agencies. CGIAR links will tend not to produce income unless discrete new projects can be presented to their boards of directors, but the linkages are still very important. Finally, links are increasingly possible -- either direct or supported by bilateral aid agencies -- to groups of private sector producers and commercial interests, both in Morocco and abroad. These are important to cultivate but they will present a challenge to management to ensure that they reinforce and not undercut the scientific program of the center.

e. Problems Identified

(1) INRA researchers themselves recognize that the internationalization of their work leads to certain kinds of conflicts within the system. Notable is the problem of publication: increased participation in international research networks leads to increased publication of results outside Morocco. The INRA Director-General has reminded staff that publication within the country is very limited, despite there being a readership among other agricultural officials and some producers themselves who could benefit from being able to read research results in existing Moroccan journals. Grant administration is also a problem. Settat researchers and management need clarification as to how support for research activities from outside the center is to be passed through to pay for the work Center researchers are doing.

(2) The well-developed and mutually-supportive links between the DAARP project and the IAV envisaged in the project design have not yet developed. Different missions and the distance involved between Settat and Rabat are issues but perhaps as important is the knowledge by INRA researchers that they have much higher workloads and much lower salaries than their colleagues at IAV. Promises to rectify the strong salary differentials have been made since the early 1980s but there always seems to be -- according to them -- just one more problem to resolve before their status as researchers can be recognized. This issue is a large part of the problem of living conditions in the quite small city of Settat, about which INRA researchers harbor strong feelings. In any case, although both Settat and the IAV have been supported for many years by USAID, although many INRA researchers got their undergraduate training at IAV, and although many of the staff at both places got similar graduate training in the United States, much work needs to be done to make the relationship between the two institutions more fruitful.

(3) Participation in networks of researchers leads to many interesting chances to travel, meet, carry out experiments of potentially international significance, and publish. Unmonitored, it can lead to dispersion of effort and carry the research focus away from the practical problems of the Settat area. INRA management -- including especially the subprogram leaders -- should continue to encourage linkages but should seek especially to support those which emanate from or lead to research grants which help to sustain the priority research of individual researchers and the Settat program.

5. The Sustainability of the Settat Program

a. The Need For A Common Mandate

In attempting to establish the facts of the present situation in Settat, the evaluation team was confronted with evidence of variances between the participating agencies -- INRA, USAID and MIAC -- as to what exactly constituted the present "overall program" in Settat and what elements of it are to be institutionalized after 1994. Our findings are outlined below by participating agency.

From the statements made by MIAC project and home office staff in Lincoln, Nebraska, it is evident that MIAC has defined the "overall program" to be institutionalized rather strictly in terms of the stipulations of the USAID/MIAC contract -- and the documents produced for the 1987/1988 DAARP Project Paper Amendment. From the contractor's perspective, the emphasis is to be placed on the perpetuation of an "Aridoculture Center" in Settat and development of an institutional capacity to carry on an agricultural research program with essentially the same scope and mandate as those defined by the Dryland Agriculture Applied Research Project documents.

Under these assumptions, the research would continued to be organized around the six research sub-programs which compose the present program. These sub-programs are cereal improvement, cereal production, forage improvement and production, food legume improvement and production, technology transfer, and sociology and agricultural economics.

With respect to the geographical scope of research activities, the assumption appears to be that Aridoculture Center and its research program would continue to serve the target zone as defined by the DAARP -- i.e. parts or all of ten different provinces in central Morocco comprising approximately one-half of the total area of dryland agriculture.

Finally, although there was considerable discussion of the scale "neutrality" of many technologies currently under investigation in Settat, there appears to be a consensus in principle among MIAC staff that the beneficiaries of an Aridoculture Center in the future should be small and medium-sized farmers -- the qualification for inclusion in either group being defined in terms of size of land holdings.

When the evaluation team conducted separate interviews with Moroccan participant trainees in Lincoln, Nebraska and St. Paul, Minnesota; with INRA staff in Settat; and with INRA senior staff in Rabat, a consistent but different appraisal of the "overall program" to be institutionalized in Settat emerged. Most Moroccan scientists indicated that what survived in the institutional structure of INRA after the end of USAID project funding would be quite different from what exists now in the context of the project. First, they pointed out that the "Aridoculture Center" per se has no institutional status within the INRA national research structure. They contended that the only INRA institution having legitimate and permanent government status in Settat at present is the INRA Centre Regional de la Recherche Agronomique de Doukkala, Abda et Chaouia. And, they went on to point out, this regional center structure is what is likely to remain

in Settat after the project has ended -- with or without a defined mandate to specifically address the special problems of dryland agriculture.

The INRA officials and scientists went on to point out several problems posed by the two different but overlapping institutional mandates. With respect to geographic zones of concentration, the zone mandated for the INRA regional center's program is defined in terms of three general regions of Morocco -- Doukkala, Abda and Chaouia. These regions do not correspond necessarily with the ten provinces defined as the current project zone. Second and more importantly, the INRA regional center is mandated to work with all farm households within its defined zone, not just with farmers having small and medium-sized farms. And, third, the INRA regional center is required to work with a broader array of agricultural enterprises within its zone than is currently the case in the DAARP mandate. Enterprises additional to the project mandate include, at a minimum, fruit, vegetable and specialty crops grown under dryland conditions and all crops grown under small-scale irrigation outside the large public irrigation perimeters -- e.g. Tadla, Doukkala, etc.. Any research in animal science and/or veterinary medicine is apparently excluded from both the INRA regional center and DAARP mandates.

The evolution of USAID thinking on its country development assistance strategy and the specific place of agriculture and the DAARP within it appears to have introduced some new elements into the institutionalization equation. Our impression is that, until recently, USAID decision-makers defined the Settat institutional development effort very much in terms of the expected outputs of the successive Project Paper Supplements, Project Agreement as amended, and the existing USAID/MIAC contracts. That is, in the context of a well-defined but rather restrictive mandate dealing with certain farmer client groups growing certain crops under dryland conditions within a broadly defined geographic zone. Primary stress in achieving this mandate was placed on institutionalization of certain research approaches and management techniques within a Moroccan public institution.

More recently, however, USAID strategic orientations in agriculture appear to be shifting toward a broader and more inclusive view of agricultural problems in Morocco. As evidenced by the evaluation team's Statement of Work, there is more concern within USAID for establishing the proper -- and complementary -- roles of Moroccan public agencies and private firms in development of the agricultural sector. There is also more emphasis on allowing market forces to determine the evolution of agricultural innovations and enterprises within Morocco and on putting USAID resources in the service of this process -- rather than using funds to "tilt" sectoral development patterns a priori in favor of certain farmer groups, crops or technological innovations for reasons of internal policy or efficiency versus equity considerations.

All this is only to say that there are two different mandates at play presently in Settat. They are the Aridoculture Center and program mandate as defined by the project and the INRA regional center program mandate as defined within the INRA national structure. This variance in opinions raise questions as to what exactly constitutes the mandated research program in Settat in the present and what elements of it are likely to be institutionalized in the future.

This lack of a common mandate for the future is causing problems in the present INRA/MIAC effort with respect to a whole gamut of prioritization issues. And, it becomes an even greater problem when one attempts to sort out the real sustainability issues for INRA as the DAARP winds down. On the one hand, it appears to the evaluation team that "Aridoculture Center" per se is a creation of the DAARP as funded by USAID and INRA and implemented by INRA and MIAC. As such, it appears to have no guarantee of long-term, independent status within the organizational structure of the INRA research programs at either the national or regional levels. On the other, the INRA regional center in Settat and the INRA national research programs being developed under the INRA/ISNAR PBO system are recognized as legitimate organizational entities within the INRA national system.

The central questions, therefore, remain: What is meant in exact terms when statements are made about post-DAARP INRA center institutional structures?; and What are the prospects for long-term sustainability of the center's program as defined by the INRA mandate?

The evaluation team has observed no clear, overarching and long-term strategy for program development in Settat that has been agreed to by all parties. Without such a strategic statement, there is little basis for setting either long or short-term program objectives and/or for prioritizing program actions to be undertaken in any particular time period. Research activities, therefore, originate primarily from discrete sub-program group appraisals of conditions prevailing in the area(s) under consideration and the disciplinary interests of the individual scientists assigned to each sub-program. Moreover, the linkages between the development of an annual research program and the resources available to enable and support such a program are not clear-cut. The same observations apply to program "planning" linkages as they apply to physical plant, development and allocation of human resources, equipment and commodities, and capital and recurrent program budgets.

Establishing a strategic approach to the long-term development of the Settat program should be the highest priority activity for the personnel from all three cooperating agencies -- INRA, USAID and MIAC -- over the remaining years of the DAARP. A functioning and well-targeted organizational structure within INRA that can determine strategic program directions, translate them into short and long-term operational objectives, allocate existing and future resources to attainment of the stated objectives, and then implement program activities is the single biggest legacy USAID and MIAC as DAARP partners can leave in Morocco.

The development of human resources to serve in such a program is the second greatest legacy. As important and successful has the training effort has been, it cannot be assumed at this point that the simple provision of better trained scientific manpower in and of itself will result in a functional research program in Settat without a concomitant and intense effort from here on out to develop the comprehensive institutional context within these new specialists can function effectively.

b. Financial Aspects Of Program Sustainability

This presentation on the financial aspects of INRA center program sustainability is broken down in two sections. The first deals with USAID funding already earmarked in the existing MIAC contract. The second presents the evaluation team's best estimate of what may happen in Settat after the finally DAARP ends and what budget provisions INRA and the GOM must make during the transition period to ensure adequate support for INRA center researchers in Settat.

(1) Preparing For The Future After The DAARP

Since a large share of financial resources remaining in the DAARP are committed to the existing MIAC contract, the evaluation team requested that the MIAC Administrative Officer (R. Cartier) provide us with three alternative scenarios for using the remaining funds in the contract from FY 1992 to the end of the DAARP. The scenarios are presented in Text Tables 6, 7 and 8. The first scenario includes MIAC activities as projected as of May 1991 plus supplementary activities in participant training, socio-economic studies, technology transfer program support, and soil mapping. The second scenario includes all projected MIAC and supplementary activities but also includes a reduction of 1.2 person years in MIAC technical assistance time as projected in MIAC's staffing proposal. The third scenario includes all MIAC and supplementary activities and a reduction of 7.7 person years in MIAC technical assistance time compatible with Moroccan questioning of certain positions and evaluation recommendations on others -- see Text Tables 4 and 5.

Given close monitoring of MIAC contract expenditures by USAID and INRA, the evaluation team believes that all DAARP project activities presently anticipated and the supplementary activities and modifications recommended by the evaluation team could be accommodated with only modest supplemental funding to the existing MIAC contract. We would expect that the total additional funding to the contract would be between about $ 12,000 as per the third scenario and $ 825,000 in the second scenario.

(2) The INRA Center in Settat After The DAARP

The sustainability of institutions is a problem that preoccupies governments and external aid agencies everywhere. As with the earlier USAID support to IAV, the DAARP has built up a high quality group of researchers supported by excellent facilities and equipment. As with IAV, the transition to post-project self-support requires early and serious planning in order to avoid an abrupt and institution-threatening deterioration of financial and working conditions. Although the evaluation team is reviewing the project, an examination of the potential threats to the INRA center as an institution forms a necessary part of the analysis and the basis for an adequate set of recommendations about the work that remains to be done during the life of the project.

We are not the first to be concerned about the sustainability of the DAARP. The MIAC project designers looked to calculations of the benefits of applied agricultural research to Morocco to justify continued government expenditures on agricultural research. As early as 1987, the MIAC

TEXT TABLE 6

Itemized MIAC Budget Projections Under The First Scenario Through Life of Project (in thousand of U.S. dollars)				
Expense Category	FY 1992	FY 1993	FY 1994 to FY 1996	Total Project Budget
MIAC Technical Assistance Costs				
Long-Term Technical Assistance Salaries	1,083.0	876.60	0	1,960
Short-Term Technical Assistance Salaries	48.65	30.30	0	79
Technical Assistance Support Costs	242.66	193.00	0	436
Participant Training				
Present Training Programs	469.05	330.88		797
Supplementary Training Programs	98.91	103.85	74.06	277
Commodities				
General Research Program Costs	122.23	76.39	0	199
Technology Transfer Program Costs	2.00	2.00	2.00	6
Socio-Economic Program Support Costs	27.00	2.00	1.00	30
Operational Costs				
General Research Program Operations	298.38	282.78	0	581
Technology Transfer Program Operations	101.75	110.15	104.14	390
Socio-Economic Program Operations	69.99	44.25	23.25	138
Indirect MIAC Costs	461.45	369.39	0	831
MIAC G and A Costs	179.45	143.65	0	323
Estimated Total Costs	3,204.5	2,565.2	204.5	5,974

institutional sustainability team (MIAC/IST, 1987) said that an extension of the project would provide "a reasonable time frame in which INRA, MIAC and USAID can and must work together to assure the sustainability of the Project." A cable from USAID/Rabat to AID/Washington (Rabat 12356 of 22 April 1987) spoke of USAID's concern to "place major emphasis on institutionalizing the research program ... and setting in place INRA's capacity to support the Center after the USAID project terminates in 1994".

TEXT TABLE 7

Itemized MIAC Budget Projections Under The Second Scenario Through Life of Project (in thousand of U.S. dollars)				
Expense Category	FY 1992	FY 1993	FY 1994 to FY 1996	Total Project Budget
MIAC Technical Assistance Costs				
Long-Term Technical Assistance Salaries	989.40	876.60	0	1,8669
Short-Term Technical Assistance Salaries	48.65	30.30	0	79
Technical Assistance Support Costs	216.26	193.00	0	409
Participant Training				
Present Training Programs	466.05	330.88		797
Supplementary Training Programs	98.91	103.85	74.06	277
Commodities				
General Research Program Costs	122.23	76.39	0	199
Technology Transfer Program Costs	2.00	2.00	2.00	6
Socio-Economic Program Support Costs	27.00	2.00	1.00	30
Operational Costs				
General Research Program Operations	298.38	282.78	0	581
Technology Transfer Program Operations	101.75	110.15	104.14	316
Socio-Economic Program Operations	69.99	44.25	23.25	138
Indirect MIAC Costs	439.65	369.39	0	809
MIAC G and A Costs	171.05	143.65	0	318
Estimated Total Costs	3,054.5	2,565.24	204.5	5,824

The evaluation team has found little evidence of the tripartite collaboration that was felt to be required in moving toward sustainability. However, on the financial side, USAID commissioned the International Development Management Center (IDMC) at the University of Maryland to study the INRA center's long-term viability. (IDMC, 1990) For the following discussion, we have used a somewhat different approach to the same problem, basing our work on the availability of updated data and on some modified assumptions.

TEXT TABLE 8

Itemized MIAC Budget Projections Under The Third Scenario Through Life of Project (in thousand of U.S. dollars)				
Expense Category	FY 1992	FY 1993	FY 1994 to FY 1996	Total Project Budget
MIAC Technical Assistance Costs				
Long-Term Technical Assistance Salaries	782.70	576.30	0	1,359
Short-Term Technical Assistance Salaries	48.65	30.30	0	79
Technical Assistance Support Costs	157.96	108.30	0	266
Participant Training				
Present Training Programs	466.05	330.88		797
Supplementary Training Programs	98.91	103.85	74.06	277
Commodities				
General Research Program Costs	122.23	76.39	0	199
Technology Transfer Program Costs	2.00	2.00	2.00	6
Socio-Economic Program Support Costs	27.00	2.00	1.00	30
Operational Costs				
General Research Program Operations	298.38	282.78	0	581
Technology Transfer Program Operations	101.75	110.15	104.14	390
Socio-Economic Program Operations	69.99	44.25	23.25	138
Indirect MIAC Costs	392.15	300.09	0	692
MIAC G and A Costs	152.50	116.70	0	269
Estimated Total Costs	2,723.3	2,084.0	204.5	5,012

The results of our analysis can be summarized as follows:

- The INRA center in Settat will have to have access to an additional 4,000,000 Dirhams for its research support budget in each of the next two years and a further 4,000,000 Dirhams from 1994 onward, if INRA intends to support its researchers in Settat at the same level as they are being supported in 1991.

♦ If the INRA research support budget goes up only at its current rate -- which is roughly at the rate of inflation meaning it is not changing at all in real terms -- then in 1994 and thereafter, the center will only be able to support a staff of 28 researchers at the 1991 level.

♦ If, on the other hand, attrition from all causes is assumed to diminish researcher numbers to a "critical mass" of 40 researchers from the present total of 56 (resident and in training), there will be a need for additional funding of 4,000,000 Dirhams each year beginning in 1992 and continuing thereafter.

♦ If the INRA budget for Settat does not increase by more than the current annual rate (about 9.1 percent), then the resources available per researcher will decline by 1994 to 51 percent of the current level -- or from 360,262 Dirhams to 183,078 Dirhams per researcher. This steep drop will obviously result in draconian cuts being made in the INRA program, especially with respect to library resources, research consumables, fuel, vehicle and infrastructure maintenance, since it is extremely difficult to cut technical and support staff salary costs.
These conclusions become inescapable from a relatively straightforward review of projected budget changes and a few fairly conservative assumptions.

MIAC and IDMC analysts calculated (IDMC 1990, Appendix 5) the amounts of money being spent from the MIAC budget on research support at Settat. Three of their categories are particularly germane to program sustainability -- i.e. the salaries of the MIAC temporary staff who provide needed additional skilled labor in Settat, the research commodities (expendables and capital goods), and other contributions to operational expenses. These are shown in Text Table 10 as Lines A, B, and C, with the total as D. We did not include short-term training and international travel funds as sustainability items, although IDMC's inclusion of these items may be plausible.

Assuming that the overall MIAC contribution to the center's research budget is being utilized by all researchers equally -- and it would be difficult to demonstrate otherwise, since, for example, many research projects are collaborative efforts between MIAC and INRA staff -- then, dividing total MIAC support (Line D) by the total number of researchers actually resident in Settat each year gives the individual researcher share of the MIAC supplement. Multiplying the individual share (Line H) by the number of INRA researchers (Line E, not counting the shares of MIAC staff) gives the total supplement that MIAC is making to the INRA research staff (Line J).

To this contribution from MIAC, we must add INRA's own research support budget (Line K). The method for arriving at this budget for 1990 -- the base year -- was explained above in the section on INRA budgeting. Basically, we added the salaries of all non-researchers and the total operations budget, including the EGS, and then we made a deduction for the share of the budgets that could be deemed to be spent on the non-research farm production activities on the field stations. The INRA operations budget for 1991 is known but it does not include the actual INRA salary component. This budget has gone up by 9.1 percent recently and, in lieu of any other reasonable expectation of annual increases, we used the same percentage to project increases in the INRA operations budget for 1992 and onward.

The total INRA research support budget, then, from both MIAC and INRA sources (Line J + K) is then shown as Line L. Note that despite the modest rises in the INRA budget, the total budget drops by 4,900,000 Dirhams from 1990 to 1991 because of the planned reduction this year in the level of MIAC support. This reduction was already being felt when the evaluation team was in Settat as money to pay for fuel and temporary labor was running out with five months left in FY 1991. For 1992 and 1993, the budget total stays at about the same level and then there is a drop of an additional 1,200,000 Dirhams projected in 1994, as the MIAC contribution ends.

During this period, more INRA researchers will be returning from participant training. Line M (Line L divided by Line E) shows the share of the total research support budget that each INRA researcher has as more INRA researchers return to share a budget that remains essentially static in nominal terms from 1991 onwards. In 1991, the INRA researcher's share of the total budget is 360,262 Dirhams, which is already a considerable reduction from the 517,656 Dirhams per researcher in 1990. By 1994, with 56 INRA researchers anticipated to be in Settat, the per researcher budget share will drop by 49 percent (Line N) to 183,078 Dirhams. It must again be pointed out that this is the money that will be available to pay all the direct costs of research operations at the center, not the funding that actually passes through the researchers' own hands for inputs, fuel, per diem and other items. It includes all of these items plus his or her share of common center administration expenses for telephones, library resources and operations, technician and laborer salaries, water, printing and photocopying, and everything else that it takes to run the center. Researchers must think about the sum not in absolute terms (183,078 is more than twice their own current annual average salary) but in terms of the prospects of having half as many resources for research activities after 1994 as they have now. We have assumed in all our calculations that INRA management believes that all the researchers should be supported over the long term at 1991 levels. To do so, however, INRA would have to supply the individual researcher's 1991 "share" (360,262 Dirhams) to an increasing number of staff on site from its own resources, as shown on Line P. For 1992 and thereafter, carrying out this intention would mean that the shortfall between the projected total support to INRA researchers and the desired total budget would have to be covered. The shortfall is shown as Line Q. The shortfall for 1992 would be 4,300,000 Dirhams; for 1993, 4,000,000 Dirhams; and for 1994, 9,900,000 Dirhams.

Alternatively, if INRA can not find additional budget resources but still wanted to support the Settat researchers at 1991 levels to make sure that they were not all reduced to office work with no real research support, then it would have to transfer staff away from Settat and support those remaining at higher than average levels per researcher. If the budget for Settat does not increase at more than the current rate, we calculate that the center in Settat could only support a staff of 28 of researchers in 1994 at the 1991 support level (Line R). This is the basis for our defining 30 researchers as the INRA survival option below.

Twenty-eight researchers in Settat may be too low a number for a sustainable research program. Offices and laboratories would be vacant and some programs would be critically low on the skills needed to design and implement a research program. Some administrators and scientists suggested to the evaluation team that 40 researchers would be the "critical mass" of talent

TEXT TABLE 10
INRA/SETTAT RESEARCH ACTIVITIES
FINANCIAL SUSTAINABILITY SPREADSHEET FOR PROGRAM MAINTENANCE REQUIREMENTS

	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994
MIAC Contributions to Settat Research Budget						
A. Salaries of MIAC-hired temporaries	877,286	1,246,232	723,144	342,456	215,108	0
B. Research Commodities	8,857,536	7,862,112	3,081,960	2,063,512	1,611,803	0
C. Center/Station operations	1,930,769	1,682,968	1,418,608	846,918	618,295	0
D. Total MIAC Contribution	11,665,591	12,791,312	5,223,712	3,252,886	2,445,206	0
Number of Researchers on Site						
E. INRA Researchers	33	31	32	43	43	56
F. MIAC Researchers	13	14	14	12	8	0
G. Total	46	45	46	55	51	56
MIAC Contributions to Settat Researchers Net of MIAC Shares						
H. Per researcher share of Total MIAC Supplement (D+G)	253,600	284,251	113,559	59,143	47,945	0
J. Total Supplement to INRA researchers (H x E)	8,368,793	8,811,781	3,633,886	2,543,165	2,061,644	0
Total Research Support Budget, INRA Researchers at Settat						
K. From INRA/Rabat (Method from INRA Budget Section)		7,235,556	7,894,482	8,613,414	9,397,235	10,252,383
L. With MIAC Addition (K+J)		16,047,337	11,528,368	11,156,579	11,458,879	10,252,383
M. Per INRA researcher on site (L + E)		517,656	360,262	259,455	266,486	183,078
Conclusions						
N. Percent Drop in support per researcher 1991-1994			1994÷1991			49.2 %
P. Total budget needed for support researchers (E) at 1991 level (M 1991)			Baseline year	15,491,266	15,491,266	20,174,672
Q. Budget Shortfall (P - L) (Dollars at 8.5 DH = $ 1)				4,334,687 ($ 509,963)	4,032,387 ($ 474,398)	9,922,289 $ 1,167,328
R. Number of researchers supportable at 1991 level if shortfall not covered				31	32	28
S. Shortfall for activities if 40 researchers is minimum critical mass				3,253,901 ($ 382,811)	2,951,601 ($ 347,247)	4,158,097 ($489,188)

necessary to keep all aspects of the research program running well. But, if 40 researchers are to stay at the center, then the looming budgetary shortfall would still haunt center planners because (Line S) to support them, the center will need 3,300,000 additional Dirhams in 1992, 3,000,000 Dirhams in 1993, and 4,200,000 Dirhams for 1994 and beyond. This is our INRA program maintenance option below.

To carry on its planned research activities at 1991 levels in the near term, INRA will have to find between 3,300,000 and 4,300,000 Dirhams for 1992; between 3,000,000 and 4,000,000 Dirhams for 1993; and from 4,200,000 to 9,900,000 Dirhams for 1994. In addition, as the evaluation team excluded any short-term training and scientific meeting travel expenses from its calculations, additional money for such items would also have to be found if they are to be funded in the future. If funds cannot be found to fill the looming resources gap, then either researchers will have to be transferred away from Settat to enable the remaining staff to get on with their work or researchers will find themselves without the means to continue their scientific activities.

The major question then is: What can be done to either reduce costs or increase funding for the center to sustain the research program? We would answer that, first, all researchers at the center must collaborate to better ensure that the funding that is available is used more efficiently to support research. In this regard, if materials or money are presently being used to help supplement salaries out of sympathy for researchers' social conditions, then INRA will have to reexamine the tradeoffs between satisfaction and work output. Second, before professional workers will collaborate with managers to economize on common resource use, they need to be given assurances that the cost savings will actually be passed through to support their research work. Third, the list of "other management issues" discussed in an earlier section -- i.e. the needs for a central stores system, better use of the existing motor pool, etc. -- needs to be carefully considered in the light of the center's diminishing resources.

Like INRA/Settat, many American colleges of agriculture have had farms given to them for research that required major expenditures before they are useful. Intent on making these farms contribute to total college resources, these institutions have often found that they can produce revenues from the cropland of these farms that is in excess of the needs of researchers. INRA, with its field stations, is faced with the same situation and the same opportunity but it must develop a comprehensive strategy for the field stations and then implement it rigorously if supplementary revenues are to be produced from the excess land on the stations and from resources like the idle seed treatment plant at Khemis Zemamra. As discussed in preceding sections on station development and INRA financial management, for a revenue generating strategy to work, the INRA center in Settat must be delegated the authority not only to produce revenues on the stations but to retain those revenues as a supplement to its regular operating budgets. In this regard, management must be careful not to sacrifice research resources -- labor, land, equipment and other inputs -- to production enterprise and field station managers, now better trained, should work with center management to optimize both research and revenue-generating operations in their stations.

Different scientists will always have different opportunities to earn money from grants and contracts and some INRA center activities will lead earlier than others to the possibility of licensing fees or royalties. Scientists in Settat, like those in Moroccan universities, must be encouraged to discern and take advantage of these opportunities, without sacrificing the coherence of their basic research work.

Increasingly, library support, travel grants to conferences, seed grants to begin new research initiatives, and participation in internationally-linked research will have to be found outside the regular operating budgets of the INRA center. As the number of researchers in the INRA system grows -- and as the total number of scientists in Morocco also increases from a number of directions -- either INRA or the governing bodies for the sciences as a group may wish to consider the founding of a competitive grants program to support the best new research being proposed, publications and international travel, and post-graduate student research within the country. Both the United States National Science Foundation and the Province of Québec's Fonds de Concertation des Actions de la Récherche (FCAR) provide models for peer-reviewed research support -- Quebec's case is interesting because a relatively small scientific community has had substantial success at funding excellent research and graduate work on the basis of merit. One way or another, given the resource constraints on the horizon, Settat researchers may have to become accustomed to the possibility that not everyone will go to international meetings every year or have all of their research protocols approved as a matter of course. Nor should they be carrying out research for the well-supported international agricultural research centers on the sole basis of fraternal collaboration.

In this regard, there is the possibility of using part of the remaining financial resources in the DAARP to cover the shortfalls projected for INRA. Financing the gaps, however, may merely postpone the day of reckoning for INRA, as Robert Zimdahl observed in comments on the first draft report of this evaluation, if MIAC had never picked up the operating costs for Settat research work, "the project might have moved more rapidly toward creating self-reliance rather than dependency" (Zimdahl, 1991).

If any proposal is made by INRA to use DAARP money in this manner, the evaluation team recommends strongly that any such supplementary funding be tied to annual proof that the INRA total operating budgets for Settat (not including salaries) are increasing in a manner sufficient cover the full costs of sustainability by 1995 -- or by whatever year the DAARP funds are expended and the project ends. Extensive analyses and negotiations are not really required in this case, but prompt action is essential to start attacking this major problem in a collaborative and constructive manner.

Finally, the question of salaries and professional status for the INRA researchers at Settat weighs heavily on the question of whether the institution can be sustained. As one of the INRA centers in a less-favored social milieu, the center in Settat will clearly suffer if its best researchers are lured away by more lucrative and/or professionally satisfying jobs. We know that this is already happening in some case and that INRA's salary policy and Settat as a place to live both figure strongly in the criteria people are using to make their decisions. Promises of change, even that

the changes are on the Minister's desk awaiting only his signature, will not alter researchers' strong feelings that the working conditions that were implicitly promised by INRA's building up of Settat as a research center of excellence have not been provided. (Annex 4 for a preliminary discussion of this issue by Settat researchers)

c. Optimal INRA Staffing After 1994

The INRA program in Settat will face many problems after 1994 when DAARP funding is no longer available. The question of an optimal staffing pattern is one of the central issues in program survival and sustainability. One INRA staffing option and two alternative evaluation team staffing options will be considered for the post-DAARP period. These options might be called the optimal INRA staffing plan, the DAARP staff maintenance option; and the program survival option.

Current institutional thinking in Morocco projects an optimal INRA staffing pattern for Settat of approximately 50 core scientific staff after 1994. The DAARP staff maintenance option suggests a core research staff of about 40 persons. This is based upon DAARP participant training slots for 56 persons and a large margin for attrition from the Settat program due to INRA reassignments and staff exodus from public sector employment for other jobs in Morocco and/or in the international research community. The program survival option would suggest a staff of between 25 and 30 researchers to cover the six Settat research sub-programs after 1994.

The IDMC report on institutional sustainability surveyed American agricultural research institutions having mandates similar to that of the Settat program as a guide to optimal staffing levels and reported fairly consistent staff ratios of 1:1:1 for researchers, technicians and support staff. In Morocco, however, support staff may constitute are higher component of the total staff and the staff ratio may more appropriately be on the order of 1:1:2 or 3. Support staff in this case would include permanent and occasional laborers, data entry clerks, secretarial staff and the like. If one uses the optimal research:technician:administrative staff ratio suggested by the IDMC report (IDMC, 1990) -- i.e. 1:1:1 -- or increases it to 1:1:2, the implications are that total INRA staffing in Settat after 1994 would be as follows:

Under the optimal INRA staffing option, there would be 50 researchers, 50 technicians, and 50 to 100 administrative support staff in Settat. Under the DAARP program maintenance option, staff would total 40 researchers, 40 technicians and 40 to 80 administrative support staff. And, finally, under the program survival option, the staff totals would be up to 30 researchers, 30 technicians, and 30 to 60 administrative support staff.

In the opinion of the evaluation team, the <u>INRA staffing option</u> cannot be supported either on technical or financial grounds. As detailed below in Section III.B. on research programs, several disciplines in Settat are already overstaffed when compared to their projected research work loads and should be reduced in size. On the financial side, we see no possibility that the INRA budgets can accommodate a research staff of 50 scientists in Settat after the project ends unless they are simply maintained in place without adequate operating funds to do research of high quality. The

DAARP program maintenance option appears to correspond best with the optimal research staff capacity needed to fully implement a program similar to that in place in Settat at present -- bit it needs a significant infusion of funds. The program survival option is the option most compatible with current and projected levels of INRA budgetary support if one projects a per researcher level of operational funding similar to that in place at the center in FY 1991.

According to the INRA center director, actual INRA staffing in Settat and at the four field stations as of May 1991 is 57 researchers -- including participant trainees in the United States -- 34 technicians, 93 permanent administrative and support personnel, and 83 temporary and seasonal staff -- a total of 267 employees. These figures do not include an additional 60 technicians and other support personnel hired on a temporary basis under the MIAC contract. Adoption of any of these staffing options, therefore, would mean modest (67) to very large (147) reductions in staff at the center in Settat.

Under the DAARP program maintenance option, a number of personnel slots and management issues will require resolution. The following section discusses each position. A number of gaps are evident now and others will arise with the departure of MIAC technical assistance personnel. These involve both research and research support functions.

One key position between the INRA center director and the scientific staff is assumed to be that of the INRA research coordinator. Such a position does not yet exist within the INRA structure. A similar position has existed with the DAARP structure for several years, having been most recently filled by Drs. Edwards and Zimdahl. A Moroccan scientist may be installed as research coordinator within the INRA structure by late 1991. This action has not been confirmed as yet but a draft job description has been prepared for the position and candidates are apparently under consideration. The holder of this position will coordinate the development of research plans, publications and reports. The position is considered to be essential under all staffing options.

Information from our interviews indicated that as much as 50 percent of the Settat sub-program leaders' time is devoted to administrative matters. This administrative burden reduces the time sub-program leaders can devote to their primary research functions. It may be advisable, therefore, to create the position of administrative assistant to the INRA center director to reduce the strictly administrative work load on sub-program leaders. The person in this new position would assist the center director by taking over certain elements of center management currently assigned to sub-program leaders. This individual would also relieve the center director of many minor and time-consuming details, which currently tax his time.

Interviews with MIAC scientists confirmed that the ratio of one scientist to one technician is an adequate level of skilled support. At present, INRA has provided 34 technicians at the center and field stations for research program support of the 32 researchers actually resident in Settat in 1991. MIAC has provided contractual funding for an additional seven technicians on a temporary basis. The INRA director told the evaluation team that INRA/Rabat has agreed to hire an additional 6 technicians for the center in 1991. This INRA total (40) will be roughly comparable to the number of INRA researchers (43) anticipated to be resident in Settat in 1992.

The problem appears to be, therefore, the actual mix of skills present among the INRA technicians and not the absolute number of technicians available at the center and field stations. This implies that a long-term training program for INRA permanent technicians already on board is needed to tailor personnel capacities to the technical skills actually in demand by researchers, rather than additional hiring of new technicians.

With regard to certain key support personnel, the position of physical plant development coordinator is staffed and paid for by INRA. The person in charge of the greenhouse/headhouse complex in Settat was trained in the United States with DAARP funds and the position is supported by INRA.

INRA has not yet assigned an individual to the post of computer program maintenance coordinator. Mrs. Rafsnider, who has a Masters degree in information science, assumed this position on a temporary basis after the departure of Mrs. Regher, the wife of another MIAC technical assistant. As the center in Settat has acquired a larger inventory of more sophisticated computers and associated software, this position has become much more important in support of the research program.

Before the mid-1980s, most of center staff were only being to realize the potential of computer technology and its relationship to scientific research. With the strong participant training effort, most Moroccan scientists have become computer literate and they expand their computer skills during their United States training. Many of these scientists return to Morocco with very strong computer skills and can handle most of their individual programming and software problems but the center has yet to develop a sustainable capacity to support and maintain its total computer program. Some computer support has been provided under contract by the firm of Etablissement La Sphere in Casablanca but experience has shown that computer servicing by this contractual arrangement is expensive and slow.

A computer technician is to be trained by the DAARP in a six week course in the United States but, even under optimal conditions, he is not likely be as effective as the present MIAC person in the position for some time. Given this situation, Mrs. Rafsnider stated when interviewed that there will be problems with the computer program in the short-term but that there is sufficient in-house capacity to keep things going. She suggested, however, that a contractual linkage be established with an IBM resident technician in Rabat through INRA national headquarters to handle more complicated problems. This appears to be a valid suggestion since INRA/Rabat will be receiving 30 more IBM computer systems from the World Bank for its research programs and these should be supported by a blanket maintenance and consulting services contract.

At present, center computer capacity is said to be adequate. The center's 60 computers are heavily used by Moroccan staff for both administrative and research purposes. Every research department has one machine per office and another 15 machines are owned by staff and used for center-related work. There is no clearly established inventory system for computer-related supplies at present. A box of ten diskettes costs between $ 50 and $ 100 if purchased in Casablanca. Under the DAARP, MIAC, as the procurement agent, provides all computer-related

supplies for the Settat operation. Development of a functional INRA inventory and internal billing system for the computer program is therefore clearly indicated before 1994.

In addition to providing the computer supplies, MIAC currently pays for two temporary employees in the center's computing facility who handle data entry and word processing tasks for the DAARP. MIAC is also funding a large proportion of support costs for the center's photocopying capacity. The status of this capacity is uncertain beyond 1994.

Mrs. Rafsnider, in addition to her work with the computer program, manages as the DAARP library/technical reference center coordinator on a one-quarter time basis. INRA has recently hired a Moroccan library coordinator. The library presently spends about $ 10,000 per year on journals and publications. These acquisitions are funded by the DAARP through the MIAC contract. Before the end of the DAARP, library space will be increased by 50 percent with the opening of new facilities but the rate of acquisition of the library resources is likely to decline after 1994. The present library resources is said to provide minimal coverage for agriculture-related research and the social sciences collection is seen to be very weak. Another problem is that the vast majority of all publications are in English which greatly reduces the utility of the library for Moroccan scientists and technicians who do not have a good command of written English materials.

The technical reference center in the library does on-line computer document searches for researchers. The INRA computer is linked to the National Library in Rabat, which in turn is linked to the FAO document search system in Rome and a number of other research database programs. Searches cost $ 60 to $ 100 each and are funded by the project under the MIAC contract.

The present vehicle maintenance repair manager/motor pool supervisor at the center is to be sent to the United States for training in motor pool management. Staff members, who rely heavily on vehicles for fieldwork, have serious reservations about the current management and capacity of the motor pool. Vehicle repairs usually have long turnaround times. The auto shop employs three mechanics, one mechanic assistant and one stock clerk. These five positions are funded from the DAARP budget.

The scientific equipment repair specialist in Settat is slated to receive additional training in the United States before the end of the DAARP. Much of the center's scientific equipment is highly specialized and scientists are concerned that INRA has resident capacity to provide maintenance after the end of the project. An INRA electronics repair specialist is currently being trained in the United States at Lincoln University. He will return to Settat in 1991.

The audio-visual and desktop publishing technician has job responsibilities which include photography, knowledge of specialized computer software for development of newsletters and publications and production of graphic presentations in research papers. This position is intended primarily to improve communications capacity at the center. Training will be provided for the incumbent through MIAC until the end of the project and INRA will support the position

thereafter.

The DAARP, in addition to the center staff positions above, is funding one janitor and one electrician/plumber for facility maintenance at the center and a variety of other skilled and laborer support positions. All of these contractual positions will disappear between now and the end of the MIAC contract.

At the field stations, present will require additional training in station management. It was also suggested that assistants be trained to help with routine matters. Equipment servicing at the field stations is a problem for researchers. A mechanic with a mobile repair van may provide one solution to servicing equipment maintenance needs at the field stations. This individual could operate out of the present central shop facility at the Sidi El Aydi Station.

d. Prospects For Other Donor Involvement

Beyond the two major donor agencies already supplying resources to the INRA center in Settat -- i.e. USAID with the DAARP and the World Bank with assistance to the national SRD program -- we are not aware of any actual or prospective sources of additional funding. To the contrary, it appears that the center in Settat is considered by INRA/Rabat to be a testing ground for the American model of agricultural research and extension. In this sense, the large MIAC presence in Settat, backed by the heavy USAID investments over the last decade, may actually have served as an active deterrent to a more collaborative program with other donors.

This situation may change in the medium-term when INRA actually comes to the realization that major USAID funding is coming to an end but, for the moment, we feel major external funding for the center in Settat is unlikely to materialize soon.

e. Commentary on the Optimal Uses for USAID Project Funding Outside the Existing MIAC Contract

After the financial and staffing critiques above, we present in this section the evaluation team's comments on the optimal, prioritized use of USAID project resources, net of the existing MIAC contract. These funds total $ 6,166,739 in May 1991, less any prior direct disbursements against this sum incurred by USAID -- i.e. costs of evacuation for MIAC personnel, costs of project evaluations, and other minor disbursements.

If one assumes that approximately $ 5,900,000 net remains available to the DAARP outside the existing MIAC contract, the evaluation team suggests that it be spent in the following order of priority -- with the approximate levels of expenditures in brackets.

- Fund the balance of project activities included in the MIAC contract -- i.e. long-term participant training, socioeconomic studies, and the technology transfer program activities. [up to $ 1,000,000]

- Fund supplementary short-term participant training not included in the MIAC budget projections as yet -- i.e. post-doctorate training in research planning and program management, and other training in station management and specialized skills. [$ 250,000]

- Fund short-term consultant services -- Moroccan and external -- to INRA in Rabat and Settat in research planning and program management. [$ 150,000]

- Fund additional socioeconomic work, as needed, to evaluate technologies and develop other information on changing patterns of agricultural enterprises and market conditions in the project zone. [$ 100,000]

- Fund an end-of-project comprehensive evaluation. [$ 250,000]

- Fund support for development of INRA field research stations commensurate with INRA's development and implementation of an acceptable strategic plan for these stations. [$ 1,500,000]

- Fund operational costs of the on-going research program over the life of the project commensurate with evidence from INRA that it is increasing its own budgets -- capital and operating -- for the center. [$ 2,000,000]

- And, finally, fund structural modifications and replacement equipment in laboratories and other facilities at the center, as necessary. [$ 650,000]

B. Progress Toward Technology Development in Agriculture Research

1. The Dryland Agriculture Applied Research Project

The important words in the title of the project are "dryland" and "applied". Beyond this, the project is directed at the needs of small to medium sized farms and has as its goal "fully establishing an applied research program and converting results from that program into usable technology for farmers." (Watts, 1987) This is a "mission oriented" research project.

For purposes of this report, a "technology" is an agricultural practice or group of practices; developed, tested, or adapted by research, which have been identified for possible release to farmers.

a. Dryland

The DAARP was given a harsh introduction to the climatic constraints on dryland farming in the 250 to 450 millimeter rainfall zone of Morocco. "The first field work on the Project was initiated in the fall of 1981 in the midst of the worst drought in 300 years." (Watts, 1987) With or without record-breaking droughts, reduced yields or crop failures resulting from insufficient moisture can be counted on to occur regularly in this region. This central fact has made a major impact on DAARP thinking and writing. But it is not the whole story. Rainfall is limited but it is also efficient. In Morocco dryland crops grow on soils which often have a high moisture retention capacity and are watered by gentle rains during the winter when evapo-transpiration is low. Humanity learned the advantages of the Mediterranean climate thousands of years ago and then used that knowledge to support some of the greatest civilizations of antiquity.

The fundamental principles of what can and cannot be done agriculturally within the context of the moisture constraint in the Mediterranean climate have been understood for a long time. It has been known that in this climate you can usually count on producing a crop but you cannot count on producing a large crop. For modern agriculture this means "Be conservative with inputs." It is low risk, low return agriculture. This imposes narrow constraints on the possibilities for agricultural production innovation. If the moisture constraint to agricultural production in the Mediterranean climate is released by means of irrigation, then this climate has the highest agricultural production potential of any climate in the world.

b. Farm Size

DAARP research in Settat is officially directed at the needs of small to medium sized farmers. But the distinction on farm size has been difficult to maintain. Outside the work of technology transfer, it is difficult to design research which benefits small to medium sized farm to the exclusion of progressive, large farms.

There is wide variation in the technology levels of Moroccan dryland farms. The position of research relative to the technology curve represented by farming practices on progressive farms

is probably more important than the position of research relative to the size of a farm. The progressive farms in any given region serve as indicators of both reliable practices and yield potential. The role of technology transfer should be to spread the benefits of known technologies as widely as possible among farms of all sizes. Limiting technology development and transfer to a corridor between the center and small to medium sized farms restricts the impact and the efficiency of the center.

c. Applied

There is a limit to the capacity of small to medium dryland farms to absorb innovation. "Dryland", "applied" and "small to medium sized farms" define a very small target. When the most obvious and important work has been done for these farms and technology development has outpaced capacity to transfer technology, then a point of diminishing returns relative to work for the target group has been reached. In the DAARP, that point was probably reached in 1988. The center should continue working on the problems of small to medium sized farms but it can do much more than that. Researchers should move on to the obvious and important problems which should be getting the attention of an applied research effort. In the Settat region, this means working on the problems of large farms and of irrigated farms.

Defining the differences between small, medium and large farms is difficult. The difference between an irrigated and a non-irrigated farm is obvious. Solving problems of large dryland farms when working on problems of small dryland farms is unavoidable, as is the corollary. However, changing to the problems of irrigated agriculture represents a major shift. Technology which is relevant to irrigated agriculture is often irrelevant to dryland agriculture and vice versa. However, if rational use is to be made of the facilities which have been developed at the INRA center in Settat, it will have to turn its attention to all agriculture in the region and not just concentrate on the needs of small to medium sized dryland farms.

The work of weed science and soil management have had only limited application to the target group of farmers. Cereal agronomy's work on supplemental irrigation falls into this same category. It is important work but it does not fit within the DAARP mandate. The methods of soil fertility would be most applicable to the production problems of irrigated agriculture. Cereal improvement, with its ability to solve problems identified by entomology and plant pathology, forages and agronomy are all disciplines which will make contributions to dryland agriculture regardless of size.

The disciplines which are most directed to the needs of small to medium sized farms are food legumes and agricultural mechanization. Obviously, this is not a normal state of affairs for agricultural mechanization. Agricultural mechanization and soil fertility have not been productive disciplines within the DAARP due, at least in part, to attempts to keep the work of these disciplines within the DAARP mandate.

Finally, it is not possible to operate a vigorous applied research program without a correspondingly vigorous program at a more fundamental level. Evidence of the former program is

measurable results. Evidence of the latter program is publication. Each scientist should be producing in both areas.

2. Description and Evaluation of Research

a. Characteristics and Phases of Research Disciplines

The 1989 scientific review panel points out that translating research into practice is "relatively simple in the case of a change to a new variety" where there is no change in the system. But transferring changes in a system, as is often required in the case of agronomic packages, requires "close liaison between the farmer and scientists who developed the system." (INRA/MIAC, 1989) Research efforts which "will need to be a continuing effort" are contrasted with research efforts which "should result in a relatively permanent solution or program once the initial investment is made and activity should begin to taper off after a period of development" in the last DAARP evaluation report. (Winrock International, 1986)

b. Time Requirements

Opinions on this subject have differed. Watts (1987) describes expectations in the early days of the project by saying "there was enormous political pressure from USAID and the Moroccan government to show quick results." One of the fundamental assumptions of the DAARP was that dryland agriculture on small to medium sized farms in Morocco was amenable to rapid change. In fact, two technologies were delivered very quickly: early planting/weed control for wheat and Hessian Fly resistant wheat. The latter innovation found only a very small niche in the less favored wheat production regions. Early planting/weed control for wheat apparently influenced practices on about 300,000 acres of wheat but these were primarily large farms.

As of the summer of 1991, the DAARP completed its seventh growing season. Watts (1987) served as MIAC team leader from 1982 through 1987 and believed that, "agricultural research normally requires a five to ten year effort to obtain major payoffs". Kumar (1991) indicated a similar time frame for his research at the ICRISAT regional station in Sadore, Niger.

Annex 7 Tables 1 and 2 show that by 1987/1988 crop season the DAARP had developed a significant number of new technologies. This was noted in the 1988 scientific review panel report as follows: "The MIAC/INRA project has reached a milestone. The efforts of scientists conducting research in each of the disciplines represented at the center are beginning to produce tangible results. The project has reached a degree of maturity." (Swanson, 1988)

The 1988 scientific review panel, however, cautioned that "agricultural research in general has a very long payback period. The diffusion of new technology even in the best of circumstances takes many years. U.S. scientists have found that the average lag time for dissemination of experiment station yield increases in the U.S. is twenty years". (Swanson, 1988)

There are disciplines within the DAARP which will require a long time period to transfer their

technologies. But that is not the issue here. The problem with this statement is that it equates highly developed agriculture and research/extension institutions with "the best of circumstances" for disseminating innovation. However, innovation in such circumstances is usually impacting at the margins of an already developed agricultural system . Where agricultural systems are less developed, innovation can have major impacts and a correspondingly shortened time requirement for dissemination. Identifying these major impact areas, however, requires both a profound knowledge of the agricultural systems in place and a process of prioritization in selecting and implementing research activities.

3. Prioritization

In 1991 when Dr. Robert Zimdahl, MIAC weed scientist and research coordinator for the DAARP, wrote his end of tour report, he identified "objective drift" as a problem in research planning. While he made no mention of the 1990 scientific review panel, it is interesting to note that for weed science this group ranked seventeen "research opportunities" in three categories: highest priority, high priority and important. The report also stated, "it is difficult to reconcile the needs with the limited human resources available".

When faced with agricultural problems in developing countries, agricultural scientists from developed countries often have a problem reconciling the enormous needs with the limited resources. In other words in setting priorities. The DAARP has generated good applied research but there has not been identification and focus on the most promising work. Nor has there been sufficient effort to develop the full capabilities in agricultural economics, rural sociology and technology transfer which would serve to help identify the most promising work. The 1990 scientific review panel stated, "there is a need to prioritize the research, but the mechanism to do this is inadequate. The Center should take a realistic look at what can be readily accomplished".

The rule of thumb for setting research priorities in developing countries is that they must make a yield improvement of 50 percent or more in order to be of any interest. Factoring in the costs and risks of innovation for a subsistence farmer, a positive impact of this magnitude is necessary to justify his investment. There are general qualifiers to this rule. For instance, single practice innovations, such as the introduction of an improved wheat variety, will gain acceptance with a positive yield impact much lower than 50 percent. In the case of the center in Settat, there are other qualifiers. Large, progressive farms will accept innovation which has a yield impact much lower than 50 percent but, in general, this principle holds true as will be seen in the discussion of the "short term impact" research priorities below.

There will not be any attempt here to discuss all of the research of any given discipline. Rather the only work discussed will be that which effects its classification here. Please refer to Annex 7 Tables 1 and 2 for a summary of the technologies produced by the disciplines discussed here.

a. Short to Medium Term (1-10 Years)

Included in this section are the high impact disciplines which can be expected to make major contributions over the next decade.

(1) Cereal Improvement

Cereal improvement has already contributed many new crop varieties since the beginning of the DAARP. Annex 7 Table 1 shows the contribution by the DAARP to each new variety that has been produced by the national cereal improvement program. Cereal improvement in cooperation with plant pathology and entomology can be expected to continue making important contributions to dryland agriculture. Official inscription in the national catalog prior to release provides a well-defined endpoint for variety development.

INRA center staffing in this area is more than adequate. It is reliably reported that half of these center scientists will be moved to other INRA centers in the near future. Given the staff that would remain at Settat and the cooperation which would be possible between the centers, reassignment of these scientists would have positive effects for both the INRA center in Settat and for the national programs in cereal improvement.

Taylor (1991) points out that "six to ten years are necessary for promising lines to be identified, evaluated and released as new varieties". In this case, the DAARP had the advantage of INRA already having a cereal improvement program in place when the project started. The cereal improvement sub-program has performed well and this is not unexpected. Crop improvement has a long tradition of being a reliable contributor to agricultural development.

In cereal improvement, the DAARP made a fundamental contribution when the sub-program was guided into selecting for specific insect and disease resistance, rather than more general characteristics. Beyond this, the cereal improvement sub-program had several built-in advantages. A strong general interest in its work probably has insulated it from any dislocations which INRA may experience after the project is completed. Also, the fact that it is comparatively easy to gain widespread acceptance of an improved variety means that this discipline is likely to have a major impact on Moroccan dryland cereal production with or without the presence of a good technology transfer program in INRA or at Settat. It is these characteristics of crop improvement which make it so popular at international centers.

Given a decade for its full impact to be felt, cereal improvement will in all probability repay many times over the investment which has been made in the DAARP. Continued development of disease and insect resistant varieties are crucial to this projection. Considering only Hessian fly resistance, Watts wrote in 1987 that "since the expansion of the program important research findings have already been made that will have enormous impact on the agriculture of the region over the next ten years. Indeed, when newly developed technology is perfected and disseminated, the annual economic gains to the region from only one major effort, the control of Hessian fly damage in winter cereals, is expected to equal 2/3 of all funds (Moroccan and American)

invested in this project from its initiation until the expected PACD in 1994."

A major contribution of the DAARP has been to supply technical assistants to help support the INRA cereal improvement work while Moroccan scientists were being trained in the United States. And, in introducing plant breeding programs which worked on specific insect and disease resistance, rather than general characteristics.

(2) Entomology

Entomology and plant pathology share the characteristic that a significant part of the contribution which they will make to the DAARP will be via their interdisciplinary efforts with cereal improvement. Entomology has sufficient staff and facilities to fulfill its role under the DAARP. The basic yield loss studies from insects affecting cereals have been completed. On-going work will provide the information necessary to integrate and refine insect management. Given the small size of the staff and the large amount of useful work which can be done there is no possibility that this discipline will be overstaffed or underworked during the life of the project. If the DAARP's mandate is expanded to include all dryland and irrigated farms, then this department will be understaffed. Irrigated agriculture would make much heavier demands than dryland agriculture on the know how of entomologists.

Entomology, along with weed science and plant pathology, are the "plant protection" disciplines. These are the disciplines which make extensive use of agricultural chemicals. These disciplines should move into integrated pest management and responsible use of chemicals. This is important both for agricultural production and the environment. Unfortunately, entomology does not have the staff necessary to work in all the areas which it could make a major contribution. It is unquestionably the most understaffed of the established disciplines at the center. Annex 7 Table 3 shows the comparisons between disciplines.

This department has experienced both achievement and opposition. It was the screening of varieties by this department which within a period of about three years led to the release of Saada wheat. Saada wheat is noteworthy because the work was done quickly and it had a positive if very limited impact on the driest, most disadvantaged wheat growing regions.

However, the Saada wheat effort has been strongly criticized. The Saada variety was identified as Hessian Fly resistant and promoted by entomology, rather than cereal improvement. One of the causes of this extra-disciplinary activity was that at the time most of the INRA plant breeders were working on their Ph.D.s. MIAC and USAID became enthusiastic about Saada wheat's prospects and pushed hard for its official release within a context of high and, as it turned out, excessive expectations. Resentments were generated within the cereal improvement section not only because its more conservative view of the true potential of the Saada wheat was proven valid but also because the Moroccan system for approving varieties was not fully respected by the American scientists.

One of the consequences of this incident has been that attempts to develop a strong entomology

department at the center have not been given adequate support by INRA. This is unfortunate because entomology should have had equal status with plant pathology in crop improvement, plant protection and integrated pest management. Work by this department in integrated pest management and in identifying further Hessian fly resistant genes serves as a good example of the type of investigation required to generate a good applied research program both in entomology and in support of applied work in other disciplines.

(3) Plant Pathology

The role and performance of plant pathology has been similar to that of entomology except that it has had stronger INRA staffing. Current staffing is more than adequate to meet the demands of the center. The yield loss and cereal disease studies have been completed. One scientist has now been assigned to another INRA center and there is the possibility that another may also be reassigned. If this happens, it will not have any serious negative influence on the work of the DAARP with its present mandate. If the mandate is expanded to include all agricultural enterprises in the region, then there would be problems because this would include the high value field and greenhouse crops, which are grown in the maritime crop zone along the coast. These growers often need the help of skilled plant pathologists. Staff is sufficient to give attention to all of the needs of the region but this is not to say that current staff would not have to make a special effort to meet the needs of this latter group.

On the basis of yield loss surveys, plant pathologists identified the pathogen Septoria tritici as a problem which needed the attention of plant breeders. Varieties which will be released in 1992 and 1994 will have resistance to this disease.

"Diseases are obvious and pervasive in a year of adequate or abundant moisture such as 1988. The same conditions also contribute to good plant growth and abundant yields. We expect cereal yields to be very good in the areas seen, but diseases are reducing potential yields. In the Merchouch area, for example, the bread wheat cultivar Nesma in some fields will likely yield substantially less than expected because of the presence of Septoria tritici blotch. Other diseases are having equally dramatic effects upon yield." (INRA/MIAC Scientific Review Panel, 1988)

Other cereal diseases which have been surveyed include net blotch on barley; BYVD on barley and durum wheat; tan spot, root rot and rusts on durum and septoria and leaf rusts on bread wheat. Yield loss estimates range from 25 to 40 percent for these diseases.

(4) Weed Science

This discipline has done some work on weed surveys and the practice of pulling of weeds which relate to the production methods of small farmers. But generally it does not work within the DAARP mandate because its work with herbicides does not have application to the needs of small farmers. Therefore, it is clear that weed science staff and facilities are more than adequate to meet the needs of the project under the DAARP mandate. Weed control is extremely important to profitable dryland and irrigated crop production. If the mandate of the DAARP is

expanded, then this department will be fully utilized and perhaps even stretched some beyond its capacity. This discipline has an excellent record for identifying research problems and then bringing experimental work to a quick, well-defined conclusion. (Annex 7 Table 2)

In 1984, a drought year, one experiment using 2-4D for broadleaf weed control in early-planted wheat resulted in an estimated 30 to 40 percent increase in grain yields. Prior to 1985, about 10 percent of the wheat farmers used this technology. In that year, a letter was prepared by an INRA Settat weed scientist which explained how this new weed control technology should be used. This information was widely publicized by the extension service and other means. As a result of this effort, in 1986 about 20 percent of the wheat farmers used this technology. This represented an increase of about 300,000 hectares in the wheat production area using this technology.

In 1989, the government started a program of jujubier weed control using the glyphosate/sweep technology developed by this discipline at the center. Currently 1,000 hectares are being treated near Sidi El Aydi by a private company under contract to the Moroccan government. Robert Zimdahl (1991) stated the following in his comments on the draft of this report:

> "The problem with control methods for jujubier is that they are complex, require petroleum energy, are fairly sophisticated in terms of chemical usage, and are costly. They do work. The control methods have those problems because the weed is difficult to control. If the research had been done in the United States, it would have been immediately transferred to farmers and commercial applicators through the extension service. The research was that good. To control the weed in Morocco is impossible without complex, sophisticated, energy intensive, costly technology. There is nothing wrong with the research, but it cannot be applied given Moroccan agricultural conditions. A good technology was developed and it was inappropriate to attempt to transfer it to farmers. If the government became involved through subsidized control or if a commercial enterprise were developed, jujubier could be controlled in Morocco."

Given the moisture constraint in dryland agriculture, it would seem clear that weeds would definitely be considered a pest but a debate does exist on this issue. One side is stated by the 1990 scientific review panel to the effect that "in Morocco, weeds are gathered from crops and utilized as forage for livestock and, as such, have a positive value for farmers. Thus, a very complex system must be elucidated so that the positive value of weeds as forage and the negative impact of weeds in reducing crop yields can be put in proper perspective. Control measures must be developed that integrate both the negative and positive values of weeds into weed management systems that maximize farmer profit." (INRA/MIAC, 1990) The other side is also stated in the same document as "...weed control is, in our opinion, the major limitation to crop yields in the region...." and "...the biomass of crop plants is reduced more or less in proportion to the weed biomass that is allowed to grow." Weed scientists also point out that only about 30 percent of the weeds pulled from cereal fields are suitable for livestock forage.

In any case, this is an area where social scientists and production scientists are disagreeing openly. Some work was done to try to resolve the issue. In 1986, the DAARP evaluation report stated that "an experiment is underway in weed science to compare the trade off of using weeds pulled from wheat for livestock feed with the additional yield of wheat grain and straw if weeds were controlled with herbicide treatment". (Winrock International, 1986) For production scientists, this study settled the issue in favor of weed control but the debate has continued.

(5) Food Legumes

Food legumes are both a discipline and a sub-program. All food legume agronomy and improvement is conducted out of this department. The fact that food legume production is declining in Morocco has become a matter of concern to the government. The food legumes discipline is often singled out as the discipline which is in the process of becoming the most overstaffed at the center. Once the work with winter chickpeas has been completed, food legumes can be expected to move to the "mature" category but this sub-program has received strong support and currently has three Ph.D. and one M.S. candidates in training. The current staff is adequate to the needs of the program which has as its most important work in testing winter chickpea varieties provided by ICARDA. (Annex 7 Tables 3 and 4) A change in the mandate of the DAARP to include all dryland and irrigated crops would not make any significant change in this situation. Normally, food legume work would not be expected to be found among innovations having a high impact. As the 1989 scientific review panel put it "....there will never be a yield breakthrough in grain legumes". The potential of winter chickpeas is apparently an exception to this general rule.

"The winter chick pea work is thought to potentially increase yield by 100 percent...." (Winrock International, 1986) The 1986 scientific review panel put the projected increase at 160 percent. The principle involved is simple and promising. If chickpeas can be planted in the late fall instead of the spring they will benefit from a longer and a better growing season. Winter chickpea yields in trials have been high and, because the plants are more upstanding, they are more adapted to mechanization than spring planted chickpeas. On the negative side, winter chickpea varieties have smaller seeds which are not desirable to commercial outlets in Morocco. More importantly, winter chickpeas have proven to be vulnerable to disease during the cool, moist winter months. Varieties currently being tested are improved in both of these characteristics. By 1987, enthusiasm for some winter chickpea varieties was so high that three were released. One was so vulnerable to disease that it was withdrawn the next year. Another of them will probably be withdrawn this year. The third is a small-seeded variety but it has some disease resistance and is being used to a limited extent by farmers. (Annex 7 Table 2)

Work in Morocco with winter chickpeas using ICARDA materials was started by M. Kamal in 1979. When he came to Settat in 1984, he was coordinator for the National Food Legumes Project. This national project has had its headquarters in Settat, with a DAARP participant as its coordinator since that time. During this period, all field testing and selection has been managed by the INRA center but all of the varieties being tested are ICARDA varieties. The best of those being tested now show somewhat larger seed size and much improved disease resistance.

Food legumes is the discipline which is intrinsically most likely to help small to medium sized farmers. Larger farmers tend to stay away from food legume production because of the hand labor involved. Because of problems with yields and mechanization, food legume hectarage in Morocco is falling. Ironically, if winter chickpeas are improved sufficiently, the improvements will probably make the crop more attractive for large farmers to grow under mechanized conditions.

b. Long Term (10-20 Years)

Soil management and forage groups are working on comparatively low intensity innovations which will change production systems. Their total impact in the long-term could be enormous but it will probably require many years to effectively transfer these technologies for farmers. For this reason, the transfer process should be initiated immediately. Enough evidence has been gathered to clearly demonstrate the advantages of ley-farming and no-till farming. The experiments should continue in order to increase the information available on these practices but they should not be allowed to continue indefinitely without becoming a part of a vigorous technology transfer effort. These are the disciplines which have a major natural resource management element in their work. Such work is seldom high return in its short term benefits. In this case, it should be factored into the contribution which these disciplines can be expected to make to the dryland farming regions of Morocco.

(1) Soil Management

This discipline is respected at the station but it is considered narrow in its approach to research. The new staff are broadening the work but they are still not inclined to cooperate with other disciplines. This discipline would not be affected by any change in the DAARP mandate since it has never operated within the original guidelines. Staffing is right for the work which is being done and which should be done in a technology transfer program.

The work is not only slow, it is expensive. Major expenditures for field equipment, trucks, trailers, labor, conservation structures are commonly needed. Theoretically, some of this money could probably be found from equipment companies for tillage and from the government for conservation. Unfortunately, while this discipline has a reputation for doing good, careful work, it also has a reputation not only for not working with other disciplines and for not being able to articulate the importance of its work.

Currently, the major effort of this discipline is a long-term -- already ten years -- rotation study which has demonstrated the usefulness of no-till cultural practices. These findings correspond with what has been found in similar environments elsewhere. They became evident about four years into the experiment. The no-till method uses herbicides and a special seed drill in place of tillage operations. The result is that the structure and organic matter level of the soil improves and the compaction of the soil declines. The no-till technology has its biggest impact under dryer conditions. Consequently, this discipline can justifiably claim that it is working on the stabilization as well as the increase of yields. No-till probably represents the only fundamental

improvement in dryland soil moisture management in Morocco since the Romans started using clear fallows.

The problem with no-till technology is that it requires the use of herbicides and specially adapted equipment along with adequate mechanized power for sowing. No-till is not adapted to either the capabilities or attitudes of small farmers. In fact, even with its demonstrable advantages, it is probably going to be a very long term job to gain acceptance of no-till among large farmers.

This discipline considers that it is working with water conservation as well as soil management. This is correct since in most instances the two are linked. Outside of this discipline other, much less tenable, claims to be working on water conservation are common. In fact "water conservation" takes its place along with "small to medium sized farms" as a justification for research where claims and reality most widely diverge.

The fundamental problem is that it is difficult to conserve something which is not being lost. Of course, there are bare, shallow soils on hillsides which are vulnerable to erosion when the rain starts and where water and soil loss are serious problems. But given the characteristics of a Mediterranean climate, such problems do not generally occur on most of the cropland in Morocco. Where they do occur, this is the discipline which should and is working on them.

(2) Forages

This discipline is overstaffed (Annex 7 Tables 3 and 4) and will not be affected by any changes in the DAARP mandate. All of its work could be more than adequately covered with half or less of projected staff. This discipline has benefitted from a large investment in stock pens for a grazing experiment. Of necessity the ley-farming work of this discipline requires long periods of time. Under such conditions, scientists should diversify their interests and be quick to participate in technology transfer efforts. Forage scientists are definitely not following such a course. No more money should be put into this discipline until its work is diversified and it becomes more serious about the job of transferring its ley-farming results to farmers.

Ley-farming is a method of rotating production of annual legumes with cereal production to the benefit of both livestock and grain production. It was developed in Australia and has increased livestock production there as a major objective. The technology is adapted for use in Morocco both on the basis of climate and the presence of native legumes -- i.e. medics.

The DAARP has made a major investment in ley-farming. "The forage program is developing along sound lines and has the potential of being one of the strongest of its type in the Mediterranean region" says the 1989 scientific review panel. In this regard, the Moroccan government was so impressed with the potential of ley-farming that in the mid-1980s an attempt was made to directly extend Australian medic varieties and ley-farming techniques to Morocco. The program is officially still in place but apparently it has been abandoned. The 1987 scientific review panel addressed the problem of establishing Australian ley-farming in Morocco and said that "simple transfer of the technology to Moroccan small farmers is sure to lead to the same

problems that various attempts to introduce ley farming to the Mediterranean basin in the last twenty years have amply demonstrated".

Ley-farming has large potential for improving Moroccan dryland agriculture but it is also widely acknowledged that it is going to require an excellent technology transfer program if it is ever going to make an impact. Again the 1987 scientific review panel stated "the on-farm experiments are a method of obtaining farmer "feed-back" or perhaps, more properly, farmer participation in the development of the new system. It is important to emphasize that this is a part of the research focus and, at this stage, not demonstration or extension". The 1989 scientific review panel said "a team of specialists should be assembled to demonstrate the ley farming method. Development of such a team seems to fall within the scope of the Service de Recherche-Developpement (SRD).... This should involve all aspects of the operation in an integrated, systems approach". In fact, the head of the technology transfer program at the center is a forage agronomist in recognition of the fact that technology transfer is so important to the acceptance of ley-farming by Moroccan dryland farmers.

While ley farming is usually thought of as having an extensive, rather than an intensive, impact, there have been some apparent dramatic increases in lamb growth and milk production on medic pastures as part of ley-farming experiments. There are also areas such as straw treatment with urea that have potential for making major impacts. On the other hand, work on perennial grasses and woody plants for dry area forage is good work but will never have a high per unit area impact.

This discipline belongs in the "long-term" impact category at present but it has potential for moving into the "short to medium term category" with immediate, high impact forage treatments and storage work.

c. Mature Disciplines

These are disciplines which are now making only marginal on-going contributions to achieving the goal and purposes of the DAARP. They are the disciplines which need to have their work redefined. Both soil fertility and agricultural mechanization have yet to contribute their first technology to the DAARP. Agronomy was an early contributor of technologies and continues to be a major participant in the technology transfer process but it does not have any prospects for delivering further technologies in the near future. All of these disciplines would probably move quickly to the top category if the DAARP mandate were changed to include both large and irrigated farms.

(1) Soil Fertility

This discipline has a very limited role to play in the DAARP. Unfortunately, it has received a great deal of attention and support. (Annex 7 Table 3) If the mandate of the DAARP is not changed, soil fertility should be combined with food legume agronomy or cereal agronomy. If the DAARP mandate is changed, its efforts should be focused on irrigated agriculture.

More than any other discipline, the work of soil fertility has been constricted by the DAARP mandate. In the drier wheat production areas and the barley production areas, few, if any, farmers use fertilizer. In fact, cereal agronomy does not recommend fertilizer use for wheat production in the dry areas. Small farmers are conservative even in the more moist wheat production areas and often use little or no fertilizer there as well. Large farmers in the moist areas who use fertilizer are both conservative and opportunistic in its use. Early applications are low. If rains are good as the season progresses, the larger farmers will top dress their crops with urea. This environment gives very little latitude for precise, aggressive fertilizer recommendations.

In spite of these facts, the scientific review panels have repeatedly praised and encouraged the soil calibration work, which formed a major part of this discipline's effort. The work of this discipline has not been theoretical or basic. It has been applied but within the confines of the project mandate there was little potential for this applied work to be of any practical value. The terms applied and practical must be kept separate in the evaluation of a project such as the DAARP. Low-impact applied work is of no practical value in achieving the goal and purposes of the DAARP. There has been more good work for less practical use in this discipline than in any other in the project. Outside the project mandate, the careful thorough approach which this section has taken to its work would have its best application in irrigated agriculture.

(2) Agricultural Mechanization

This discipline is attempting to accomplish in the late 1980s and early 1990s what most other disciplines accomplished in the mid to late 1980s -- i.e. to test and recommend at least one technology which is relevant to farmers, if not small farmers. Agricultural mechanization is about five years behind the other disciplines. INRA had a difficult time recruiting staff. Efforts by early MIAC technical assistants proved to be ill-conceived. Anticipated staffing (Annex 7 Tables 3 and 4) should be adequate to meet the needs of this discipline. A broadening of the DAARP mandate could have a dramatic effect on agricultural mechanization activities if the discipline is allowed to start working with large dryland and irrigated farms. This is where there are both an obvious need and a willingness to accept mechanization. Working within the DAARP mandate and trying to solve the mechanization problems of small farmers has been a very difficult and, to date, unsuccessful effort.

The seed drill is the current focus of activity. Opinions are mixed as to its prospects. Some progress has been made but it has been slow in coming. Two years has been mentioned as a reasonable outside limit for continued effort on this technology without strong evidence of interest in the drill by farmers.

In retrospect, it is difficult to believe that in the early stages of the DAARP agricultural mechanization was ranked with cereal improvement in terms of its likely impacts on dryland farming. By 1986, in referring specifically to the sweep and planting equipment, the evaluation report expressed some doubts about projections saying "benefits of the agricultural engineering program are thought to increase yield per hectare by up to 100 percent; however, we think this

is very unlikely". (Winrock International, 1986)

This program was definitely hurt by the lack of an on-going INRA project when the DAARP started. Additional setbacks were the difficulties INRA experienced attempting to recruit engineers for this program and the lack of results from its work on the sweep. The heralded benefits of a sweep for mechanical weed control are another example of technology development having a negative impact on an important discipline within the center. To this day, the sweep is not without its defenders. Weed scientists even found an unexpected application for this implement in jujubier control but it has never remotely approached its projected benefits as a water conserving tillage implement. Table 2 of Appendix L in the Winrock (1986) evaluation report put projected benefits at 65 percent for the arid region tillage sweep machine - generation 1 and at 85 percent for arid region and general tillage for Morocco - sweep machine generation II. It is difficult to conjecture as to what assumptions and calculations went into these projections. The use of offset disks for tillage in Morocco corresponds to tillage practices in similar dryland production regions in other parts of the world. Excessive moisture loss is not a characteristic of this tillage method. Consequently, there was little, if anything, to be gained by changing it.

Besides the sweep problem, INRA had a difficult time recruiting engineers as participant trainees. One position remained open for three years. The contrast between MIAC and INRA enthusiasms for and participation in this discipline are clearly shown by the fact that agricultural mechanization is the only discipline which has had more MIAC technical assistants than Moroccan engineers assigned to it--- and that by a resounding margin of 16.5 to 6.25 scientist/years. Agricultural mechanization actually edges out entomology by one scientist/year as the discipline having the lowest complement of INRA staff. (Annex 7 Table 3)

An attempt was made to import technologies. This discipline sent a sociologist/ag engineer team to other developing countries to look for machinery adapted to the needs of small to medium sized Moroccan farms. Several promising machines were imported but they all failed to generate any interest. Now three INRA engineers/researchers are either abroad or appointed for participant training. This should eventually help reconcile this department's performance and promise.

Settat has the only agricultural mechanization program in the INRA national system. Despite its problems, the fact remains that progress in agricultural mechanization has been fundamental to the progress made in modern agriculture. With this in mind, there are two reasons why this department is important to the project, especially if the DAARP mandate is broadened. First, even progressive Moroccan dryland farms have major discontinuities in their levels of mechanization. Second, mechanization efforts at a somewhat reduced scale will probably be necessary to extend the impact of expected production innovations to small and medium sized farms

(3) Cereal Agronomy

This is a productive discipline but it needs some rationalized direction to its work. It has outgrown the DAARP mandate. The cereal agronomy program is disproportionately large relative to the needs of the DAARP program at Settat. However, if cereal agronomy continues to expand its activities in technology transfer and if its work in supplemental irrigation is officially sanctioned as a part of the DAARP, then the level of cereal agronomy staffing would be justified.

Questions about work by cereal agronomy in crop modeling and crop physiology are legitimately raised. At some point, these experiments need to be brought to a conclusion and written up. Cereal agronomy had contributed several technologies to the DAARP by 1988. This is characteristic of the nature of agronomic research. It can generally come up with recommendations quickly compared to other disciplines -- all the more so in this project where the practices of progressive farmers provided direction for this work. Agronomy is also in the best position to combine contributions from various production disciplines into "packages". The problem for agronomy is that its contributions to agricultural innovation often involve changes in production systems and thus are difficult to transfer.

4. Definition of Future Programs

For production research, the requirements of the DAARP to deliver applied technologies were being met by 1988. Relevant technologies had been developed for small to medium sized dryland farms. From that point on, the DAARP's major problem relative to the target group became one of technology transfer. The production researchers have and will continue to develop technologies faster than they can be transferred to small to medium sized farms. This can be done with less staff and facilities than those available at the INRA center in Settat. As was stated in the 1988 scientific review panel report what is lacking is a respect among center scientists for the importance of a technology transfer process. It said that "finally, it needs to be reemphasized that on-farm experimentation is scientific research. It can in some cases be appropriate for thesis research and it always calls for broad scientific skills, in planning, execution, analysis and publication. In no way is it of lower status than on-station research and it is likely to be more rewarding for young Moroccan scientists".

In this context, the lack of appreciation for the work of agricultural economists and rural sociologists is nearly absolute among production researchers. Numerous yield reduction studies have been done by plant pathology, entomology and weed science without any thought being given to incorporating economic analysis into the work. Also, economic analysis is never a part of problem identification or of protocol preparation. But the lack of interest in agricultural economics is most injurious to the project in the complete lack of interest in documenting the positive impacts which the DAARP has had on dryland farming. Progress on technology transfer has been slow but there is general agreement that attitudes and personalities at the center have delayed progress in this area.

The problems which the DAARP has had with its research program have not been faced forthrightly. In print, they are usually generalized with expressions like "lack of priorities" and "drift". In conversation, identification of the problems becomes focussed on a contrived mandate, hidden agendas and inequities in the balance of development and contribution among disciplines. Forages, food legumes and cereal improvement have all received excessive support from the DAARP. In the case of cereal improvement, this is tolerable because the discipline is highly productive. However, forages and food legumes are disciplines which have not been highly productive. Entomology has been highly productive and is unquestionably a crucial discipline but support and staffing have been minimal.

The purchase of high-tech equipment is also regularly criticized. That high tech equipment purchases have been made without attention to maintenance and practicality is widely acknowledged. While it is beyond dispute that the Center will have problems maintaining equipment, it should be noted that it would not have been easy to avoid this situation. There would not have been any point in searching out old fashioned equipment for the project. When all new equipment is purchased for a project, the impression is often conveyed that an excessive purchase has been made. "Our equipment is not that good in the States" is a common comment but research institutions which have been established for many years would be expected to have equipment of varying ages.

The problem between the DAARP and its mandate is the result of the contrast between its generous funding and its small, narrowly defined target. Although constant lip service is paid to meeting the needs of small to medium sized dryland farms, in practice it is impossible to focus the work of the project on this target group or for this target group to utilize even a small portion of the innovation which has been and will be generated by this project.

If the time, resources and staff remaining to the DAARP are going to be put to best use, it will be necessary for all participants to discuss frankly and in an atmosphere of realism what the goals should be. The top priority is to develop a technology transfer process. The main goal would be to spread the benefits of innovation to as many farmers as possible. But it would be an active part of all technology development including those being designed for the most progressive farms. The work of the center should also be expanded to include the problems of all dryland and irrigated farmers. And, disciplines which are overstaffed should have some of their MIAC trained personnel distributed to other INRA centers.

These changes would represent moves toward optimum use of the facilities and staff which are available as a result of the DAARP effort. They will mean that the DAARP will have a major, long-term impact on Moroccan agriculture well beyond the technologies and varieties which are usually thought of as one of the main outputs of the project. It is neither realistic nor desirable for the facilities and trained staff provided by the DAARP to remain focused for any extended period of time on the production problems of small to medium sized dryland farms.

If work at the center were broadened to include irrigation and all sizes of dryland farms, the expanding and diversifying program would need more biometrics support than is available or

projected. Zimdahl (1991) in his comments on the draft report writes "the review team is apparently assuming that the statistics and biometry needs of the Settat program can be handled by the student now working at Nebraska. I disagree. I think more statistical assistance will be needed if the Center is to be staffed with 45 research scientists. The student now working at Nebraska will become a servant of the rest of the scientists and be unable to do his own work if he is the only statistician." Technology transfer and diversifying research would mean many new experiments to design. Work being done at scattered locations in situations where plots can be lost would need the help of biometricians to salvage reliable conclusions.

Morocco is beginning to tighten its pesticide regulations. Apparently new regulations will soon be put in place establishing qualifications for businesses selling agricultural chemicals. The DAARP should be careful to be a model of responsibility in its use and storage of chemicals. Dryland agriculture does not require large quantities or a wide variety of chemicals so it would not be difficult to get on the right side of this issue now. If the program starts working with irrigated agriculture, the importance of this issue will be multiplied several times.

Zimdahl, in his 1991 end of tour report, states that:

> "During my first few months at the Aridoculture Center, I identified a problem with pesticide storage and use. I submitted a lengthy memo to Dr. Keith and M. Kamel (then Center Director) in which I presented an inventory of all pesticides stored at the Center and at Sidi El Aydi. I recommended a review of pesticide use practices. To the best of my knowledge, nothing happened as a result of my initiative. My memo was informative and critical. Criticism is not easy to receive and deal with especially when it is appropriate.
>
> A new pesticide storage facility is near completion but I think a pesticide accident is going to occur at the Center or with Center staff. I don't know when or where, but I am sure it will happen if attitudes and practices don't change. Center personnel need a series of seminars or an instructional course on pesticide safety and appropriate use practices. My efforts failed to change things.".

Concern expressed by MIAC staff on this problem is what led to the decision on INRA's part to construct a pesticide storage facility. So the issue has not been neglected but it does need some forceful attention.

5. Review of Technology Development Process

The process of implementing PBO has been underway for several years now. The eventual goal is to bring a multidisciplinary effort to bear on specified problems. At the center, this would mean that disciplines would eventually be abolished in favor of sub-programs. Currently, sub-programs have been identified but disciplines have not been disbanded. The cereal improvement sub-program, with its plant pathology and entomology components, is probably already functioning along the general lines considered ideal within this method of organizing

scientific research. Otherwise, sub-programs exist in name only.

After 1987, the SRD program was modified. One of the results of having the same panel review the project every year had been that antagonisms had developed between some INRA scientists and some panelists. By that time, it was also felt that the recurring panel did not represent a broad enough spectrum of research interests. In 1988 and thereafter, panelists were invited to serve only once. This solved the problem of antagonisms being generated but it also resulted in a loss of continuity and perspective. In retrospect, it probably would have been better if the scientific review panel had been expanded and modified in 1988 but remained recurrent.

To date, the DAARP has benefitted from the fact that both on-going programs and well-defined problems existed at the time of its implementation. This has minimized the impact of any adverse effects which might have resulted from not having good prioritization and technology transfer programs in place. The preliminary indication at the beginning of this evaluation was that adaptive and applied research were not being given the priority intended and that the project might have lapsed from applied research work to basic research and publication. However, this has not been the case as is demonstrated by Annex 7 Table 5.

In retrospect it can be seen that the years 1987 and 1988 are important to understanding the prioritization and technology transfer problems of the DAARP. By that time, the project was making its first major deliveries of technologies. In 1988, cereal improvement group released sixteen new crop varieties; weed science had three technologies; a major innovation in chickpea production was initiated; and agronomy had developed five promising technologies. But there was not any capacity in place to facilitate or measure impact. The lack of a technology transfer process was severely felt at that time and since repeated attempts to remedy this situation have failed.

During this time, the overall continuity of the DAARP suffered the inevitable consequences of a change of leadership and a turnover of half of the resident MIAC technical assistance staff. Next, the scientific review panel process changed. The 1987 scientific review panel was the last with permanent members who brought continuity to their work. The 1988 panel was the first made up of one-visit experts. Although the latter panels have contributed a great deal of good advice to the project, they have often lacked perspective and, on more than one occasion, have generated low-priority, impractical suggestions.

During those years, the training program was going well and INRA was making a major commitment of money and talent to the center. There was a great deal of activity. The 1987 scientific review panel described it as follows: "The situation of the INRA/MIAC Project is in some aspects unique for it represents a bold attempt to develop both the physical and human resources of a new regional dryland agricultural research center through a partnership of experienced expatriate scientists and young Moroccan staff, most of whom have been, or still are involved in thesis work". Building -- and especially training -- were going well. In 1988, more money was committed to the project. After that building and training continued to go well resulting in an increase in research skill and capacity but even with the large infusion of funds,

establishing a systematic program for adapting promising technologies for small farmers has not been achieved. The DAARP had come up against the most difficult problem which a project such as this has to face. The 1988 panel put it succinctly "while there has been much discussion of interdisciplinary work in many agricultural research institutions, and there are a number of success stories, there are few examples to follow on how to institutionalize interdisciplinary research and technology transfer". In the meanwhile, the same promising technologies which were backlogged in 1988 are still backlogged in 1991. A few have been added but basically, as the technology transfer problem has remained intractable, the flow of promising technologies has decreased while research capacity has increased.

C. Progress Toward Development of a Technology Transfer System

1. Evaluation of Current Mechanism and Process

The present technology transfer mechanism has three main components:

- Researcher-directed on-farm trials of discrete technologies;
- Farmer-managed on-farm technology evaluations (OFTE); and
- Demonstration programs undertaken by the Service de Recherche et du Developpement. (SRD).

The researcher-directed trials are undertaken by scientists in the context of their on-farm trials. Their objectives are to assess the validity of on-station research program's findings and to get farmer's feedback in different agro-ecological zones. They are a good diagnostic tool for promising technologies being developed by the INRA sub-program scientists. The trials are completely managed by an individual researcher or a small research team.

The farmer-managed on-farm technology evaluations (OFTE) are carried out by the OFTE unit, which include sociologists, economists and agronomists. The technologies ready for transfer are introduced in the program to be evaluated in the farmers's own setting.

The INRA Service de Recherche et du Developpement (SRD) unit works through on-farm demonstrations, training and other linkage development activities. Demonstration trials are organized by the SRD with the Provincial Agricultural Extension Offices (DPAs). These trials display promising technologies which the local DPAs, the SRD and other national bodies intend to disseminate to local farmers.

In spite of the fact that concept of technology transfer emerged quite late in the project, there have been many attempts within the center at extension of technologies. A technology transfer model has been advocated within the DAARP but field experiences have already shown many limitations and drawbacks in this model. First, the model is highly theoretical and complex. Even among scientists at the center, there are various interpretations and understandings of how the model should be applied. (Annex 8 Figures 1 and 2) The second limitation is that there are divergent views of the roles for each component in the technology transfer process. This is general agreement on the steps needed, but there is disagreement on their order. Some people believe that the steps are as follows :

- Diagnostic Trials
- Evaluation Trials (OFTE)
- Demonstration Trials

Others believe that the demonstration trials should precede the evaluation trials. While still others prefer to proceed directly from the experiment station to demonstrations.

Limitation three is that the process is time consuming. It is estimated that if the entire model is implemented, it would require an average of seven years for a promising technology to progress through all of the technology transfer steps. Finally, the steps themselves are subject to comment and should take into consideration the following :

♦ Diagnostic trials -- ie. researcher managed on-farm trials -- are useful for identifying limiting factors to crop production in the various environments of the project zone. These trials would be more representative and relevant if the different agro-ecological zones of the region are clearly identified. It is urgent to speed up the agro-ecological characterization of the region.

♦ Another observation on diagnostic trials is that, while they are effective for getting feedback from farmers about the technology being tested, there is a high risk that the efforts will be spread too thinly among many zones. What is needed is to set up target zones and plan the diagnostic trials according to priorities zone by zone.

♦ The evaluation trials are believed to be a novel and effective technology transfer mechanism. The original design strongly recommended testing only one or two technical variables in each trial because of the difficulty involved in handling many variables on the farmers' fields. This strategy failed in many areas. As a result, many OFTE fields performed poorly in comparison to adjacent farmers fields. The incapacity to incorporate the optimum technology package is responsible for this failure. For example, Saada wheat and nitrogen fertilizer trials did not include appropriate seed bed preparation, early planting, weed control or other innovative practices.

♦ The technology transfer group does not involve scientists from other research programs at critical times during the growing season. Consequently, appropriate decisions are not made. The lack of good advice on weed control would be an example of this problem.

♦ Demonstration programs are undertaken by SRD, in association with the extension services of the DPA, DVRA and DPV. This work is progressing very rapidly since these programs are gaining national institutional support. It is expected that this evolution will render the OFTE system obsolete by drawing away the interest of research scientists.

2. The Interface Between Research Programs and Technology Transfer -- Or From Research Area Identification To The Farmer's field.

Research priorities at the center are not based on well-documented farmers' needs. Fortunately, so far, the research agenda development has not been a critical issue because the most important regional and national problems had already been identified and, in some cases, addressed prior to the start of the DAARP. Moreover, the problems greatly outnumbered the scientists available at the center. Scientists came to the DAARP from national programs in plant breeding, agronomy, soil management, forages, plant protection and food legumes. On the basis of their

previous experience, early scientists from these disciplines were able to quickly outline relevant research themes as they saw them. Scientists who joined the DAARP later chose research topics based on a combination of factors including the advice of their American faculty advisors; MIAC resident technical assistant preferences; an understanding of local conditions; their own scientific interest; and their own perceptions of farmers needs. Given the weight of these factors and the academic pressures to obtain degrees, actual needs articulated by real farmers were relegated to low priority.

Awareness of the importance of linking INRA/MIAC research programs to development needs of farmer is recent. At the project level, the technology transfer component was introduced only recently. At the INRA level, the SRD was created in 1988. SRD is now found at all eight INRA regional centers. Technology transfer does not as yet have any official status and it exists only as a program in Settat. A more important complicating factor in linking research and development is that the official mandate to disseminate agricultural technologies to farmers is in the hands of the government extension service -- i.e. the Direction de Vulgarization -- and the regional DPAs. Research and extension are not institutionally integrated in Morocco.

The SRD and scientific programs are actively involved in extension activities through demonstration trials, information dissemination and training. The number of on-farm demonstrations has increased as shown in Text Table 11.

In addition, 108 extension agents from different DPAs were trained (Text Table 12) during the last three years.

For the first time in the history of the Settat Center, a joint comprehensive demonstration program was launched in cooperation with the Settat DPA in crop year 1989/1990. In crop year 1990/1991, a similar program was added with the Safi DPA. This cooperation is, in our judgement, a success and even a unique experience in Morocco. With adequate support and refinement, this joint institutional effort could serve be a model for INRA centers and extension services throughout Morocco.

On the negative side, after the third year which was the 1990/1991 crop season, 50 percent of the original farmers who had cooperated in the FMTE trials in the past refused to participate again. In the activity report of January 1991, the team concentrated their efforts on explaining farmer-participant attrition. No convincing conclusions were reached. If technology was tested during three years and rejected, at least the reasons for rejection should have been identified. The reasons could have been one or more of the following: the inappropriateness of the technologies; the philosophy behind the OFTE process; or the inability of the team members to communicate effectively with farmers.

The technology transfer process should include a decision-making mechanism that allows it to drop or stop pushing for technologies that failed to be accepted by farmers. Research projects are not evaluated to check if they are both technically and financially viable for farmers. And, in this regard, center agricultural economists should play an important role during the

exploration, screening, development and marketing of a technology.

TEXT TABLE 11
ON-FARM DEMONSTRATIONS COORDINATED BY SRD (1986-1991)

	1988/1989	1989/1990	1990/1991
Number of Trials Technologies tested	Few 2	103 8	150 8
Location	Chaouia	Chaouia	Chaouia and Abda
Farmer/Extension Agent Visits	260	2,385	1,150
Cooperating Agencies	None	DPA Settat	DPA Settat DPA Safi

TEXT TABLE 12
NUMBER OF TRAINED EXTENSION AGENTS (1988-1991)

Year	Number	DPA
1988/1989 1989/1990 1990/1991	20 21 67	Chaouia Abda Khouribga,Marrakech, Essaouira.
Total	108	

3. The Research Program Outputs: Technologies For Users Or For Publications?

The number of extension leaflets is increasing but it is still very low when compared to the large audiences to be reached. The center distributed a total of 1,281 copies of four different extension leaflets and books, as shown in Text Table 13.

During the decade 1982 to 1991, staff at the center produced 643 publications. Only 5 percent of these publications were for extension publications. (Text Table 6)

TEXT TABLE 13
PUBLICATIONS DISTRIBUTED AS EXTENSION LEAFLETS AND BOOKS

Title	Number
Manuel de Lutte Contre les Mauvaises Herbes	1,000
Guide Comptable des Exploitations	100
Fiches Techniques	147
Mauvaises Herbes des Régions Arides et Semi-Aride du Maroc Occidental	34
Total Publications	1,281
Yearly Average	378

TEXT TABLE 14
TOTAL NUMBER OF ARTICLES PRODUCED AT THE INRA CENTER (1981-1991)

Type of Publication	Number of Publications	Percent of Total
Refereed Journals	200	31
Reports	306	48
Communications for Seminars	101	16
Extension Publications	36	5
Total Publications	643	100

Source : Computed from Repertoire de Publications des Chercheurs du Centre Aridoculture, Volume 1, 1990

Among the 200 refereed publications, 90 percent were in international journals and only 10 percent were in Moroccan journals. Local publication and extension leaflets should have received more balanced attention. (Text Table 15) In addition, it is striking that publication in Arabic has not been seriously considered.

The Center does not publish regular newsletters or bulletins for use by the Moroccan agricultural community. Without such technical material, it is difficult to see how it will be possible to serve effectively the wide range of audiences. Neither traditional nor mass media channels for communication are considered.

The basic and crucial element which is missing in the center's technology transfer program is staff who are knowledgeable in extension methods and agricultural education. Without this

ingredient, all the effort on technology transfer and SRD will be futile.

TEXT TABLE 15
TOTAL NUMBER OF ARTICLES PUBLISHED IN SCIENTIFIC JOURNALS (1980-91)

Category	Number of Articles	Percent
International Journals	180	90
INRA Journals	18	9
Other National Journals	2	1
Total Articles	200	100

Source : Computed from Repertoire de Publications des Chercheurs du Centre Aridoculture, Volume 1, 1990

4. Are There Missing Opportunities in Small-Scale Irrigation, Agro-Forestry and Horticulture?

Agro-forestry generally helps solve problems in areas with high rainfall and depleted soils. It would have little or no application in dryland production areas of Morocco, where soils tend to be young and moisture scarce.

Small-scale irrigation would have potential. The climate is superior and the soils adequate for good returns on irrigated crop production. However, given water quality problems in some areas where irrigation is being developed, care must be taken to avoid salinization of new irrigated soils. The center would be well-advised to investigate the problems and potential of irrigated agriculture. The agronomists already have some on-station experience in this area.

The maritime climate found on the Abda and Doukkala coast is well adapted to high value horticultural crops. The center is probably not equipped to advise on this highly specialized, intensive agriculture but it could play a supportive role in helping growers to avoid adverse environmental impacts, such as soil salinization, groundwater contamination and accumulation of pesticide residues.

5. Constraints to Technology Adoption: Macro-Economic and Sector-Level Policies

INRA scientists do not have any real incentives to engage in the dissemination of agricultural technologies to farmers. INRA should make drastic changes in its management procedures. Selected scientists should devote part of their time to technology transfer activities as an integral part of their jobs and receive commensurate rewards for doing so. If this step could be institutionalized, it would be a tremendous achievement. It would affect the whole INRA

structure. At present, however, scientists are motivated and evaluated according to their research activities and no incentives or career advancement steps accrue to them as a result of their participation in the center's extension program.

There are four observations which can be made on constraints to technology adoption.

- Decisions on research priorities are usually made against the background of little information on the potential markets for research outputs. Thus, technologies may be developed that are irrelevant to farmers' needs. An example of this type of mistake is the sweep developed by the agricultural mechanization section.

- All of the technologies being tested at the center need to have a vigorous economic evaluation in parallel with their technical development. Examples would be food legume harvesting equipment and seeders.

- There are no studies on the impact of government policies on research priorities and potentially desirable technologies. Market demand, import restrictions, price controls, tax incentives, loans, property rights and other regional opportunities need to be consider as an integral part of planning and implementing technical research activities.

- The ability to adapt to the changing socio-economic environment is a critical element in any technology transfer process. It is extremely important that mechanisms should be built-in to the center program to ensure that appropriate planning and feed-back from various clients are taken into consideration. Examples would be farmer interest in barley and sunflowers because of recently improved market conditions and the government pricing program.

6. Are Technology Users Integrated in the Technology Development Process?

Potential technology users are not integrated in an organized manner into the technology development process at the INRA center. However, through informal contacts and a few formal contacts, input from the following sources reaches the center -- field days, demonstration trials, meetings organized with the Chambre d'Agriculture and experiment stations' "open door" days. It is not clear how these activities and inputs influence the technology development process. It is quite likely, though completely undocumented, that farmers are benefiting much more than the research programs, from these contacts.

7. The Targeted Farmer and Technology Needs

In the dry zone, barley is the major crop. Maize is an important crop in the western coastal zone. Until now, these two crops have not received sufficient attention -- particularly as dual purpose crops. Crop-livestock multidisciplinary studies are needed.

If the users were integrated into the technology development process, they would like most like these programs and would express concerns about deficiencies in four neglected areas:

- Range Management;
- Barley Systems;
- Corn Production; and
- Alternative Feeds for Livestock.

Among these, the first two interest farmers in the southern project sub-zone and the third the farmers in the western coastal zone. The fourth would be a general concern across all zones.

From the list of technologies defined by researchers as ready for transfer to farmers (Text Table 16), it is interesting to note that only 5 percent of the recommended technologies are directed solely to the needs of small farmers. An additional 30 percent of the technologies listed are scale neutral. The remaining 65 percent of technologies are directed to medium and large farms

TEXT TABLE 16
NUMBER OF TECHNOLOGIES RESEARCHERS FEEL ARE READY FOR TRANSFER TO AREA FARMERS

Category of Farms	Number of Technologies	Percent of Total
Small Farms	3	5
Medium Farms	18	32
Large Farms	19	33
All Farms	7	30
Total Farms	57	100

8. Unanticipated Impacts of the DAARP

Major unanticipated impacts from the DAARP were identified. First, the project seems to have had effects on INRA with respect to stimulating a greater awareness of the need to take steps toward sustainability in research. Second, many scientists involved in the project are playing leading roles in INRA at the national level. Third, the project has contributed to the development and release of new and highly productive varieties of cereals in Morocco.

D. Relationships With Agribusinesses and the Private Sector

1. Analysis of Technologies

Within the framework of the DAARP, the theory and practice of techno ·gy transfer is in its infancy. This is because, over the life of the project, major emphasis has been placed on agricultural research and attention to extension activities is a very recent development. This

is why awareness of the importance of linking research programs to private sector needs is recent. Public agencies, such as SONACOS for seed marketing, SOGETA for seed multiplication and FERTIMA for fertilizer production and distribution, which have the mandate to market these basic inputs are actively involved in the technology transfer process, in association with extension services.

There are four areas where work at the center has related directly to the private sector:

a. Agricultural Chemicals -- Insecticides, Herbicides and Fungicides

In 1989, the government started a program of jujubier control using the glyphosate/sweep technology developed at the center. Currently, 1,000 hectares are being treated near Sidi El Aydi by a private company under contract to the Moroccan government. The INRA center has also been retained to perform the tests required for labelling before agricultural chemicals can be released in Morocco. The work has involved insecticides, herbicides and fungicides and has been performed for BASF, Rhone-Poulenc, Bayer, Ciba-Geigy, CPCM, and SIF (ICI). Finally, a recommendation by the weed science department to use 2-4D and other phenoxy herbicides for broadleaf weed control in early planted wheat resulted in 75 percent increase in the area sprayed.

b. Seeds

Most of improved cereal varieties used by the private sector have been adapted or developed by INRA. The project's contributions to development of new varieties vary from 30 to 100 percent depending on the variety (Annex 7).

c. Fertilizers

The mobile soils laboratory may have some application in high rainfall areas where progressive farmers want to refine fertilizer recommendations. Originally developed as a part of the project, the INRA administration now considers this to be a likely technology for private sector use.

d. Agricultural Mechanization

The agricultural mechanization section has already enlisted private sector participation in the construction of the animal traction seed drill. RIAM, a private company, has already signed an agreement with INRA to manufacture this equipment. In addition, a tractor-drawn seed drill is in its final phase of development, in collaboration with IAV.

For large farmers, there are several areas where the project could offer advice. These would include a sunflower/food legume seeder, sprayers, and calibration of planters.

e. Agronomy

Center agronomists are regularly sought out by private sector interests to provide information and advice on proposed innovations or enterprises.

2. Encouraging the Transfer of Technologies to the Private Sector

The GOM has instituted major reforms and liberalization measures. As a result, the private sector will play a more important role in technology dissemination in the future. In the seed industry, the private firm, Benchaib Limited, is now able to register and sell its own cereal varieties (Mouna variety). INRA should make appropriate changes in its procedures so that all private companies could compete for released varieties. This may provide higher royalties to help sustain research programs.

In a meeting held on May 10, 1991, Moroccan seedsmen stated their interest in cereal varieties being developed by INRA. Specifically, it was stated that they would be willing to pay one Dirham per quintal more for certified seed than INRA now receives from SONACOS. Specific prices and amounts of seed were not discussed but prices are unlikely to reach the 8 Dirhams per quintal, which INRA currently needs to cover its costs for cereal improvement.

In the area of advisory services -- i.e. agronomy, soil testing, plant disease diagnoses -- the project could charge fees for its services. In the past, private farmers have attempted to have soil analyses done at the center's laboratory for soil analysis but with little success because of institutional constraints imposed by public financial system. INRA needs to introduce new procedures to serve these potential clients.

Regarding the other technologies -- agricultural mechanization and agricultural chemicals -- there is a little scope to accelerate their transfer to the private sector.

3. Analysis of Demand Within the Private Sector

To date no market analyses of potential technologies has been done by the DAARP. As mentioned before, decisions on research priorities were made without consideration to the potential markets for technology outputs.

In the seed industry, there is evidence of an increasing demand for certified seed, as indicated in Annex 8 Figure 3. This is supported by the observation made earlier about Benchaib Limited company. Seed technology has the highest potential.

High demand exists also for fertilizers (Annex 8 Figure 4) and for pesticides (Annex 8 Figure 5), an area where the project should improve its services in fertilizer formulation, pesticide application, and agricultural chemical safety procedures.

The potential market for existing agricultural machinery, such as tractors (Annex 8 Figure 6)

and other implements (Annex 8 Figures 7 and 8) is showing good prospects. It is doubtful that the various machines developed by the project will compete effectively with the machinery sold by the stronger implement firms (Annex 8 Figure 9). However, there may be a niche for the animal traction seed drill for hillside farmers. Well-known Moroccan implement companies have visited the center but they did not express any interest in manufacturing the small equipment developed by the agricultural mechanization section.

IV. EVALUATION RECOMMENDATIONS

A. General Recommendations

1. Developing a Common Mandate for Program Planning and Sustainability

The zone of influence mandated by the GOM for the INRA regional center program based in Settat is defined in terms of three regions of Morocco -- Doukkala, Abda and Chaouia. These regions do not correspond necessarily with the ten provinces defined as the current project zone. Second and more importantly, the INRA regional center is mandated to work with all farm households within its defined zone, not just with farmers having small and medium-sized farms. And, third, the INRA regional center is required to work with a broader array of agricultural enterprises within its zone than is currently the case in the DAARP mandate. Enterprises additional to the project mandate include, at a minimum, fruit, vegetable and specialty crops grown under dryland conditions and all crops grown under small-scale irrigation outside the large public irrigation perimeters -- e.g. Tadla and Doukkala.

The evolution of USAID's country development assistance strategy and the specific place of agriculture and the DAARP within it appears to have introduced some new elements into the institutionalization equation. USAID strategic orientations in agriculture appear to be shifting toward a broader and more inclusive view of agricultural problems in Morocco. There is more concern for establishing the proper -- and complementary -- roles of Moroccan public agencies and private firms in development of the agricultural sector. There is also more emphasis on allowing market forces to determine the evolution of agricultural innovations and enterprises within Morocco and on putting USAID resources in the service of this process -- rather than using funds to "tilt" sectoral development patterns a priori in favor of certain farmer groups, crops or technological innovations for reasons of internal policy or efficiency versus equity considerations.

At present, then, there are two different mandates at play in Settat. They are the "Aridoculture Center" program mandate as defined by the project and the INRA regional center program mandate as defined within the INRA national structure. This variance in mandates causes problems with respect to what elements should rightfully be in the present center research program and, more importantly, what elements are to be institutionalized in the future.

To remedy this situation, the evaluation team strongly recommends that USAID take steps to rationalize the points of conflict between the DAARP and INRA mandates so as to create a more solid basis for program planning in the present and discussions of center sustainability for the future. To make the mandates compatible, we specifically recommend that USAID take the following steps:

a. That the DAARP goal statement be revised to read "The goal of the project is to increase food production in order to meet the needs of Morocco's fast growing population and to improve the income of farmers.

b. That the zone of influence for DAARP activities be considered the same as for the INRA center -- i.e. the regions of Chaouia, Abda and Doukkala.

c. That, while research on problems of dryland agriculture continues to be the primary focus of the DAARP, scientific assistance to other types of agricultural enterprises also be considered as equally appropriate.

d. That the center being developed in Settat be formally referred to by its proper legal name -- i.e. the Centre Regional de la Recherche Agronomique de Doukkala, Abda et Chaouia at Settat -- and no longer as the "Aridoculture Center".

e. That full recognition in program planning be given to the fact that the center in Settat is and will continue to be a regional research center within the national INRA system of eight research centers -- and that the center has no accepted status in Morocco as a national center in and of itself with international linkages.

ACTION: USAID

2. Program Focus and Prioritization

Beginning with the INRA/MIAC work plan for FY 1992 due to October 1991, the MIAC and INRA work plans must include, at a minimum, the following sections:

a. A defined and well-articulated agro-ecological and socio-economic typology of project zone and its farmer-client groups;

b. A clear statement of how the research objectives including diagnostic trials and other SRD activities are linked to that typology and to a recognition of the potential impacts to be achieved from each project;

c. A concise recapitulation and assessment of the previous year's research work enumerating both the successes and the failures;

d. A discussion of the anticipated research to be carried out, in four categories: continuing work by non-degree candidate researchers, new work to be initiated by non-degree candidate researchers, continuing research by degree candidates (marked as to whether it is or is not research for the degree), and new work to be initiated by degree candidates;

e. A concise statement of general problems encountered in the project in the past year and proposed measures to alleviate those problems; and

f. A clear and unambiguous presentation of the state of program finances -- including both actual and projected disbursements from the MIAC contract budget and the INRA budgets. To help develop this plan and work in this area on a permanent basis, an INRA Deputy Director for research planning should be recruited.

ACTION: MIAC and INRA

3. Center Management

A range of center management problems require resolution. There are questions that bear directly on center sustainability. In the opinion of the evaluation team, they require the appointment of a deputy director for administration at the center. Key goals that must be achieved are:

a. Technical and support staff time needs to be allocated and managed much more efficiently;

b. A formal motor pool system needs to be established in order to reduce vehicle operating costs;

c. A central stores system is needed for all parts and disposable supplies;

d. To avoid task duplication, soils and quality analysis laboratories should serve the entire center and bill other sections for their services;

e. To reduce costs, attempts should be made wherever possible to group on-farm trials, evaluation trials, and demonstration plots within each relevant area.

In addition to these specific items, in order to maximize the utility to be derived from the capital expenditures on facility construction over the last decade, we strongly recommend that INRA priorities now shift to providing adequate financial and human resources for INRA center maintenance. In this regard, a common rule of thumb used in the United States is that one must anticipate annual maintenance costs on infrastructure to be between 10 and 15 percent of the total value of the buildings in question.

Maintenance and upkeep of capital equipment within the center is another source of increasing concern as the project moves towards 1994. Given that rapid replacement of costly pieces of equipment will be difficult due to INRA budgetary constraints, we recommend that INRA administrative personnel at both the national and center levels place a premium on developing and maintaining a capacity to properly operate and adequately service all of necessary capital

equipment in place.

ACTION: INRA AND MIAC

4. **Improvement of Field Research Stations**

Field stations need improvement both in physical terms and with respect to their management systems. Evaluation team priorities are as follows:

a. One of the four stations -- Jemaa Riah -- is in need of almost total renewal of buildings and equipment. Erosion control work must be undertaken on some fields. Two other stations -- Khemis Zemamra and Jemaa Shaim -- need infusions of capital for new equipment and building repairs. All three stations need to be linked to the INRA/Settat by an effective communications system.

b. Before any investments are feasible, however, INRA must develop and begin to implement an operational plan for the cost-effective utilization and self-management of the four stations.

c. The plan must include a five-year strategy to:

(1) Manage land use for all field station cropland -- research and commercial activities;

(2) Manage technical staff and field labor -- permanent or seasonal -- much more efficiently;

(3) Provide operational budgets to purchase necessary inputs for both research and revenue-generating activities and to use them in a timely way; and

(4) Arrange for rational sales of commodities produced on the stations.

Most important, the operational plan must be reinforced by a legal guarantee and delegations of authority from the Ministry of Finance and INRA in Rabat that the annual revenues generated from the improved management of the field stations will be retained as part of the INRA center's operational budget for the following year.

Once it is independently confirmed that these conditions are met, USAID should make the further investments in the three field stations divided over a three year period (FY 1992-1994). Actual disbursements should be made commensurate with INRA presentation of evidence demonstrating progress in implementing the new field station operational plan.

ACTION: INRA AND USAID

5. INRA/SETTAT Financing for Sustainability

To carry on its research activities at FY 1991 levels, the INRA center in Settat will have to find between 3,300,000 and 4,300,000 Dirhams in additional budgetary support for 1992; between 3,000,000 and 4,000,000 additional Dirhams for 1993; and from 4,200,000 to 9,900,000 Dirhams for 1994 (not including international travel grants or short-term training. If funding is not found to fill the looming resources gap, then either researchers will have to be transferred away from Settat to enable the remaining staff to get on with their work or researchers will find themselves without the means to continue their scientific activities.

To help fund the Center, four actions need to be taken:

a. INRA/Settat and its individual researchers need to ensure that the funding that is available is used more efficiently to support research.

b. The part of the strategic plan for the field stations having to do with increasing and retaining revenues from non-research activities must be developed and implemented. As well, INRA/Settat should be authorized to retain potential income that can be made from soil analysis, plant diagnosis, and agronomy consultations and tests for local farmers.

c. Scientists must be encouraged to discern and take advantage of these grant, consulting and contract work.

d. USAID should consider using part of the remaining money in the DAARP to cover the operating shortfalls being projected, provided that funding be tied to annual proof that the INRA total operating budgets for Settat (not including salaries) are rising in a manner to cover the full costs of sustainability by 1995 or whatever year the DAARP funds could be extended to cover.

ACTION: INRA AND USAID

6. Research Programs

There are disciplines which need to have their work redefined. Both soil fertility and agricultural mechanization have yet to contribute their first technologies to the DAARP, although there may be a niche for the seed drill that is under development. Agronomy was an early contributor of technologies and continues to be a major participant in the technology transfer process which exists at the Center but it does not have any prospects for delivering further technologies in the near future.

There are research areas that would serve INRA/Settat's regional mandate that have not up to now formed any part of the DAARP. These include research on storage losses, on the great importance of livestock and mixed farming within the total dryland agricultural system, and

on small-scale irrigation -- with due regard to salinization. Agronomy, agricultural engineering, and soil fertility would quickly regain importance if irrigation work were added to the Settat program.

ACTION: INRA, MIAC AND USAID

7. On-Farm Technology Evaluation Activities

On-Farm Technology Evaluation (OFTE) trials are currently testing only one or two technical variables in each trial out of the sense that farmers cannot handle more complex packages. As a predictable result, many OFTE fields perform poorly in comparison to adjacent farmers fields. There is no sense planning for failure. OFTE should get its planning right by redesign of these trials wherever necessary.

ACTION: MIAC AND INRA

8. SRD and the Extension Function Outside INRA

The SRD activity within INRA must not duplicate the activities of the extension agencies now being redeveloped within other national institutions. At the same time, INRA scientists in an applied research institution like Settat should have more frequent and direct contacts with the extension agencies. SRD has a primary role to play in linking scientists to extension -- e.g. in providing scientists for the training aspects of the "Training and Visit" extension system being installed with World Bank assistance in the region. INRA/Settat management must ensure that SRD limits itself to the appropriate linking role with the extension system and that center scientists provide their information through SRD to farmers and the other elements of the GOM agricultural administration in the project area.

ACTION: INRA

9. Long-Term Participant Training

Of the supplementary long-term training positions requested, only five should be approved. In priority order, they are:

(1) MS in Research Station Management (1991)
(2) MS in Agricultural Mechanization (1991)
(3) PhD in Agricultural Economics with a minor in Agronomy (1992)
(4) PhD in Food Legume Pathology or Entomology (1992)
(5) PhD in Weed Science (1992).

In addition, INRA should consider presently an additional request to USAID for training of two biometricians to the Master of Science degree level.

In the interest of strengthening effective linkages between Moroccan institutions, the three Ph.D. opportunities in 1992 and the additional biometry posts should be handled as a collaborative training effort between INRA and IAV. Under this arrangement, the candidates would be jointly selected and accepted as candidates for the IAV Ph.D. or M.S. degrees. They would proceed to do a tailored combination of course work at IAV and at an American university and return to Morocco to conduct their dissertation research. The candidates would then defend their work before a committee of IAV, American and INRA advisors.

ACTION: INRA, IAV, MIAC and USAID

10. Short-Term Participant Training

Short-term post-doctoral training should be provided in research program planning and management for up to six INRA scientists. In addition, we believe that other short-term training opportunities should have a major focus on developing planning and management skills among a broader spectrum of the research staff in Settat. In this regard, we have the following specific recommendations:

(1) Dr. Sefrioui be sent to the University of Missouri to work with Drs. Jere Gilles and Constance McCorkle on effective planning, design and implementation of rural sociology research.

(2) Mr. Hamel of the Technology Transfer/SRD unit should be sent to the University of Florida to work with Dr. Peter Hildebrand and his colleagues on matters related to rapid reconnaissance surveys and the process of technology testing and dissemination.

Finally, with respect to technical support services, we believe there is a great need to strengthen staff capacities in field station management, operations of technical library resources and computer maintenance and operations, central laboratory operations and maintenance, motor pool operations and vehicle maintenance, and desk top publishing techniques to improve the presentation and quality of INRA center publications, particularly for distribution within Morocco. While we cannot at this point define in precise terms the nature and contents for each of these training opportunities, we believe that INRA and MIAC project leadership should be directed to select INRA staff candidates and develop such short-term training programs as a matter of high priority.

ACTION: INRA AND MIAC

11. The Pending "Supplementary Budget Request"

The primary conclusion of the evaluation team as a result of its discussions with MIAC and INRA staff is in fact there are ample funds already in MIAC's existing contract to cover the costs of all of the requests we are recommending USAID accept. Phrased differently, MIAC, as a contractor, does not appear to us to be in any real danger of running out of contract funding in FY 1991, if it is authorized to disburse funds to cover all of the recommended activities in FY 1991, FY 1992 and FY 1993. There will be a separate issue at some later point in the project of replenishing the MIAC contract -- probably in FY 1993 -- to add a final amount of funding to compensate for actual disbursements authorized by USAID but this is a completely separate issue and should be handled as such.

In addition to long-term and short-term participant training discussed below, the evaluation team would recommend that the following activities in the "supplementary budget request" be approved for implementation.

a. Socio-economic Studies

(1) USAID should issue a project implementation letter (PIL) specifically authorizing ex poste actual MIAC disbursements for baseline study activities incurred prior to FY 1991.

(2) USAID should authorize MIAC to expend up to a total of $ 126,000 in FY 1991 to complete all activities related to project baseline studies, with the stipulation that MIAC clearly demonstrate to USAID that a final report on the baseline studies has been completed in calendar year 1991 and that a typology has been developed from baseline study data and utilized as a management tool in development of the MIAC Integrated Plan of Work for FY 1992.

(3) Finally, USAID should consider authorizing funds for socio-economic studies up to a total investment of $ 167,000 in FY 1991 to 1994, either under the MIAC contract or by separate arrangement with INRA directly which is more convenient for USAID. Such authorization should be dependent upon further refinement of the proposals and the budgets.

b. On-Farm Technology Evaluation

The situation with respect to on-farm technology evaluation activities is much the same as that for the "baseline" studies and our recommendations are the same.

(1) USAID should provide ex poste authorization in a PIL for on-farm technology evaluation activities conducted prior to FY 1991.

(2) USAID should provide authorization FY 1991 on-going technology transfer activities.

(3) USAID should provide specific authorization for a program of technology transfer activities spending up to $ 323,000 in FY 1992, FY 1993 and FY 1994.

c. Soil Mapping

The revised mapping proposal for soils and agro-ecological zones contained in Annex 5 should be implemented as soon as possible under the existing MIAC contract.

None of these actions require that additional funding be added to the existing MIAC contract at this time.

ACTION: INRA, MIAC and USAID

d. The In-Vitro Laboratory

The evaluation team believes this request is completely outside the purview of research activities anticipated under the DAARP. We, therefore, see no merit in considering possible USAID funding for this unrelated activity so late in the DAARP.

12. MIAC Staffing

There are serious questions as to the utility of recruiting new MIAC technical assistance staff and/or extending the contracts of existing MIAC resident staff for the following positions: research coordinator, forage specialist, entomologists -- both the long-term and sabbatical positions, agricultural engineer, and cereal agronomist sabbatical consultancy. If the proposed technology transfer position is not be filled before the end of 1991, then it should be eliminated.

If all of the positions in question were to be eliminated, a total of 92.25 person months (7.69 person years) of budget resources could be shifted to other DAARP activity categories -- either within or outside the MIAC contract.

The MIAC chief of party and research coordinator positions should be combined after the departure of the present chief of party and a candidate to fill the combined position should be selected from within the ranks of existing MIAC technical assistants in Settat.

In line with efforts to improve field station program planning and management, two persons-months per year of consulting time should be added to the MIAC program. The consultant's primary task would be to help INRA administrators develop and implement the strategic plan

for the stations discussed above.

In addition, consulting services should be provided to INRA under the MIAC contract in research program planning and management as a supplement to post-doctoral training for INRA scientists in this important area.

Finally, MIAC orientation sessions to date have apparently been wanting when it comes to explaining to MIAC scientists the need for them to play a broader role in communicating skills to their Moroccan colleagues. We believe that every one of the specialists resident in Settat possesses a much broader array of skills -- e.g. skills in developing budgets for research protocols, in economizing on costs through common use of resources, in setting overall and daily priorities for work activities, and in evaluating and writing up research results -- that they could and should communicate to their colleagues in daily interaction. And, in this regard, we recommend that MIAC administrators be strongly urged to push MIAC technical assistants more aggressively to communicate these supplementary skills during their remaining tours of service in Morocco.

ACTION: INRA, MIAC AND USAID

13. Agricultural Chemicals Storage and Handling

The DAARP should design and implement a model program for the safe storage and handling of agricultural chemicals as a demonstration for all Moroccans involved with distribution and use of these products. In this regard, the agricultural chemicals storage facility at Settat should be completed and a strict policy on the use and safe handling of insecticides, pesticides, herbicides and other agricultural chemicals should be implemented.

ACTION: INRA AND MIAC

14. Development of Linkages

INRA/Settat linkages with an international network are diverse. They are all useful but there is a risk of diluting the focus of the research program and of diverting attention from the applied work for service to local agriculture. These networks should increasingly be focused on those activities which reinforce core research areas in Morocco and on those which actually have the potential for producing grant and contract funds for the center.

At the national level, INRA/Settat scientists have many roles to play in linking their work to the wider agricultural network in Morocco. The joint demonstration program with the Safi DPAs was a success that should be disseminated as a model to other areas of the country. Links with IAV have also been productive. Local publication of agricultural research results in Morocco and distribution of information leaflets and newspaper articles on those results in French and Arabic should also be increased as an essential part of each researcher's role.

ACTION: INRA

15. Budgeting of Remaining Authorized Funds

In line with our financial and staffing critiques in this report, we would like to present the evaluation team's tentative recommendations on the optimal use of the USAID project resources, net of the existing MIAC contract. To the best of our knowledge, these funds total $ 6,166,739 in May 1991 and the evaluation team suggests that these funds be spent in the following order of priority -- with the approximate levels of expenditures in brackets.

- Fund the balance of project activities included in the MIAC contract -- i.e. long-term participant training, socioeconomic studies, and the technology transfer program activities. [up to $ 1,000,000]

- Fund supplementary short-term participant training not included in the MIAC budget projections as yet -- i.e. post-doctorate training in research planning and program management, and other training in station management and specialized skills. [$ 250,000]

- Fund short-term consultant services -- Moroccan and external -- to INRA in Rabat and Settat in research planning and program management and other management skill areas as needed. [$ 250,000]

- Fund additional socioeconomic work, as needed, to evaluate technologies and develop other information on changing patterns of agricultural enterprises and market conditions in the project zone. [$ 100,000]

- Fund an end-of-project comprehensive evaluation. [$ 250,000]

- Fund support for development of INRA field research stations commensurate with INRA's development and implementation of an acceptable strategic plan for these stations. [$ 1,500,000]

- Fund operational costs of the on-going research program over the life of the project commensurate with evidence from INRA that it is increasing its own budgets -- capital and operating -- for the center. [$ 2,500,000]

- And, finally, fund structural modifications and replacement equipment in laboratories and other facilities at the center, as necessary. [$ 300,000]

ACTION: USAID

ANNEX 1

EVALUATION STATEMENT OF WORK

EVALUATION STATEMENT OF WORK

MOROCCO DRYLAND AGRICULTURE APPLIED RESEARCH PROJECT

I. PURPOSE

The purpose of this evaluation is to assess progress in achieving project purpose and outputs and to assess the impact of the technologies developed and disseminated. Project implementation has been underway for ten years; it is therefore timely to assess achievements to date and to determine what actions should be taken to insure project sustainability after the scheduled termination of AID assistance in August 1994. Specifically, the following are the objectives of the evaluation:

1. Assess and document progress, achievements, and the impact of research carried out to date;

2. Assess progress in technology transfer, measure the rate of adoption among the target farmers and determine the impact of this technology dissemination;

3. Measure progress in institution building including the institutionalization of research functions to insure sustainability and progress in staffing, facility construction, management and budgeting;

4. Measure progress in the transition to Moroccan leadership at the Aridoculture Center and at satellite centers; and

5. Make and prioritize recommendations to enhance the sustainability of the project following termination of AID assistance.

II. DESCRIPTION OF THE PROJECT TO BE EVALUATED

The Moroccan Dryland Agriculture Applied Research Project purpose is to establish a sustainable applied research capacity relevant to the dryland farming systems and natural resource constraints of the 250-450 millimeters rainfall region of Morocco and capable of providing technologies to improve farmer productivity.

The goal of the project is to increase food production in order to meet the needs of Morocco's fast growing population and to improve the income of farmers with small and medium sized land holdings.

Morocco faces a serious crisis in agriculture. Persistent drought, poor soil conditions, and lack of appropriate technologies, coupled with a high population growth rate, have forced Morocco to rely increasingly on food imports. Food crop production in the dryland, semi-arid regions of Morocco, which in a normal year contributes almost half of Morocco's cereal production, has stagnated since 1970.

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AID has been working with the GOM to overcome constraints to agricultural productivity in the semi-arid, dryland region of the country through the Dryland Applied Agricultural Research Project, authorized in 1978. With support from the contractor, Mid-America International Agricultural Consortium (MIAC), the GOM's National Institute for Agricultural Research (INRA), a Dryland Research (Aridoculture) Center was established at Settat. The Aridoculture Center has developed crop varieties which are disease, insect and drought resistant; improved cultivation practices; and appropriate mechanized equipment for the dryland regions.

The Project Agreement was initially signed with the Government of Morocco in 1978, for a LOP funding level of $ 4,500,000 and a PACD of August 31, 1983. Implementation was delayed due to contractor and GOM problems. In addition, in 1981, Morocco was hit by severe drought. While research trials were planted beginning in 1981, there were four successive crop failures due to the worst drought conditions in the last 300 years. Hence, there were no significant research results during this period although progress was made in establishing a regional research station at Settat (the Aridoculture Center). The first project evaluation took place in 1983. In spite of the lack of research results, the evaluation team determined that there was a great potential for important research to be conducted in the region and that the institution building activities had been impressive. Hence, they recommended greatly increasing the project resources and extending the project. The project was extended to August 1988 and funding was increased to $ 26,323,400. The expanded project provided additional technical assistance and related funding to enable a more complete treatment of the identified constraints for increasing agricultural production and improving productivity in the semi-arid zones.

A second evaluation was carried out in 1986, to determine the extent to which the project purposes and goal were being achieved and recommend additional program activities or adjustments. In 1988, a revised Project Paper (Amendment 4) extended the project by six years to August 31, 1994 and increased AID life-of-project funding by $ 23,676,600 to a total of $ 50,000,000. The GOM increased its contribution to the equivalent of $ 28,231,400.

The project extension provided inputs to strengthen the research programs, focus and upgrade the technology transfer program, and ensure the institutional sustainability of the Center. AID added 72 person years of resident technical assistance, 84 person months of short term technical assistance, 7 M.Sc. and 19 Ph.D. training positions, additional short term training, and commodities.

The project, as revised in 1988, focuses on:

(1) Applied Research
(2) Technology Transfer, and
(3) Institutional Sustainability.

The applied research program at the Aridoculture Center is designed to study and develop technologies in the context of the agricultural production system. Multidisciplinary research is promoted. Activities have been broken down into four categories based on a Planning by Objectives management system: cereals production systems, forage and livestock production systems, legume production systems, and integrated applied production system. Specific

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objectives for each of the four categories are identified in the Project Paper.

Under the transfer of technology component, the Aridoculture Center was to reach out selectively to farmers through special studies, on-farm trials, selectively institutionalize the feedback by assuring that scientists and extension agents formally obtain information from the farmer and systematically review it when writing research protocols.

An important part of the institutional sustainability focus is the training in the U.S. of 51 Moroccans at the M.Sc. (17) and PhD (34) level. In addition, the GOM is to provide adequate staff, construct facilities including laboratories, greenhouse units, and other infrastructure, resolve salary and budget issues, and improve the internal management of INRA in part through consultation with the International Service for National Agricultural Research (ISNAR).

III. PROJECT STATUS

Based on a recent (10/1990) project review, the following is a summary of progress achieved on the seven major project outputs:

1. Agronomic technologies, farming systems practices and equipment appropriate to small/medium (5-10 hectares) scale dryland farmers. Twenty technologies identified from the research program and are candidates for technology transfer. On-farm research is underway including 7 new wheat varieties, winter chickpeas, etc..

2. Direct links between researchers and representative farmers have been established. Major efforts are underway to complete baseline data in two provinces related to technology transfer. On-farm technology evaluation in progressing in three areas.

3. Links between the national and international institutions involved in dryland agriculture research linkages developed in particular with the Moroccan Ecole National d'Agriculture, the Institut National Agronomique et Veterinaire (with the Dryland Project, one of AID's major project investments in Morocco), and the Ministry of Agriculture extension service as well as with several international research centers.

4. Functioning and sustainable Regional Research Station at Settat (The Aridoculture Center). Completion of planned construction projected for 1992/1993. 60 % of long term training completed. GOM budget commitments appear to correspond to Project Agreement levels.

5. Functioning and sustainable network of satellite research sub-stations. Construction 70 % and training 30 % complete. Plan for funding and management developed through 1994.

6. Management systems in place to carry out effective research programs, develop budgets, accountability, evaluation. A multidisciplinary Programming by

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Objectives (PBO) system put in place in ISNAR technical assistance. Periodic TA continues in order to improve the system.

7. Functioning and sustainable technology transfer unit transmitting technology information to clients. Training workshops for extension agent and field days for farmers held. On-farm technology evaluation trials initiated in 1990. Contact with private sector is developing.

IV. STATEMENT OF WORK

The basic frame of reference for the evaluation and for assessing to what extent the project purpose has been achieved will be the current Project Paper logical framework. The evaluation team will place particular emphasis on issues which focus on technology transfer and the sustainability of the Aridoculture Center and satellite stations. This section defines the specific tasks and questions for which individual team members are responsible for addressing.

There will be six expatriate and one Moroccan team members. It is suggested that the Institutional Planning Specialist be the team leader. All of the team members must have a minimum of 7 years and preferably ten years of previous successful international development experience. There is a strong preference for team members who have worked in North Africa and who are familiar with the agro-economic conditions of the area.

In order to function effectively, each team member must speak French sufficiently fluently to be able to work independently without translator or translation assistance from other team members. French language skills at the Foreign Service Institute level of 3 in speaking and 3 in reading is required.

The following is a description of the responsibilities of each team member.

A. Institution Planning

1. Senior Institutional Planning Specialist and Team Leader

The Senior Institutional Planning Specialist in his capacity as team leader will be responsible for the coordination and administration of all team activities. He will be responsible for presenting an integrated final report.

2. Institutional Planning Specialist

The Institutional Planner will work directly under the supervision of the Senior Institutional Planning Specialist. Together these two team members will look at all issues related to institution building and sustainability including human resource development, financial requirements and resources and infrastructure development and operations and maintenance. The Institutional Planning Specialist will have the following tasks and address the following question:

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a. Determine if the overall program has objectives that are sufficiently well articulated to permit orderly planning of physical plant, human resources and operational budget.

b. Infrastructure

Is the plan for physical infrastructure well conceived, and is it being implemented in a timely manner? Does the plan enhance and support the achievement of overall program objectives?

The Institutional Specialist will recommend the level and describe in detail the infrastructure which would be reasonable in support of an optimal applied program. He will recommend also what if any additions (e.g. pending request for in vitro laboratory) should be made to the existing plan. The Institutional Specialist will provide an opinion on the current funding request for station development, considering land and locale requirements, ecological zones, and soil types. He will determine to what extent experimentation could be shifted off station to farmer's land.

c. Human Resources

The IPS shall recommend the number of personnel required at each organizational level and location in order to operate an optimal program including technical assistants. The issue of staffing of technicians, station manager and auxiliary personnel should receive attention equal to that of researchers.

What additional staff training should be funded? The IPS should furnish an opinion on the current training request for an additional 12-14 MS and PhD candidates.

To date, the project has been totally dependent on staff trained in the U.S. with project funds and, early on, on staff trained under the Institut Agronomique Veterinaire project. Should INRA be oriented toward filling personnel requirements with graduates from IAV and/or other Moroccan institutions?

d. What management issues need to be addressed on the INRA and GOM side (e.g. delegation of authority, preparation of job description) and what action is recommended? Who has ultimate authority to approve research activities and make other important decisions?

e. Planning by Objectives

Has Planning by Objectives improved the conceptual quality, planning and management of the program? Is it correctly focused on improved technology production and technology transfer?

f. Evaluation the 1991-1994 work plan and recommend changes if appropriate in long and short term contractor staff to achieve project objectives and, in particular, technology transfer and sustainability.

g. Linkages and Networking

IAV Linkages

Do IAV and the Dryland Applied Agricultural Research Program have the well-developed, mutually supportive linkages envisaged by project design? Is there joint planning and regular, institutionalized consultation?

International Linkages

Is the Research Center taking full advantage of the resources available through the CGIARs, communicating on a regular basis with appropriate centers, and developing functional linkages with them?

Future Linkages

As USAID/MIAC support to the GOM is reduced what are the networks and linkages that the project should be developing now to help guarantee that the DAARP program benefits?

Private Sector Linkages

Do the technologies developed to date and the clients involved in their application present opportunities for private enterprise to extend technologies, support further technology development by INRA and/or to carry on technology development?

Linkages to Producers, Processors and Agribusiness

What linkages currently exist with producer groups? What is the potential of groups such as the Chambre d'Agriculture to furnish support and guidance to dryland research? Are there formally or informally organized influential groups (producers, traders,

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processors) that could play a large role in supporting the research program?

Sustainability of Program with GOM Funding

Is the GOM commitment to the program sufficient to carry on the program at the current level? Is there adequate funding available to continue the program at the current level? Are there alternative sources and means of public sector fund raising that should be considered for agricultural research?

Other Donor Involvement

What other donors are involved in Research and Technology Transfer, and what effect does their involvement have on research planning and funding.

h. Define an optimal and sustainable scope for the DAARP program in terms of research program and human and physical resources.

i. Propose a project budget that will make optimal use of GOM and USAID funding to the end of the project (FY 1992/1994).

B. Technology Transfer Specialist

This specialist will examine the technology transfer system currently in place and the accomplishments to date. He will develop a priority agenda for technology transfer through the PACD. He will assess the strengths and weaknesses of this existing system and the institutions involved and what actions can be taken to enhance the system and technology transfer. The specialist will focus on the following tasks and questions:

1. Describe and evaluate the effectiveness of current mechanisms and process -- both formal and informal -- for technology transfer.

2. Describe and evaluate the process by which research areas are identified and the relationship of that process to technology transfer.

3. Determine whether the organization of the current research program is optimal for effective technology development and transfer?

4. Is the program output oriented toward technology users as opposed to research publications? Should the program place more emphasis on information dissemination?

5. Is there sufficient understanding and assessment of the economic feasibility of the technologies being developed by the research program?

6. Is the research program overly focused on commodity production as opposed to the optimal use of farm resources? If so, what adjustments are needed?

7. Are agroforestry, small irrigation and horticulture crops areas for research and technology transfer that should be considered in the future to make optimal use of dryland resources?

8. What are the major constraints to the adoption of "improved technologies"? Are there macro or sector level policies (e.g. seed marketing, pricing) policies that constrain technology transfer and adoption?

9. Are targeted technology users sufficiently integrated in the process of technology development?

10. What categories of farmers should be targeted for transfer of technology? Are there significant differences between the technology needs according to farm size? Is this and related questions adequately addressed and understood by the program? If not, what action is needed? Has the program inhibited the technology transfer process by imposing limits on the size of farms to be targeted?

11. Are there unanticipated project impacts (e.g. attitudinal changes at different levels of GOM)?

C. Research Planning Specialist

The Research Specialist will review the research carried out to date in each area. He will describe the research pathways followed to date and the results obtained. He will recommend a prioritization of future research, identifying which research is more basic than applied and therefore may be of lower priority. The Research Specialist's report will include a projection of when different lines of research will lead to results and will recommend which efforts should be modified or dropped. He will make a prediction of the time and resources necessary to obtaining impact from the research areas examined.

1. Description and Evaluation of Research

The Research Specialist's report will contain a graphic, schematic presentation using computer software currently available at USAID. It will present the work being done by the project, giving the Mission an encapsulated view of the research chronology from inception to the present and a projection of when conclusions or results can be anticipated from each area of research.

2. Prioritization

A major output of the evaluation should be a recommendation of what areas of research offer optimal use of DAARP resources and what areas should be reduced or excluded. Taking into account the likelihood of reduced resources in the future, the Research Speciaiist will make recommendations concerning the areas of research which should be continued, expanded, reduced or excluded. Is some work overly basic as opposed to adaptive? Is sufficient use made of known principles and research completed elsewhere?

3. Definition of Future Programs

As different lines of research are pursued they will evolve in a variety of ways. Some will be dropped, some will result in useful support knowledge, some will result in development of transferable knowledge. The Research Specialist will look at the process by which the research program can productively evolve as the Settat program moves into subsequent generations of research issues.

4. Review of Technology Development Process

In collaboration with other team members, the Research Specialist will examine the process by which research topics are selected, the technology monitoring process, and the process for insuring modifications due to changes in the farm level environment. In short, the team will dctermine if there is a dynamic process in place to insure that research will not stagnate once the current pursuits have run their course.

D. **Agribusiness Specialist**

The Agribusiness Specialist will determine the potential of technologies developed by the DAARP program for dissemination by private entrepreneurs. He will recommend what technologies might merit new or additional research for eventual dissemination by agribusinesses. He will determine what research might be carried out or supported by private companies. The Agribusiness Specialist will suggest possible linkages between the DAARP and the Morocco Agribusiness Project (MAP) currently in the design stage.

Working in close collaboration with the Transfer of Technology Specialist, the Agribusiness Specialist shall be responsible for undertaking, inter alia, the following:

1. Analysis of Marketable Technologies

Identify and delineate examples of technologies developed within INRA that have been successfully transferred to the private sector with a view to determining what has worked and lessons learned.

Assess the extent to which research under the project has developed technologies which can be exploited by the private sector. The Specialist shall list and provide a brief description of each technology.

2. Encouraging the Transfer of Technologies to the Private Sector

In the areas identified above, make recommendations on the methods, procedures and institutional arrangements which need to be established or modified to transfer technologies to interested private sector entities.

3. Analysis of Demand Within the Private Sector

Examine a sampling of companies from appropriate sub-sectors to determine the potential market that exists for technologies developed in the project activity.

Look at the extent to which companies are already funding research as a measure of interest in purchasing new research.

E. Moroccan Team Member

The Moroccan Team Member will be a resource to the entire team, promoting an integrated and multidisciplinary understanding of the context in which the project developed and currently operates. He will more specifically develop relevant briefing materials on the project, which will aid the other team members to rapidly acquaint themselves with the Moroccan dryland agricultural sector and the institutional and physical in which the project operates. He will facilitate team members' interviews and contacts in Morocco.

He will review project team analyses and provide guidance and feedback on the context, thoroughness and accuracy, based on his knowledge of Moroccan agriculture and Moroccan institutions.

He will review and advise on recommendations to assist the team in developing recommendations which are of optimum feasibility. He will assist in the editing and review of the French translation of the final report. The Moroccan agricultural expert will work collaboratively with all members of the team, under the supervision of the team leader. He should have sound analytical skills and a sound understanding of macro and sector policy issues and excellent writing skills.

F. Evaluation Team Qualifications

The following are the recommended skill requirements and qualifications for each expatriate team member.

1. **Senior Institutional Planning Specialist and Team Leader**

Senior program and program management experience.

Ten plus years of in-depth and responsible experience in the design, management, implementation and evaluation of agricultural programs.

Graduate degree in one of the agricultural sciences or agricultural economics.

A record of successful consultations related to institution building and management of sizeable agricultural research or comparable institutions in LDCs.

Outstanding interpersonal skills. Previous and successful experience as team leader for an assignment comparable to this evaluation. Hands-on experience in personnel planning, human resource development and financial analysis/budget development and management.

Experience with the international network of research institutions as an employee or through considerable direct interaction.

2. **Institutional Planning Specialist**

Program management experience.

Five years of in-depth and responsible experience in the design, management, implementation and evaluation of institutional development programs.

Graduate degree in one of the agricultural sciences or agricultural economics, or a management related science.

A record of successful consultations related to institution building and management.

Good interpersonal skills.

Experience in institutional resource planning and management with good understanding of human resource planning and personnel management.

Sound analytical skills. Understanding of macro and sector policy issues.

3. **Technology Transfer Specialist**

Advanced degree in one of the agricultural sciences.

Ten or more years experience related to technology transfer in the form of agricultural extension and related work in LDCs.

Experience (preferably in North Africa) working with dryland agriculture. An in-depth understanding of the human, natural resource, and biophysical issues and constraints involved and the range of possible responses to address them.

Experience working with farming systems in LDCs.

Broad-based and practical experience related to the full range of farming systems issues and exogenous issues including macro and agriculture sector level policy issues.

4. **Research Planning Specialist**

PhD in an agricultural science relevant to the project.

Ten or more years experience in agricultural research.

Demonstrated successful experience in planning and managing agricultural research at a U.S. institution and at least five years experience with LDC agricultural research institutions.

Extensive experience with cost/benefit and other relevant analytical techniques needed to project potential returns of current and future research.NOTE: One or more team members must have these analytical skills and may assist other team members with analyses.

5. **Agribusiness Specialist**

Hands-on experience in all aspects of agribusiness development including private enterprise involvement in promoting agricultural research, testing, extension, marketing, input supply and financing.

Deep understanding of the opportunities and constraints, macro and agriculture sector level policy issues and incentives that are necessary to encourage private sector investment in dryland agriculture in the project zone.

Knowledge of market opportunities for produce from the project zone primarily within Morocco but potentially in overseas markets.

V. SCHEDULE OF WORK AND MINIMUM LEVEL OF EFFORT

The evaluation will take place over a six week period. It should be completed no later than March 1, 1991. An evaluation debriefing shall be completed and the draft evaluation report submitted to USAID by March 1 and in all cases before the beginning of the Ramadan which is approximately March 15, 1991.

Prior to departure for Morocco, the team will be allotted one day in Washington for briefings in AID/W and to discuss the terms of reference and for technical interviews. In Morocco and, to the extent possible, prior to departure from the U.S., team members should familiarize themselves with key project documents as follows:

Mission CDSS and Concept Paper;
Project Paper, Amendment 4, March 9, 1988 (Washington);
Project Agreement, Amendment 11, May 16, 1988 (Washington);
Project Work Plans (1984-1991);
Report on Experimental Stations of the Aridoculture Center, Dr. Hannibal Muhtar (June 1990);
Scientific Panel Reviews as follows (identify currently relevant reviews): Agricultural Mechanization; Socio-Economic Review; Forage Program Review;
Mid-Term Evaluation (Winrock) May 1986;
IDMC Financial Sustainability Study;
MIAC Contract and Annual Reports; and
SRD Annual Reports.

An illustrative schedule follows:

Week One

Discussions with AID/W and other technical interviews. Discussions related to scope of work and project status. The team will fly to Rabat and, after meeting with USAID Mission officials, they will engage in two days of team planning meeting (TPM) sessions with Moroccan counterparts and teammates. They will read key project documents cited above and others as appropriate. On Day 3 or 4, they will meet with selected representatives of the Ministry of Agriculture and Agrarian Reform, with the IAV, and with other appropriate GOM representatives in Rabat. The team should also make contact with the Peace Corps regarding the potential role of volunteers in the project. Efforts will be made to schedule a scientific panel review during the evaluation and in which the team could participate or observe. The team will travel to the project area by the end of the first week.

Weeks Two to Five

The team will focus its time and effort in the project area, based in Settat, conducting on-site meetings and interviews with the contractor (MIAC), INRA, farmers, representatives of the private commercial sector, and ISNAR. The team shall function independently of the contractor, MIAC, and shall be responsible for arranging its own meetings. The team will make weekly

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progress reports to the Mission Project Manager. The Agribusiness Specialist will join the team in Weeks 3, 4 and 5. The Technology Transfer Specialist departs at the end of Week 4.

Week Six

Draft evaluation report is presented along with an oral briefing to USAID. Revisions will be made based on Mission review. A final draft of the evaluation report will be left with the Mission Project Officer prior to departure. Briefings for the GOM will be arranged prior to departure at the discretion of USAID.

VI. LOGISTICAL AND ADMINISTRATIVE SUPPORT

The Contractor is responsible for all, repeat all, logistical support for the evaluation team and contracting arrangements with Moroccan team members. Office space, transportation (vehicle and chauffeur rental), printing, typing, transformers, word processing, translation, etc. will not be provided by USAID. Team members are advised to carry with them their own word processing equipment.

VII. DELIVERABLES

The team will be responsible for producing an evaluation report which responds to the terms of reference in this scope of work. Seven days prior to departure, the team will submit to the USAID Project Manager a draft evaluation report with copies and make an oral presentation to USAID and to the GOM. Based on comments from review of the draft report, the team will make appropriate revisions. The team leader will submit four copies of a final integrated report to the Project Officer prior to departing Morocco.

Ten copies of the final printed report will be delivered by air express (e.g. DHL) to the USAID Project Manager within two weeks of the team departure from Morocco. An additional 50 copies of the final printed report will be sent to USAID at the same time by APO.

The French translation of the entire report will be done in Rabat and 100 copies will be delivered to the USAID Project Manager within two weeks of the departure of the team from Morocco.

The team will provide USAID with diskettes containing both the French and English report texts on a system that is compatible with USAID/Rabat word processing equipment.

ANNEX 2

EVALUATION MISSION ITINERARY

EVALUATION MISSION ITINERARY

First Phase

Monday, 11 February 1991

Three Evaluation Team members (J. Eriksen, J. King and E. Brusberg) arrived at the University of Nebraska, Lincoln, Nebraska.

Tuesday, 12 February 1991

0900-1230	General Orientation Meeting With Senior MIAC, University of Nebraska and INRA/MIAC Project Officials (Eriksen, King and Brusberg)
1330-1630	Evaluation Team Organizational Meeting (Eriksen, King and Brusberg)
1700-1830	Meeting with INRA/MIAC Project Scientists (Eriksen, King and Brusberg)

Wednesday, 13 February 1991

0930	Meeting with Dr. K. Moore, MIAC Rural Sociology, on Technology Transfer
1030	Meeting with Mr. R. Riddle, MIAC Research Associate, on Sociology Program
1130	Meeting with Dr. T. Gillard-Byers, MIAC Agricultural Economist, on Technology Transfer
1400	Meeting on General Financial Issues with Dr. D. Keith and Dr. D. Bigbee
1600	Meeting with Drs. D. Keith, R.K. Bansal and J. Ryan

Thursday, 14 February 1991

0900	Meeting with Dr. G. Rafsnider, MIAC Agricultural Economist
0900	Meeting with Dr. D. Keith, MIAC Project Team Leader and Entomologist
1100	Meeting with Dr. L. Bitney, MIAC Sabbatical Agricultural Economist
1400	Meeting with Dr. J. Ryan, MIAC Soil Fertility Specialist
1530	Meeting with Dr. R.K. Bansal, MIAC Agricultural Engineer

Friday, 15 February 1991

0900-1200	Meeting with INRA/MIAC Project Administrators on Project Sustainability Issues

1530	Meeting with John Mullenax, USAID Project Officer for MIAC Project

Saturday, 16 February 1991

All Day	Team Discussions and Reading Project Documents

Monday, 17 February 1991

0900	Session on Project Financial Planning/Supplementary Budget Request (Team)
1400	Session on Project and Center Personnel Planning and Allocation (Brusberg)
1530	Meeting with Mrs. Jean Rafsnider on Center Computer and Information Access System (Brusberg)
1530	Session with MIAC Personnel Responsible for Technology Transfer (Eriksen and King)
1730	Teleconferences with former Project Research Coordinators (Dr. Lewis Edwards, Oklahoma State University and Dr. Robert Zimdahl, Colorado State University (King)
1930	Dinner with Mr. R. Riddle, MIAC Research Associate/Sociology, Dr. T. Gillard-Byers, MIAC Agricultural Economist, and Mr. J. Mullenax, USAID/Rabat Project Officer (Team)

Tuesday, 19 February 1991

0900 - 1700	Sessions with the First Three of the Six Research Systems Groups: Cereals Production, Cereals Breeding and Forages (Team)
1900	Meeting with Dr. J. Tiedemann, MIAC Forage Specialist, Dr. L. Buschman, MIAC Entomologist, and Dr. Owen Merkle, MIAC Agronomist (King)

Wednesday, 20 February 1991

0900 - 1700	Sessions with the Remaining Three Research Systems Groups: Food Legumes, Sociology/Economics and Technology Transfer (Team)
2000	Meeting with MIAC Team Leader Dr. David Keith on Center and Research Farm Infrastructure and Staffing (Team)

Thursday, 21 February 1991

0900	Meeting with Dr. David Keith on Institutional Issues (Brusberg)
0930	Session with Moroccan Participant Trainees (Eriksen and King)
1300	Session with Dr. Darrell Watts (King and Eriksen)

Friday, 22 February 1991

0900	Session on Technology Transfer Program (Eriksen and King)
1000	Meeting with Dr. Hanway, Agronomist and former MIAC Project Coordinator
1130	Session on Center Linkages to Other Parties and Organizations (Team)
1400	Meeting with MIAC Project Scientists to Review Technology Test Questionnaire (King and Eriksen)
1600	Debriefing for MIAC Personnel by Eric Brusberg on Institutional Issues

Saturday, 23 February 1991

All Day	Document reading and team discussions. Eric Brusberg departs for Ottawa.

Monday, 25 February 1991

All Day	Document reading and report writing (Eriksen)
0900	Meeting with Dr. W. Stroup, MIAC Consulting Biometrician, and Mrs. J. Rafsnider, MIAC Computer and Information Resources Specialist (King)
1300	Meeting with Dr. G. Monroe, MIAC Agricultural Engineer

Tuesday, 26 February 1991

0930	Meeting with Moroccan Participant Trainees on Sustainability and Other Institutional Issues (Eriksen)
1000	Meeting with Dr. Glen Vollmar, Dean and Director of International Programs at the University of Nebraska (King)
1300	Meeting with Dr. L. Bashford, former MIAC Agricultural Engineer in Morocco (King)

1530 Meeting with Dr. Anand Kumar, ICRISAT Center in Sadore, Niger and MIAC Project Staff (King and Eriksen)

Wednesday, 27 February 1991

0900 Team Debriefing with MIAC Staff and Project Technical Assistants (Eriksen and King)

1100 Departure Meeting with MIAC and University of Nebraska Senior Staff

1515 Eriksen and King depart for Minneapolis/St. Paul

Thursday, 28 February 1991

0900 Meeting with International Programs staff and IAV Morocco Project officials at the University of Minnesota

1130 Meeting with MIAC Moroccan Participant Trainee at University of Minnesota

1230 Meeting with MIAC Technical Assistants (Drs. James Kirby and Allan Taylor) in French Language Training in Minneapolis, Minnesota

Friday, 1 March 1991

0730 Eriksen returns to Ithaca, New York

0930 King returns to Lincoln, Nebraska

Saturday, 2 March 1991 to Wednesday, 6 March 1991

King report writing in Lincoln, Nebraska

Saturday, 2 March 1991 to Saturday, 16 March 1991

Eriksen report writing in Ithaca, New York

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Second Phase

Saturday, 4 May 1991

1445	Three Evaluation Team members (J. Eriksen, J. King and D. Aronson) arrive in Rabat, Morocco

Sunday, 5 May 1991

1000-1300	Informal Meeting with USAID Project Officer, J. Mullenax (Eriksen, King and Aronson)
1700-1830	Informal Meeting with Dr. S. Ouattar, the fourth member of the evaluation team

Monday, 6 May 1991

0900-1230	Orientation Meeting with USAID Mission Officials (Team)
1500-1615	Orientation Meeting with INRA Secretary-General and Other Officials (Team)
1700-1745	Meeting with USAID Mission Director (Team)

Tuesday, 7 May 1991

0700-0900	Evaluation Team Travels to INRA Regional Center in Settat, Morocco
0900-1300	Orientation and Planning Meeting with INRA Director, MIAC Team Leader and combined project staff (Team)
1430-1630	Discussions with the Forages Research Group (King and Ouattar)
1630-1830	Discussions with the Entomology Research Group (King and Ouattar)
1430-1830	Meeting with INRA Director, MIAC Team Leader and MIAC Administrative Officer on MIAC Staffing, Participant Training and INRA Center Staffing (Eriksen and Aronson)
1800-1845	Team Tour of INRA Center Facilities
2030-2230	Team Planning Meeting

Wednesday, 8 May 1991

0830-1030	Discussions with the Weed Science Researcher Group (King and Ouattar)
0830-1100	MIAC Staffing Analysis (Eriksen)

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0900-1030	Meeting with the Rural Sociology Research Group (Aronson)
1030-1300	Discussions with the Soils Management Research Group (King and Ouattar)
1100-1200	Tour of INRA Center Facilities with Plant Operations Manager (Eriksen)
1100-1300	Meeting with the Agricultural Economics Research Group (Aronson)
1430-1700	Meeting with INRA Director and MIAC Team Leader and Administrative Officer on Project Supplementary Budget Request (Eriksen and Aronson)
1430-1630	Discussions with the Agricultural Mechanization Research Group (King and Ouattar)
1630-1930	Discussions with the Agronomy Research Group (King and Ouattar)

Thursday, 9 May 1991

0800-1300	Travel to and Visit the Jemaa Shaim Experimental Station (Eriksen and Aronson)
0800-1300	Travel to and Visit the Sidi El Aydi Experimental Station (King and Ouattar)
1400-1500	Visit to Khemis Zemamra market, discussion of Agricultural Chemicals on sale with various stall vendors (Eriksen and Aronson)
1500-1930	Visit Khemis Zemamra Experimental Station and Return to Settat (Eriksen and Aronson)
1400-1930	Visit the Jemaa Riah Experimental Station and Return to Settat (King and Ouattar)

Friday, 10 May 1991

0800-1300	Travel to and Visit the Jemaa Shaim Experimental Station, and various farmer trial plots (King and Ouattar)
0900-1300	Travel to and Visit the Sidi El Aydi Experimental Station (Eriksen and Aronson)
1400-1930	Visit Khemis Zemamra Experimental Station and Return to Settat (King and Ouattar)
1400-1830	Visit the Jemaa Riah Experimental Station and Return to Settat (Eriksen and Aronson)

Saturday, 11 May 1991

0830-1300	Discussions on Technology Transfer and the Service Recherche-Developpement (Team)
1430	Departure for Rabat (Eriksen, Aronson and Ouattar)

Sunday, 12 May 1991

All Day	Document Reading and Discussions (Eriksen and Aronson)

Monday, 13 May 1991

0830-1045	Meeting with Mr. M. Zouttane, Director of Administrative Affairs, INRA, Rabat (Eriksen, Aronson and Ouattar)
0830-1030	Discussions with Soil Fertility Group, Settat (King)
1030-1300	Discussions with Grain Legume Group, Settat (King)
1100-1245	Meeting with Mr. A. Benjamma, Director, Information and Training, INRA, Rabat (Eriksen, Aronson and Ouattar)
1400-1700	Meeting with Mr. A. Kissi, Director of Programming, INRA, Rabat, (and coordinator of Planning by Objectives activity of INRA), Mr. M. Achahboun, Coordinator of IBRD Research and Extension Project, and Mr. A. Sqali Adoui, Department of Programming (Eriksen and Aronson)
1430-1700	Discussions with Plant Pathology Group, Settat (King)
1700-1800	Meeting with Dr. Ahmed Amri, Barley Breeder, Settat (King)
1800-1900	Meeting with Dr. M. El Mourid, Dr. John Ryan on soil mapping (King)

Tuesday, 14 May 1991

0700-0900	Travel to Settat (Eriksen, Aronson and Ouattar)
0830-1030	Meeting with Cereal Improvement Research Group (King)
0930-1200	Meeting with INRA Budget and Accounting Officers, Settat (Eriksen and Aronson)
1400-1530	Meeting with Dr. M. El Mourid, Director, INRA/Settat, on budgetary and administrative planning (Eriksen and Aronson)

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2000-2400 Evaluation Team Meeting, Progress review

Wednesday, 15 May 1991

0800-0900 Meeting with Dr. A. Taylor, Cereal Improvement Group (King)

0900-1200 Meeting with Settat Researchers on Institutional Linkages (Team)

1400-1430 Meeting with Mr. M. Salihi, Administrative/Finance Officer (Aronson)

1600-1800 Meeting with Socio-economic Research Group on baseline and further studies planned (Eriksen and Aronson)

Thursday, 16 May 1991

0900-1215 Meeting with Dr. Keith and Mr. Cartier on budgetary issues (Eriksen and Aronson)

1500-1730 Continuation of Keith/Cartier meeting (Eriksen and Aronson)

1400-1800 Visit to Provincial Department of Agriculture, Settat (King and Ouattar)

Friday, 17 May 1991

0730-0900 Discussions with Technology Transfer Group on Activity Planning (Team)

0900-1130 Discussions with Sub-Program Leaders on Research Planning process (Eriksen, Aronson and Ouattar)

1400-1700 Visit to Seed Farm (King and Ouattar)

1500-1800 Discussions with INRA/Settat Researchers (Other than Sub-Program Leaders) on Research Planning process (Eriksen and Aronson)

Saturday, 18 May 1991

0900-1200 Discussions with MIAC Technical Assistance Staff on Research Planning process and institutional sustainability issues (Eriksen and Aronson)

Monday 20 May 1991

0800-1130 Meetings with Mr. El Brahli (Weed Science), Dr. Kirby (Grain Legumes), Dr. Merkle (Agronomy), Dr. Derkaoui (Forages), and Mrs. Rafsnider (Computers) (King)

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0930-1130 Meeting with Dr. Keith and Mr. Cartier on Budgetary and Accounting issues at INRA/MIAC interface (Aronson)

1330-1530 Meetings with Dr. Amri (Plant Breeding) and Dr. Derkaoui (Forages) (King)

Tuesday, 21 May 1991

All day Analysis, Report Writing and Preparation for Debriefing in Settat (Team)

Wednesday, 22 May 1991

0900-1200 Debriefing session for all Settat personnel (Team)

1330 Departure for Rabat (Team)

Thursday, 23 May 1991 to Friday, 31 May 1991

Report writing [Dr. King's debriefing was held at USAID on Tuesday, 28 May 1991]

Friday, 31 May 1991

1600 Draft evaluation report delivered to USAID for review

Saturday, 1 June 1991 and Sunday, 2 June 1991

Revising report sections

Monday, 3 June 1991

0800-1500 Revising report sections

1600-1830 Team debriefing at INRA Rabat

Tuesday, 4 June 1991

0900-1200 Team debriefing at USAID

1300-1900 Revising report

Wednesday, 5 June 1991

Revising report

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Thursday, 6 June 1991

Revising, printing and reproducing the report

Friday, 7 June 1991

0900	Delivery of the report to USAID and final informal debriefing
1450	Eriksen and Aronson depart Rabat

ANNEX 3

LIST OF PERSONS CONTACTED

LIST OF PERSONS CONTACTED

INRA National Headquarters

Dr. Mohamed Kamel	Secretary-General
Mr. El Madani Zouttane	Director, Administrative Affairs
Mr. Abdelkrim Benjamaa	Director, Division of Information and Training
Mr. Zarhouane Ali Senhaji	Head, Department of Training and Cooperation
Mr. Moha Khettouch	Director, Inspection Generale
Mr. Ali Kissi	Director, Programming Division
Mr. Abdellatif Sqalli Adoui	Engineer, Programming Division
Mr. Mohamed Achahboun	Engineer, Programming Division (Project Officer, World Bank Research and Extension Project)

USAID/Rabat

Mr. Dennis Chandler	Director, USAID
Dr. James Lowenthal	Deputy Director, USAID
Mr. Charles Uphause	ADO (incoming, on TDY)
Mr. John Schamper	Acting ADO
Mr. John Mullenax	ADO/DAARP Project Officer
Mr. Mohamed Hanafi	ADO/Project Off

INRA Regional Center in Settat and Associated Experimental Stations

Dr. Mohammed El Mourid	Director of INRA Regional Center
Mr. Abdellah Bouayad	Agricultural Economics
Mr. Abdelaziz Hasnaoui	Agricultural Economics
Mr. Ali Ait Ounejjar	Agricultural Mechanization (INRA Agadir)
Mr. Mohamed Mergoum	Wheat Breeding
Mr. Nasserelhaq Nsarellah	Wheat Breeding
Mr. Abdellah Ouassou	Wheat Breeding
Dr. Mohamed Jlibene	Wheat Breeding
Dr. Ahmed Amri	Barley Breeding
Dr. Abdellaziz Selmani	Maize Breeding
Mr. Mohamed Guedira	Cereal Agronomy
Mr. Mohamed Karrou	Cereal Agronomy
Mr. Hassane Farihane	Cereal Agronomy
Mr. Mohamed Boutfirass	Cereal Agronomy
Mr. Mustapha Moujib	Cereal Improvement
Mr. Abdelmalek Azzaoui	Cereal Production
Mr. Khalil El Mejahed	Cereal Production
Mr. Azzedine El Brahzi	Cereal Production
Mr. Mohammed Amrani	Cereal Production
Mr. Abbes Tanji	Weed Science
Mr. Mohamed Lamnouni	Food Legumes
Ms. Fatiha Hamdaoui	Food Legumes

Mr. Mohamed Lamnouni	Food Legumes
Ms. Fatiha Hamdaoui	Food Legumes
Mr. Mustapha Mabsoute	Food Legumes (INRA Dar Bouazza)
Dr. Abderrahim Arif	Forage Agronomy
Dr. Mohamed Derkaoui	Forage Breeding
Dr. Mohamed Mazhar	Forage Agronomy
Dr. Abdelilah Sefrioui	Sociology
Dr. Fatima Nassif	Sociology
Mr. Hassan Benaouda	Sociology (Agronomy)
Dr. Mohamed El Yamani	Plant Pathology
Mr. Khalil El Houssaini	Entomology
Mr. Mustapha El Bouhssini	Entomology
Dr. Abderrahman Bouzza	Soil Science
Mr. Mouloud Kacemi	Soil Management
Mr. Rachid Mrabet	Soil Management
Mr. Lotfi Chraibi	Technology Transfer
Mr. Mohamed Boughlala	Technology Transfer/Economics
Mr. Abdelhamid Hamal	Technology Transfer
Mr. Abderramane Ait Lhaj	Technology Transfer
Mr. M. Salihi	INRA Administrative/Finance Officer
Mr. Houcine Backhad	INRA Administrative Officer
Mr. M. Tlohi	INRA Accounting Officer
Mr. Brahim El Yousfi	Station Management
Mr. Reddad Mouktafi	Station Management
Mr. Mohamed Chaoui	Station Management
Mr. Mohamed Rahmi	Station Management

INRA Research Scientists in Participant Training

Mr. Moussaoui Mohamed	Agricultural Economics/University of Nebraska
Mr. Boulanouar Bouchaib	Forages and Animal Science/University of Nebraska
Mr. Douiyssi Azzeddine	Plant Breeding (Barley)/University of Minnesota
Mr. Hadarbach Driss	Statistics and Biometry/University of Nebraska
Mr. Bahri Abdeljabar	Agricultural Engineering/University of Nebraska
Mr. Chriyaa Abdelouahid	Agronomy and Forages/University of Nebraska
Mr. Meskine Mohamed	Food Legume Pathology/University of Nebraska

University of Nebraska/Lincoln

Dr. Glen Vollmar	Dean and Director of International Programs
Dr. Darrell Watts	Professor and former Team Leader for MIAC Project
Dr. D.G. Hanway	Professor Emeritus and former Coordinator for MIAC Project

MIAC

Dr. William Miller	Executive Director of MIAC
Dr. Duane Everett	Associate Director of MIAC

MIAC Moroccan Dryland Agriculture Applied Research Project (DAARP)

Dr. Dan E. Bigbee	Project Coordinator at University of Nebraska
Dr. David Keith	Team Leader and Entomologist (University of Nebraska)
Mr. Richard Cartier	Financial/Administrative Officer
Dr. R.K. Bansal	Agricultural Mechanization/Animal Traction Specialist (University of Nebraska)
Dr. Larry Bitney	Agricultural Economist (University of Nebraska)
Dr. Thomas Gillard-Byers	Agricultural Economist (Washington State University)
Dr. Keith Moore	Rural Sociologist and Technology Transfer Specialist (Oklahoma State University)
Dr. Giles Rafsnider	Agricultural Economist (University of Nebraska)
Mr. Richard Riddle	Rural Sociologist (University of Missouri)
Dr. John Ryan	Soil Fertility Specialist (University of Nebraska)
Dr. Larry Buschman	Plant Pathology (Kansas State University)
Dr. Owen Merkle	Agronomist (Oklahoma State University)
Dr. Gordon Monroe	Agricultural Engineer
Dr. G. Allan Taylor	Plant Breeder (Montana State University)
Dr. James Kirby	Plant Breeder (Food Legumes)
Dr. James Tiedemann	Forage Specialist (Washington State University)
Ms. Jean Rafsnider	Information Systems
Mr. Glen Hartman	Electronic/Equipment Maintenance Specialist (Oklahoma State University)

University of Minnesota

Mr. Steven Clarke	Project Coordinator of the IAV Hassan II Program for the Office of International Agricultural Programs
Dr. Frank Busta	Department of Food Science and Nutrition/former Professor in the IAV Hassan II Program
Dr. Richard Goodrich	Department of Animal Science
Dr. Dale Hicks	Department of Agronomy/former Professor at IAV Hassan II Program
Dr. Donald Johnson	School of Veterinary Medicine/former Team Leader for the IAV Hassan II Project in Morocco
Dr. Ben Lockhart	Technical Assistant with the IAV Hassan II Program in Morocco for ten years
Dr. Ashley Robinson	School of Veterinary Medicine
Dr. James Sentz	Former Manager of Participant Trainees in the IAV Hassan II Program

Dr. Roy Wilcoxson	Department of Plant Pathology/former IAV Hassan II Project Coordinator for the Office of International Agricultural Programs

Others

Mr. Alami Sounni El Abed	Director, Provincial Department of Agriculture, Settat
Mr. M. Laklalech	Chief, Agricultural Development Service, Settat
Mr. Lahcen Abdane	Technical Director, Ets. Benchaib Marosem, Ain Borja, Casablanca
Mme. K. Abbada	Company Director, Réalisations Industrielles et Agricôles Marocaines

ANNEX 4

RESPONSES TO QUESTIONNAIRE ON RESEARCH SYSTEM WEAKNESSES AND REPORT ON STAFF SOCIAL CONDITIONS IN SETTAT

RESEARCH SYSTEM WEAKNESSES

Agricultural research planning is a process that has only recently begun to be well understood in terms of its linkage to outputs for client groups. Marie-Helene Collion and Ali Kissi have recently summarized the deficiencies that ISNAR has found in over 40 reviews of national agricultural research systems around the world. Their summary points are listed below.

We would like you to indicate the degree to which you feel that these points apply to INRA-Settat, as you have experienced the research planning process during your work here. Just circle the number that you feel best represents your thinking.

1 = This issue is definitely not a problem here.
2 = This issue is rarely a problem with work here.
3 = This issue is a problem for us sometimes, but we have made progress toward resolving it.
4 = This issue is a moderately serious problem here.
5 = This issue is a very serious problem here.

1.	Research objectives are often not well linked to economic and agricultural development objectives.	1 2 3 4 5
2.	Program activities are not relevant to the needs of the research users.	1 2 3 4 5
3.	Regular evaluation/review of research activities is lacking.	1 2 3 4 5
4.	Not enough is known about the technology available from external sources.	1 2 3 4 5
5.	Research activities are often proposed without reference to the resources they demand.	1 2 3 4 5
6.	Scarce resources are dispersed among too many activities.	1 2 3 4 5
7.	Researchers and producers' interests are potentially divergent.	1 2 3 4 5
8.	Research programs are often made up of a hodgepodge of projects, activities, and experiments.	1 2 3 4 5
9.	Researchers tend to overlook socioeconomic and institutional constraints on the adoption of their research results.	1 2 3 4 5

Please indicate which SUB-PROGRAM you belong to: _____

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ANNEX 4 TABLE 1

Question	1	2	3	4	5	No Answer
1	3 (75)	0	0	0	1 (25)	0
2	1 (25)	0	1 (25)	0	2 (50)	0
3	1 (25)	0	3 (75)	0	0	0
4	3 (75)	0	0	0	0	1 (25)
5	1 (25)	1 (25)	1 (25)	0	1 (25)	0
6	3 (75)	0	0	1 (25)	0	0
7	3 (75)	0	1 (25)	0	0	0
8	2 (50)	0	2 (50)	0	0	0
9	2 (50)	0	1 (25)	0	1 (25)	0
Other Moroccan Scientists						
1	1 (5)	2 (10)	10 (50)	7 (35)	0	0
2	1 (5)	6 (30)	11 (55)	2 (10)	0	0
3	1 (5)	1 (5)	8 (40)	7 (35)	1 (5)	2 (10)
4	6 (30)	8 (40)	2 (10)	3 (15)	0	1 (5)
5	1 (5)	4 (20)	3 (15)	8 (40)	4 (20)	0
6	1 (5)	3 (15)	1 (5)	4 (20)	11 (55)	0
7	3 (15)	3 (15)	9 (45)	2 (10)	2 (10)	1 (5)
8	0	3 (15)	5 (25)	7 (35)	4 (20)	1 (5)
9	2 (10)	1 (5)	8 (40)	4 (20)	5 (25)	0
MIAC Technical Assistance Personnel						
1	0	1 (6)	4 (27)	6 (40)	4 (27)	0
2	0	3 (20)	7 (47)	5 (33)	0	0
3	1 (6)	1 (6)	2 (13)	7 (47)	4 (27)	0
4	0	3 (20)	7 (47)	7 (20)	2 (13)	0
5	0	0	3 (20)	7 (47)	5 (33)	0
6	0	2 (13)	1 (6.5)	7 (47)	4 (27)	1 (6.5)
7	0	2 (13)	6 (40)	6 (40)	1 (7)	0
8	0	1 (7)	5 (33)	7 (47)	2 (13)	0
9	0	0	6 (40)	7 (47)	2 (13)	0

Note: Numbers represent actual respondents and percentages in brackets.

Aridoculture Center Researchers' Social Situation: An Assessment

Draft of Preliminary Findings

by

Dr. Fatima Nassif
INRA Center
Settat

May 22, 1991

I. Introduction

Human resources are a key element to success for every institution and usually are the most difficult to secure. Thanks to the Dryland Applied Agriculture Research project, the Aridoculture Center is to be commended for its highly qualified research staff. Evidently progress is increasingly made with respect to research facilities, training, institutional building and many other areas. However, researchers' social situation remains the weakest aspect in institution building of the Center. The far-reaching implications of this situation could affect Center's sustainability.

It must be pointed that this is not the first time Center researchers social situation is addressed. In every fall conference, researchers have voiced their social needs and problems. As early as 1986 and in conjunction with the fall conference, a report focusing on "suggestions to increase the Aridoculture efficiency" was drafted and presented to INRA and MIAC management. Social aspects constituted a major component of that report.

Letters have been sent to INRA Headquarters on numerous occasions. Some of these contained recommendations and suggestions to improve the situation. In addition, cries for help have been addressed to local authorities especially with respect to housing.

Several researchers have acknowledged that MIAC has been supportive. It even proposed some kind of "salary supplements" to help with the rent especially before the salary increase. Such a proposition was rejected by INRA (personal communication).

However, progress is being made in certain areas. Examples of these are the provision of school transportation for researchers children, on-going construction of the Centre d'Accueil, last increases in per diem quota and salaries. All these improvements are well appreciated by Center researchers. But they remain insufficient to overcome the feeling of malaise and frustration shared by many. Salaries, housing, and researcher status are areas where improvements are urged.

This report presents preliminary findings of a survey conducted at the Center. These concern 36 researchers out of 40 who are currently working at the Aridoculture Center. Two of the respondents are female. Age ranges between 24 and 41 with an average of 32. While half of respondents are single, 47 % are married and one case of divorce. The average number of children per researcher family is 2. On the average, respondents have one relative living with them and support 3 others.

Eighty percent of respondents actually reside in Settat. The remaining 20 % reside in other cities with 10 % commuting regularly to Settat and 10 Percent with living arrangements in Settat.

One fourth of respondents hold a Ph.D degree or equivalent. About 20 % are working towards the Ph.D. Thirty three and 17 % have an MS and a BS or equivalents respectively.

The major key issues are:

1. Salaries

Monthly salaries vary between 1,837 and 8,700 Dirhams (received by the head of the Center. The average salary is 4,785 Dirhams with 36 % of respondents in the 4,000-4,999 Dirhams category, 25 % in the 5,000-5,999 category, and 19 % in the 3,000-3,999 category.

Given the kind of degrees held by researcher (25% with Ph.Ds), the nature of work they do and salary levels in other national institutions, Center researchers are underpaid and overexploited. The initial salary for a new Ph.D recruit in a teaching institution is twice that provided by INRA (4,660 vs 8,900 Dh). In addition, the average work load of a faculty member is far less than what is carried out by the average researcher at the Center. It is no surprise that salaries are becoming the most serious cause of concern among researchers.

Indeed, when asked to rate the importance of 4 categorical variables in determining the quality of life, work was considered the most important. Family and local social environment scored second. When asked to rate the importance of individual factors in each category, salary was the most important with the highest score within the category and among all 16 factors rated.

2. Housing

The overwhelming majority of researchers (94%) live in rented houses, predominantly apartments. A few researchers share apartments or one-floor houses. The average size is 3 bedrooms and the average monthly rent is 1,014 Dh.

When asked whether they were satisfied with their housing conditions, 86 % answered negatively. When asked to choose among alternatives to resolve this problem, purchasing a place with payment and/or loan facilities attracted 44 % while government housing was chosen by 28 %.

Nineteen percent of Center researchers live outside Settat, mainly Rabat and Casablanca. When asked whether they have considered living in Settat, 6 out of 7 answered positively. The most important factor that kept them from doing so was housing conditions in Settat (availability, price and quality).

Center researchers, especially those who have been with INRA almost as long as the life of the Dryland Project feel cheated because they had been promised housing in Settat. Some researchers participated in early meeting on these issues and saw the first Aridoculture Center blueprints with houses for researchers (personal communication). In fact, a copy of the 1982 blueprint (Plan de Construction) of the Center includes 15 houses (villas).

3. Researcher Status

The non-application of a researcher status within an institution whose primary mandate is research has been a source of major concern among Center researchers. Although a proposal on this is being finalized, some
researchers see the proposition as insufficient, others are skeptic that this will not ever happen.

Their argument is that it has been years since the discourse on researcher's status and the process/procedure of developing such a status have started. In fact, researcher's status received the fourth highest score of importance after salary (the highest), work advancement opportunity and housing.

II. Assessment and Implications for Center Sustainability

When asked about INRA headquarters' attitude towards their social situation, 64 % of respondents declared it to be either very negative or negative. One fourth considered the INRA attitude to be indifferent.

When asked to identify what major impediments to the application of the researcher's status, the overwhelming majority declared INRA administration and Director to be responsible.

Many Center researchers have considered leaving the Center or even INRA. Three fourth and 70 % of respondents declared having thought about leaving the Center and INRA respectively. Just during 1990-91, four researchers have actually taken steps to leave INRA and join other national institutions. Two have been successful in their move. A few are considering staying with INRA but not in the Center.

Researchers' social situation calls for serious and urgent action. Researchers' calls for improvement of their status, their salaries, and their housing conditions need to be taken seriously and very soon.

While there is an overall agreement on key issues, there are differences which seem to be associated with the researcher's current status at the Center.

1. Researchers with Completed Ph.D.s

This group (25 %) is the strongest and most determinate to bring about change, for it is also the oldest group at INRA and used to have advantages which they lost once gone for training. Researchers in this group are confident and well-aware of their capabilities, qualifications and credentials. They are the most frustrated and disappointed group. In their view, INRA is holding them back for three main reasons. It undervalues their efforts since their work is often gone unrewarded. It shows no concern of the quality of life they lead. INRA is not committed to research.

2. Researchers completing their Ph.D.s

For this group (19%), thesis and degree completion appear to provide the impetus to their research commitment. They are less determined to change that the first group. Once they get their degrees, they will join the first group in voicing their frustration and call for change.

3. New INRA Recruits

Members of this group (28%) joined INRA during its recent recruitment since the beginning of

1990. They are very young and relatively voiceless at the present time. Even though they have not been at the Center for long, several of them start expressing some disappointments. Since the majority of this group is
at the MS level, their main goal revolves around training opportunities.

4. Contractual Group (about 17 %)

Given their temporary job situation, job insecurity remains the major problem on their agenda. Nevertheless, they share other groups concerns about improving researchers quality of life.

ANNEX 5

REVISED PRESENTATIONS OF ORIGINAL SUPPLEMENTARY BUDGET REQUESTS ON SOCIO-ECONOMIC STUDIES, TECHNOLOGY TRANSFER ACTIVITIES, AND SOIL MAPPING

STRUCTURE OF FOOD PRODUCTS AND INPUTS MARKETS IN THE CHAOUIA AND ABDA REGIONS OF MOROCCO

May 21, 1991

I. Justification

The characteristics of the marketing system in Abda and Chaouia region need to be defined in terms of Aridoculture Center's demand for information. Technologies developed at the Aridoculture Center are all destined for exchange within the market either directly or after having been processed through the rearing of animals. Two major components of marketing activities exist; marketing in the souk and marketing activities undertaken by private entrepreneurs operating businesses. These can further be broken down into private and public marketing activities which occur both in the Souk and in the urban area. Within the Souk there are different marketing functions which result in the transfer of agricultural commodities and inputs. Understanding the processes by which exchange of goods occurs within the market will provide information necessary to better serve the agricultural producers in their attempt to sale output and purchase inputs. It will also provide information to Center researchers who are interested in promoting technology development activities which may fall outside the domain of Vulgarisation. Furthermore, it will promote linkages between private enterprise and Aridoculture Center scientists which may be used to encourage the smooth flow of technology to farmers.

II. Purpose

To provide information on market structure for use by the socioeconomic section for future evaluation and facilitation in transfer of Aridoculture technologies.

III. Objectives

1. Characterize the market structure for sub-regional and regional markets in the Chaouia and Abda regions of Morocco.

2. Investigate the marketing margin of buyers/sellers in the Souk and in the permanent markets for agricultural outputs and inputs.

IV. Procedures

The "Structure of Food Products and Inputs Markets: Chaouia and Abda Regions of Morocco" will be implemented using formal survey questionnaires which will include both closed and open ended questions. Target areas will be located in Abda and Chaouia Regions. The interview process will include participation by DPAs in each region is anticipated. Instrument design, analysis, and reporting will be undertaken by the Socioeconomic Section.

V. Methodology

Markets will be chosen in areas where Center research activities are underway or being planned.

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Data collection will be undertaken utilizing instruments which focus on structure, conduct and price levels within the markets and marketing margins obtained by market participants. Secondly, a questionnaire will be developed which will focus on both on activities undertaken by both private agencies or individuals and through government or parastatal organizations. Each of the questionnaires will include information on marketing margins attained from different market strata (sub-regional or regional).

This data collection activity will utilize instruments which will compliment the other the Technology Transfer "Market Information" study but will be undertaken in other locations and during separate time periods as well as simultaneous with the latter mentioned activity.

A minimum of 8 markets, 4 in Abda and 4 in Chaouia, will be identified. A minimum of twenty participants in these markets will be contacted and requested to participate in the data collection activities on a random basis. All types of participants operating in the market for the reallocation of agricultural resources will be incorporated into the study. These would include as a minimum the producer, the intermediary and the merchant.

Data collection will be undertaken by the Agricultural Economics Section, and DPA. Data analysis will be undertaken by the by personnel in the Socioeconomic Program.

The results of this activity will compliment the activities undertaken in the "Market Information Protocol" and the consumption protocol; two protocols which will be implemented by the and by the Technology Transfer and Socioeconomic Section Group, respectively.

VI. Budget

		Costs in Dirhams
1.	Technician for 12 months	45,600
2.	Computer Paper (2 boxes)	490
3.	Fuel and Lubricants	34,091
4.	Hotel Charges (27 nights)	44,760
5.	Equipment Maintenance	1,200
6.	Vehicle maintenance (19,697 km. @ .14 Dirhams)	2,759
7.	Subsistence allowance (55 nights)	5,500
	TOTAL	134,399

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Farm-Household Consumption Research Project

by
Abdellah Bouayad
INRA Center
Settat

22 May 1991

Farm-Household Consumption in Chaouia

I. Justification

The farming family is at the center of the micro rural economy. This unit integrates production as well as consumption activities in the farm-household. The two activities define why and how resources are obtained, controlled, allocated, and utilized.

The definition of mathematical models and the estimation of production and consumption function parameters are essential to an understanding of development possibilities. Without these, the identification of research and extension strategies capable of improving farmer socio-economic status is difficult.

Quantitative and qualitative data on consumption are useful for (1) describing different consumption patterns and developing consumption models, (2) identifying differences in consumption on the basis of household size, agro-ecological zoning, seasonality, and socio-economic strata, and (3) distinguishing between home-produced and purchased consumables.

Technology adoption is affected by farmers' resources and income. These criteria are important and must be taken into account in all development actions and particularly extension. This study will attempt to explain farmer income in its multiple facets: amount, sources, distribution, and its relation to consumption. Other aspects of the study include the assessment and analysis of the following: food ration, seasonal variation in consumption, purchases and sales, and evolution of consumption patterns.

II. Objectives

1. To determine whether farmers main goal of feeding their family is satisfactorily met.

2. To examine how consumption affects production decisions.

Other objectives revolve around questions such as to what extent will farmer adoption of innovations improve their consumption and whether it is possible to develop technologies purposively to improve consumption.

III. Procedure and Sample Selection

Based on the Training and Visit extension method, the Settat province is divided into 34 sectors. In each sector, 32 farm-households are monitored by an extension agent. For this study, only 3 farm-households will be chosen in each sector -- about 100 total farm-households.

The study will be based on data collected from farmers by the DPAE team of interviewers. A questionnaire is being developed. Major components of the questionnaire include the following:

Family characteristics; crop production costs; livestock production costs; food ration (quantity and quality); purchases, sales and savings (amount and form); evolution of consumption patterns; food products prices in local markets of the study area (This information will be collected in conjunction with the Markets Study Project).

The survey will be carried out in four phases with each corresponding to a season.

IV. Proposed Budget

Vehicle (R4-F)	D	80,000
Epson Portable computer		40,000
Computer supplies		11,000
Fuel		7,000
Per diem		10,000
Engineer (2 years @ 3,600 Dirhams per months)		86,000
Consultant (Dr. Iraqui for two years)		60,000
Training for A. Bouayad in the United States		44,000
Total	D	338,000

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DIVISION OF LABOR RESEARCH PROJECT

by
Dr. Fatima Nassif
INRA Center

May 22, 1991

Farm Household Division of Labor in the Province of Settat

I. Justification

Women and children are key labor suppliers for agricultural and non-agricultural activities. Yet their contributions have often gone unnoticed and/or undervalued. A study of the division of labor is thus needed to generate accurate assessments of labor participation, labor allocation and task specialization. It will also help in identifying potential ways of increasing labor use efficiency and labor returns. Furthermore, precise information on the division of labor can be instrumental in opening up opportunities for age and gender sensitive agricultural research, technology development, and policy making.

II. Objectives

1. To investigate the organization of labor in farm households based on age, gender, source and type of activity.

2. To explain the existing division of labor by socio-economic factors such as education, size of landholding and off-farm opportunities.

3. To establish calendars of different activities and labor allocations.

4. To identify areas for appropriate research and technology interventions.

III. Methodological Framework

Obviously, a review of relevant literature is necessary. This will be undertaken intensively before the elaboration of data collection instruments and will continue moderately until the drafting of the report. The study will draw from the sociology baseline data set in three major areas which are sample selection, background/socio-economic variables, and collected data on the division of labor.

IV. Sample Selection

The baseline sample is recently established and is representative of various agro-ecological zones in the province of Settat. Ten percent of the 396 Settat sample is large enough to allow statistical manipulation; yet fairly small to permit frequent visits and collection of detailed data. More importantly, the 10 percent sample will be selected across major socio-economic categories.

V. Explanatory Variables

A study of the division of labor will yield better insights into labor organization and implications for technological and social change if the division of labor-related variables are examined in the light of other variables. Thus, ownership and control of land, livestock and farm equipment, and other wealth indicators will be used to explain existing divisions of labor.

VI. Research Method

Direct observation will be used for accurate recording of the actual participation of household members in different activities. It thus will supplement data on household members participation in various activities, already collected based on recall.

VII. Duration of Field Work

A full calendar year is necessary for examining labor seasonal variation across age, sex and socio-economic strata and identifying off-farm work possibilities. Consequently, four visits will be spread out at different labor requirement seasons: planting, maintenance (entretien des cultures), harvest, and post-harvest seasons. These visits will last at least the full 13 to 15 awakening hours.

VIII. Data Entry and Analysis

This could begin after the first visits are done and continue until all data are entered. Analysis awaits the end of the data collection process.

IX. Time Frame

October-November	Review the literature
December-January	Develop and pretest data collection instruments
February-April	Collect first visit data (maintenance season)
May-July	Collect second visit data (harvest season)
August-October	Collect third visit data (post-harvest season)
November-January	Collect last visit data (planting season)
February-April	Analyze data
May-July	Draft report
August-September	Finalize the report, seminar and publication

X. Proposed Budget

Vehicle (R4-F)	D	80,000
Computer with monitor and printer		44,716
Interviewers (2 for 14 months @ D 3,500		98,000
Data management technician (24 months @ D 3,500)		84,000
Computer and interview supplies		30,000
Fuel (150 kms. per visit at 200 visits (30,000)		40,000
Total	D	376,716

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Socioeconomic Research Project: Farmer Decision-Making Processes
By
Sefrioui A. and Moore K.

I. Justification

The Aridoculture Center is interested in the development of farms in arid and semi-arid zones. Knowledge of the logic of the choices made by farmers in these zones (how do they make decisions? what are the factors and criteria which influence the management of their operations?) is indispensable for proposing improvements which are not simply technocratic transfers.

During recent PBO workshops, major constraints have been identified which are linked to farmer management practices. The programming of future research has been linked to this definition of researchable problems. That is, based on researcher reasoning, problems and technologies to resolve them have been and are being developed. Experience has shown, however, that many of these technologies have not been accepted by the farmers. Therefore, it is important to define the reasoning of farmers in regard to their decisions concerning these researcher defined constraints.

II. Objectives

1. Define how and why farmers make the decisions they do.

2. Provide a basis for adapting the improvements proposed by the Aridoculture Center to the decision making conditions existing on regional farming operations.

3. Contribute to the improvement of research efficiency in aridoculture by taking into consideration the diversity of actual agricultural practices.

4. Develop models of farmer decision-making.

III. Procedure

1. Inventory problems identified by researchers in order to target researchable questions on farmer decision-making.

2. Elaborate a sample of farmers within barley, wheat and pasture systems.

3. Develop and test survey instruments for informal, open-ended interviews. Familiarize interviewers with the zones in which they will be working.

4. Conduct an initial survey of farmers in each of the three zones. Thirty farmers are to be interviewed in each zone (total sample size of 90). The interviews would involve in depth discussions lasting approximately three hours each.

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5. Analyze data collected and develop models of farmer reasoning to be tested in the second set of interviews. Revise survey instruments to test the models developed.

6. Conduct the final survey of farmers (90) to confirm and revise the decision making models.

7. Analyze and describe the farmer reasoning as demonstrated in the functioning of these models, distinguish between different management styles, and identify the key decisions linked to the major farmer constraints.

8. Draft and submit final report.

IV. Time Frame

1991

October-November	Inventory problems linked to farmer decision-making
December	Sample identification and selection

1992

January-February	Develop survey instruments
March	Recruit and train interviewers
April-May	Pre-test survey instruments and familiarization with milieu
June	Modify survey instruments
July-October	Conduct initial survey
November-December	Data preparation and preliminary analysis

1993

January	Model construction
February	Revise survey instruments
March-May	Second Survey
June-September	Final analysis and drafting of final report

V. Budget

Interviewers (4 x 16 months x 3500 Dh)	D	252,000
Vehicle purchase (Renault Express)		110,000
Fuel and Lubricants (60 days x 250 km x 1.5 Dh)		22,500
Food and Lodging (20 nights x 200 x 6 persons)		24,000
Purchase of Computer, Monitor and Printer		44,716
Computer Supplies		2,000
Office Supplies		1,000
Total	D	456,216

MAPPING PROJECT PROPOSAL TO USAID

DEVELOPMENT OF A SCHEMATIC SOIL-LAND CAPABILITY MAP FOR TECHNOLOGY TRANSFER IN THE ARIDOCULTURE CENTER'S ZONE OF INFLUENCE

by
Mohamad El Oumri
Chef, Depart. du Milieu Physic
Institut National de la Recherche Agronomique, Rabat

Since its inception, the Aridoculture Center in Settat has focused on developing technologies that can be readily adopted by the predominately small-scale farmers throughout the vast arid and semi-arid area (4 million hectares cultivated) under its mandate. While this area can be classified into three broad agro-ecological zones based on rainfall and temperature data, characterization of soil in these zones is non-existent to rudimentary at best for most of the area; only a small proportion is satisfactorily mapped. Successful implementation of useful technologies at the farmer's level requires a recognition of recommendation domains which account for climatic and soil diversity. The recommendation domain should be large areas for transfer of technologies such as water conservation, fertilizer use, varieties, and management practices according to rainfall and soil properties, such as depth and texture.

It is instructive to examine the extent to which the region's soils are known and mapped, either at the higher intensity local level or the larger scale regional level. The soils at the experimental stations, where potential technologies are developed are comparatively well identified - with simple maps available for Sidi El Aydi (Typic Calcixeroll, Vertic Palexeroll), and Jemaa Shaim (mainly typic Chromoxerert with some shallower Petrocalcic Palexeroll). Chromoxererts dominate at Khemis Zemamra and at Jemaa Riah, while Jain N'Zagh varies from Petrocalcic Palexerolls to Argixerolls. With the possible exception of the latter station, the experimental stations are located on the region's better and deeper soils. However, a disproportionate amount of the dryland zone does not involve these soils. Recognition of these discrepancies in addition to the fact that fertility levels at stations are considerably higher than in farmers' fields (Ryan et al., 1990) led to increased emphasis towards on-farm research. Ideally, this provides a more meaningful basis for technology transfer.

Fertilizer use, notably nitrogen and to lesser extent phosphorus, lends itself readily to farmer adoption. However, our work at the Center (Soltanpour et al., 1989; Ryan et al., 1990) showed that crop responses were not only related to major rainfall zones, but within any zone yield potential could differ two- to threefold as a result of soil differences (Abdel Monem et al., 1990). Our findings with deep (Vertisols), moderately deep (Calcixerolls), and shallow soils (Petrocalcic Palexerolls) enables us to generalize to most of the Chaouia region since these soils represented at least 60% of that area. That the Chaouia area is mapped (Stitou, 1986) at the 1:100,000 level provides the basis for this generalization. Technologies other than fertilizers are no less sensitive to soil varieties within any climatic zone.

However, less than 25% of the cultivated dryland project area is characterized by a soils map to any extent. In addition to the Chaouia area (240×10^3 hectares), other areas mapped include

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Doukkala ($60x10^3$ ha, irrigated), Abda ($350x10^3$) and Bahira ($120x10^3$ ha), all at a scale of 1:50,000. Despite these efforts, soils of the greater
part of the Project zone, where farmers or the end-users of our developed technologies, remain uncharted.

Casual observations would suggest that, within any rainfall zone, large areas of diverse soil types exist. For example, while deep Vertisols are extensive in the Settat-Oulad Said area and again in the south at Jemaa Shaim, a vast area of red sandy soil extends from JBoulaouane to Khemis Zemamra. Recommendations for fertilizer use - indeed any technology - would have to consider such differences.

Thus, a prerequisite to successful transfer of technology is information on the soil resource. The issue is one of scale - and that involves time and money. While a medium-intensity survey of the Project zone would be desirable (1:25,000), this would take many years to complete and be prohibitive in terms of labor and financial resources. Even low intensity maps such as that of Stitou (1985) for Chaouia at 1:100,000 is time - and resource-consuming; Other than its general utility in helping select trial sites for on-farm research, its utility has been limited.

Given the area's low output and the urgency to address it, it is probable that a schematic-reconnaissance type map of the Project area at 1:250,000 would suffice. This should, 1) delineate climatic zones, 2) identify major soil groups or orders in these zones and, 3) broadly classify the area in terms of land use capability and cropping systems.

Such a map could be constructed based on available satellite and aerial photos, topographical and geological maps, extensive ground observations of the soil distribution, the landscape and associated cropping systems, and available rainfall and temperature data, and exposure of profiles of "benchmark" or major soil orders. The major soils types will be identified in local vernacular terms.

The output of the effort, which should be competed in 9-12 months, would be a limited number of well-defined recommendation domains. This would greatly assist selection of sites for on-farm research in each domain and help to make the ensuing research findings more meaningful, and target technologies to fitted environments.

While the Project will be mainly carried out by INRA, it will involve IAV which has considerable expertise in satellite imagery of the Settat area. The budget of $135,000 is attached.

In summary, the beneficiaries of the project will include:

1. Researchers at the Aridoculture Center whose effort at technology transfer sill be enhanced,
2. Agents from local DPA and CD Centers who can more effectively make recommendations to farmers,
3. Ultimately, the farmers of the dryland region who are the recipients of developed technologies, and

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4. Institutions such as INRA and IAV-Hassan II, which will benefit from such collaborations.

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PROJECTED BUDGET

1.	Material Supplies		
	Vehicle (Land Rover)	$	36,000
	Sampling equipment		10,000
	Maps/Photos		10,000
	Cartography		7,000
	Laboratory		10,000
	Weather Stations		12,000
	Labor		5,000
	Fuel		5,000
	GIS Equipment		10,000
	Printing Maps and Reports		10,000
2.	Short-Term Training		
	One person to United States or The Netherlands for 1 to 3 months	$	10,000
3.	Consultancy		
	Dr. Touchet visit from United States for 3 weeks	$	10,000
	TOTAL	$	135,000

ANNEX 6

INFORMATION ON SUSTAINABILITY ISSUES

ANNEX 6 TABLE 1
INRA/SETTAT RESEARCH ACTIVITIES
FINANCIAL SUSTAINABILITY SPREADSHEET FOR PROGRAM MAINTENANCE REQUIREMENTS

	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994
MIAC Contributions to Settat Research Budget						
A. Salaries of MIAC-hired temporaries	877,286	1,246,232	723,144	342,456	215,108	0
B. Rereach Commodities	8,857,536	7,862,112	3,081,960	2,063,512	1,611,803	0
C. Center/Station operations	1,930,769	1,682,968	1,418,608	846,918	618,295	0
D. Total MIAC Contribution	11,665,591	12,791,312	5,223,712	3,252,886	2,445,206	0
Number of Researchers on Site						
E. INRA Researchers	33	31	32	43	43	56
F. MIAC Researchers	13	14	14	12	8	0
G. Total	46	45	46	55	51	56
MIAC Contributions to Settat Researchers Net of MIAC Shares						
H. Per researcher share of Total MIAC Supplement (D+G)	253,600	284,251	113,559	59,143	47,945	0
J. Total Supplement to INRA researchers (H x E)	8,368,793	8,811,781	3,633,886	2,543,165	2,061,644	0
Total Research Support Budget, INRA Researchers at Settat						
K. From INRA/Rabat (Method from INRA Budget Section)		7,235,556	7,894,482	8,613,414	9,397,235	10,252,383
L. With MIAC Addition (K+J)		16,047,337	11,528,368	11,156,579	11,458,879	10,252,383
M. Per INRA researcher on site (L + E)		517,656	360,262	259,455	266,486	183,078
Conclusions						
N. Percent Drop in support per researcher 1991-1994			1994+1991			49.2 %
P. Total budget needed for support researchers (E) at 1991 level (M 1991)			Baseline year	15,491,266	15,491,266	20,174,672
Q. Budget Shortfall (P - L) (Dollars at 8.5 DH = $ 1)				4,334,687 ($ 509,963)	4,032,387 ($ 474,398)	9,922,289 $ 1,167,328
R. Number of researchers supportable at 1991 level if shortfall not covered				31	32	28
S. Shortfall for activities if 40 researchers is minimum critical mass				3,253,901 ($ 382,811)	2,951,601 ($ 347,247)	4,158,097 ($489,188)

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ANNEX 7

INFORMATION ON TECHNOLOGY DEVELOPMENT AND AGRICULTURAL RESEARCH

ANNEX 7 TABLE 1 – VARIETY DEVELOPMENT BY THE CEREALS IMPROVEMENT SUB-PROJECT

Cereal Varieties	Actual or Projected Year of Catalogue Inscription and Release											Project Contribution in Percent
	84	85	86	87	88	89	90	91	92	93	94	
Barley												
O. Aani	R											50
O. Tamelait	R											50
O. Tissa	R											50
1O. Aglou					R							80
O. Tiddaz					R							80
Bread Wheat												
B. TJouda	R											50
2B. TMarch	R											50
B. TSais		R										50
B. TSibara		R										50
B. TKanz					R							50
B.TSaba					R							0
3B. TAchtar					R							80
B. TBaraka					R							80
B. TAlkhair					R							80
4B. TSaada					R							100
4B BT 1735									R			0
4B BT 1736									R			0
4B HFXSEPT											R	0
Hard Wheat												
B. DMarzak	R											50
5B. DKarim		R										30
B. DBelbach					R							30
B. DSebou					R							80
B. DSarif					R							80
B. DMazza					R							80
B. DIsly					R							80
6B. DOumRabia					R							80
B. DTazzaout					R							80
B. DTensift					R							80

Notes: 1,3 and 6 – Performance and popularity indicate eventual widespread acceptance; 2 and 5 – Estimated 30 percent of current certified seed sales for their respective categories; 4 – First variety released with specific pest – Hessian Fly – resistance. Related varieties will have improved agronomic and commercial characteristics.

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ANNEX 7 TABLE 2 – TECHNOLOGY DEVELOPMENT BY DISCIPLINE

Practices Under Development	Known or Projected										
	84	85	86	87	88	89	90	91	92	93	94
Weed Science											
Jujubier Control		T	T	F							
Weed Control in Winter Chickpeas		T	T	T	F	R					
Early Weed Control in Wheat	TF	RE	E	E	E	E	E	E			
Weed Control in Lentils		T	T	T	T	T	T	T			
Winter Chickpea Varieties											
195				R	E	E	E	E			
482				R	E	E	E	/			
484				R	/						
83-47C					T	T	T	F			
83-48C					T	T	T	F	R		
84-92C					T	T	T	F	R		
84-93C						T	T	T	F		
Agricultural Mechanization											
Sweep			T	T	T	T					
Drill				T	T	T	T	R	E	R	
Seeder							T	T	F	R	
Wheat Threaher				T	T						
Legume Threaher						T	T	T	F	R	
Soil Management											
No-Till	T	T	T	T	T	T	T	T	T	T	T
Forages											
Ley-Farming	T	T	T	T	T	T	T	T	T	T	T
Australian Ley-Farming		F	E	E	E	/					
Soil Fertility											
Calibration		T	T	T	T	T	T	T	T	T	T
Agronomy											

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Food Legumes Package	T	T	F	E							
Small Grain Early Planting	T	T	T	F	E						
Package for Dry Environments	T	T	T	F	E						
Package for Wet Environments	T	T	T	F	E						
Corn Early Planting		T	F	E							

Notes: T = testing and refers to all testing processes
F = finalization is the point at which the researcher considers that testing is conclusive
R = indicates the point at which the technology is released for extension
/ = indicates that a technology was subsequently retracted
E = active and focused extension underway

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ANNEX 7 TABLE 3 – TIME AND CONTINUITY OF STAFFING BY DISCIPLINE EXPRESSED IN SCIENTIST YEARS AND LISTED IN ORDER OF DESCENDING QUANTITY

Discipline	Year										Total Scientist Years
	82*	83	84	85	86	87	88	89	90	91	
Cereal Breeding											
INRA	0	0	0	0	.25	1.75	2.25	6	5.75	6	22.0
MIAC	1	1	1	1.5	2	1.5	1	1	.50	1	11.0
Cereal Agronomy											
INRA	0	0	0	3	3	4	4	4	3.25	3	24.25
MIAC	0	0	1	1	1	1	.25	1	1	1	7.25
Forages											
INRA	0	0	1	1.25	2.75	2.75	2.75	3	2.25	2	17.75
MIAC	1.75	1	1.5	1	1	.50	1	1	.50	1	10.25
Soil Fertility											
INRA	1	1	1	3	2	2	2	1.75	2	2	17.75
MIAC	1	1	1	1	1	1	1	1	1	1	10.0
Agricultural Mechanization											
INRA	0	0	0	.50	1	1.5	2	.75	0	.50	6.25
MIAC	0	.25	1	2	2.25	2.75	1.75	2.75	1.75	2	16.5
Plant Pathology											
INRA	0	0	0	1	3	3	2.75	2.75	3	2	17.5
MIAC	0	0	0	0	0	.50	1	1	.50	0	2
Food Legumes											
INRA	0	0	1	1	1	2.25	2	2.50	3	2	14.75
MIAC	0	0	0	0	0	0	0	0	.75	1	1.75
Weed Science											
INRA	0	.50	1	2	1	1.50	1.50	1	1.50	2	12
MIAC	0	0	.50	1	1	.50	0	.50	1	0	4.5
Soil Management											
INRA	0	.75	1	1	1	1	1.25	2	3	3	14.0
MIAC	0	0	0	0	.50	1	.50	0	0	0	2.0
Entomology											
INRA	0	0	0	.50	2	2	1.50	.50	0	.75	7.25
MIAC	0	0	0	.25	1	1	.25	0	.50	1	4.0

Note: * = includes participation prior to 1982

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ANNEX 7 TABLE 1 – CURRENT AND APPOINTED INRA PARTICIPANT TRAINEES BY DISCIPLINE

Discipline	Trainee Abroad	Trainee Appointed	Total Trainees
Cereal Improvement			
Ph.D.	1	1	2
Cereal Agronomy			
Ph.D.	3	1	4
Soil Fertility			
Ph.D.	1	0	1
Forages			
Ph.D.	3	0	3
Plant Pathology			
Ph.D.	1	0	1
Agricultural Mechanization			
M.S.	2	1	3
Weed Science			
Ph.D.	1	0	1
Food Legumes			
M.S.	1	0	1
Ph.D.	3	0	3
Soil Management			
M.S.	1	0	1
Entomology			
Ph.D.	1	0	1
Others			
Station Management M.S.	0	2	2
Rural Sociology Ph.D.	1	0	1
Ag Economics Ph.D.	1	0	1
Entomology Ph.D.	1	0	1

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ANNEX 7 TABLE 5 – RESEARCH PRIORITIES BY DISCIPLINE AS INDICATED BY PROTOCOLS SUBMITTED FOR THE 1990/1991 MIAC INTEGRATED PLAN OF WORK

Discipline	Classification of Protocols			Total Protocols
	Fundamental	Background	Technology	
Cereal Improvement				
Maize	0	3	1	4
Barley	0	7	8	15
Bread Wheat	0	17	4	21
Hard Wheat	0	0	4	4
Triticale	0	1	3	4
Other	2	0	0	2
Cereal Production				
Soil Fertility	0	5	11	16
Soil Management	0	4	0	4
Ag. Mechanization	0	2	0	2
Other	0	6	0	6
Forage				
Medicago	0	5	0	5
Ley-Farming	0	2	4	6
Hay	0	2	0	2
Food Legumes				
Chickpeas	0	1	5	6
Lentils	0	7	3	10
Dry Peas	0	1	1	2

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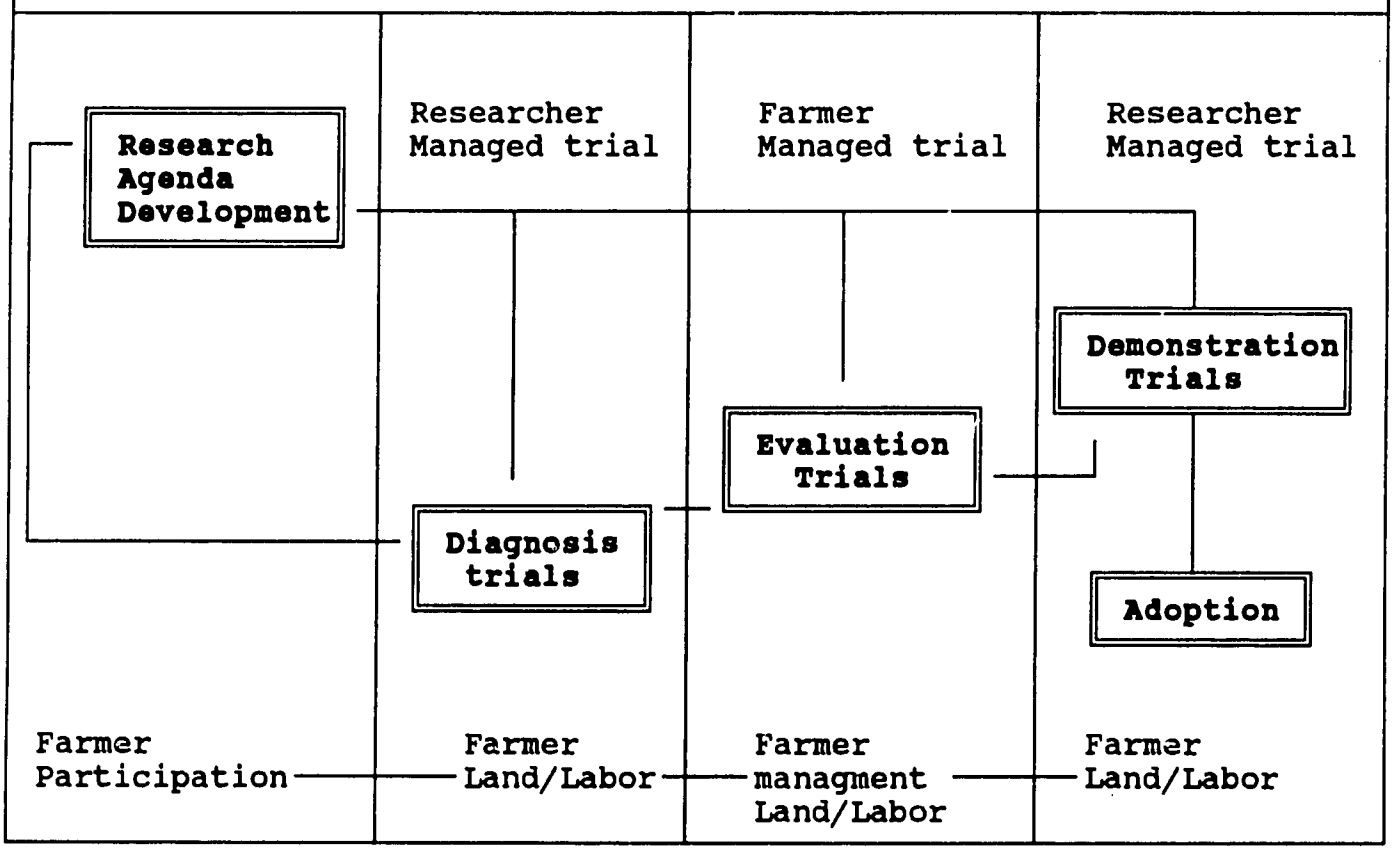
ANNEX 8

INFORMATION ON TECHNOLOGY TRANSFER AND AGRIBUSINESS

ANNEX 8 FIGURE 1 : **Technology Transfer Process 1**



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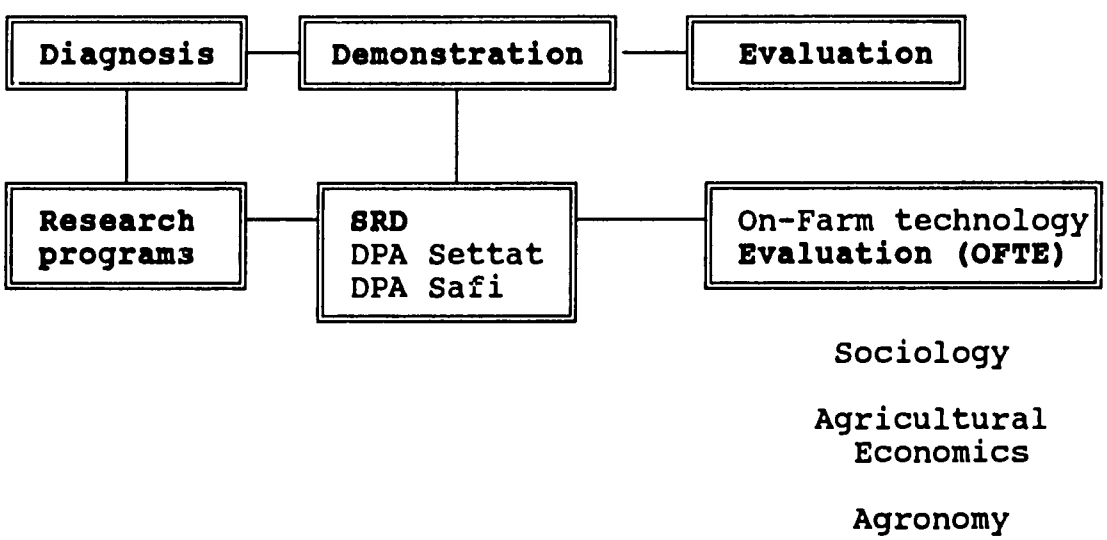
ANNEX 8 FIGURE 2 : **Technology Transfer Process 2**



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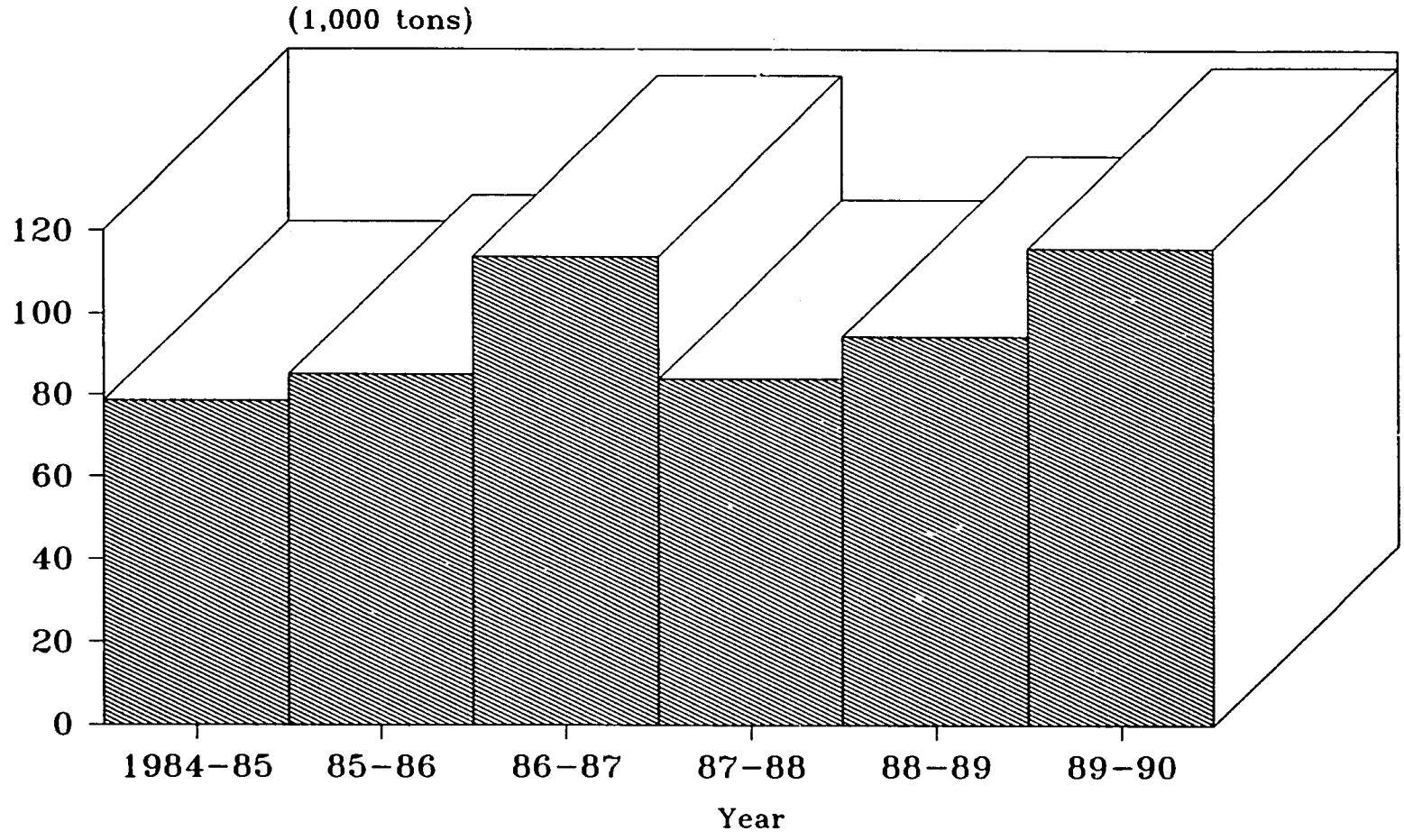
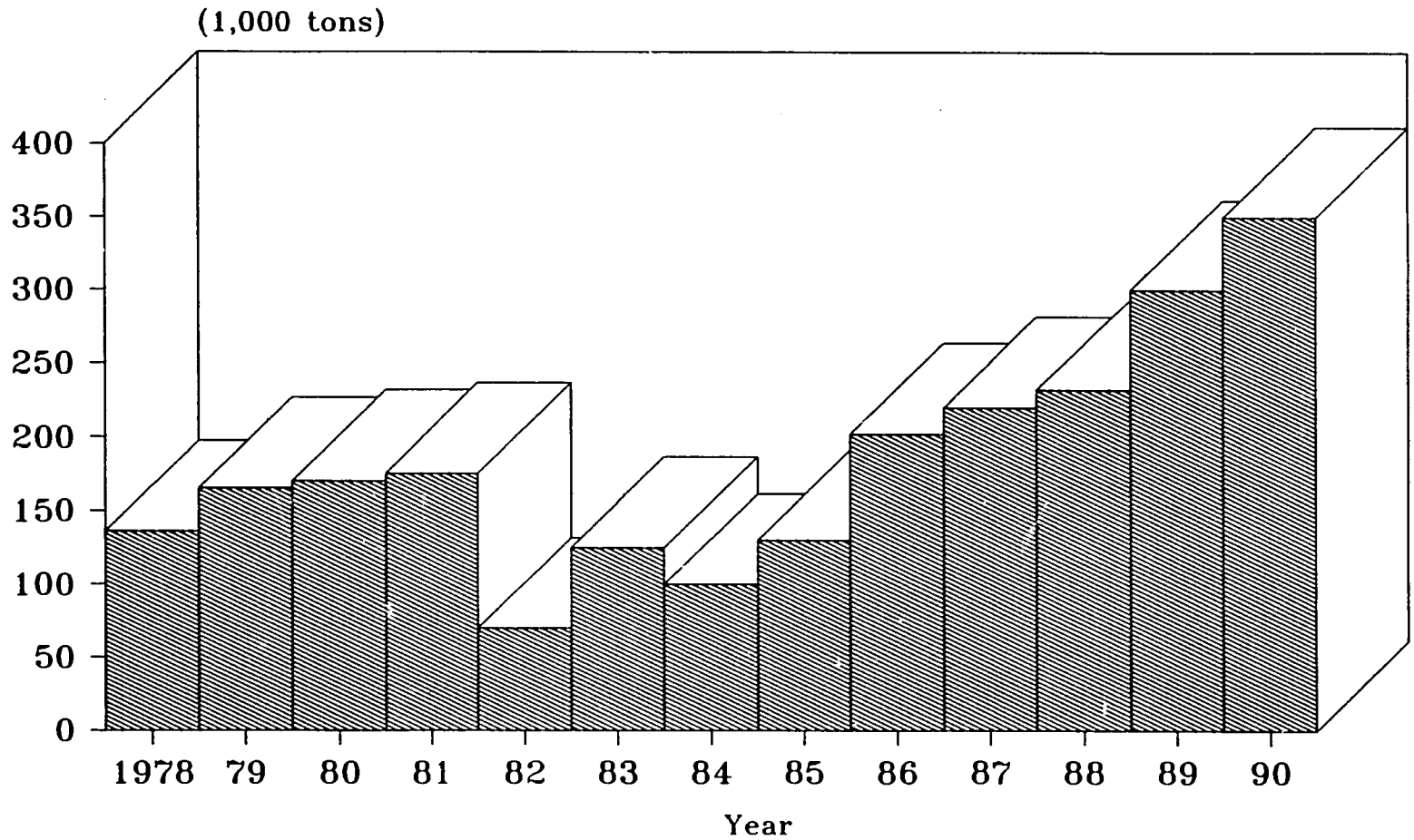
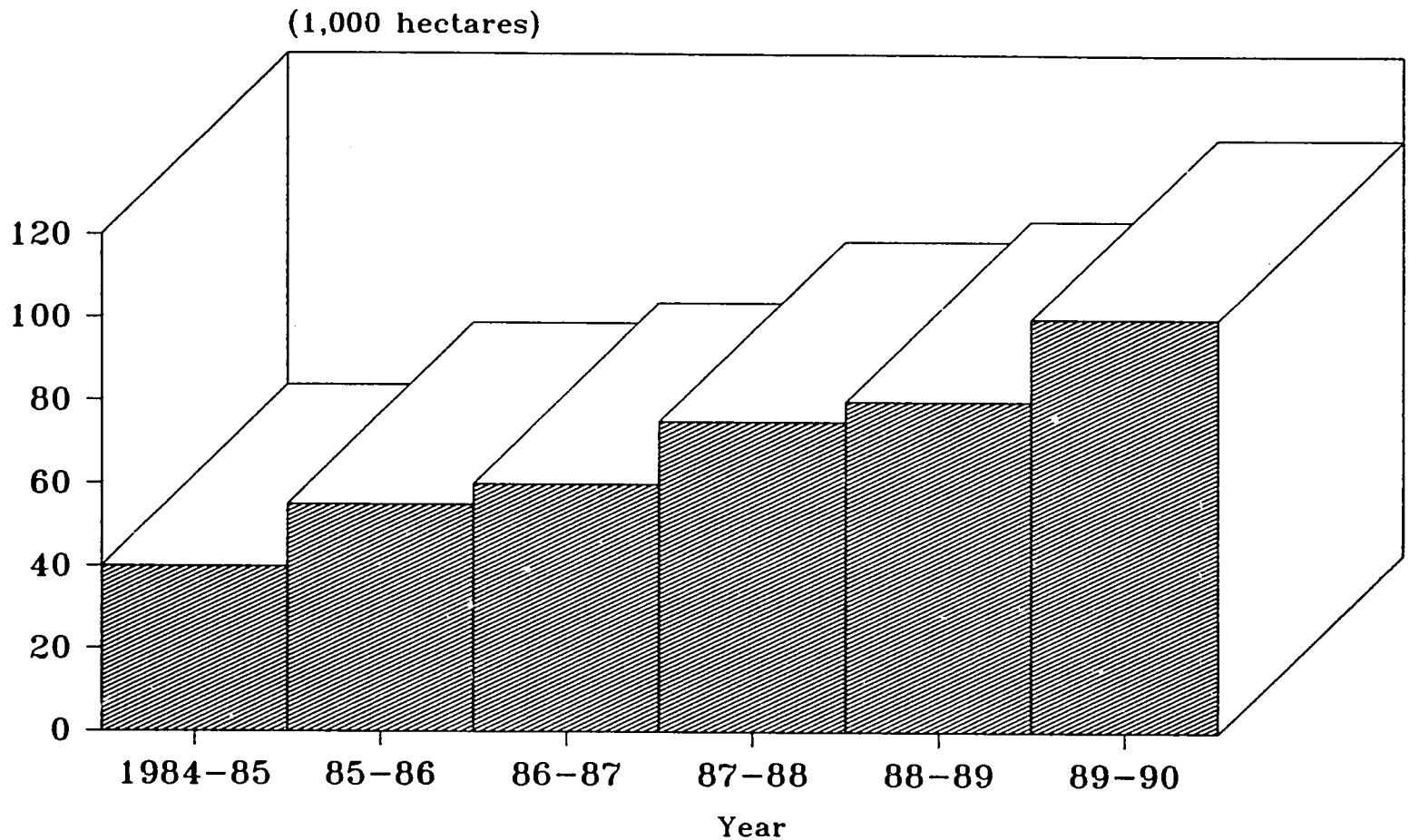


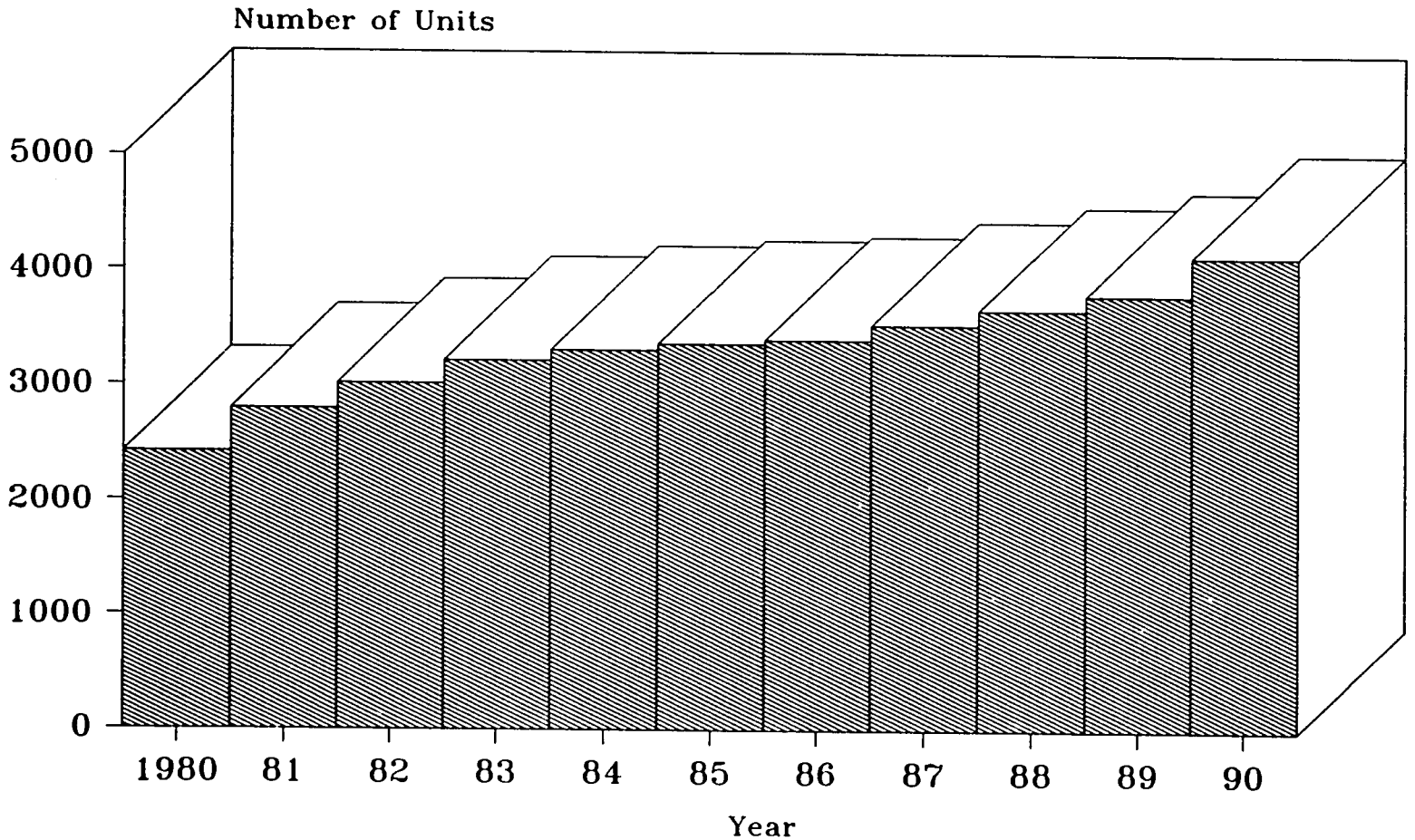
ANNEX 8 FIGURE 3: Evolution of the Amount to Certified Seed Sold to Farmers in Settat Province



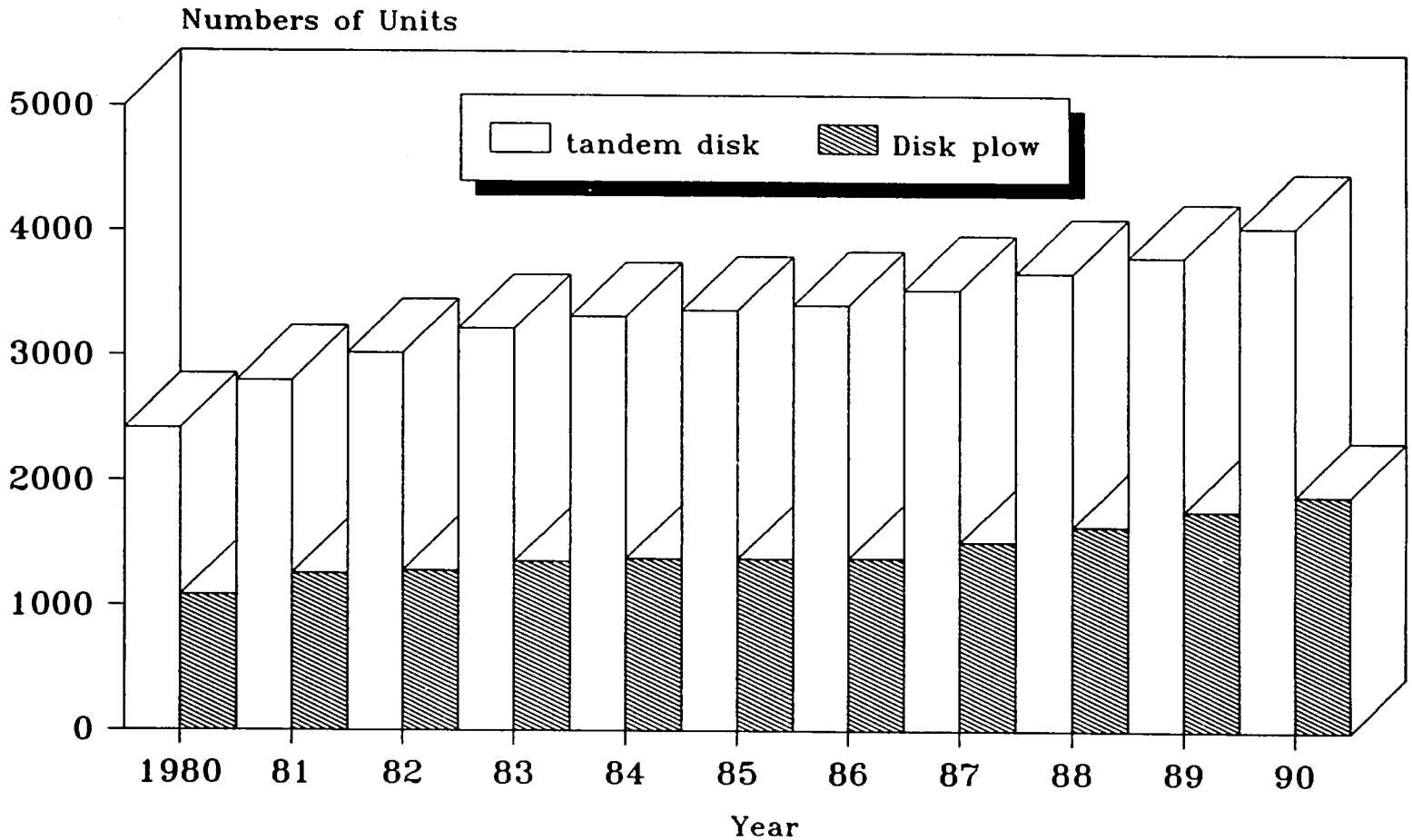
ANNEX 8 FIGURE 4: Evolution of the Amount of Fertilizers Sold to Farmers in the Settat Province



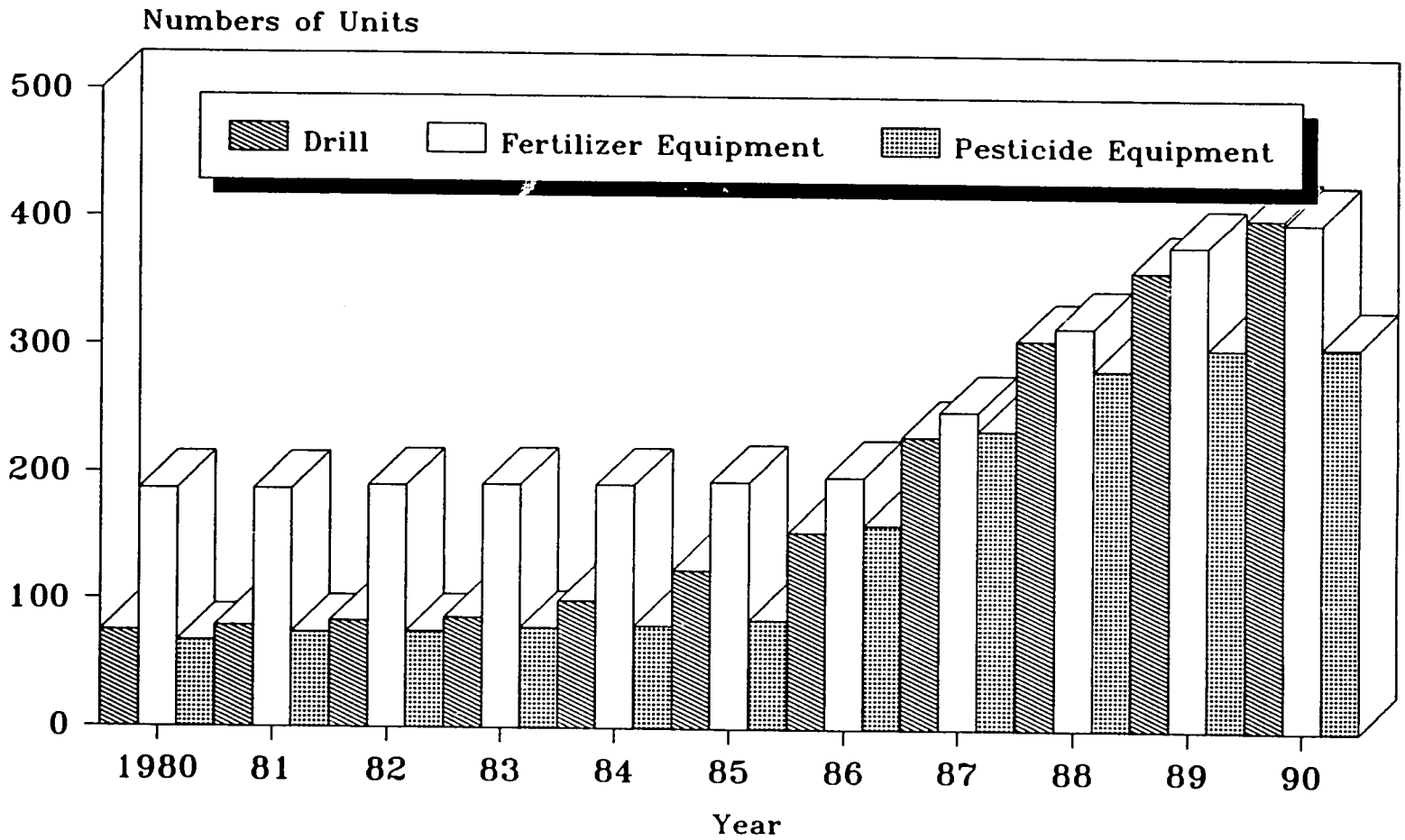
ANNEX 8 FIGURE 5 : Evolution of Acreage Treated Using Pesticides in the Settat Province



ANNEX 8 FIGURE 6: Evolution of the Number of Tractors Sold to Farmers in the Settat Province



ANNEX 8 FIGURE 7 : Evolution of the Implements Sold to Farmers in the Settat Province (Soil Preparation)



ANNEX 8 FIGURE 8: Evolution of the Implements Sold to Farmers in the Settat Province

ANNEX 8 FIGURE 9
LIST OF PRIVATE FIRMS

1. CIMAGET

Name: Compagnie Internationale des Machines Agricoles et de Génie-Civil.
Address: 21, Rue Rabia Al Adaouia - ex Audenga B.P. 13413, Casablanca.
Brands: Agrix, Berthoud, Case i.h., Eurodrip, Lindsay, Mailleux, Pasquali, Poclain, Schmotzer and Sogema.

2. Auto Hall

Name: Auto Hall
Address: 44, Avenue Lalla Yacout, B.P. 13884 Casablanca.
Brands: Ahdi, Allweier, Balkancaripex, Berthoud, Campeon, Champion, Charlotte, Cummins,Dresser, Ensival, Fiat, Fleetguard, Ford New Holland, Full Spray, Magenti Marelli, Mitsubishi, Monchiero, Nodet Gougis, Ocmus Sbuelz, Otma, Piva, Ransomes, Toyo and Welger.

3. COMICOM

Name: Compagnie Marocaine Industrielle et Commerciale
Address: 9, Blvd. d'Oujda, B.P. 3236, Casablanca.
Brands: Agrator, Burel, Comet, Comicom, Driltech, Faucheux, Gouvy, Gyro, Hamm, Hanomag, Harnlschteger, Huarducf, Kuhn, Law, Nejma, Oma, Ribouleau, Torpedo and Valpadana.

4. MAGIDEUTZ

Name: Nouvelle Société MAGIDEUTZ
Address: 4, Rue Layris Verger, B.P. 13024, Casablanca.
Brands : Deutz, Deutz Fahr, Deutz Mwm, Galucho, Gil and Mellote.

5. STOKVIS

Name: STOKVIS Nord Afrique
Address: 42, Blvd. Emile Zola, B.P. 2183, Casablanca.
Brands: Advance, Ariso, Belfo, Bencini, Berkel, Bolzon, Bourgoin, Cachapuz, Cascade, Ceres, Claas, Diesel, Energie, Duru+therme, Ebra, Exa, Faras, Faucheux, Fiat, Fiona, Fressori, Goldoni, Gould Imperial, Hard Hassia, Herriau, I.T.T., Inter Motor, Kenmore, Lombardini, Mobylette, Motobecane, Nardi, P.M. Autogrue, Pimespo, Rasspe, Rau, Sogema, Unelec, Unger, Unite Hermitique, Valcke and Velosolex.

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ANNEX 9

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REPORT BIBLIOGRAPHY

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