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**FINAL EVALUATION OF THE
MOROCCO DRYLAND AGRICULTURE APPLIED
RESEARCH PROJECT
(DAARP)**

Prepared for

The Agency for International Development
Rabat, Morocco

by

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LIST OF ACRONYMS AND ABBREVIATIONS

AID	Agency for International Development
APAPTA	Agricultural Policy Analysis Project (USAID)
ARS	Agricultural Research Service of the United States Department of Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CD-ROM	Compact Disk-Read Only Memory
CMV	Development Center/Centre de Mise en Valeur
CNCA	National Agricultural Credit Bank/Caisse National de Credit Agricole
CRRA	Regional Research Center/Centre Regional de la Recherche Agronomique
CT	Extension Center/Centre du Travaux
CRSP	Collaborative Research Support Program
DAARP	Dryland Agriculture Applied Research Project
DERD	Directorate of Education, Research and Development/Direction de la Education, Recherche et du Developpement (MAMVA)
dhs	Dirhams
DPA	Provincial Agricultural Office/Direction Provincial d'Agriculture
DPV	Directorate of Plant Production/Direction de la Production Vegetale (MAMVA)
DVRA	Directorate of Extension and Agrarian Reform/Direction de la Planificacion et des Analyses Economiques (MAMVA)
EEC	European Economic Community
ENA	National Agricultural College/Ecole Nationale d'Agriculture (Meknes)
FAO	Food and Agriculture Organization of the United Nations
FY	Fiscal Year
GDP	Gross Domestic Product
GOM	Government of Morocco
GTZ	German Agency for Technical Cooperation/Gessellschaft fur Technische Zusammenarbeit
IARC	International Agricultural Research Center
IAV	National Agronomic and Veterinary Institute/Institut National Agronomique et Veterinaire Hassan II
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)
INRA	National Agricultural Research Institute/Institut National de la Recherche Agronomique
IFAD	International Fund for Agricultural Development
IQC	Indefinite Quantities Contract
IPM	Integrated Pest Management
ISNAR	International Service for National Agricultural Research
ha	Hectare (2 5 Acres)
Kfw	German Development Bank
LAN	Local Area Network

LOP	Life of Project
MAMVA	Ministry of Agriculture and Agricultural Development/Ministere de l'Agriculture et de Mise en Valeur Agricole
MARA	Ministry of Agriculture and Ararian Reform/Ministere de l'Agriculture et de la Reforme Agraire
MIAC	MidAmerica International Agricultural Consortium
MU	Maghreb Union
NGO	Non-Governmental Organization
OICD	USDA Office of International Cooperation and Development
OCP	Cherifian Phosphate Office/Office Cherifienne des Phosphates
OMB	Office of Management and Budget (USAID)
ORMVA	Regional Agricultural Development Office/Office Regional de Mise en Valeur Agricole
PACD	Project Assistance Completion Date
PBO	Programming (Planning) by Objective/Programmation par Objectif
PVO	Private Voluntary Organization
RSA	Research System Approach
SCE	Cherifian Fertilizer Society/Societe Cherifienne d'Engrais
SRD	Research and Development Service/Service de Recherche et du Developpement
TA	Technical Assistance
TSMM	Tropical Soil Moisture Management component of Soil Management CRSP
TT	Technology Transfer
UNDP	United Nations Development Program
UNL	University of Nebraska, Lincoln
UPS	Uninterrupted Power Supply
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

EXECUTIVE SUMMARY

INTRODUCTION

Over the past fifteen years the Government of Morocco (GOM) and the USAID have cooperated in the development of a research center that would have the capability of generating technology to improve the productivity and stability of production of rainfed agriculture in the dryland areas of Morocco. The GOM contribution of approximately \$28 million has provided for the salaries of Moroccan staff, a major portion of operational costs of the center, construction of new facilities at the center and its satellite research stations, and airfare for participant training in the U S. The USAID contribution of about \$50 million has provided technical assistance, training and field and laboratory equipment, through the Drylands Applied Agricultural Research Project (DAARP). Most of the DAARP has been executed through a contract with the MidAmerica International Consortium (MIAC). Technical assistance by MIAC has included 1208 person years (41 persons) of resident technical assistance (TA) staff and 89 person months (223 persons) on short-term visits as technical consultants and advisors to higher degree students. The DAARP is scheduled to be completed by August, 1994.

The economic environment in which the DAARP has been executed is in a country that has experienced sustained economic growth but a growing dependence on imports to meet its basic food needs. The policy context is one in which the GOM is embarked on a policy of liberalization and restructuring of the economy. GOM policies are to give increased attention to dryland agriculture, which provides about half of the country's cereal production. The institutional environment of the project is within a national agricultural research institution (INRA) that is in the process of decentralization of its efforts, upgrading of the scientific capacity of its staff and modification of its institutional culture to one that places greater emphasis on "hands on", applied field research aimed at solving the needs of farmers. It is being assisted in achieving these goals by a World Bank Research and Extension project.

This is the fourth, and final, evaluation of the DAARP. In addition to assessing progress made towards meeting the goals of the project, the evaluation team was charged with the responsibility of identifying priority areas for future assistance to assure long-term sustainability of the center developed through its efforts as well as highlighting lessons learned from this project that will assist USAID in the design and execution of similar projects in the future.

SUMMARY OF MAJOR ACHIEVEMENTS

- 1 A functioning and sustainable research center (Aridoculture Center), along with four satellite research stations, has been developed that is capable of generating technology for dryland agriculture. This Center will serve as a model for other INRA centers as INRA pursues its goal of decentralization.
- 2 A critical mass of highly-skilled and motivated scientific staff has been trained. By the end of the project 61 INRA staff will have received higher degree training in the U S, 45 at the Ph D

level. In addition, non-degree training, both in the U.S. and at the Center, has upgraded skills in areas such as research station management, research planning and budgeting, rapid rural appraisal, technology transfer, human resources management, financial management, and equipment maintenance.

3. Substantial progress has been made in the planning, prioritization, and evaluation of research activities, based on an assessment of production constraints faced by farmers. This process, however, is still incomplete, especially as relates to the prioritization of research projects and the linkage of these projects to resource allocation.

4. Effective linkages have been forged between technology generation and technology transfer.

5. A useful body of knowledge has been generated on dryland agriculture, including socio-economic data on low-resource farmers in the regions and the production constraints they face. An impressive list of publications also indicates that a body of scientific knowledge has been generated that will serve as the basis for the generation of technology to address these constraints.

6. An impressive volume of technology in terms of improved varieties and improved agronomic practices has been generated. Farming equipment suitable for small and medium-scale farmers in dryland areas has been developed. Some of this technology has already been adopted by farmers, but it is too early to expect that the results of such adoption are reflected in national production figures.

FUTURE ACTIONS TO ENSURE SUSTAINABILITY OF PROGRESS MADE

A number of recommendations (contained in the body of this report, and summarized in the following chapter) have been made by the evaluation team. These were aimed at overcoming perceived weaknesses as well as ensuring sustainability of the progress made to date. In addition, two sets of actions that need to be taken after the project's completion (PACD) are described. The first is a list of general areas that need attention, irrespective of the funding source, to ensure institutional sustainability. The second set is a prioritized list of specific, post-PACD activities recommended for USAID funding to the extent that post-project funding is available.

The general areas that most require continued attention are

- equipment maintenance,
- linkages with the international scientific community,
- in-service training, and
- improved access to scientific information.

The specific actions that should be supported by USAID (in order of declining priority) are

- completion of course work by Ph D students still in the U S ,
- facilitation of continued linkages between CRRA Settat staff and MIAC universities,
- a study on the development of a national agricultural science documentation service,
- additional diagnostic/appraisal work to identify problems and prioritize research,
- collaborative research on sustainability and natural resources management issues,
- an assessment of the impact of Center-developed technologies,
- collaborative research on integrated pest management,
- policy analyses,
- provision of stand-by electric power facilities,
- continued assistance in development of a research planning and monitoring system, and
- procurement of publications and CD-ROM disks for the Center's Technical Reference Center and the national documentation service

SUMMARY OF LESSONS LEARNED

Lessons learned from this project that may help design and execute more effective projects of this nature are divided into three groups those that offer examples of positive elements that should be incorporated in future projects, project components that should be done earlier in the life of a project, and actions that might be done better than they were in this project

1 Positive elements of project design and execution include

- a long-term commitment for agricultural research and institution-building,
- involvement of U S universities in agricultural institution-building projects,
- conduct of thesis research in the host country, and
- management training

2 Components that should have been done earlier in the project include

- baseline studies on farming systems and socio-economic indicators in the target region,
- program planning by objectives,
- human resources needs assessment based on program planning, and
- attention to post-PACD needs

3 Actions that might have been done better include

- phasing of project to provide for and orderly, end-of project transition, with less or no TAs in the latter years,
- more on-farm research, with farmer feedback loops,
- integration of project activities with those supported by other donors,
- site selection of center to be developed,
- integration of project activities with those of the host center, and
- timing of equipment purchases

SUMMARY OF KEY RECOMMENDATIONS

The following is a summary of key recommendations contained in the body of this report. The recommendations are best understood in the context of the discussion of the subjects to which they relate. In the full text of this report the recommendations are numbered sequentially, and the relevant numbers are given in parentheses in the summary of recommendations that follows.

NATIONAL LEVEL RECOMMENDATIONS FOR INRA AND THE MAMVA

So as to ensure that the considerable progress made in planning and prioritization of research made under the DAARP at the Settatt Center benefit all of INRA, and that Center's efforts in the future benefit from continued external assistance and be fully integrated within the INRA system, **it is recommended (#9) that** USAID and/or other donors, and ISNAR, continue to give support to the planning and management function of the CRRA Settatt until it is fully operational and integrated into the management structure. Similarly, in relation to human resources management, **it is recommended (#12) that** INRA, ISNAR, and the University of Arkansas make every effort to ensure that related activities in this area are complementary.

In order to speed up the process of varietal release and to provide for testing of promising new crop varieties on farmers' fields at an earlier stage in the varietal development process, **it is recommended (#20) that** cataloging procedures be revised so as to permit inclusion of unlisted varieties in on-farm trials during the catalogue testing stage, **and that** efforts be made (**#18,19**) to increase on-farm varietal evaluation and validation work. In order to expedite the promotion of new varieties, as well as generate more income for INRA, **it is recommended (#24) that** more INRA-generated material be offered for open public bid.

RECOMMENDATION FOR THE CRRA SETTAT

A Planning and Evaluation of Research

It is recommended that (#6) CRRA Settatt prioritize its research programs and projects as soon as possible, using cost/benefit analyses that take into account the affect of different price regimes resulting from the current changes in overall national economic policies, **that (#7)** the allocation of research resources be done by project, with the chief investigator as the budget officer, **and that (#8)** special one-on-one training be given to researchers who are having difficulty preparing an annual project plan of work.

B Research Focus and Methodology

It is recommended (#17) that future research programs be based on client needs as determined by baseline studies and rapid rural appraisals, **that (#23)**, when designing research

programs, explicit discussion of the environmental issues associated with the projected technology be required, **that (#21)** the Center increase its efforts in integrated pest management (IPM) and attempt to link up with other institutions that may be able to provide assistance and collaboration in this important area, **and that (#22)** the Center work with the DPA's to study why contour farming practices are not used extensively, and to promote such technology to the farmers in the target zone where appropriate. **It is also recommended that (#5)** Center management encourage and provide budgetary support for more on-station and on-farm research by scientists in all sub programs. **The recommendations for future USAID assistance (#33)** provide for collaborative research in the areas of IPM and soil and water management.

C Research Management

To improve internal communication and leadership **it is recommended (#1)** that the Head of the Center be supported by a deputy or scientific coordinator **that (#2)** sub-program Coordinators be named by the Head of the Center for specific, multi-year periods on a renewable basis, **and (#3)** that alternative modalities be explored to cover management functions that have been the responsibility of the Scientific Committee. To achieve a better balance in the mix of human resources **it is recommended (#10)** that the staffing pattern be reassessed once the planning process has clarified the highest priority research areas, **and (#11)** that strong efforts be made to increase the number of technicians at the CRRA Serrat.

D Technology Generation/Transfer Linkages

To facilitate the effective transfer and adoption of technology generated by the Center, **it is recommended (#4)** that a technology transfer team be formed within the SRD, whose main concentration would be on technology transfer activities, **that (#31)** researcher/farmer managed trials be fully incorporated into the research system approach.

E Sustainability of Financial Requirements

To ensure that adequate financial resources are available to maintain the Center at a high level of productivity after DAARP funding is terminated **it is recommended (#15)** that future INRA budgets allocate sufficient funds to provide for a reasonable rate of replacement of vehicles, farm machinery and scientific equipment, as well as such additional equipment that may be required by program growth, **that (#25)** an economic analysis be conducted on the feasibility of using field research station land for revenue generation, **and (#32)** that means be found to channel funds obtained from such activities, as well as from royalties and sale of goods and services, directly back to the Center and station producing such income.

F Sustainability of Research Excellence

To facilitate continued scientific collaboration **it is recommended (#27)** that INRA, through its Aridoculture Center at Serrat, strengthen its linkages with regional and international institutions involved in research for dryland agriculture **and (#28)** become more involved in plans for

collaborative research within the context of the "Desert Summit" **Recommendations for future USAID assistance (#33)** also include elements to facilitate scientific exchanges with U S universities and provisions for better access to scientific information

I. INTRODUCTION

A BACKGROUND

This is the report of the fourth, and final, evaluation of the Morocco Dryland 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 responsible for the design and implementation of the project are the United States Agency for International Development (USAID) in Rabat, and the Ministère de l'Agriculture et de Mise en Valeur Agricole (MAMVA)¹ 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). This consortium is composed of the following 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 execution of all USAID/MIAC contractual obligations of the project.

The first evaluation of the project took place in 1980, six years after the project was designed and three years after the MIAC contract was initiated. The second evaluation, by a team under contract with Winrock International, was executed in 1986. The third (Mid-Term) evaluation was carried out in 1991 by a team under contract with Chemonics. The first two evaluations resulted in significant project modifications. The third thoroughly assessed progress to date and made a number of important recommendations for actions to be taken during the three years remaining before the project completion date (PACD) of August, 1994, and for post-PACD support aimed at redressing perceived weaknesses and ensuring achievement of project objectives. This final evaluation was commissioned to take a broad overview of the activities and achievements over the life of the project, with the principal objective of ensuring long-term sustainability and effectiveness of the research center developed through project assistance.

This report is the product of the efforts of a four-man team. Three were consultants contracted by USAID/Morocco through AGRIDEC, the fourth, (Alan Hurdus²) was provided by USAID/Washington. This team was made up of John L. Nickel, Team Leader and research management specialist, Alan R. Hurdus, Agronomist and agricultural development specialist, Ralph Nelson, Economist and institutional and agricultural development specialist, and Stephen B. Walls, Agronomist and farming systems and agribusiness specialist. The evaluation was carried out during the period 22 November to 22 December, 1993.

¹ Until recently, this ministry was called the Ministère de l'Agriculture et de la Réforme Agraire (MARA). The current designation is translated as the Ministry of Agriculture and Agricultural Development.

² Currently Director (A), Office of Agriculture, Bureau for Global Programs, Field Support and Research.

B OBJECTIVES OF EVALUATION

The specific objectives of the Final Evaluation, as detailed in the Scope of Work (Annex A) were to

- 1 Measure progress made toward the achievement of project outputs and purpose since the last evaluation,
- 2 Assess and document achievements and the impact of research and technology transfer carried out to date, including the rate of adoption of project-identified and recommended technologies among the target farmers and the impact of this technology dissemination,
- 3 Assess the long term sustainability and financial viability of the CRRA Settat³ within the overall INRA context including overall funding requirements and resources (including extra-governmental), research programming and implementation, budgeting and financial management, human resource development, and facilities management,
- 4 Assess key lessons learned and recommendations, and
- 5 Formulate and prioritize recommendations to enhance the sustainability of the CRRA Settat, including detailed assessment of post-project institutional linkage options

C EVALUATION METHODOLOGY AND APPROACH

The entire evaluation team spent one day in Washington, D C for an overall briefing at USAID One member of the team then travelled to Lincoln Nebraska for discussions with the MIAC administration, former MIAC Technical Assistance staff of the project, and Moroccan students studying for higher degrees in several U S universities The remainder of the team remained in Washington for two more days for continued discussions in USAID and the World Bank and assembly of relevant documents One team member then proceeded to the Hague, The Netherlands, for discussions with the International Service for National Agricultural Research (ISNAR), which has a long history of cooperation with INRA The entire team then travelled to Morocco for three-weeks

Given the relatively short time available in Morocco and small size of the evaluation team, it was not possible to enter into great detail on various aspects of the facilities and programs at the CRRA Settat and its four field research stations Nor was it considered necessary to give

³ For purposes of simplicity the INRA regional center located in the Province of Settat is referred to in this report as the CRRA Settat Its correct, full name in INRA nomenclature is Centre Regional de la Recherche Agronomique de la Chaouia, Abda et Doukkala Owing to its current agro-ecosystem mandate, it has recently also been referred to in INRA as the Centre Aridoculture Settat (Settat Aridoculture Center) This terminology is used from time to time in the report as synonymous with the CRRA Settat

highest priority to such a detailed examination, owing to the recentness of the Mid-term Evaluation, and the excellent, detailed and through coverage of these aspects in its report. Instead, priority was given to a broad overview of what had been accomplished during the entire life of the project, what had been its principal strengths and weaknesses, what impact the project has had on Moroccan agriculture and institutions, what linkages had been forged, and how could these be further strengthened, and, above all, what are the prospects for, and constraints to, the long term sustainability and effectiveness of the CRRA Settlat and its programs, including future actions that need to be taken to facilitate this goal.

The methodology employed to pursue this approach was to interview CRRA Settlat staff and visit the most important governmental and private sector institutions that are key stakeholders and partners of the CRRA Settlat for discussions with relevant staff. Details of the itinerary and schedules for these visits and interviews are contained in Annex B. A list of persons contacted is given in Annex C.

The team also studied many documents, a list of the key documents consulted is shown in Annex D. In addition to the reports of the last two evaluations, the documents that were particularly useful in providing summary information about the project were a paper by Dr. Gillard-Byers, prepared specifically for this evaluation, entitled "Project Evaluation Summary Discussion Paper", and the draft of a report "Aridoculture Center Laboratories Achievements and Perspectives". The Gillard-Byers Paper forms part of this evaluation report as Annex E. The Achievements and Perspectives report (not attached) is a compilation of reports from each of the sub programs and service laboratories. Each report covers the entire period of the project, and summarizes for each section its history, objectives, personnel, training, equipment, achievements, linkages, constraints and publications.

II PROJECT SETTING

A MOROCCAN ECONOMY

Morocco has a population of 28 million, with a per capita GDP of approximately \$1030 (1991). Over the past decade Morocco has made impressive economic progress. As a result of profound adjustments associated with a liberalization of the economy and associated structural adjustments that began in the 1980s, stabilization has been achieved without recession. The rate of inflation has remained below 5% since 1987. Real growth of the GDP has averaged more than 5% over the same time period, while both the current account deficit and budget deficit have been substantially reduced from previous high levels. GDP growth in 1991 and 1992 was around 4%. During the past decade the rate of population growth has declined from 3.2% to 2.6%.

B AGRICULTURAL SECTOR

Of the 60 million hectares⁴ of land in Morocco about 8.5 million are considered as suitable for cultivation, with another 20 million suitable for grazing. Of the arable land, 1.6 million ha are considered suitable for irrigation, of which about 1.3 million are currently irrigated. As of 1989, 83% of the arable land was under cultivation. During the 1970s and early 1980s the growth in agricultural GDP has averaged only 1.2%, compared to a 3% annual growth rate in the 1960s. Yields of staple foods have generally increased during the past decade, nevertheless, production of cereals, pulses and edible oils have not kept pace with increasing domestic demand. As a result, food importations have been growing at a rate of 10% annually.

In the 1985/86 season, 81% of arable land was devoted to cereal production (chiefly wheat, barley and maize). Half of agricultural production is on land receiving low (< 400 mm/yr) and erratic rainfall. While total area devoted to cereal production during the past 15 years has remained relatively stable (between 4.1 and 5.5 million ha), total production has fluctuated greatly, due to dramatic fluctuations in yield related to erratic rainfall (see figures 1 and 2).

As part of its liberalization policy the Government of Morocco (GOM) has modified its policies for agricultural production from one of food self-sufficiency to one of food security, thus giving greater attention to export earnings and focusing greater attention on agricultural production for which Morocco has a comparative advantage. This policy shift should be reflected in production goals for various commodities and profoundly influence the agricultural research agenda and research priorities.

The rural population of Morocco in 1989 was estimated to be 13 million, or 58% of the total population. At that time there were 1.3 million farms employing 3.8 million people, 82% of whom were illiterate.

⁴ A hectare is approximately 2.5 acres. Hectares are abbreviated as "ha" in this report.

C IMPORTANCE OF DRYLAND AGRICULTURE

Improvement of rainfed agricultural production in the semi-arid regions (those that receive between 250 and 450 mm of precipitation per year) will achieve two important goals: increasing the production of some of Morocco's most important crops and animals, and alleviating poverty. Of the 1.3 million farm households in Morocco, over 1 million rely on rainfed agriculture. Of these, 85% are reported as living in poverty. Food crop production in the dryland, semi-arid regions of Morocco contributes almost half of Morocco's cereal production.

Livestock production is an integral part of agriculture in the dryland regions. Animals consume cereal crop residues and poorer quality grain, and forage production can form part of a crop rotation cycle. Livestock production is especially important to low income farmers. Those with less than ten hectares of land own 78% of the country's cattle, 64% of the sheep and 84% of the goats. Generally, the drier the year, the more grain producers rely on their livestock to generate cash earnings. In this way they attempt to stabilize family income and reduce the ever present risk associated with dryland farming.

Agriculture in the semi-arid regions faces serious constraints. As compared with the more favorable areas, rainfall is much more erratic in amount and distribution through the growing season. Years of marginal crop production are common. Soils are frequently shallow with low moisture holding capacity. Mechanization that is well adapted for the better rainfed or irrigated areas is frequently inappropriate for the semi-arid dryland conditions, often wasting scarce soil moisture. Risk is inherently greater under these conditions, as investments in inputs (such as fertilizer, improved seeds, and pesticides) that might increase yields may be lost when drought causes crop failure. The generation of new, more appropriate technology to solve these problems has not been sufficiently developed due to relative inattention. Until recently the highest priority for agricultural development was given to irrigated agriculture. Concerned with the low dryland crop yields, in the early 1980s the GOM increased budget allocation to dryland agriculture, including support for dryland agricultural research.

It is not surprising, therefore, that GOM and USAID selected this ecosystem as the target for this project.

D INSTITUTIONAL ENVIRONMENT

1 Ministry of Agriculture and Agricultural Development (MAMVA)

The MAMVA is a large and complex organization, a detailed description of its various components and structure would go well beyond the scope and purpose of this report. What is important to note, however, is that -- unlike what is found in most countries -- all of the major public sector institutions dealing with agricultural development, including higher education, research, and extension, fall within the purview of this single Ministry. The two agricultural higher education institutions, the Institute Agronomique et Veterinaire Hassan II (IAV) at Rabat, and the Ecole National d'Agriculture (ENA) at Meknes, come under this Ministry. Extension

services in Morocco are provided by the MAMVA through the Extension and Cooperatives Division of the Directorate of Education, Research and Development (DERD) At the central level in Rabat, the Extension and Cooperatives Division is responsible for integrating all extension activities with the exception of livestock, which is dealt with by the Livestock Department of the MAMVA through a small group of specialized extension agents Several institutions carry out agricultural research The most important of these is Institute National de la Recherche Agronomique (INRA) The IAV and the ENA also conduct research in addition to their educational responsibilities

While having all the agricultural education, research and extension institutions under the same ministerial "roof" might seem to facilitate strong linkages and cooperation, this has not been the case With the Ministry so large, and the institutions operating as separate, semi-autonomous agencies and separated physically, collaboration has been far from what it might or should be Recently, the former Directorate of Research and Training and the Directorate of Extension and Agrarian Reform (DVRA) have been merged under the new DERD, with the goal of promoting stronger linkages and cooperation between these institutions The Director of this department has great admiration for the U S land grant system and is giving strong and visionary leadership to this important endeavor

The MAMVA operates geographically in a decentralized fashion through a miniature version of the Ministry, the Direction Provinciale de l'Agriculture (DPA), located in each province The head of each DPA is technically responsible to the Minister He is also responsible to the respective provincial Governor for coordination of all agricultural activities in the province Provincial governors are appointed by the King

2 Institute Nationale de la Recherche Agronomique (INRA)

INRA was established by law in 1981 as the public enterprise responsible for coordinating agricultural research in Morocco This was, however, not the beginning of agricultural research in Morocco The history of what is now INRA began in 1919 with the establishment by the colonial power of the Service de l'Experimentation Agricole (Agricultural Experiment Service), based in Rabat On becoming independent in 1956, Morocco inherited a research structure centered in Rabat with 10 or so experiment stations, all located in the most favorable areas, which were occupied largely by French settlers This research structure continued to grow rapidly, while its nature remained unchanged, although research was now national, the scientific staff was largely made up of expatriates (117 out of 127 in 1963 and 58 out of 86 in 1966) The number of experiment stations grew to 22 in 1966, but these were still almost all in the most favorable areas, and most scientific staff remained concentrated in Rabat In 1962 the research organization became an autonomous institution, the Institute for Agricultural Research In 1966 it lost its autonomous nature, becoming a Directorate of the MARA It continued to add experiment stations, to a total of 41 in 1980 and 48 in 1982 Though many of these were now located in less favorable areas, most were being managed from Rabat and research methods continued to favor development of technology under controlled conditions and aimed at the modernized agricultural sector

INRA has financial autonomy and is under the aegis of the MAMVA (until recently the MARA). INRA's general director reports to a Board of Directors (Conseil d'Administration), which is responsible for approving research programs, budgets, financing, and organizational changes. The Board of Directors includes representatives of six ministries, "Chambres d'Agriculture", and farmers' associations, and is chaired by the Minister of Agriculture and Agricultural Development. Until 1986, INRA's structure was very complex and unevenly balanced. At the provincial level, definition of responsibilities was unclear with ambiguous criteria defining links between units and an ill-defined hierarchy, which caused many conflicts. To remedy this a new organization was prepared on the basis of proposals made by ISNAR in 1984. This was approved by the Ministry of Finance in 1986. In the new organizational structure (see Figure 3) INRA is divided into four divisions: information and training, planning, management of the CRRA's (Centres Regional de la Recherche Agronomique) and administration. It has seven scientific departments for the major disciplines. Regional research is managed through eight CRRAs at Tangier, Oujda, Kenitra, Meknes, Settat, Afourer, Marrakech, and Agadir. A third dimension has been added to this matrix with the establishment of 15 national programs, with a coordinator named for each. An individual scientist located at a CRRA is, therefore, in some way or other responsible to three "chiefs": the national scientific director, the national program coordinator and his/her respective CRRA director. The scientific departments and commodity programs, and the location of the respective directors and coordinators are shown in Table 1, below.

Table 1 Names and Headquarters of Scientific Departments and Commodity Programs of INRA

<u>Name</u>	<u>Headquarters</u>
<u>NATIONAL DEPARTMENTS</u>	
Agronomy	Settat
Plant Protection	Kenitra
Socio-Economics	Settat
Plant Breeding	Rabat
Food Technology	Rabat
Animal Science	Rabat
"Milieu" (Soils/Climate)	Rabat
<u>NATIONAL PROGRAMS</u>	
Palmier (Palms)	Marrakech
Olivier (Olives)	Marrakech
Aridoculture (Dryland)	Settat
Cereals d'Automne (Fall cereals)	Settat
Cereals d'Printemps (Spring cereals)	Rabat
Fourrages (Forages)	Rabat

Plants Sucreres	(Sugar crops)	Rabat
Les Agrumes (citrus)		Kenitra
Vian des Rouges	(Small ruminants)	Beni Mellal
Legumes Alimentaires	(Food Legumes)	Meknes
Plants Oleagineaux	(Oil Seed Crops)	Meknes
Bour Favorable (Fav	Rainfall Prod)	Meknes
Pastoralisme	(Range Management?)	Oujda
Maraichage (Horticulture)		Agadir
Radio Elements	(Use of Radiation)	Tangier

The World Bank Staff Appraisal Report of March, 1989 reported that about half of the scientific staff were still concentrated in Rabat, and that most of the CRRAs had a staff of less than 10 scientists at the Engineer⁵ level. This report also indicated that after a period of stagnation from 1963 to 1975 staff had grown to a level of about 2,225, of which only about ----- were at the Engineer level or higher. It also stated that "INRA's staff situation is characterized by (a) an uneven distribution of research scientists between headquarters (52%) and the regions (48%) where they are scattered in small inefficient groups with inadequate incentives, financing, and equipment, (b) a rapid turnover of regional research scientists due to the above conditions which inhibits continuity, experience and useful training and has detrimental consequences for research work, (c) an inadequate number of research scientists of disparate skills who often have to carry out time-consuming administrative and management tasks, (d) an insufficient staffing at medium level (technical agents), (e) an over-abundance of unqualified workers who are unproductive and consequently costly and difficult to manage, and (f) a lack of qualified administrative personnel who could relieve research scientists from administrative tasks"

The institutional history of INRA, and the characterization of it by the World Bank team in 1989, have been given here in some detail to portray the institutional setting in which the DAARP was placed and to serve as a sharp contrast between INRA as a whole and that part of it that has been developed by the project. In this context the changes at the CRRA Settat can be characterized as revolutionary.

3 Agricultural Education

a Higher Education in Agriculture Morocco has two post-secondary agricultural education institutions, the Ecole National d'Agriculture (ENA) located at Meknes, and the Intstitut Nationale Agronomique et Veterinaire Hassan II (IAV) with its main campus in Rabat and another campus at Agadir. Both offer the six-year "Ingenieur d'Etat" degree in agricultural subjects, which is roughly equivalent to the U S Masters Degree. The four-year "Ingenieur

⁵ The term "Engineer" is used in a generic sense to include all professional staff with a university degree. Under the French system inherited by Morocco there were two types of university degrees in agriculture: "Ingenieur d'Application" and "Ingenieur d'Etat". The former is roughly equivalent to the U S Bachelor's degree and the latter to the U S Masters degree.

d'Application" degree, roughly equivalent to the U S Bachelor's Degree, was give by both, but has been discontinued IAV also offers a Ph D -level degree in, the "Doctorate en Science Agronomique" Additionally, the Faculty of Science of the University of Cadi Ayyad, at Marrakech, have agricultural programs leading to a D E S S (equivalent to the U S Masters in agriculture) and a doctorate degree, and the Faculty of Science of the University Mohammed Ben Abdallah at El Jadida, have agricultural programs leading to the D E S S

b Technical Education in Agriculture Historically, there have been two levels of agricultural technical education The first involves the training of adjoins techniques (technical assistants) in a three-year program Though participation in this program requires completion of secondary school, it does not require the attainment of a baccalaureate Second, there is a one year program for agents techniques (technical agents), individuals who have completed the lower secondary cycle (grade 9) However, due to the increased number of secondary school graduates available, and the need for better educated personnel to carry out extension functions, the GOM eliminated the program for agents techniques

Eleven schools provide technical training in agriculture six of these provide a wide range of technical agricultural studies The others are specialized in livestock, rural development, topography, horticulture, agricultural mechanics and forestry all students receive scholarships which cover the full cost of their studies They are boarded at the schools and receive stipends to cover living expenses

4 Agricultural Extension

Extension services are provided by MAMVA through the Extension and Cooperatives Division of what was until recently the Directorate of Extension and Agrarian Reform (DVRA) and is now under the Directorate of Education, Research and Development (DERD) Under supervision of MAMVA's "Comite Technique de la Vulgarization", this Division is responsible for integrating all extension activities and applying the same extension methodology throughout the country , defining suitable techniques, means and methods for extension, and organizing extension training It also has responsibility for promoting the development of cooperatives and ensuring liaisons between MAMVA, professional associations and farmers' unions

At the regional level, rainfed and irrigated areas have different extension structures In the rainfed sector, MAMVA is represented by 35 provincial offices (DPAs) in which the extension services are represented by a "bureau" within the Service de la Mise en Valeur under management of both the national DERD and DPV (Directorate of Crop Production) In the irrigated sector, extension services operates through an office within the Agricultural Production Service in the nine regional extension and development offices (ORMVAs)

For both irrigated and rainfed agriculture, the extension "bureaux" deal with cultural practices, extension, training, subsidies, credit, cooperatives and audio-visual activities They are also responsible for sale of agricultural inputs to farmers, this activity, however, is to be discontinued in the future

At the farmers level, there are 121 CTs (extension centers in rainfed areas) throughout the country. The CT staff includes about 2,000 technical agents of which 800 work on extension providing a coverage of 1 agent for 1,740 farmers. Within the ORMVAs, there are 156 CMVs (Extension Centers in Irrigated Areas) which are the field administrative and technical units responsible for the implementation of ORMVA agricultural development programs. The CMV staff includes some 1400 technical agents of which some 800 work on extension, providing a coverage of 1 agent for 195 farmers.

5 Agricultural Private Sector

a Fertilizer Production and Distribution The public sector controls all fertilizer imports, manufactures over two-thirds of locally produced fertilizer, and distributes at the wholesale level approximately one-half of all fertilizer used. Domestic fertilizer is produced by two firms. The largest producer is Maroc Chimie, a subsidiary of the publicly-owned Office Cherifien des Phosphates (OCP). The second producer is the Societe Cherifienne d'engrais et de Produits Chimiques (SCE), a private firm. SCE manufactures about 25% of the fertilizer produced in Morocco.

In addition to the one fertilizer producer, the role of the private sector is limited to distribution. Nine private companies participate in wholesale fertilizer distribution, of which SCE is the largest, accounting for about 30% of total fertilizer sales. FERTIMA, the public sector distributor, and SCE make up 80% of total fertilizer sales, with the other eight private firms sharing the remaining 20%. Retail fertilizer distribution is primarily handled by small-scale private firms who purchase from the larger wholesale outlets.

b Seeds The private seed sector has been the most successful in high value vegetable seed sales. Varieties are imported and sold directly to consumers. Large multinational seed companies are starting to respond to increasing demands for high-yield oil-rich corn and for sunflower varieties. Pioneer Seeds and others are setting up marketing operations in the country and entering varieties into the Catalogue system⁶. The market for forage seed is also largely in the hands of the private sector. Seed distribution by the private sector is generally handled through an authorized agent who markets seeds at the local level.

The public sector continues to dominate in cereal seed production through SONACOS, a large parastatal seed company. SONACOS is charged with coordinating, organizing and controlling

⁶ The Catalogue system is the mechanism used for varietal release in Morocco. The catalogue refers to the official register of approved crop varieties, and only those varieties listed in the catalogue may be sold as seed in the country. Breeders may nominate candidate varieties to the Variety Testing and Certification Service (DPVCTRF) for verification testing, normally requiring two years of on-station testing. All materials, including those commercial varieties imported from outside the country, must be tested in Catalogue trials before release. At the end of the official catalogue verification trials, a successful variety is selected by a variety release committee (made up of members representing research, extension and the private sector) and entered into the National Catalogue. At this time a variety may be multiplied for commercial seed production.

certified seed production. This company does not directly produce seed. Rather, it contracts for seed production with state companies, private contract growers, and cooperatives.

In the past few years more private seed companies have begun to produce and sell cereal seeds. One company, Benchaib, a large corporation which deals in all types of seeds and commercial crop production, has initiated its own research and development program. One bread wheat variety has been officially released through the National Catalogue system and is being marketed. Additionally this company has received an exclusive right with INRA to produce seeds of a new promising wheat variety, Tilila, just released from the Catalogue. The company is paying INRA an initial fee plus a royalty of 5 dhs for each quintal (100kg) sold.

c Pesticides Morocco does not manufacture insecticides, herbicides, and other pesticides. These compounds are imported and they may be marketed in the form (and containers) in which they are imported, or they may be repackaged, or diluted and repackaged by the importer. Pesticides are registered and regulated. Over 2000 different pesticides are presently registered for marketing in Morocco. Of those registered, however, only a few are in stock. About 25 firms sell pesticides in the country. Several of these firms are national in scope and apparently repackage chemicals purchased in wholesale lots and/or bulk.

d Agricultural Machinery The mechanization of farming practices has been expanding at a very rapid rate in Morocco and much of the country's cereal production is now mechanized. The private sector has been very active in farm equipment sales as well as manufacture of locally built harrows for land preparation. Several large companies such as COMICOM import a wide range of agricultural equipment such as tractors, combines, and seed drills.

e Agricultural Credit In Morocco, agricultural credit is provided by informal sources, by commercial banks and by the Caisse Nationale de Credit Agricole (CNCA). Agricultural credit is well integrated into the farm production system.

Informal credit exists in the form of loans between private parties and in the form of production through association (arrangements whereby each party contributes some factor of production such as land, labor or capital, and the proceeds are distributed based upon prior agreement).

There are no commercial banking institutions in Morocco that provide significant amounts of medium and long-term credit to the agricultural sector. Almost all commercial bank credit is short-term.

The principal source of institutional credit for the agricultural sector is the CNCA. The CNCA consists of a head office, 38 regional branches and 99 local branches. The CNCA's head office primarily conducts business with state-owned production and marketing companies, private agroindustrial enterprises and the ORMVAs. The regional offices service medium and large-scale farmers and the local branches service smaller-scale farmers.

Approximately 55% of the institutional credit extended to agriculture is short-term. It is primarily used to purchase seed, fertilizer, and animal feed, and to pay the cost of hiring labor or tractors for land preparation and harvesting. Medium-term credit is used to purchase livestock, equipment, construct stables and other farm buildings, develop tree crops, etc. Four types of investment represented more than 75% of the total term lending by the CNCA in FY 1983: livestock (34%), construction (9%), mechanization (25%), and draft animals (9%).

Despite a rapid expansion of activity by the CNCA in local loan expansion programs, the World Bank estimates that only about 500,000 farmers have access to credit through the CNCA. This would represent about 35% of potential borrowers.

E RELATED EXTERNAL ASSISTANCE ACTIVITIES

Various bilateral and multi-lateral agencies are providing economic and technical assistance to Morocco. The discussion that follows will be limited to those that are most likely to complement or impinge on the DAARP.

1 USAID Support for the IAV

The USAID has provided major, long-term support to the development of the IAV. This 25-year institution-building effort was completed in September of this year. It was executed in three successive projects, all of which were implemented through contractual relationships between the IAV and USAID with the University of Minnesota. The goals set at the initiation of this effort were to enable Morocco to "improve the quality of its higher education in agriculture by providing exposure to modern teaching, research, and problem-solving methods and to provide highly trained Moroccan manpower to assist in the development of the agriculture sector."

The last of the three projects had a termination date of 1990. In September, 1988, the PACD was extended to September, 1992, to allow the remaining 43 doctoral participants to complete their degree requirements. A second extension of one year, on a no-cost basis, was granted, to September 30, 1993, "to allow IAV and the University of Minnesota to complete the implementation of the doctorate training program." While no USAID funds are currently available to this project, linkages between the University of Minnesota and the IAV are expected to continue through an agreement that provides for up to 17 staff members of either institution to visit the other for periods of about 10 days, with the sending institution paying the air fare and the host institution providing local subsistence costs, has recently been signed. This significant linkage activity represents a rare example of a U.S. university investing core funds on such a project.

The project has placed strong emphasis on doctoral level participant training. Through the life of the project a large number of participants have been funded for Ph.D. studies in U.S. universities. Most of these are currently members of the IAV faculty. Technical assistance throughout the project was chiefly through short visits, the number of resident expatriate advisors was usually 4-6.

The success of this combined effort of the GOM and the USAID-funded institution-building effort was summarized in the July, 1987 AID Project Impact Evaluation Report No 65 as follows

"In sum, the Institute has evolved in the space of two decades from 12 students taking their basic science training from non-Moroccan faculty in temporary facilities at Mohammed V University to its present status with approximately 2,300 Moroccan students and 346 faculty members (of which 85 percent are Moroccans) on its own campuses in Rabat and Agadir. The Institute now offers the Moroccan equivalents of the U S B S , M S , and Ph D degrees in agriculture and a doctorate in veterinary medicine "

2 The World Bank Agricultural Research and Extension Project

Morocco's 1985-89 medium term sector adjustment program was supported by a World Bank Agricultural Sector Adjustment Loan. As part of that program the GOM decided to implement a reform of agricultural research and extension. A World Bank loan to Morocco was approved in 1989 to fund a project to support the first, five-year phase of a 10-year development program for both research and extension prepared by the MARA. The \$28 million Bank loan is complemented by a co-financing loan from the Kfw (Germany) and bilateral grants for technical assistance by France and Germany (GTZ). This project has just completed its mid-term evaluation, and it is expected that another project will be formulated to execute the second part of the 10-year program.

The research component of the current project includes (a) INRA's reorganization, (b) development of programming by objectives for 5 research priority themes including bread wheat, forage crops, livestock, oil crops and olives, (c) decentralization of research, and development of two regional research centers, (d) rehabilitation of 13 research farms, (e) establishment of 8 research/development units, (f) strengthening of the information/documentation division, (g) training, technical assistance and fellowships, and (h) improvement of INRA's personnel and financial management.

The extension component includes (a) establishment of an extension service at MARA (now MAMVA), (b) introduction of a new national extension system based on the T & V (training and visit) system, (c) provision of improved research and extension linkage through the research development approach, (d) training, technical assistance and fellowships, (e) reorganization of audio-visual units for mass extension, and (f) establishment of Monitoring and Evaluation units at DVRA and DPAs.

3 ISNAR

ISNAR has actively cooperated with INRA over the past ten years. In addition to the major review of INRA in 1986, referred to above, ISNAR's involvement has been primarily in the areas of human resources management and program planning. ISNAR has assisted INRA in developing manuals on the missions and functions of key management positions and procedures for staff.

evaluation and rewards through performance planning and performance evaluation methods. It has also cooperated with INRA, the GTZ and the CRRA Settat in workshops on Programming by Objective (PBO). An ISNAR staff member was a member of the MIAC-funded, 4-person Scientific Review Panel that conducted an annual program review of the CRRA Settat in September of this year.

ISNAR cooperation with INRA has been largely financed from ISNAR's core budget. In recent years funding limitations have forced ISNAR to reduce these activities, and it has sought special project funding to continue and strengthen them. It now appears that, in response to a request from INRA, the German technical assistance agency, GTZ, will fund a project to enable ISNAR to help strengthen INRA's research organization and financial management. The components of this project include

- research program planning and priority-setting,
- financial management (budgeting),
- organization management,
- human resources management,
- technology transfer (SRD), and
- communications

4 Bilateral Assistance Activities

As mentioned above, the GTZ is providing technical assistance within the World Bank project in the area of Forages. This is a continuation of earlier GTZ cooperation on this subject. Unfortunately, there appears to be little, if any, cooperation between this project and the Forages Sub Program of the CRRA Settat. The latter has made efforts to bring all organizations together to address production constraints faced by livestock producers. These include a workshop, held at the CRRA Settat during the summer of 1993, on forage and livestock production. This brought all interested parties together for three days of planning.

III THE DRYLANDS APPLIED AGRICULTURE APPLIED RESEARCH PROJECT

A PROJECT GOAL

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

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 PROJECT HISTORY

The Dryland Applied Agricultural Research project (DAARP) was authorized in 1978 with a USAID life-of-project (LOP) contribution of \$4.5 million. Through the project USAID and the GOM agreed to construct, staff and equip a regional dryland research institution to be known as the Aridoculture Center. The INRA regional center at Settat, was to serve an area of ten provinces in Morocco: Safi, El Kelaa, Settat, Casablanca, El Jadida, Essaouria, Marrakech, Beni Mellal, ben Slimane and Khouribga.

The Mid-America International Agricultural Consortium (MIAC) was contracted in 1980 to field a team of U.S. agricultural scientists to develop a multi-disciplinary research program at the Aridoculture Center, and to simultaneously train a cadre of Moroccan personnel in selected disciplines so they could eventually assume full responsibility of Center activities.

During the period between the signing of the Project Agreement in 1978 and the arrival of the first MIAC technical assistance personnel to the CRRA Settat in 1981⁷ the project was managed directly by USAID/Rabat, during which time the first participants were selected and sent to the U.S., initial equipment procurement was made, and the design for construction of CRRA Settat facilities was developed. With the arrival of a MIAC team in Settat management of the project was fully assumed by MIAC.

Despite early implementation setbacks, USAID and a 1983 Project Evaluation team remained convinced that a strong research program was critical to increased dryland productivity. Following the arrival of a new MIAC team leader and the selection and departure of several highly competent Moroccan scientists for U.S. degree programs the Aridoculture Center demonstrated promise of becoming a productive institution. Consequently, the project was amended to expand the scope of its activities, increase the USAID contribution (from a grant of

⁷ The first three MIAC personnel assigned to Morocco in 1980 lived in Casablanca, and were eventually replaced.

\$4 5 million to one of \$26 3 million), and extend the project implementation to August 31, 1988 This 1983 amendment planned for long-term participant training of 15 M S and 17 Ph D candidates, 294 person months of short term training opportunities, and funding for 62 person years of resident technical assistance

At the beginning of the project, and for several years thereafter, the traditional Moroccan regional program was carried on in parallel with the MIAC project Daniel Watts (the MIAC team leader from 1982 to 1987) reported that 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 government circles "

In 1986 a second major evaluation of the project was undertaken (Winrock International, 1986) The evaluation confirmed the soundness of the project objectives and approach It recommended an extension of activities in order to fully achieve the original goal and purpose of the project This resulted in Project Amendment #4 of March, 1988 This amendment extended the DAARP by six years, until 31 August 1994 It also provided for an increase in USAID LOP funding to \$50 million⁸ The additional funding was to add 72 person years of resident expatriate technical assistance, provide for 26 additional participant training opportunities (7 M S and 19 Ph D), fund additional short-term training, and provide commodities for the project

Information on the long-term resident technical assistance and short-term consultancies provided by MIAC during the entire length of the project is summarized in Annex F This shows that a total of 41 persons lived and worked in Morocco as Technical Assistants (TAs) for a total of 1208 person months The average length of stay for the TAs was 29 5 months In addition, 179 persons visited Morocco as technical consultants (average length of stay 0 41 months) and 44 professors visited the project as advisors to postgraduate students (average stay 0 34 months) These figures do not include the administrative visits by MIAC and associated university staff We do not have the information before September, 1981, between that date and May, 1993 there were 61 administrative visits

In 1991 the project was subjected to a major mid-term evaluation The report of that evaluation (Chemonics, June 1991) found that the project was successful in achieving the outputs

⁸ In 1992 USAID/Washington "borrowed" \$1 275 million from the funds allocated to the project to meet other urgent needs Efforts are underway to restore these funds to the DAARP The current financial crisis in USAID is making this difficult, thus, at the time of the writing of this report it is not certain how much, if any, of can be recovered Thus the total LOP funding may be somewhat less than the \$50 million indicated Such a reduction in funding so near the PCAD has serious implications for sustainability of project achievements Already, the 1994 Plan of Work of the DAARP has had to be severely cut back, and the availability of funds for post-PACD activities on a "no-cost" basis will be greatly affected if the allocation is not restored to its planned amount

expected, but was having difficulties in achieving its goal of increased agricultural production due to difficulties in targeting and prioritising research, and deficiencies in technology transfer and management and administrative weaknesses. It also expressed concern regarding the post-project sustainability of the institution-building efforts without substantial increases in GOM budget support for the CRRA Settats and improvements in personnel and financial management. The report made a number of recommendations to overcome these perceived weaknesses and for post-project funding to provide for an effective transition and continued external linkages.

IV EVALUATION FINDINGS AND RECOMMENDATIONS

A ACTIONS TAKEN IN RESPONSE TO MID-TERM EVALUATION

In general, we find that MIAC and the CRRA Settlat management have responded very positively to the recommendations of the Mid-term Evaluation, especially after the arrival of T E Gillard-Byers as the MIAC team leader. Indeed, actions taken and planned on the issues highlighted by that evaluation have gone well beyond what was recommended. The pity is that these issues were raised so late in the life of the project as to make it difficult to fully address all of them before the PACD. This problem has been confounded by the unexpected reduction in LOP funds available, reducing the ability of MIAC to fully implement key items in the 1994 Plan of Work that were specifically designed to address these issues. This will also affect the potential for a "no-cost" contract extension proposal that was being planned in order to solidify linkages.

The Mid-term Evaluation was thorough and perceptive. It highlighted a large number of problems, particularly relevant to the issue of institutional sustainability, that should have been addressed much earlier in the project. The recommendations contained in that report are detailed and lengthy. A good summary of the key recommendations is found in the "AID Evaluation Summary". The evaluation team asked the MIAC team leader to summarize, in a table, what actions had been taken on these recommendations. Table 2, below is his response.

Table 2 Summary of key recommendations made in the Mid-term Evaluation and the and MIAC summary of actions taken and results of these actions in relation to each recommendation

KEY RECOMMENDATION	ACTIONS TAKEN	RESULTS
<p>1 That the project focus its resources on institutionalization of planning and management systems within the INRA structure and on issues of institutional sustainability</p>	<p>Introduction of Project Management Systems during FY 91, 92 and 93 Project Management Systems operable and functional</p> <p>Development of linkages focusing on natural resource base issues</p> <p>Planning for introduction of Local Area Network as a predecessor to a Management Information System (MIS)</p> <p>Introduction of Electronic Mail Service for Administration and Research (Operating)</p> <p>Management training programs at USDA undertaken to improve administrative management capacity</p>	<p>Compliments PBO without replacing PBO</p> <p>LogFrame Research and Development introduced in FY 1991, TeamUP procedures for budgeting and scheduling introduced during FY 1992 and FY 1993</p> <p>Focuses efforts on sustainable agriculture to ensure a sustainable institution Technologies for Soil Moisture Management, Soil Management CRSP, and Sustainable Agriculture and Natural Resource CRSP (MOU signed and activities underway with TSM) SANREM planning activities with the CRRA in Mknas as a result of CRRA at Settat husbandry of the process Future collaboration with the Soil Management CRSP expected in FY 1995</p> <p>Provides opportunities to increase capability to communicate world-wide, regionally, in-country and at station LAN and EMAIL planned for FY 94 implementation</p> <p>Reduces costs of communication by FAX and or TELEX while providing enhanced linkages with external organizations</p> <p>Project planning and management is becoming standard and routine</p>
<p>2 That USAID take steps to rationalize the points of conflict between the DAAR Project and INRA mandates so as to create a more solid basis for program planning</p>	<p>No transparent action by USAID in support of the DAAR Project</p> <p>USAID support for private sector initiatives through other projects</p> <p>Utilization of baseline studies, Sondeos, and improved interaction with DPAs, Chambers of Agriculture and the Centre de Travaux</p> <p>Farm typology report completed</p> <p>Sondeos complete</p> <p>Collaborative research plans are in place</p>	<p>USAID initiatives have had an indirect impact on Project orientation</p> <p>Research has become more focused on constraints faced by producers in the context of scientific capability at the Center</p> <p>Utilization of baseline data for targeting researchable issues exists</p> <p>Sondeos provide basis for plan of action in Oulad Said and improve collaboration with DPAs and CTs</p>

KEY RECOMMENDATION	ACTIONS TAKEN	RESULTS
<p>3 That management procedures at the Center be revised in order to make more efficient use of capital and human resources</p>	<p>Introduction of the Research System Approach in Fiscal Year 1991</p> <p>Sub Program structure institutionalized at the CRRA in Settat</p> <p>Scientific Committee accomplishes tasks which it identifies for action</p> <p>Accounts Compatible provides option for off budget financing alternatives</p> <p>Inventory control procedures are being developed by MIAC and INRA for more efficient utilization of resources</p> <p>INRA improved management of vehicles</p> <p>CRRA Administrative Booklet published</p>	<p>Provided opportunities to compartmentalize research and administrative constraints</p> <p>Improved ability to focus on specific issues</p> <p>Allocation of resources undertaken more efficiently</p> <p>New opportunities exist to utilize the scientific committee more on science related issues and less on administrative issues</p> <p>Off budget financing option has been and continues to be investigated</p> <p>Inventory procedures provide a model for future INRA inventory control procedures</p> <p>On site training in inventory control and maintenance is planned for Fiscal Year 1994</p> <p>On Station and On farm activities are more effectively coordinated</p> <p>Vehicle pool established under control of INRA</p>
<p>4 That Field stations be improved both in physical terms and with respect to their management systems and that INRA develop and implement an operational plan for the cost-effective utilization and self management of the four stations</p>	<p>Improvement of station management capability emphasized</p> <p>Training in electrical equipment undertaken to improve maintenance of the capital base</p> <p>Training in the calibration of equipment was undertaken during FY 1993 by MIAC and INRA</p> <p>An operational plan for the stations has been drafted</p>	<p>Two trained station managers returned (November, 1993)</p> <p>Training in station maintenance, inventory control and refrigeration equipment planned for FY 1994</p> <p>Electrical equipment maintenance staff person working at the Center Training conducted during FY 1989-90</p> <p>Improved capability to undertake efficient research trial activity exists</p> <p>1993 Scientific Panel Review recommendation acted upon</p> <p>Plan exists and can be reviewed to determine additional modifications necessary</p> <p>FY 1991 Station Management consultancy recommendation acted upon</p>

KEY RECOMMENDATION	ACTIONS TAKEN	RESULTS
<p>5 That the operations budget be increased substantially by funds from all potential sources to accommodate the increased number of trained scientists</p>	<p>INRA has allocated more funds to the Center on a percentage basis relative to other CRRAs</p> <p>Income generating activities have been pursued</p> <p>Proposals to generate unsolicited funding have been generated</p> <p>Arrangements for collection of royalties on Center-produced varietal technologies</p>	<p>Sustainability of the Center has been enhanced</p> <p>Group Benchaib for revenue generation from production on the Jemaa Riah station</p> <p>Irrigation development for research and production on the Khemis Zemamra station</p> <p>Contracts with private farmers and public organizations (DPA-Safi) for soil fertility testing have been implemented</p> <p>Development of external research projects and/or consultancies with USDA, Washington State University, IFAD, IBRD have generated research dollars</p> <p>Status of royalty revenue generation unknown</p>
<p>6 That the project fund consultancies to assist INRA at the national level in research planning and management</p>	<p>The Human Resource Development Project was designed and implemented</p> <p>PBO activities funded and fully supported by the DAAR Project</p> <p>Training in Sondeos was participated in by scientists from other CRRAs, DPAs and Cts</p> <p>Project Management Systems training was participated in by scientists from each of the CRRAs in the country as well as from INRA-Rabat</p> <p>Communication/Communications workshops held during FY 1992 and FY 1993 were attended by INRA-Rabat staff, staff from other CRRAs, DPAs and Cts</p>	<p>Provides information on human resource requirements for INRA as a national agricultural research service</p> <p>PBO provided an opportunity to introduce Project Management Systems at the CRRA at Settatt This in turn has strengthened PBO at the national level and at each of the other CRRAs</p> <p>Scientists, extension personnel, policy makers and farmers have participated in a multicultural activity to target technology development projects</p> <p>All scientists who are knowledgeable of the activities at Settatt are aware that the Project Management Systems has improved capabilities at the Center</p> <p>Personnel in different agencies are informed about a growing capability at the CRRA in Settatt to disseminate information generated through the technology development and transfer process</p>

A more detailed discussion of the current status of the CRRA Settat in relation to these and other issues raised by the Mid-term Evaluation can be found under the "Progress" sections, below

B PROGRESS IN INSTITUTION BUILDING

It is important to recognize that this was, basically, an **institution-building** project. The statement of the **purpose** of the project makes it clear that the principal aim was to **establish** a sustainable applied research capacity that would be **capable of** providing technologies to improve farmer productivity. Unfortunately technical assistance personnel often tended to ignore the development of a sustainable capability in their understandable enthusiasm for generating technologies. Such hands-on research activities were important to the institution-building as a role model to young Moroccan scientists and to change the institutional culture, but they were done at the expense of a relative neglect of other important aspects of developing a sustainable institution, such as planning, organization and human resources and financial management -- at least not until recently, after the Mid-term evaluation had pointed out many of the defects. This is not too surprising, since scientists coming from land grant universities are often not well trained in the art and science of management and institution-building.

1 Institutional Structure

a INRA

The CRRA Settat does not operate in a vacuum, but in the broader institutional environment of the MAVDA, and particularly, of INRA. In this respect the project is not only affected by, but has played an important role in influencing the organizational effectiveness of INRA.

INRA is in a period of profound change, as it attempts to move from the traditional model of agricultural research it inherited to a decentralized institution with more capable scientific manpower who are aware of and work to overcome the constraints of farmers. In this respect the DAARP is having a significant effect on INRA's transformation. The history and major institutional defects of INRA are summarized in the "Project Setting" chapter, above. The impact of the DAARP on helping INRA to address problems include

- Staff development The vast majority of all scientific staff of INRA trained beyond the engineer level are in the CRRA Settat and have received their higher degree education under the DAARP. Of the few Ph D level scientists who are found in INRA regional centers most are personnel who were trained under the DAARP and subsequently transferred to other CRRAs.
- Decentralization INRA's goal of strengthening its CRRAs and assigning qualified staff to work closer to farmers has been greatly supported by the development of the first strong regional center through the DAARP. This center now contains about a third of the

INRA scientific staff located outside of Rabat Two of INRA's national departments and two of its national programs are headquartered at the CRRA Settat

- CRRA Infrastructure and Equipment INRA, through the World Bank project, is constructing new facilities and equipping several CRRAs The CRRA Settat, with modern facilities constructed with GOM funds, and equipment provided by the DAARP, has led the way
- Agroecologically-based Farming Systems Approach The CRRA Settat, with its designation as the Aridoculture Center, and with the baseline study funded by the DAARP, has led the way also in establishment of several national programs aimed at entire agro-ecosystems The conflict between the CRRA Settat responsibilities as serving a specific geographic region and its nature as an Aridoculture Center, identified in previous evaluations, has largely been eliminated When asked what the mandate of the CRRA Settat is, the Secretary General of INRA stated unequivocally, its mandate is "to provide technology for dryland farming "
- "Hands On" Approach to Applied Research Before the DAARP nearly all of INRA's scientific staff had been trained in France The infusion of a critical mass of scientists trained in land grant universities in the U S has added a new dimension to the mix of scientists of the Institute Furthermore, as pointed out in the section on INRA in the chapter on "Project Setting", the history of INRA resulted in an approach to agricultural research that was insufficiently oriented to "hands on", problem-solving field research The approach to applied agricultural research the participants learned and witnessed in the U S , re-enforced by the example set by DAARP technical assistance personnel working at the CRRA Settat, have created a more practical orientation at the Center that will assist INRA in its goal of having scientists do hands-on work in the fields and set their research agendas based on farmers' needs
- Socio-Economics Before the DAARP there were no economists or sociologists in INRA The training of staff in these important fields and the establishment of a sub program in Rural Sociology and Economics at the CRRA Settat has added a new dimension to the Institute

The above is best summarized by the statements made to the evaluation team by high-level INRA officials, to the effect that the CRRA Settat is seen as the model of what all of INRA will someday become While it is unlikely, even with the World Bank project, that each INRA center can expect to receive the amount training, equipment and technical assistance that the DAARP has provided for the CRRA Settat, the general direction of institutional changes at that center, in terms of upgrading staff and facilities and adopting a more client-oriented, applied research approach, does serve as a viable example that can be emulated throughout the Institute

b CRRA Settat

The current organizational structure of the CRRA Settat is shown in Figure 4. The Head of the Center has four line functions reporting to him: Sub Programs, Research Stations, the Research/Development Service (SRD), and Administrative Services. He is advised by a Scientific Committee. This is a considerable improvement over the earlier administrative structure of CRRAs, but there are still several important aspects of the organizational structure that need to be improved. The four most important problem areas are: non-functional clustering of research activities, too broad a management span of the Head of the Center, lack of research leadership, and an inadequate committee structure. Each of these are discussed below.

1) Organization of Research The research activities are officially grouped under the eight sub programs (Cereal Breeding, Crop Protection, Soil Management, Crop Management, Agricultural Mechanization, Forages, Food Legumes, and Rural Sociology and Economics). The fact that these are a mixture of six disciplinary groupings and two commodity programs is peculiar. Clustering research on a multi-disciplinary basis around major commodities or the principal aridoculture farming systems might be more appropriate. On the other hand, organization by discipline would be more in line with the national INRA scientific departments. Furthermore, it appears that the sub programs do not fully function as a cluster, but rather as the individual component disciplines they comprise. For example, the "Achievements" document given to the evaluation team, did not mention, nor was it organized by, sub programs. Rather, each discipline presented a separate report (e.g., soil physics and soil fertility vs soil management, entomology, plant pathology, virology and weed control vs plant protection). Yet the budgets are allocated by sub program. These anomalies should be largely overcome when budgets are allocated to projects, since many of the projects are multi-disciplinary.

2) Management Span The most important problem with the current organization of research into sub programs is that all sub program coordinators report directly to the Head of the Center. Given the fact that the Head of the Center is also Director of one of the national Scientific Departments and Coordinator of one of the national Commodity Programs, he is seriously overburdened. In the absence of a formal scientific or research coordinator, many of the responsibilities of scientific direction and administration fall on the Scientific Committee, which, as discussed below, is overworked and feels powerless. We note that the staff list of the Center shows one person as "Scientific Coordinator", but understand that this is unofficial, as such a position has not yet been approved by INRA headquarters.

Recommendation #1. that consideration be given to the official naming of a Deputy Head or Scientific Coordinator, reporting directly to the Head of the Center, with responsibilities of overseeing the research programs

3) Research Leadership The sub programs are each headed by a Coordinator. Currently this person is elected by the scientists in the respective sub program, on a rotating basis. While the Head of the Center, commendably, indicated to the evaluation team that he

believes in and is exercising delegation of both responsibility and authority, the authority of sub-program coordinators is weakened because they are not named by the Head of the Center. Furthermore the election process does not always produce the most capable leader. We believe that the Head's admirable desire to be democratic by allowing sub programs to elect their own leadership has weakened both the Head's and the Coordinators' ability to manage.

Recommendation #2. That sub-program Coordinators be named by the Center Head for specific, multi-year periods on a renewable basis.

4) Committee Structure The Scientific Committee reports that they are devoting over half of their time to Committee activities, and that they receive no recognition (i.e. in evaluation or compensation) for their work. They devote much of their time to administrative, non-scientific tasks, taking time away from their research, activities by which they are evaluated. Since the Committee is made up of some of the Center's most qualified staff, devoting half of their time to administrative tasks is a regrettable waste of valuable scientific talent. At the time the Committee was interviewed, they had just submitted their resignations from the Committee and prepared a memorandum to the Center Head, suggesting changes in its functions.

The naming of a Deputy Head, as recommended above, would resolve the need for direct management of scientific activities by the Head of the Center. It may also be necessary to name an Administrative Assistant to the Head to handle routine administrative matters currently occupying the time of the Committee. In addition, it would probably be best to divide advisory functions between several committees, so that the load of essential services to the Center, such as organization of seminars, monitoring the quality of publications, promoting linkages to other institutions, and evaluating training needs and selecting candidates for training -- currently all handled by the Scientific Committee -- be spread over a larger number of the Center staff. Not only would such a committee structure spread the burden of these functions, it would give a greater number of scientists a sense of involvement in the Center's management.

Recommendation #3: that the Head of the Center give careful attention to the suggestions of the outgoing Scientific Committee members and use the occasion of their resignation to consider alternative modalities for managing and being advised on scientific research and related matters.

2 The Research/Development Service (SRD)

The mandate of the SRD section is to coordinate technology transfer research activities of the Center and to liaise with supporting agencies. It works through technology transfer evaluation trials, on-farm demonstrations, training and other linkage development activities. The large range of activities this section performs include

a coordinating and participating in rapid rural appraisals (Sondeos⁹) as well as analyzing data and writing reports,

b liaising with the various sub programs and facilitating researcher managed on-farm diagnostic trials as well as working with the programs to determine technologies to include in evaluation testing,

c conducting on-farm technology transfer evaluation trials and working with farmers on problems encountered in technology transfer as well as providing feedback to the research programs on the acceptability of a given technology under evaluation,

d coordinating extension demonstration trials- this entails working with the DPA and extension agents to determine protocols for these trials and ensuring that protocols are followed correctly The SRD works closely with regional and CT extension personnel through coordination of multidisciplinary team activities,

e coordinating all CRRA Settat in-service training programs, including training programs for extension personnel and farmers,

f coordinating all visiter activities at the Center and handling the logistical responsibilities for students working at the Center,

g coordinating all field day activities sponsored by the Center and its various Stations,

h preparing technical bulletins for extension, Center brochures and other publications, such as covers for documents,

i coordinating all external linkages with the private sector including any seed production/land-use or other royalty agreements with private companies, and

j coordinating all SRD activities with other INRA SRDs

Due to the diversity and continual expansion of training, and linkage responsibilities, the team feels that the this section will experience difficulty in allocating sufficient time to research and evaluation of technologies coming out of the various research sub programs This is evident from the apparent lack of on-farm evaluation trials planned by this unit for the 1994 program The work plan has the SRD conducting only two technology transfer evaluation activities involving 20 farmers, 10 for each project (One trial will evaluate dual purpose barley varieties under

⁹ The term "Sondeo" refers to rapid rural appraisal, following a methodology developed in Guatemala, thus the use of the Spanish-language term

20 farmers, 10 for each project (One trial will evaluate dual purpose barley varieties under grazing and non grazing regimes, and the other on evaluating two maize varieties) Both trials are being conducted in the CT Oulad Said Considering the amount of technologies being generated by the various research sub programs, this appears to be a rather small number of activities at the evaluation stage

The team is in agreement with the 1993 Scientific Review Panel assessment of task allocation within the SRD "Competition among tasks is likely to affect time allocated to each component and therefore induces a negative impact on performance especially if operations outside technology development are not annually planned Linkage activities and special emergencies, even when closely related to SRD mandate, are hardly executable when they are not in the working plan of SRD "

A careful review of the activities and functions of this section should be conducted by the CRRA management It is not possible to expect one program to take on all the assigned and proposed activities of this section

Recommendation #4 That a technology transfer team be formed within this unit whose main concentration would be on technology transfer activities. This team would consist of at least an agronomist, a forage production specialist, a sociologist, and an economist The leader of this team could also serve as the on-farm research trial coordinator for the Center to facilitate the on-farm research activities of the research sub programs (Diagnostic trials), the SRD (Verification Trials), and extension Service (Demonstration Trials)

3 On-Station and On-Farm Research

One of the most important achievements of the DAARP has been the training of scientists and the changes in the institutional culture to promote more field-oriented research, with farmer participation in planning of the research and evaluating its results Yet the team believes that there is still much improvement that must be made in this direction Ideally, applied agricultural research should be a continuum from laboratory and greenhouse research through on-station research to on-farm research and on-farm technology validation Our review of research activities suggests that the emphasis is still too much on the laboratory/greenhouse end of this spectrum One factor affecting this balance may well be the fact that the CRRA Settat is the Center itself plus four field research stations, and that the Center is made up only of offices, laboratories and greenhouses, without research fields This means that all on-station, field research involves travel to one of the stations This physical arrangement cannot be easily remedied, but every effort must be made to encourage scientists to do more work on the stations This involves both motivational mechanisms as well as budgetary provisions for travel

Most important is the small proportion of research that is conducted on farmers' fields It has already been noted that the amount of on-farm research by the SRD seems inadequate This

appears to be even more the case for scientists outside the SRD. One of the inherent weaknesses of having a unit such as the SRD in any agricultural research institution is the tendency for scientists to feel that on-farm work is being handled by that unit, and thus they tend to perceive less of a need to work on farmers' fields themselves. This tendency must be vigorously resisted, since technology that has not been generated and validated at farm level is often not appropriate to the farmers' needs. Furthermore, on-farm research provides an essential feedback mechanism into the entire research continuum. Scientists in all sub programs should be encouraged to conduct both researcher-managed, on-farm technology generation and farmer-managed on-farm technology evaluation.

Recommendation #5 that Center management encourage and provide budgetary support for more on-station and on-farm research by scientists in all sub programs

4 Planning and Monitoring System

To be efficient, a research institution must **do things right**. To be effective, it must **do the right things**. The latter can only be accomplished if an effective system for planning and evaluation of research is in place. Thus an evaluation of progress made in institution building of the CRRA Sett at must include an assessment of how research is planned and evaluated at the Center.

The purpose of a planning and monitoring system for agricultural research is to

- Develop a prioritized research agenda that is consistent with national agricultural policy and goals
- Develop and manage annual project plans of work
- Develop an evaluation system that provides continuous feedback to the research agenda and to the project plans of work and provides an assessment of technology-generated impact

This evaluation deals chiefly with progress made in planning and monitoring at the CRRA Sett at. Such efforts cannot, however, be made in isolation. The research plans of the Center must fit within the overall research plans of INRA, which must, in turn, respond to national policies and priorities. At the MAMVA level, the DPA has set national production priorities among commodities. These have not, however, yet been translated into national agricultural research priorities. INRA and ISNAR are collaborating in this process. In spite of the absence of such national research priorities, progress has been made at the CRRA Sett at in developing a planning and monitoring system. This progress, and what remains to be done, will be discussed below.

a Development of a Prioritized Research Agenda at CRRA Settlat

A prioritized research agenda should be based on a long term plan for research, including 1) the development of a long-term research plan, 2) a statement of the objectives of each research program, 3) prioritization of research activities, and 4) a mechanism for evaluating achievements and making mid-term adjustments (including verifiable indicators that specify the criteria to be used in measuring progress)

INRA and ISNAR have collaborated to utilize Planning-By-Objective (PBO) to establish a research agenda, formulate and manage projects, and evaluate results. INRA, with the assistance of ISNAR, conducted two one-week workshops with 60-70 scientists from INRA headquarters, CRRA-Settat, and other CRRAs, on the PBO system. The objective was to introduce the PBO system as a means of developing national research goals and priorities. These national-level workshops were followed by two training workshops at Settlat, conducted by INRA headquarters and ISNAR staff. These two workshops defined the three principal farming systems (pasture-based, wheat-based, and barley-based) in the aridoculture agro-ecosystem, and identified the production constraints for each. At this point it became evident that the ISNAR PBO system was designed primarily for single crop research (as had been done, using the PBO system for olives and Faba beans), but was less useful for establishing a research agenda for an ecosystem with multiple farming systems. Since then, INRA headquarters and the CRRA Settlat have worked together to develop a modified PBO for mixed-farming enterprises.

During the time period described above, the Rural Sociology and Economics Sub Program was collecting data on the farming systems of the mandate area that resulted in the publication of "The Aridoculture Baseline Study and Farming Systems Typology". They were also conducting a rapid rural appraisal (Sondeo) of the C T Oulid Said Zone, and published a report on the constraints and programs for development of that area. A strategic plan of research for the CRRA Settlat for each of the three aridoculture farming systems was prepared in January, 1993, based on information from the two studies describe above and the judgement of senior research scientists of the Center. Program priorities, however, were not established.

In reality, it is usually not possible to carry out all of the projects that have been identified as worthwhile, due to limitations of human, financial, and physical resources. A priority-setting process needs to be developed. Part of this procedure should be a cost-benefit analysis for each project. At first this will be a rough approximation, but, through experience, the economists will be able to fine tune their analyses and it will be of increasing value in the priority-setting process.

b Development and Management of Annual Plans of Work at the CRRA Settlat

This involves the development of annual project plans of work which are consistent with the research agenda and includes tasks, schedules, responsibilities, budgets, and on-farm trials, when appropriate. The CRRA Settlat has selected the Logical Framework (LogFrame) methodology and software to strengthen the development and management of the research process. The DAARP

contracted with Team Technologies, Inc to conduct training in this methodology The rationale for utilizing the LogFrame was to strengthen project designs, increase collaboration among researchers, and increase access to outside funding sources

A series of workshops was conducted by Team Technologies which included introduction of the LogFrame system to 40 researchers, and follow-up workshops on budgeting and scheduling, training of trainers, management and evaluation, and team building All of the research activities in the 1993 annual work plan were submitted in this form, but with varying degrees of completeness and consistency

c Evaluation and Feedback

Evaluation and feedback is a continuous process and may be formal or informal Formal evaluations include

- Annual project reports based on the annual plan of work The chief investigator should evaluate the annual progress toward the long-term objective of the project/program The feedback is usually into the research process
- End of project reports should evaluate the project relative to the verifiable indicators that specify the criteria for measuring the success of the project If the project specifies on-farm trials, the results should be included in this report Feedback should be recycled into the research process and the research agenda
- Impact studies on the dissemination, utilization, and farmer benefits of technology transfer
- External evaluation of research programs Feedback would normally be to both the research process and research agenda
- Sondeo studies will reveal changes in farming practices, farming system changes, etc , which will be fed back to both the research process and research agenda

Informal evaluation would include

- A mid-year informal oral evaluation of the project plan of work between the chief investigator and the Head, or Deputy Head for Research if one is appointed
- Researcher's visits with farmers who are cooperating with on-farm trials
- Discussions among researchers To date the evaluation of the Center's activities is limited to external and informal evaluations Significant evaluation will not occur until the Planning and Management System is operational

d Summary Observations on Planning and Budgeting at the CRRA Settat

1) The mechanisms for establishing a research agenda are basically in place. This includes PBO, the Aridoculture Baseline Study, and the Sondeo methodology. Missing is the feedback from annual and end of project reports and impact studies.

2) The task of setting priorities within the Center's research program needs to be completed as soon as possible. Using the combined judgment of the Head of the Center and the Scientific Committee to establish priorities is better than having no priorities.

3) There is a critical disconnection between the research project plan of work and the budgeting process. If this continues the researcher will view the development of the annual plan of work by LogFrame as an exercise in futility and the project planning and management system will die on the vine.

4) The sub programs are useful for administration but the resources, including financial, should be allocated to the chief project investigators and he/she should be held responsible for allocating them in accordance with the project's budget.

5) Sub program coordinators are elected and are subject to annual change. This results in unnecessary discontinuities in leadership. An alternative would be to have the sub program leaders appointed by the Head of the Center for a fixed period of time. With a large number of young Ph D and M S researchers it would be advantageous that a senior researcher be appointed to this position. (See Recommendation # 2, above)

6) The PBO and LogFrame exercises have done a very successful job of team building which has resulted in collaborative research projects.

7) This development of realistic budgets and the scheduling of activities are the weak sisters of the annual project plan of work. One-on-one training in their weak areas should be done. This could be done in-house by CRRA-Settat staff.

8) The Planning and Management System of the Center has all of the components necessary to successfully plan and manage a research program that will make a significant impact on the rainfed areas of Morocco and the world. At present, however, it is very fragile. Changes suggested above need to be made. But, even with these changes, the system will need feed and care for 2-3 years before it becomes institutionalized into the research program.

Recommendation #6 that CRRA Settat prioritize its research programs and projects as soon as possible. Cost/benefit analyses should take into account the affect of different price regimes resulting from the current changes in overall national economic policies.

Recommendation #7. that the allocation of research resources be done by project, with the chief investigator as the budget officer. As budget officer he/she should know at the beginning of the fiscal year what resources are available for the project

Recommendation #8 that special one-on-one training be given to researchers who are having difficulty preparing an annual project plan of work. Special attention should be given to developing a realistic budget based on the resource needs of the activities

Recommendation #9. that USAID and/or other donors and ISNAR continue to give support to the planning and management function of the CRRA Settati until it is fully operational and integrated into the management structure

5 Human Resources Management

Effective management of human resources is important in any enterprise, it is fundamental in a research institution. It is people who generate the product of the CRRA Settati, and personnel costs that represent the largest component of the budget. An assessment of progress in building the institution that is CRRA Settati must include an appraisal of whether sound human resources management has been developed in the Center.

a Needs Assessment One of the most important components of human resource management in agricultural research institutions is planning the personnel requirements in terms of the number and disciplinary mix of scientists that are needed, and how many and what types of support staff are required to make the scientists most effective. There is no evidence that planning of this nature has been done for the Center. Rather the current staffing pattern appears to be the result of historical patterns of INRA staffing, INRA and DAARP budget constraints, DAARP staff and INRA selection of disciplines for higher degree training, and success of participants in completing their education. Ideally form should follow function, i.e. the human resource planning should follow program planning. In the real world this is hardly ever possible. In the case of the CRRA Settati the current staffing pattern is not the result of systematic planning of programs and projects, based on a baseline study of farmers' needs. This is still underway but not completed, as discussed above. This is not to say that no planning went into the earlier assessments of what types of research was needed for drylands agriculture research and what disciplines would be needed to carry it out. However, a better assessment of what is needed to do the job should be possible once the program planning has been done.

The ratio of Ph D -level scientists to other levels should also be appropriately balanced, with each Ph D scientist supported by several lower level staff at M S , Bachelors and technician levels. In this regard, the human resources mix appears to be relatively "rich". When all of those currently studying for PhDs return the Center will have a preponderance of Ph D -level scientists in relation to the other levels. The balance will probably be shifted somewhat as Ph D -level staff trained under the project are transferred to other centers and are replaced by recent graduates at

the M S level. If this occurs it will represent a loss to the CRRA Settats of high level staff trained under the project, but a solid contribution of the DAARP to improving the mix at other centers. Whether or not this happens, the most important imbalance in the human resources mix is the small number of staff at the technician level. While it can be argued that the shortage of staff at this level forces the scientists to conduct field research themselves, rather than send a technician to the field, too great an imbalance represents a waste of time of highly qualified staff and reduces their total productivity.

Recommendation #10 that the staffing pattern be reassessed once the PBO process has clarified the highest priority research areas.

Recommendation #11 that strong efforts be made to increase the number of technicians at the CRRA Settats

b Functions and Relationships It is always important for staff to have clear understanding of what their job is and what their relationships are to others within the organization. This is especially in the management of a complex matrix, as described above, in which individual scientists are responsible in various ways to different managers. INRA and ISNAR have been cooperating for some years on this subject. A product of this effort is an INRA manual "Mission et Fonctions des Postes". Recently the University of Arkansas has entered this area of work through a project to assist INRA in developing a Human Resources Development Plan. This activity is financed from DAARP funds outside the MIAC contract. The Arkansas/INRA team is currently working with the Marrakech CRRA to determine the educational level and nature of activity of all staff at that station, as a means of developing a better classification of personnel and job descriptions for all of INRA. At the same time, the GTZ-funded project will enable ISNAR to continue and expand its efforts in this field. There is, obviously, a danger of overlap and confusion between the ISNAR and Arkansas efforts, yet the Arkansas study was requested by INRA, as was the expansion and continuation of ISNAR's work under the GTZ-funded project.

Recommendation #12. that INRA, ISNAR, and the University of Arkansas make every effort to ensure that related activities in the area of human resources management are complementary

c Evaluation and Rewards ISNAR and INRA have also been cooperating on the subject of personnel performance assessment. Although official policies require formal evaluation for promotion, and permit the payment of bonuses for outstanding work, provided a transparent system is followed, the evaluations are in fact usually perfunctory, with almost everyone confirmed to tenured positions and promoted irrespective of performance. The system being developed with ISNAR's assistance attempts to tie performance evaluation to performance planning. This represents progress in an important field, and the CRRA Settats should make every effort to be a leader within INRA in improving its evaluation and reward system.

d Salary Structure Trying to remain competitive in salary scales so as not to lose the most competent staff is a constant challenge for research institutions. INRA has made strong efforts to achieve an attractive salary scale for its researchers. In 1985 a new statute was adopted for INRA's personnel with a more attractive salary scale and a special classification for research scientists. The comparative advantage for research was lost when MARA professional salaries were increased by 100% in 1986, making INRA's scale uncompetitive. INRA salary levels were realigned with those of MARA in 1989. The CRRA Settlat has a special problem in that is the INRA center with the most scientists with Ph D s, and the INRA salary scale, unlike that of IAV, does not provide for special recognition for education above the Engineer level. Fortunately, a new salary scale for INRA, that overcomes this problem, has just been approved at all levels and requires only official publication to become effective.

e Motivation Motivation of all staff is a cornerstone of effective research leadership. This is a combination of management actions that reduce negative factors ("de-motivators") and those that encourage and reward effective and dedicated work. While inadequate, or non-competitive salaries tend to be de-motivators, there is a limit to what can be done in this area. When salaries are adequate, even if not all that would be desirable, other motivating factors can be more important than financial compensation. Positive motivators include a good working environment, with adequate facilities and support staff, a sense of meaning and purpose to the work, recognition for a job well done, and effective leadership that respects the worth of individuals and inspires them through personal attention. The evaluation team was impressed that most of these elements are to some degree in place in the CRRA Settlat. The Head of the Center and the head of the Scientific Committee had recently completed six weeks of management training by the USDA/OICD in which they learned basic management practices and leadership skills. We note plans have been made, if the funds become available, to provide in-house management training to additional staff. This would be highly desirable, as we note that there are still many complaints by scientists of poor communication and recognition from top management.

Recommendation #13 That training be provided in leadership skills, especially for sub-program coordinators

6 Gender Issues

Five of the 38 scientific staff of the CRRA Settlat are women, one of these received her higher degree training, and two more received short term training, under the project. In addition, two women are now studying in the U S under the contract.

Most research positions at CRRA-Settlat could be filled by either men or women, but there are certain positions that are more suitable for women. Collection of data on the role of women in farming systems can best be done by women. In some areas women are responsible for livestock production and in marginal farming areas many of the men go outside the farm for work and the women manage the farm. This underlines the important role women scientists and technical staff in on-farm data collection and analysis.

Recommendation #14 That equal opportunity continue to be given to men and women alike for all positions at the CRRA Settat, and that special preference be given to women for positions for which they are uniquely suited in the Moroccan context

7 Budgets and Financial Management

INRA's budget allocations to the CRRAs are classified into three categories: salaries, operations and capital. The salaries component ("Salaire du Personnel Titulaire") is paid from INRA/Rabat, and is an automatic function of the numbers and categories of salaried staff assigned to the CRRA and the salary scale. The operations budget ("Credit de Fonctionnement") is made up of many line items (e.g. temporary labor, travel per diem, fuel, office supplies, etc.). It is requested and allocated by CRRA by the major sections in the Center. In the case of the CRRA Settat these are: Administrative Services, Overall Center Costs, Accounting Office, SRD, the eight sub programs, and the four research stations. The capital investment component (Credits d'Equipement) covers the areas of construction, office furniture, specialized equipment, vehicles and land purchase. None of the three major categories are fungible.

Figure 5 shows the evolution of the CRRA Settat budget in the three categories from 1988 through the projected budget for 1994. Longer-term trends for operations and salaries are shown in Figures 6 and 7. A breakdown of the capital budget for 1988 through 1994 is given in Figure 8.

The steep increase in operations funding approved for 1994 is encouraging in that it demonstrates a willingness of INRA and the GOM to at least partially assume some operational costs previously covered by the DAARP, and to provide funding for a growing number of staff as participants return. While this increase appears moderate in terms of what has been paid for from DAARP funds, and many scientists fear that there will not be enough funds for items such as fuel and supplies after the DAARP is terminated, this issue must be viewed in a broader perspective. The CRRA Settat must now face up to the realities of competition for scarce funding from which the project has, to some extent, shielded it in the past. In this respect it is not doing badly, as the proportion of the budget available for operations is better than found in most agricultural research institutions. Furthermore, INRA officials informed the team that the increase in funding allocated to the CRRA Settat was made by INRA in spite of an overall cut in the INRA budget, i.e. at the expense of reduced funding for other CRRAs. Thus, while it would be desirable for the Settat budget to be increased to make up all of the slack resulting from the phasing out of the DAARP, it must be recognized that there is a limit of what can be accomplished without causing a serious imbalance in INRA and the potential for jealousies and conflicts that this would cause. INRA should be commended for the effort being made and encouraged to continue to provide sufficient funding to ensure the sustainability of the progress made towards developing the CRRA Settat as an effective Center serving a vital agro-ecosystem.

What is unfortunate, and, hopefully, only temporary, is the dramatic decline in the capital investments budget. The dh 1.85 million allocated for 1985 is what is estimated as essential to

complete guest house construction already underway, restore the soil fertility laboratory and restore the Sidi El Aidi Station. This restriction is said to be due to a shortage of funds for 1994. It would indeed be disastrous to the sustainability of the CRRA Sett at as an effective center if limiting capital funds to construction were to continue into future years. As shown in Figure 8, these funds have been used in the past for equipment and vehicles, they must be allocated in sufficient quantity for such purposes soon in the future. Even for 1994 this reduction is untimely, since some equipment is currently in need of replacement. It is essential that, when the construction is completed, an adequate level be maintained in the capital investment budget to cover necessary equipment, vehicle and field equipment replacement.

Recommendation #15: that future INRA budgets allocate sufficient funds to provide for a reasonable rate of replacement of vehicles, farm machinery and scientific equipment, as well as such additional equipment that may be required by program growth

The fiscal year for INRA is the calendar year. The current budget planning and allocation for the CRRA Sett at for a year begins in the middle of the preceding year with a meeting of the Head of the Center with the sub program coordinators and station heads to discuss requirements. Based on information received from them the Center Head submits a budget request to INRA headquarters (for 1994, this was dated July, 1993) with a justification of increases requested. The request is usually considerably higher than the Center expects to receive. Towards the end of the year or early in the next, a final figure is approved. Once this is approved it is assured, and payments are made monthly, based on a cash flow plan submitted by the Head. When the budget is approved the Head meets with the same group described above and they discuss how to allocate the reduced amounts. Then each unit is informed of the amounts they have been allocated during the year. The procedures depicted above are as described by the Head of the Center. This contrasts markedly from what we were told by some sub-program coordinators, who complained that they were only parcelled out funds on a month-to-month basis and did not know how much they would be receiving for the year. Since we have no reason to question the veracity of either the Center Head or the sub-program coordinators interviewed, we can only conclude that there continues to be a need for better internal communications and clarification of authority.

The CRRA Sett at plans to allocate funds in the future by project, rather than by sub program. Accomplishment of this objective will require progress in two areas. One is to complete the PBO process, described above, to establish priorities among projects that emerge from the planning process. The other is to gain experience in project formulation and budgeting. The project profiles we saw demonstrated that considerable improvement is needed in attaching realistic cost figures to planned activities. We commend the DAARP for the establishment of the pilot competitive grant program, in which \$50,000 was made available for project grants based on proposals presented by scientists to the Scientific Committee for review. Last year 11 projects were presented, of which only 3 were recommended for approval by the Committee, even though funds for more were available.

Additions to centrally-funded salary positions are allocated from a modest number of additional posts allocated to the Ministry based on requests from INRA. Positions for returning participants are already included in the CRRA Settat allocation, as their salaries continued while away for studies. The personnel needs assessment, discussed above, should provide the basis for any future requests from the Center for additional posts.

8 Research Station Management

The MIAC Project trained two persons in Station Management at the University of Arkansas. They completed their Masters degree and recently returned to Morocco to resume their responsibilities at two Stations. Three participants studied station management for six months at CIMMYT and four spent six weeks in Nebraska studying station management. Twenty-seven participants attended a 5 day training workshop on Farm Trial Design.

The evaluation team was able to visit each of the four research stations under the jurisdiction of the Aridoculture Center at Settat -- Sidi El Aidi, Jemaa Riah, Khemis Zemamra and Jemaa Shaim. In each case we were impressed with the capabilities of the Station Manager, no doubt enhanced as a result of the long and/or short-term training in research station management that each received. The stations were clean, well kept, and the research plots appeared to be well managed. It was not our intention to critique in detail station operations or facilities. However, in the course of our short visits, we were nonetheless impressed by the large amount of catalogue testing, seed multiplication and commercial production operations going on relative to mainline, Settat-managed, applied research. It seemed to us that the catalogue testing, seed multiplication and production activities were afforded a higher priority than the Center research program. Given that the Aridoculture Center at Settat has no experiment station physically attached to it, we were somewhat surprised at the relative dearth of experimentation going on at the four research stations. This may be due partially to the preference of scientists to work in laboratories, greenhouses and growth chambers at the Center, due to the physical separation of the Center from the research stations, discussed earlier. It may also be due to emphasis given to other functions, such as seed multiplication, catalogue testing, and commercial production, at the stations.

Recommendation #16 that CRRA Settat research be afforded highest priority amongst competing activities at the research stations

The evaluation team also reviewed a very recent Scientific Review Panel Report (September, 1993) which examined research station management systems for the Settat Center. We support, broadly speaking, the recommendations made. See Annex G.

C PROGRESS IN HUMAN RESOURCE DEVELOPMENT

By all accounts, the most valuable and long-lasting contribution of the DAARP to the development of the CRRA Settat, and INRA as a whole, has been the training opportunities provided by the project. A summary of training provided under the DAARP is given below.

1 Long-term Degree Training

Sixty four students commenced post graduate studies at U S universities under this project Of these 64 matriculations, seven completed their M S studies, worked at INRA, and returned to enroll in Ph D programs

The current status of the participants is as follows

STATUS	NUMBER
Completed M S	13
Completed Ph D	18
M S to be completed by 12/31/93	1
M S to be completed by 12/31/94	2
Ph D to be completed by 12/31/94	12
Ph D undetermined completion date	1
Withdrew from program	1
Terminated from program	<u>2</u>
TOTAL	64

The distribution of participants for higher degrees, according to areas of study is as follows

<u>Area of Study</u>	<u>M S</u>	<u>Ph D</u>
Crop Breeding		9
Crop Protection	5	7
Soil Management	3	6
Crop Management	2	7
Crop Physiology		2
Agric Mechanization	2	2
Food Legumes	2	3
Forages		5
Rural Sociology & Econ		3
Support Services (Biometry)		1
Station Management	2	
Technology Transfer		2
Terminated from program		2
Withdrew from program	1	
TOTAL	17	47

The sub programs to which project-sponsored Ph D staff are currently assigned at Settat, and the year in which they received their degrees are as follows

<u>Name</u>	<u>Sub Program</u>	<u>Degree Date</u>
AMRI, Ahmed	Crop Breeding	1989
ARIF, Aberrahime	Forages	1987
BOUZZA, Aberrahime	Soil Management	1990
DAHAN, Rachid	Legumes	1992
DERKAOUI, Mohamed	Forages	1988
EL BOUHSSINI, M	Plant Protection	1992
EL MOURID, Mohamed	Center Head	1988
ELYAMANI, Mohamed	Plant Protection	1989
FARIH, Ali	Plant Protection	1992
KARROU, Mohamed	Crop Management	1993
MAZHAR, Mohamed	Forages	1987
MERGOUM, Mohamed	Crop Breeding	1991
NASSERALLAH, N	Crop Breeding	1991

Classification of these by year in which the Ph D degree was received is as follows

<u>Year</u>	<u>No</u>
1987	1
1988	2
1989	2
1990	2
1991	2
1992	3
1993	1

2 Short-term Non-degree Training

The distribution of Short Term participants according to areas of study is as follows

<u>Area of Study</u>	<u>Number of Participants</u>
Station Management	9
Cereal Breeding	1
Computer Training	19
Lab Technicians	4
Pathology	1
Research Management	13
Cereal Agronomy	6
Soil/Plant Analysis	1
Soils Workshop	1
Driver's License	3
Entomology	1
Soil Management	1
Seed Multiplication	1
Crops Management	1
Communications	1
In Vitro methods	3
Electronics	6
Agric Engineering	2
Greenhouse Management	1
Plant Pathology	2
Nies Ops	1
French Workshop	1
Team Technology/Log Frame	21
MIAC Log Frame	21
Farming Systems	5
Rapid Rural Appraisal	20
On Farm Trials	27
Technology trainer of trainers	2
Sondeo Farming Systems	2
Technology Management	2
TOTAL	178

The degree and non-degree training was distributed among the following universities. The MIAC universities are University of Nebraska, Oklahoma State University, Kansas State University, Iowa State University and University of Missouri.

<u>University</u>	<u>Number in Training Program</u>
<u>MIAC Universities</u>	
University of Nebraska	21
Kansas State University	12
Iowa State University	5
University of Missouri	5
Oklahoma State University	6
<u>Non-MIAC Universities</u>	
Colorado State University	13
Others	13

D IMPACT OF RESEARCH AND TECHNOLOGY TRANSFER

As indicated earlier, 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 project purpose is to establish a sustainable applied research capacity relevant to 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. All project outputs relate directly to the accomplishment of these institutional development or technology generation and transfer goals and objectives.

Although much of the work of the technical assistance group during at least 2/3 of the life of project was aimed at technology generation, it is the judgement of the evaluation team that the institution building accomplishments of the project to date outweigh the technology generation and transfer successes. The Aridoculture Center at Settati is a very young research institution, with human and physical capital, and management systems only now coming together in sufficient strength to begin to produce a flow of relevant research findings which can be developed into technologies with impact on farmers' production and incomes. The knowledge generation, technology development, technology transfer, impact chain has not been fully articulated throughout the project, and still more needs to be done to insure that the last two links of the chain become fully operational.

Nonetheless, to the extent possible, this section will examine the technology generation outputs to date and detail the impact of the research carried out at CRRA Settati on knowledge generated, technology developed, technology transferred and adopted, the production and income of target farmers and the sustainability of dryland agricultural production in the arid and semi-arid target areas. It must also be noted, however, that the evaluation team relied upon interviews and secondary data only, and had a short time in country to address this issue. Furthermore, only

now are CRRA Settat scientists developing methodologies to assess the impact of Center-generated technologies. We regret any omissions.

1 Knowledge Generated

The project has generated a considerable amount of knowledge about various aspects of dryland agriculture in the arid and semi-arid zones of Morocco. This accumulated knowledge about the agro-ecological zones and target commodities has been well documented in numerous publications to date. Although some of these are thesis and dissertation related, the project should be commended for the direct relevance of this research to Moroccan agriculture. The decision to require Moroccan scientists being trained at the Masters and Ph D level in the United States to do their thesis/dissertation work in Morocco contributed directly to this. A list of all publications of the Settat Aridoculture Center appears in Annex H. Many publications are in the form of bulletins, reports, abstracts and newsletters -- entirely appropriate for Center activities in the Moroccan context. However, there are also a fair number of refereed journal articles, attesting to the high caliber of the scientists trained under the Project and to the management systems in place, which value both the rigorous, applied nature of the research program, as well as the equally important scientific underpinnings.

The knowledge generated thus far has been quite diverse, reflecting the wide-ranging interests of a young and enthusiastic scientific staff. This enthusiasm and productivity should be encouraged. However, there appears to have been little, if any, strategic planning based on sound diagnostic work done during the first half to 2/3 of the project. The result was that much of the early research was not as tightly focused as it should have been, reducing the likelihood of impact at the farm level.

Recommendation #17 that to enhance impact, future research programs be based on client needs as determined by baseline studies and sondeo-type appraisals. As a corollary to this, more effort should be taken to do such appraisals on a regular and continuing basis, and more on-farm trials should be undertaken.

2 Technology Generated

For a research organization as young as the Aridoculture Center at Settat, there is a rather impressive array of research that has been developed into technology for Moroccan agriculture. Technology can be defined as an agricultural practice, or group of practices, developed, tested, or adapted by research, and identified for possible release to farmers. This review will be organized around Aridoculture Center Laboratories, the lowest level unit responsible for research and technology generation. Because of the complex nature of the INRA organizational structure, as discussed in Section III-B-1b research appears to be reported through laboratories rather than the sub programs of the Center.

a Soil Fertility Laboratory The Soil Fertility Laboratory was established in the early '80's. Three stages of development can be discerned. During the period '82 through '84, the physical

infrastructure of the lab was put into place and methods of analysis were tested and adapted to Moroccan conditions. From '84 through '89, the research program was initiated and developed. During the period from '89 to the present, the laboratory oriented itself to serving the analytical needs of Moroccan farmers.

The main achievement of the laboratory to date has been the development of a soil test calibration research program designed to establish a rational and economic basis for fertilizer use in dryland farming. Before the Center's soil test calibration program, fertilizer recommendations for cereals were uniform throughout the country, and were based only on the crop grown, e.g., wheat, barley, etc. Soil fertility research has demonstrated that nutrient deficiency, particularly nitrogen, and to a lesser extent, phosphorus, is the key constraint to crop production in the semi-arid and arid areas, after water availability. Recommendations are today made based upon a number of factors including soil type, previous crop, and the level of soil nitrate, rather than a uniform recommendation by crop, as in the past. This has been a major technology generated by the Aridoculture Center.

b Soil Physics Laboratory The Soil Physics laboratory was established in 1982, but has moved location at least once during its history, and lost two project-trained Ph D staff, which has had a disruptive influence. The lab seems to have functioned as a service for the other researchers at the Center rather than been engaged in research aimed at directly serving the farmer. Given the importance of soil moisture management and erosion in this agro-ecosystem, soil physics research should have gotten more attention than it has. We have not been able to find specific technologies attributable to this lab.

c Weed Science Laboratory The Weed Science laboratory is a small lab with most of its scientific staff currently in training for their Ph D degrees. The group has worked on the identification of major weeds and their control in the cereals, food legumes and in fallow systems. Beginning in '85, they did over 200 surveys of weeds in corn, chickpea, wheat and barley fields, and carried out more than 60 on-farm trials. They have also focused some attention on the control of wild jujube and buttercup, two important weeds.

d Food Legume Laboratory The Food Legume laboratory was established in 1983, with the main goal of improving the productivity and quality of the principal food legumes (chickpea, lentil and pea) in the arid and semi-arid regions of Morocco. Because of staff constraints and relative importance, much less emphasis was given to pea than to the other two crops. Since the principal factors affecting food legume production in semi-arid and arid locations are heat and drought, the Food Legume group stressed drought and heat avoidance through winter planting of chickpea and early maturity of lentil. Three chickpea varieties with good grain size and high resistance to ascochyta blight associated with the wet, cool conditions of the Moroccan winter were registered in the official catalogue in '87 and '92. Four chickpea varieties were proposed for registration in '92/'93. Three high yielding lentil varieties with good seed quality and resistance to rust were registered in the official catalogue in '89.

e Plant Pathology Laboratory The Plant Pathology laboratory is relatively new, having been established in 1985. The pathology group has identified the main prevailing diseases of wheat and barley, mapped their geographical distribution and severity, characterized the main fungi and identified sources of resistance, some of which are being used in the wheat and barley breeding programs. They have also identified grain legume diseases as well as some sources of resistance to rust pathogens in lentils, peas and faba beans.

f Agricultural Engineering Agricultural engineering research at Settat commenced in 1986, with the goal of increasing the production of cereals and food legumes in the semi-arid and arid regions of Morocco through the application of mechanization and improved farming practices. Since that time, the group has produced a tractor-mounted sweep, a tillage implement for rainfall retention, an animal-drawn seed drill, a tractor-mounted seed drill, a tractor-mounted planter, a no-till seeder, a blade harrow, food legume production mechanization equipment, and stationary threshers. Current thrusts include cereal crop establishment, food legume production mechanization, testing of low volume sprayers for the application of herbicides on wheat and multicrop stationary threshers.

g Forage and Livestock Laboratory The Forage and Livestock laboratory was not established until 1985. It now has three Ph.D. scientists, with three more in the pipeline. The objective of the group is to develop adapted technologies to improve livestock production while protecting the natural resource base in the arid and semi-arid areas of Morocco. The main technologies developed are as follows: cultural practices and seed production techniques for the annual medics, cereal/legume forage mixtures (e.g., oats/vetch, barley/vetch and barley/peas), crop rotations (e.g., comparing wheat/forage with wheat/wheat and wheat/fallow), identification of two adapted perennial grass species (*Phalaris aquatica* for the Abda region and *Eragrostis curvula* for the coastal region), phosphorus fertilization of weedy fallow to improve the legume stand, "Ley-farming" (cereal/medic rotation with grazing) system, adaptation and utilization of forage shrubs, feeding alternatives for sheep during dry periods, and the development of a research infrastructure for forage quality evaluation.

h Cereal Breeding Laboratory The cereal breeding laboratory commenced operations in 1986, with the objective of developing new, improved cultivars or hybrids of barley, bread wheat, durum wheat, maize and triticale, adapted to the arid and semi-arid zones of Morocco. Emphasis is on increasing yield potential, disease and insect resistance, quality, drought tolerance, and dual purpose types. Since 1983, more than 40 cultivars of these crops have been released by INRA, several of which were developed by the Aridoculture Center at Settat. These have been mostly wheats, triticale and, to a lesser extent, barley. Of particular importance has been the work done on Hessian fly resistant cultivars of bread wheats and interspecific crosses to incorporate resistance genes into durum wheats.

i Virology Laboratory This currently one-person laboratory was begun in 1986, with the objective of diagnosing, inventorying and monitoring of virus diseases in the reference crops, assessing the economic importance of the diseases and determining means of control. The major

contribution of the laboratory thus far appears to have been the identification of resistance genes against barley yellow dwarf virus in barley, durum wheat, bread wheat, oats and triticale

j Entomology Laboratory The Entomology laboratory was established in 1986, with the objective of identifying means of controlling the main wheat and barley insects (Hessian fly, barley stem gall midge, stem saw fly, grey fly and Russian wheat aphid) Since then, the entomology group has studied the biology of these insects, estimated the losses due to them, identified an insecticide effective against the Hessian fly and the barley stem gall midge, identified 10 resistance genes in wheat to Hessian fly and five other sources of resistance

k Crop Physiology Laboratory This now large laboratory commenced operation in 1985, with the objective of developing cultural practices adapted to the arid and semi-arid areas of Morocco In addition, the group was interested in calibrating and validating crop production and weather models to help orient research and assist in decision-making The group's research helped in defining technical packages for wheat, barley and corn in the target zones These packages were used in writing technical guides used by extension workers and farmers, and typically include recommendations for planting dates, seeding rates, seeding methods and nitrogen application rates In addition, the group's work on establishing the morphological and physiological criteria for drought tolerance in these crops is being used by the Center's breeders to screen adapted varieties The laboratory is also now examining traits involved in heat and salt tolerance, as well as in nitrogen use efficiency

l Socio-Economy Section At the time of the inception of the Aridoculture Center, there were no plans to develop agricultural economics and rural sociology expertise Socio-economic work was to be done through the IAV Hassan II group in Rabat It was not until '84 that socio-economic research began at Settat and not until '85 that the first INRA social scientist was recruited for Settat The objectives of the program were to gather socio-economic information geared to the development and adoption of technologies designed to minimize the risk of agricultural production in the arid and semi-arid areas of Morocco The main contributions of this group have been in stressing the importance of the farmer as the best source of relevant information about needed agricultural technologies, feeding that information into the research system, highlighting the diversity of a farmer's needs and activities and the part played by women and children in the rural economy Most recently, the work done by this unit, in cooperation with the SRD group, on a baseline study and farming systems, and on rapid rural appraisal (Sondeo), has been extremely important in the research prioritization process The work currently underway to develop a methodology to assess impact of Center-developed technologies is equally important

3 Technology Adoption and Its Impact on the Production and Income of Target Farmers

This section is much more difficult to assess and quantify than the preceding section on technology generation As indicated earlier, Center staff are just now developing the methodology to assess impact of Center-developed technologies Most of the varietal releases

are still too young to have reliable data sets associated with area under cultivation to draw out quantifiable conclusions about technology adoption. The difficulty in assessing the adoption of non-variety technology is even more daunting without extensive survey work, which has not yet taken place. Based upon our rather extensive discussions, earlier reports and evaluations, and the limited data that we were able to assemble, the evaluation team would like to highlight a few of the most promising technologies produced by the Aridoculture Center at Settât to date. While some of these have been adopted to a certain extent already, others are coming along in the pipeline.

a Fertilizer Recommendations The soil test calibration research carried on by the Settât Center demonstrated that soil analysis prior to fertilization maximizes the economic benefits from the use of fertilizer by fine tuning the application recommendation. The research also demonstrated conclusively that nitrogen is the major limiting nutrient to cereal crop production in the dryland region of Morocco, with phosphorus deficiency somewhat less limiting. Potassium was generally found to be sufficient. Under normal rainfall conditions, the critical levels for winter cereal production are 50kg/ha of nitrogen and 5ppm phosphorus (25Kg/ha of P₂O₅). The expansion of fertilizer use has been an important factor behind the growth in output of common wheat, durum wheat and barley from the '60's through the '80's. In the period since the establishment of the Settât Aridoculture Center, nitrogen use in terms of kg/ha in the rainfed areas of Morocco has increased by 13%, while phosphorus use has increased by 46%. Although the average applications are still well below recommended levels, we conclude that cereal yield increases have taken place due to the work of the CRRRA Settât and that farmer incomes have been positively affected.

b Bread Wheat, Durum Wheat, and Barley Variety Development Since its inception, the Aridoculture Center at Settât has produced 12 new bread wheat varieties, 12 durum wheat varieties and 7 barley varieties. Two new bread wheat selections (BT88P401 and BT90E112) are resistant to Hessian fly, rust and septoria and have a higher yield potential and better seed quality than the earlier released "Saada" variety. They are adapted to the drier Abda and Chaouia regions. One of these was released in 1992. Other bread and durum wheat varieties, and barley varieties with high yield potential and disease resistance have been selected by Settât scientists and are ready for on-farm trials.

Recommendation #18: that on-farm trials for promising new varieties be speeded up to enhance the technology transfer process. Varieties and other technologies appear to be backlogged in a queue awaiting either SRD staff time or resources to move them into on-farm trials.

Recommendation #19: that during the two years of catalogue testing, yet-to-be released varieties be tested in researcher- managed on-farm diagnostic trials. This would insure some farmer feedback to the researchers.

Recommendation #20 that INRA and the MAMVA work together to achieve a revision of the cataloguing procedures so as to permit inclusion of unlisted varieties.

in farmer-managed on-farm trials during the catalogue testing stage This would encourage plant breeder contact with farmers and strengthen positive feedback loops, and ultimately enhance impact

Two dual purpose barley varieties, Tamelalt and ACSAD 176, are currently in on-farm trials and have the potential to have considerable impact on farmers income Both varieties are resistant to some foliar diseases, but unlike the traditional barley varieties, have the ability to produce significant amounts of grain after grazing (Barley grazed at the tillering stage is highly nutritious, with crude protein content of 20-30% on a dry weight basis) Even after clipping/grazing, the improved Settata varieties produced 25% more than the standard barley check variety Since a large number of farmers in the semi-arid agricultural regions of Morocco graze their animals on barley in the winter when feed is in short supply, this technology has the potential for significant impact

c Winter Grown Chickpeas The advantage to growing chickpeas in the winter rather than the spring derives from the longer growing season and higher amounts of moisture At the same time, the main constraints to winter chickpea cultivation are the higher incidence of disease due to the increased pathogenicity favored by wet and cold environments A variety introduced by Settata, ILC 195, with good ascochyta resistance, failed to be adopted by farmers because of small seed size Based on that experience, Settata scientists tested and released two new winter chickpea varieties with good tolerance to ascochyta, but with more acceptable kernel size These are currently under diagnostic trials on farmers' fields, and have the potential for significant impact

d Agricultural Machinery A few potentially important implements have been developed by the agricultural engineering group at Settata, with strong collaboration from the private sector An animal drawn grain drill was patented by the Center and then tendered to a local private sector equipment manufacturer based in the city of Settata, for manufacture and extension/sales Unfortunately only about 25 of the drills were produced and thus far they have not been adequately marketed, in the opinion of the Center engineers who developed the implement A large, tractor mounted seed drill has been designed by Center staff and a prototype is now being fabricated by another private sector firm in Casablanca This has commercial potential, but, if taken up, will have impact among the medium to large farmers in the dryland region Finally, and potentially most important, is the work being done on a no-till planter Although the evaluation team has some questions about the appropriateness of designing and producing such equipment here, rather than importing, testing, and modifying, if necessary, already commercially available machinery, there is no doubt about the importance of no- or minimum-tillage technology for moisture management in the arid and semi-arid areas of Morocco

e Ley Farming Ley farming is a year-to-year rotation system of grazed annual medics with cereal crops Medic is a highly productive self-regenerating annual forage legume which fits in well with the annual crop rotation system found in the target zone It has the additional benefit of providing nitrogen to the following cereal crop During the '89/'90 period, farmers purchased 50,000 kg of seed in Settata province alone, enough for about 3,300 hectares

4 Impact on the Sustainability of Dryland Agricultural Production

A number of technologies developed, extended and/or in the pipeline will have a positive effect upon the sustainability of the dryland agricultural production systems in the arid and semi-arid zones of Morocco. Selection and breeding for resistance to a wide range of disease and insect pests of the target crops will reduce the use of chemicals in the farming systems. The work of the soils group on fertility management will insure that fertilizer overuse or inefficiency does not take place. This work will be enhanced by the collaborative research planned with the Soil Management CRSP (USAID Collaborative Research Support Program). A joint Memorandum of Understanding has recently been signed, and a workplan agreed to for collaboration in soil and water management research between INRA (at the Aridoculture Center), IAV, and the CRSP (USDA and Washington State University). The work on minimum or no-tillage will improve soil physical properties, including structure and water holding capacity, and will have a positive effect upon erosion and runoff. The work of the forage and livestock group on range ecosystem management to reduce the incidence of overgrazing will also be beneficial to sustainability of such pastoral systems.

Notwithstanding these contributions to the sustainability of dryland agricultural production systems, the Aridoculture Center at Settlat has probably paid too little attention to ecosystem sustainability and natural resources management issues. We have, for instance, found little evidence of any concerted effort to develop an integrated pest management program at the Center. Although overuse of agricultural chemicals has thus far not been a major problem, this has more to do with the reluctance of farmers to invest in a very risky business -- dryland farming in arid and semi-arid areas -- than of any alternate systems approach developed by the Settlat Center.

Recommendation #21 that the Aridoculture Center at Settlat consider developing a program in integrated pest management and attempt to link up with other institutions that may be able to provide assistance and collaboration in this important area

In our travels through the arid and semi-arid target area of the Center, the evaluation team often observed cultivation running up and down slopes, rather than across the slope or on the contour. There may be important underlying causes for the neglect of this obvious practice, these need to be studied. To the extent that such practices can be more fully employed, they will have a positive effect on soil and water conservation.

Recommendation #22 that the Center work with the DPA's to study why contour farming is not used more extensively, and to promote contour farming technology wherever appropriate to the farmers in the target zone

The sustainability of the natural resources base must be factored more centrally into research aimed at increasing production in the arid and semi-arid areas of Morocco.

Recommendation #23 that, when designing research programs, explicit discussion of the environmental issues associated with the projected technology be required

E PROGRESS IN DEVELOPMENT OF EXTERNAL LINKAGES

1 Linkages with Extension and Development Institutions

The DAARP project and the CRRRA Settati Center got off to a relatively slow start in forming its linkages with extension and development. This is because over a large part of the life of the project, major emphasis has been placed on agricultural research (in many cases, dissertation/thesis research) and the linking of the Center research programs to development needs of farmers received little attention from the project until the late 80's early 90's

Another complicating factor is that the official mandate to disseminate agricultural technologies to farmers is in the hands of the government Extension and Cooperatives Division and the regional DPAs. Research and extension have not been well integrated in Morocco.

The operation of the present extension system allows neither effective or permanent feedback of information from farmers to extension workers and researchers nor constant adaptation of new recommendations to farmers' needs.

As part of the restructuring efforts implemented by the World Bank Research and Extension Project, it was suggested that a linkage group be formed within INRA to transfer technologies to the extension service and have a mechanism for feedback from farmers. 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 in INRA, and exists only at Settati (see section on TT).

SRD at CRRRA Settati is mandated to provide the interface between on-station research and farming conditions as well as insuring the liaisons required with agricultural development agencies and private businesses.

In implementing the above mandate, SRD has organized a sequence of technology testing and evaluation on-farm activities:

a Diagnostic on-farm researcher managed trials—these trials are managed by the various sub programs and are useful for identifying limiting factors to crop production in various environments of the project zone. They are also useful for getting feedback from farmers about the technology being tested.

b Evaluation verification—on-farm farmer managed trials are conducted as a collaborative effort with extension and farmers. The farmer manages all aspects of the production and provides feedback to the SRD.

c Demonstrations trials are carried out by extension in collaboration with SRD researchers and the last step before technology transfer

d Impact assessment is carried out to insure the flow of information needed for technology development

The liaison function is achieved through provision of training, information, and advice to extension agents and farmers as well as the promotion of agricultural innovations and research services offered by the Center

Through a large number of training activities funded by the DAARP, the Center, through the SRD, has been able to greatly increase and improve its linkages with extension and the farming community. The Center has sponsored training of extension personnel at the regional and CT levels. Center scientists serve as member/advisors on the multidisciplinary teams at the DPAs of Settât and Safi and Ouled Said CT level. A rapid rural appraisal (Sondeo) carried out in Ouled Said in 1992 has provided a useful tool for prioritizing research and involved members from research, extension and farmers. The use of Sondeos can be a valuable tool to incorporate the needs of farmers into the research agenda.

2 Linkages with Educational Institutions

a INRA has an agreement with IVA, ENA, CRRA-Settât and the Science faculties of the Universities of Marrakech, El Jadida, Meknes, and Rabat to exchange information, act as Ph D advisors, act on PBO examinations, cooperate on research and give lectures

b INRA has an agreement with ICARDA that includes CRRA Settât, ENA, and the research institutes of Algeria, Tunisia and Libya to cooperate on technology development, evaluation and the impact of new agricultural technologies

c CRRA Settât has a collaborative agreement on Tropical Soil Moisture and Management with Washington State University and USDA

d CRRA Settât has a proposal written for a collaborative relationship with Colorado State University to improve CRRA communications

e CRRA Settât has an agreement with Kansas State University, Purdue University, and USDA for Hessian fly and Russian wheat aphid control

f CRRA Settât has submitted a proposal for funding a collaborative relationship for soil conservation techniques with Colorado State University

g CRRA Settât is writing a proposal to establish a collaborative relationship with the University of Nebraska on socio-economic impact assessment

h CRRA Settatt is writing a proposal for a collaborative relationship for irrigation technologies with the University of Nebraska

i A memorandum of agreement has been signed by USDA, INRA, and IAV for collaborative research on national resource base issues

j University agricultural students from IAV, ENA, the University of Eljadida and the University of Marrakech do their senior year research paper at the CRRA-Settat. There are currently about 20 such students at the Center. This is a valuable linkage activity, since it provides opportunity for students to do more applied research than might be possible at the respective universities, and also contributes to the solution of dryland agricultural problems

k Each year 5 to 6 women students from Ecole Chaouia Girls Agricultural Technical School (post secondary, 3-year) do 5 to 6 months of work and training at the CRRA-Settat

l Each year 6 to 10 students from other agricultural technical schools do 5 to 6 months of work and training at CRRA-Settat. These may be male or female as the technical schools are co-ed

m Each year some students from the 3 year Institute of Technology at Settatt spend 3 to 4 months in practical training in auto repair, electrical work, computer operations or refrigeration at CRRA-Settat

3 Linkages with the Private Sector

The project has made strides in forming linkages with the Moroccan private sector. In this regard, the CRRA Settatt has mainly been working with the seed sector, the farm implement manufacturing industry, and agricultural chemical firms

In the seed industry, the private firm Benchaib Limited, through its Marosem Co. has been working cooperatively with INRA and the Settatt Center in variety selection and evaluation. Recently the company has won the exclusive rights to produce the INRA developed wheat variety, Tilila, in an open bid initiated by INRA. The company has agreed to pay INRA a royalty of 40,000 dirhams for this right and pays a fee for each quintal of seed sold.

An interesting point about this company is that it also is conducting its own privately funded research program and has had developed varieties accepted in the Variety Release Catalogue, e.g., wheat variety Mouna. This is an encouraging sign that a local private company is taking an active part in variety research and development.

Given that the GOM has instituted major reforms and liberalization measures which has allowed private companies to bid on varieties developed by INRA, it is anticipated that the private sector will play a more important role in technology dissemination in the future.

Recommendation #24 that more INRA-generated material be offered for open public bid, as the private sector is generally more efficient in producing and distributing their products than the large parastatals. In addition, increased competition for INRA developed material could allow for increased royalty fees.

The company is also using CRRA research station land to increase seed of INRA and company varieties. In this arrangement, INRA and Benchaib have worked out a profit sharing system.

There are several different types of revenue generating activities being undertaken by the CRRA Settats. These include royalties for new varieties as mentioned above, sales of general production on field research station land and leasing land to the private sector or other organizations.

Under current Moroccan financial regulations, neither the research stations nor the Center are able to retain the revenues generated from these types of activities and they must be sent to INRA Rabat. This has resulted in very little incentive for the Stations to give the required attention needed to produce quality crops and control costs.

Since the actual cost of production, other than the direct out of pocket expenses, are not known, it is difficult to calculate whether this is a significant revenue generating activity. Administrators at Rabat indicated that revenues from seed sales and other revenue generating activities account for less than 10% of the operating budget.

Recommendation #25 that an economic analysis be conducted on the feasibility of using field research station land for revenue generation. This analysis should include all direct and indirect costs incurred in the production of the different crops.

If done wisely, revenue generating activities such as these could help offset the cost of operating the field stations and offer a hedge against reduced financial support from the MAMVA.

The agricultural mechanization sub program has enlisted private sector participation in the construction of the animal seed drill. RIAM, a private company has produced 25 drills, sold mainly to the extension service for demonstration purposes. The Farm Mechanization program has indicated that the construction of the equipment by this company was somewhat inferior and that the company has not aggressively marketed the drill.

Recommendation #26 that this sub program continue to follow up on why the company has not marketed the equipment. They should also should contact any purchasers of the drill and survey their opinions on its performance.

In cooperation with IAV, a tractor-drawn seed drill was designed and shop plans given to COMICON, a large agricultural machinery sales and implement manufacturing firm, to produce a prototype model. The cost of producing the prototype was covered by the company and the

evaluation will be handled by the CRRA Settât Farm Machinery Sub Program. This type of collaborative effort should be commended and used as a model for future collaborative efforts.

Two members of the team had the opportunity to meet with COMICOM company officials in Casablanca to discuss their opinions on the feasibility of producing and selling a Moroccan drill at this time. They showed the team several imported drills which they currently sell which would cost only a little more than the estimated cost of the locally produced model. If given a choice, they were sure that the farmers would go with the imported model which had proven reliability and quality. Also they were unwilling to make a large financial investment to produce a large number of indigenous machines (which would be necessary to bring down cost per unit and increase uniformity and quality control) given the uncertainty of the market. This indicated that they saw little chances of pursuing manufacture of more units in the future, but were willing to cooperate closely with the project in evaluating the performance of their prototype model.

Unfortunately it is doubtful that the machinery developed by the project will compete effectively with the machinery imported and sold by the larger farm machinery firms. However, there may be a niche for the animal traction drill for hillside farmers.

INRA has 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).

4 Linkages with Institutions External to Morocco

If the CRRA Settât is to be sustainable, it must maintain the level of quality of the scientific research which has been generated during the life of the project. The Center has been able to obtain an increasing number of grants and research projects which will allow the institute to continue to develop external linkages and conduct collaborative research activities with internationally respected institutions and other national programs with mutual interests. The Center has developed and maintained the following linkages with institutions outside of Morocco:

a ICARDA The International Center for Agricultural Research in the Dry Areas (ICARDA) remains the strongest international center link with INRA and the CRRA Settât. Currently there is one ICARDA scientist, located in Meknes who has been working closely with the national program in cereal breeding. Contacts and collaboration between CRRA and ICARDA scientists have been established on chickpeas, lentils, and faba beans. These strong linkages have resulted in-country training programs, several international workshops, and a Soil Test Calibration workshop. Many CRRA scientists have visited ICARDA in Syria. Given the similarity in ecosystem mandates between ICARDA and the CRRA Settât, and the growing capabilities of the latter, Morocco, through this Center will be able to provide a strong partner in regional networks promoted by ICARDA.

b Regional Programs/Maghreb Union In 1988, Morocco, Mauritania, Algeria, and Tunisia formed a cooperative agreement known as the Maghreb Union. Negotiations between the countries have resulted in the formation of an agricultural research network (MU/TRAM), the *Reseaux Thematiques de Recherche Agricole au Maghreb*. The INRA Secretary General (who was the former head of the CRRA Settati) serves as the Regional Coordinator for this activity. Linkages with the Center have included a MU/TRAM sponsored Hessian fly workshop held in 1989 at the CRRA Settati and a workshop on Farming Systems held in Casablanca in 1989.

c CIMMYT Historically, INRA cereal breeding programs have maintained close contacts with CIMMYT through exchanges of genetic material and in training personnel in plant breeding and research station management. Two of the CRRA field station managers received the course in Research Station Management.

Recommendation #27 that INRA, through its Aridoculture Center at Settati, continue and strengthen its regional and international linkages in the area of dryland agriculture research

d The "Desert Summit" In our discussions in the Royal Cabinet, we were informed of a meeting that took place recently in Casablanca of the Steering Committee for a Desert Summit. This was based on an initiative that originated in a conference held earlier in San Diego, California by the San Diego Foundation through the Fred Hanson Institute. The purpose of this initiative is to promote regional cooperation on various desert issues. Unfortunately, the San Diego conference reportedly did not involve persons with agricultural expertise. The Casablanca meeting had as its purpose the setting up of an international program on research and development in dryland areas (apparently for discussion at the Desert Summit), but, apparently did not involve anyone from INRA. At the same time INRA is planning a workshop on Dryland Agriculture in the near future. Some observers feel that the Desert Summit (which has the support of several heads of state) and the related proposal for an international program on dryland agriculture is still too heavily based on a one-way flow of technology from the Ben Gurion university, and that other countries in the region also have a lot to contribute. With the strength in dryland agricultural research that has been developed through the DAARP, Morocco can be an important player.

Recommendation #28 that INRA and the CRRA Settati staff be involved in future discussions on the Desert Summit proposal for a program on research and development for dryland areas, and that efforts be made to avoid duplication between these initiatives and the forthcoming workshop on dryland agriculture.

5 Grants and Collaborative Research Linkages

ICARDA/IDRC Project (Morocco-Turkey) Package for Agro-Ecological Characterization (PAC), 1990-1994. This project has a total budget of 137,000 dhs, with 62,895 dhs for INRA and 74,965 dhs for DMN (to be managed by ICARDA). The PAC is a computer simulation which allows researchers to estimate potential production based on meteorological events during

the cropping season, various physical factors (soils, topography, etc) and other variables National coordinators are El Mourid Mohamed, CRRA Settata and Ben Arafa, DMN

ICARDA/IFAD Magreb Transfert de Technologie Project The first phase (1989-1993) had a budget of \$178,000 managed by IFAD/ICARDA The second phase (1993-1995) has a budget of \$175,000 to be managed by AFESD/IFAD/ICARDA This is a regional research and technology transfer Project aimed at increasing barley, food legume and Livestock production in North Africa The National Coordinator for Morocco is El Mourid Mohamed, Head of the CRRA Settata

EEC/INRA Morocco Study on Salt Stress and Barley, 1990-1994, with a budget of 443,446 dhs The National Coordinator is Amir Ahmed, CRRA, Settata

TSM/CRSP/CRRA, Settata/IAV Hassan II, Soil Water and Land Strategies for Sustainable Agricultural Growth and Development in Morocco, 1993-1999 This collaborative project has a budget of 2,301,000 dhs, managed by IAV, for the first year, of which 450,000 dhs are allocated for the CRRA Settata This study is a collaborative support activity to identify problems in managing natural resources National Coordinators are Bendaoud Lahbib, CRRA Settata, and Rachi Doukkali, IAV

UNDP/Morocco, Algeria, and Tunisia 1991-1995 This project has a budget \$1,070,803 for the three countries for the length of the project It involves a disease survey and germplasm enhancement of cereals and food legumes in the cooperating countries The National Coordinator is El Yamnaï Mohamed UNDP, Rabat

The above collaborative research activities would indicate that the Center has and is continuing to establish its credibility as a viable national arid land institute

Recommendation #29 that INRA continue pursuing further linkages to allow not only revenue generation for conducting research, but also for increasing the flow of ideas and knowledge from outside

F INFRASTRUCTURE DEVELOPMENT

1 Status of Construction

At the time of the Mid-term Evaluation most of the construction of laboratories and office facilities at the CRRA Settata had been completed The following were still under construction biotechnology research building (shell partially finished), agricultural chemicals reception/ storage center (90% complete), agricultural mechanization center and headquarters motor pool facility (75% complete), plant breeding research center (80% complete) and technology transfer center (80% complete) In addition to these buildings at the Center, construction was proceeding on an INRA guest house and recreational facility in Settata across from the new university By December, 1993, all of these had been completed, except for biotechnology research building

(expected to be completed by March, 1994) and the guest house (expected to be completed in April/May, 1994) All of the construction has been paid for from the INRA budget, and the 1994 budget includes provision for completion of the two buildings whose construction is still underway The Center plans to request funds to construct a laboratory for animal science

2 Suitability of Facilities and Equipment

The evaluation team was, in general, favorably impressed by the appropriateness of the facilities and the equipment The buildings are adequate and modern, without being ostentatious, if anything, they are on the modest side The same could be said for the scientific equipment and farm machinery, with a few possible exceptions The relatively large number of precision plot planting/fertilizing machines are very useful labor-saving equipment, and the Wintersteiger precision cereal harvesters are of highest quality, but both sets of field equipment are very expensive and need to be properly used and maintained The team agrees with the recommendations of the September, 1993 Scientific Review Panel on this subject (see pages xiii and xiv of Annex G)

We wonder about the need for the controlled environment growth chambers, given that they are so difficult to maintain -- and useless when electrical power fails Obviously some of the research is best done under controlled conditions, but more could be done in the greenhouses if they could be provided with the facility to be heated in winter The evaluation team was told by some scientists that more growth chambers are needed, but we advise caution in adding to the maintenance problems and the attraction of doing work in growth chambers rather than in the field that would result

3 Remaining Needs

Although not able to make a thorough assessment of needs for additional equipment or facilities, the team was surprised that no provision had been made for emergency, stand-by electrical power A small plant to provide power to the most essential facilities (e.g. greenhouse fans, growth chambers, cold storage) is an essential facility for research stations in areas that experience frequent power outages UPS (uninterrupted power supply) equipment would also be highly desirable for computers Since one of the chief reasons for greenhouses is to be able to grow plants the year around, it is essential that they be heated in the winter

Recommendation #30 That a stand-by electrical power plant and heating facilities for greenhouses be given high priority for future procurement

G STRATEGIES TO ACHIEVE INSTITUTIONAL SUSTAINABILITY

Work that USAID commissioned over the last five years on institutional and financial sustainability has focused on institutions as systems that function in relation to their environment, as entities whose organizational structures and procedures must match the tasks, products, people, resources and contexts they deal with, and as settings where economic and

political relationships intertwine to create varying incentive patterns. Out of this work has emerged a definition of sustainability as the ability of an institution to produce outputs that are sufficiently well valued by beneficiaries (users of the goods and/or services produced) and stakeholders (actors other than users with an interest in what the institution does) so that enough inputs are provided to continue responsive performance. Institutional sustainability therefore depends upon maintaining responsive output flows (high quality and valued goods and services), cost-effective goods and services delivery mechanisms (organization and management), and, resource flows (recurrent costs, capital investments and human resources)

1 Responsive Output Flows

The outputs of an agricultural research system are the knowledge generated and technologies developed and ultimately transferred to the system's beneficiaries -- the farmers and extension agents of the arid and semi-arid zones of Morocco, and to the other stakeholders -- INRA/Rabat, the Ministry of Agriculture, the Ministry of Finance and the donors. Without such valued outputs, the Aridoculture Center at Settât will not be sustainable.

This conclusion was reinforced at a meeting the evaluation team and USAID staff had with the Minister of Agriculture. After hearing about the many laudable institutional development accomplishments of the project -- staff trained, facilities constructed, management systems in place -- the Minister asked about technologies the project produced to help Moroccan farmers. He was clearly most interested in impact! Examples of impact were given, along with an explanation of the long lead time required in the biological research/technology generation and transfer chain. However, since research is such a long-term endeavor, it is always less likely to receive support from the political side than investments with more rapid paybacks. As a public sector institution with resource-poor farmers in the marginal areas as its main clients, the Center will ultimately depend upon Government funding as its primary source of support. That funding will likely be contingent upon the demonstration of reasonably high rates of return to the investment made. It is therefore exceedingly important for the Center to target its program on farmer-identified constraints amenable to research solutions, and follow the process through to adoption and impact.

2 Cost Effective Goods and Service Delivery Mechanisms

The articulation of agricultural technology generation, and delivery and adoption by the farmers is not the responsibility of the research organization alone. The national extension organization and its local branches have primary responsibility to get the technology out.

One major impact of the DAARP has been the implementation and seemingly institutionalization of a Research Systems Approach (RSA) by the CRRA Settât (see figure 9). This approach involves three components: Research Agenda Development, the Research process, and Monitoring and Impact Assessment. These components are all interrelated and allow for feedback all along the technology development and transfer process. The team feels that the RSA approach has enabled the Center to better develop research strategies and define priorities. In

addition the linkages implicit in this design allow for the integration of the extension service and farmers into the research agenda and technology development process

The research process must be a collaborative effort of all the partners concerned in the generation and transfer of technologies. Unfortunately there is a tendency for some researchers to consider their work complete when a technology has been proven on the research station and take little interest in seeing their material or technology tested under farmer conditions

The sequence of technology testing and evaluation on-farm followed under the RSA performs the function of getting researchers, extension personnel and farmers working together to solve problems. As outlined earlier in this report, there are steps in which a technology is evaluated as it moves from the research station to on-farm. The first diagnostic trials are researcher managed and controlled and are generally used for determining how a technology performs under different agro-ecological conditions. Although they are researcher managed, this can also be an important time for the researcher to work with farmers to share ideas and perhaps adapt the technology in the process

If a technology performs well under researcher managed on farm trials, the next step is generally farmer-managed evaluation trials. Farmers are given a technology and the trial is under their control. The researcher who generated the technology may not be involved in these trials, as this is the responsibility of the SRD section. These trials are conducted as a collaborative effort with extension and farmers, however there could be the risk that the researcher becomes less connected to the technology development process

An intermediate step is needed in the technology development process which involves the researcher further downstream in generating and testing the technology. These are often referred to as researcher/farmer managed on-farm trials. Here the researcher works with the farmer setting up the trials and has some control over the experimental process. He may also superimpose treatments on farmer managed fields. The researcher also gets important feedback from the farmer on problems he may be experiencing trying to adopt the technology under his farming system and conditions

Recommendation #31 that researcher/farmer managed trials be fully incorporated into the RSA as indicated in figure 10. The addition to these trials to the on-farm research program will further strengthen the linkages and information flow between research and the farmer. In addition, they will provide opportunities for scientists to use their expertise under real situations and give insights to farmers' reasons for rejection or acceptance of technologies

Proven technologies at this level are further evaluated under farmer-managed trials involving collaborative efforts with extension and farmers. Finally, a technology is ready for transfer and diffusion

Technology transfer has been mandated to the Extension Service. It carries out this function through demonstration trials which are coordinated with the SRD section. The liaison function of the SRD is achieved through training, information, and advice to extension agents and farmers, not to conduct the demonstration trials themselves. The extension agent's efforts can only be successful if the agents have been active partners in the technology development process.

3 Resource Flows

The GOM has expressed, and has indeed demonstrated through its budget allocations, that it intends to continue to fund the CRRA Settat and to absorb, within budgetary limitations, relevant costs previously paid through the DAARP. Nevertheless, the financial sustainability of the Center will be enhanced to the extent it is able to **diversify** its funding base.

One way of diversifying funding is to actively seek opportunities for contract research. Opportunities for such funding are likely to be limited, owing to the mandate of the Center, which places it out of the main area of interest of agribusiness firms working on high value crops that may wish to contract for specific research. Some opportunities may exist in the area of agricultural inputs. These should be pursued only to the extent that they do not divert the Center from its research agenda nor conflict with its work on integrated pest management.

Royalties for technology generated and licensed to private firms are already providing modest sources of incomes, as is the sale of products from portions of research stations not needed for experiments. Opportunities for sales of services, such as training, consulting and plant and soil analysis offer further opportunities for diversification of funding sources. As a means of stimulating the increase of such funding, and ensuring that production is profitable

Recommendation #32 that means be found to channel funds obtained from royalties and sale of goods and services directly back to the Center and station producing such income; and that an internal cost-accounting system be established to determine the real costs and profits of commercial operations on the stations

H KEY LESSONS LEARNED

The evaluation team has been asked to highlight lessons learned from the DAARP. From the vantage point of a broad overview of what will have been accomplished by 15 years of efforts by INRA and MIAC, \$28 million of expenditures by the GOM, and nearly \$50 million of contributions by USAID, this project offers an example of a long-term, institution-building project from which lessons can be derived. The lessons learned should help those who design similar projects in the future. This is done from the viewpoint of what is known now, rather than what information was available to those who designed the project or its several amendments. With this caveat, and without any attempt to apportion blame or credit, we make the following observations:

1 Positive Elements of Project Design and Execution

a A long-term commitment is essential for agricultural research and institution building projects

Building an agricultural research institution, literally from scratch, takes time. Site selection, design and construction of buildings and laboratories, off-shore procurement of equipment, and the training of Ph D-level scientists, starting from the English language study stage, is at least a 10 year effort. Once physically built, equipped and manned, a research operation still has a long gestation period before the fruits of the scientific method of inquiry can be translated into technology that can have impact at the farm level. In the United States, it takes at least from 5 to 10 years for agricultural research to travel the knowledge/technology/transfer/impact route. The Mission should be commended for understanding the long-term nature of this kind of research institution building project.

b Advantages of U S university involvement in institution building projects

U S universities have a great collective wealth of experience in the process of institution building, and the land-grant colleges offer a useful model for the integration of agricultural education, research and extension. Although this model needs to be adapted to the local conditions in developing countries, the direct involvement of university staff in problem-solving technology generation and transfer is a valuable concept. In addition to the obvious value of this experience to the developing country institutions with which they collaborate, the cultural richness of the overseas experience and the technical advantages of such collaboration often bring unplanned for advantages to the U S institution. A case in point is the reverse technology flow to the U S of Moroccan wheat germplasm with resistance to Hessian fly, which has had an economically significant benefit to U S farmers.

While these advantages point to the desirability of contracting with U S universities for such USAID projects, several project weaknesses pointed out in this report suggest some words of caution on how such contracts should be executed. It has been pointed out that the technical assistance personnel in general tended to neglect the institution-building and management functions in their greater attention to technology generation. To overcome this weakness, staff members should be given training in management and leadership, and the essential components of institution-building, prior to field assignment. Additionally, consideration should be given to the possibility of drawing some of the technical assistance personnel from university departments outside the Colleges of Agriculture who would have specific expertise and give attention to management and leadership aspects. The large number of administrative visits has also been noted. This may be partially the result of contracting with a consortium as opposed to a single university.

The contrast between the DAARP and the IAV projects have also been described, with the former using far more resident technical assistant personnel and the latter dedicating most of its resources to participant training and relegating direct management of operations mostly to

Moroccan staff On balance, we consider the DAARP approach best for the specific project goals and circumstances of the CRRA Settat As demonstrated in the data on when Ph D -level staff returned to Settat, it is only recently that there has been a sufficient number of highly trained scientists in the various disciplines, and management of the research programs was turned over to them when they became available Meanwhile, the large number of U S university staff at the Center provided a good example of a "hands-on", problem-solving research approach that has served well to change the institutional culture Some feel that such an institutional culture is still not in place at the IAV

c Benefits of in-country thesis research

The advantages of this approach are obvious Doing the thesis research in Morocco meant that research would contribute directly to resolving Moroccan agricultural production constraints It also resulted in the participants learning to do research within the local institutional environment, rather than becoming used to the facilities and procedures in the U S , that might have caused more frustration when they returned to face the realities of doing research in a developing country This probably is one of the reasons for the relatively low attrition rate of returning staff

d Value of management training

The two senior management personnel of the CRRA Settat (Head and Scientific Coordinator) whom the project supported to take the 6-week management course conducted by USDA/OICD appear to have gained greatly from this training In discussions with them it was clear that they had learned a great deal about management methods and leadership skills and are trying to apply what they have learned The only pity is that such training has been limited to so few Since many participants studying for Ph D s in the U S will, on return to their institutions, take on leadership roles, it would be highly desirable for a course in management to be included as part of their higher degree studies

2 Components that Should be Done Earlier in the Project Life

a Baseline studies on farming systems and socio-economic indicators

The Aridoculture Baseline Study and Farming Systems Typology was published in June, 1993 Although elements of the information that went into that report were already available in the 1991 document "Reajustement du Programme Aridoculture", lack of baseline information on farming systems in the target zone was a hindrance to early PBO efforts More important, such information should have been some of the first gathered in the life of the project, in order to set the research agenda as a basis for a staff development plan Indeed, the need for such information was identified early in the project At that time, however, it was considered that the IAV was the institution that should conduct such studies and a contract was made with the IAV, with DAARP funding, for that purpose Due to a combination of strained relationships and the untimely, accidental death of the head of that activity, the study was not completed and the

information gathered was not made available to the CRRA Settat. With the benefit of hindsight, it is clear that the CRRA Settat was better located to conduct such a study, which would have helped developed the installed capacity for continuation of such work in the future.

b Program planning by objective and related human resources needs assessment

Systematic program planning and prioritization should have been introduced much earlier in the project. This is a basic element of the development of an effective agricultural research institution. The development of a long-term, strategic plan for research to meet the needs of the target zone would have made it possible to produce a staff development plan. This, in turn, would have provided a more systematic basis for identification of key areas of study for participant training.

c Emphasis on inter-disciplinary, program-focused research rather than disciplinary research

Inter-disciplinary research is now, gradually being introduced through multi-disciplinary research projects. That such collaborative research is still weak is not surprising, since most of the scientists have just returned from completing higher degrees in universities that are, as is necessary for teaching purposes, organized by disciplinary departments. One solution to this type of problem is to organize students into groups in which each contributes, through his/her disciplinary thesis research, to the a multi-disciplinary research project. Such an innovative approach was introduced in the 1970s in a collaborative program between Cornell University and CIMMYT.

d Management training

As discussed above, the management training that has been provided under the project for senior administrators and research station managers has proven very useful. It would have been desirable to initiate such efforts earlier in the project, both through management courses for Ph D students as well as through in-house training courses.

e Planning for post-project sustainability

Those who designed and executed the DAARP should have focused more clearly at an earlier stage in the project life on what needed to be done before the project termination and what funds needed to be reserved for post-project activities to better ensure sustainability of project achievements. This is discussed more fully in the section on An Orderly Transition, below.

3 Actions That Might Be Done Better

a More on-farm trials and farmer feedback loops

The need for this key component of applied agricultural research has been discussed earlier in this report. Projects of this nature should pay greater attention to the institutionalization of such activities.

b Integration with activities supported by other donors

Several examples have been mentioned in this report in which there is real or potential conflict or overlap between activities of the DAARP and those of other institutions. USAID, which is in a position to be in close contact with other donors, should be constantly alert to such problems and make every effort to ensure complementarity rather than competition.

c Site selection

There are two problems in relation to the location of the CRRA Settati. One is that the Center has no contiguous research fields. This has been discussed earlier. The other is that it is located on the favorable end of the rainfall spectrum for the target, dryland agriculture region. After all that has been invested in the Center, it is too late to change these facts now. In similar projects in the future, however, those designing the project should try to find solutions for such problems before major investments in infrastructure are made.

d Integration of project and host center activities

This problem seems to have been resolved at this time, with project activities apparently an integral part of the CRRA Settati programs. Earlier in the project, however, there appears to have been two sets of activities, MIAC's and the Center's. To the extent that this was the case, it was probably related to the large number of resident Technical Assistance staff present during much of the project's life, reaching as many as 16 during the late 1980s. Such a large expatriate staff component can easily overwhelm a small, developing center staff, tending to develop the appearance, if not the reality, of a life of its own. This was also compounded by the fact that the DAARP was aimed at dryland, low-resource agriculture, and the CRRA Settati had a different, geographic mandate. As discussed above, this problem appears now to have been resolved.

e Timing of equipment purchases

The natural tendency of technical assistance staff in a project of this nature is to order as much laboratory and field equipment as the budget will permit in order to have everything they need to do their work. On the other hand, there is value in having returning participants involved in the selection of equipment as much as possible. Since most of the participants have only recently returned, or are still in the U.S., these two goals are incompatible. We have no specific information on examples of equipment that was ordered too early in this project, but it is true that

much of the equipment is now quite old, and some already non-functional, just when returning participants need it and the funds to replace or repair it will be very limited. This points to the desirability, in projects of this nature, to limit early equipment procurement to only the most essential.

V. PREPARING FOR THE FUTURE

A AN ORDERLY TRANSITION

A long-term, institution-building project must be planned, from its initiation, with a careful assessment of what is needed to ensure the viability and effectiveness of the institution developed after external funding ceases. This is particularly important when the project includes large elements of resident technical assistance personnel, equipment procurement and project supplementation of operational budgets and support staff. The host institution and government must have sufficient time before the end of project funding to make such provisions as are feasible to absorb the costs and positions that need to continue into the approved budgets and cadre, and the size of the operation complements and equipment procurement should not be built up to a level for which it is not feasible to make such provisions within reasonable host country resource allocations. This calls for a phased project execution, divided into several stages, with declining external support and expatriate management in the latter stages, including a final stage in which the project management is fully in the hands of local personnel, and modest funds are available for essential elements such as linkages and equipment maintenance.

Although sustainability has been emphasized in project documents and evaluations from the start, there is little evidence that the project designers and the contractor gave adequate attention to the need for phasing. The natural tendency of contractors and individuals engaged in an activity is to spend all of the funds available. With normal delays in execution the result has been a relatively large level of resident technical assistance staff and budget supplementation right up to the last year of the project, leaving few resources to fund a final, transition stage. This has been compounded by unexpected funding shortfalls in USAID's budget. The result could be an abrupt end to external assistance without the necessary time to permit the host institution to adjust to a new funding environment.

B KEY FUTURE NEEDS

We have tried to identify what we consider to be the most important elements that need to be funded during the next few, transition years, without identifying sources for their funding, and then give recommendations on how any USAID funds that might be available for a post PACD period might be most usefully employed.

1 Equipment Maintenance

Maintenance of the equipment that has been purchased under the DAARP is one of most frequently mentioned concerns by INRA management and CRRA Settat staff alike. Much of the equipment was purchased early in the life of the project, and is now at age that problems will increase. One of the chief causes of concern is that much of the equipment is from the U S from firms that are not well represented in Morocco, and contacts for parts and maintenance services are more with Europe than with the U S. Thus the question of spare parts is seen as critical.

2 Linkages

The other item mentioned most often by INRA staff and officials as concerns for the future was how to maintain the linkages with the broader scientific community, especially with U S university staff, once funding for such two-way contacts is no longer available from the project. Such linkages are essential to the maintenance of high level of quality of the research efforts and serve as a powerful motivator of scientific staff.

3 Training

Some key training needs will not have been fully accomplished by the PACD. These include management training for additional leaders and potential leaders, training in laboratory and farm equipment maintenance, training of trainers, especially the type of training in project formulation as given by Team Technologies, and management information systems.

4 Scientific Information

The library does not have a large collection and there is concern about maintenance of the limited number of subscriptions to scientific journals it not has, once project funds are no longer available. Use of electronic mail for less expensive searches in data banks, along with the use of CD ROM would help broaden access to scientific information. Use of electronic mail has already been introduced in the Center, and provisions have been made in the reduced 1984 DAARP workplan to pay for the dedicated line and mail boxes for that year. As some CD ROM disks are quite expensive, means of sharing the costs and the information through among INRA, IAV and ENA, using a central information and documentation center and sharing information through a local area computer network should be considered.

5 Expanding the CRRA Settatt Model

The CRRA Settatt will be more likely to be sustainable as a center of research and technology transfer excellence if it is not the only CRRA within INRA with a large number of highly qualified staff and adequate facilities. Fortunately the MAVDA has a plan to reform agricultural research and extension, that includes strengthening of other CRRAs and INRA looks at the Settatt Center as a model.

C FUTURE USAID/RABAT ASSISTANCE

By the current Project Assistance Completion Date of August, 1994, the Aridoculture Center at Settatt will be an agricultural research institution with the human and physical capital necessary to accomplish the project goal of increasing food production to meet the needs of Morocco's fast growing population and to improve the income of farmers with small and medium-sized land holdings in the dryland arid and semi-arid zones. It will also have in place a management system capable of translating the needs of farmers and national policy makers into an applied agricultural

research program targeted at farm-level impact. But the system is still fragile and not yet fully operational, and requires additional, incremental support to insure sustainability.

As the evaluation team was completing their work, the DAARP chief of party and USAID/Rabat were in the final stages of finalizing the 1984 Plan of Work up to the PACD. The possible reduction in total LOP-funding (discussed in the footnote on page 15), as well as the desirability of reserving some funds for post-PACD activities, resulted in the reduction of the 1994 Plan of Work budget request by a total of \$1,557,840 from what had been proposed in the Draft Plan of Work on October 14, 1993. Unless some or all of the "borrowed" funds are recovered, this would leave just under \$300,000 for post-PACD activities on a "no-cost" basis. Since these negotiations were underway it would not be appropriate for us to comment on that budget. We are compelled, however, to express our concern that such major adjustments happened so late in the LOP. Although we question the prudence of MIAC's decision to have a six-person TA team in country by the PACD, funding reductions at this late date virtually preclude a reduction in this number of resident TA staff in the last months of the project. Contractual obligations, and the fact that some have children in school, would cause serious family problems, which should be avoided. Also, understandably, INRA would like to see a larger amount of funds reserved for post-PACD activities, and CRRA Settat staff see the expenditure of a large amount of remaining funds on U.S. staff as directly affecting such funding availability. This situation is regrettable.

A number of key future needs have been outlined above. This section will suggest some opportunities for targeted, relatively low cost USAID investments in the post-project period that should help to maximize the return on the considerable U.S. and Moroccan investment in the Center to date. These will build on the strengths already established and provide for continuation of these developments into the future.

Our recommendations are divided into three priority groups. Priority One activities are those that could be accomplished with the post-PACD funding availability is limited to about \$300,000. Priority Two consists of additional activities that we consider most important if, as is hoped, additional funds can be found. Priority Three activities are also considered as being of high priority for execution, but may be of lower priority for USAID because it is possible they can be accomplished in other ways.

Priority One

1 Course work completion for Ph D students now in the U.S.

There will apparently be a number of MS and Ph D students completing course work in the U.S. after the project terminates in August, 1994. Once these students complete their course work and return to Morocco, funding for the remainder of their degree work at the IAV should be picked up by GOM. MIAC estimates that the maximum cost for their stay in the U.S. will be \$94,500.

For purposes of continuity and administrative ease, we suggest that provision for this be made in an extension to the MIAC contract

2 Scientific exchange with U S universities

The evaluation team encourages the development of a mutually beneficial linkage arrangement between U S universities and the Aridoculture Center at Settata after the project terminates. A good example of such an arrangement is the IAV/University of Minnesota agreement to host regular staff exchanges and support collaborative activities that develop based upon those exchanges. If such an arrangement (discussed earlier in this report), in which the U S university(ies) use core funding to pay for the travel of and the host institutions pay local costs, is used, funds would need to be found to pay for the travel of Moroccan staff to the U S and the local costs of U S staff visiting Morocco. USAID support should be contingent on U S university support, as described above. Costs, for four scientists per year in each direction for three years, are estimated at \$36,000.

We suggest that funding for such an arrangement be handled directly by INRA-USAID/Rabat

3 Information and Documentation Study

The evaluation team is concerned about the weakness of the Center's library and information systems. Agricultural scientists must have access to state of the art information to be effective researchers. We have also noted that the IAV has similarly been criticized for weakness in this area. An electronic mail system is already in place at the CRRA Settata, and the revised Plan of Work contains elements to fund the development of a Local Area Network (LAN) and continuation of the electronic-mail services through provision of the salary of a systems manager, purchase of software, and payment for a dedicated telephone line through 1994. We suggest that a study be made to determine the feasibility of supporting a central information exchange, using electronic means for data accessing and transmission to all agricultural institutions in Morocco.

We suggest that funding for such an arrangement be handled directly by INRA-USAID/Rabat and a PASA arrangement with the USDA Library be put in place to provide the information system consulting services. Alternatively, an OMB transfer to the R & D/AGR Office to support these activities through their PASA may be used.

4 Additional Diagnostic/Appraisal Work to Identify Problems and Prioritize Research

The Aridoculture Center, under the leadership of the Socio-Economics Sub Program, has recently produced an excellent baseline study and farming systems typology for a portion of the target area. This provides a comprehensive frame of reference for the understanding of the target population of farmers and their agricultural, household and off-farm activities, within the context of four agro-ecological zones of Settata and Safi Provinces.

Unfortunately, this study, which, in hindsight, should have been one of the first pieces of research done by the fledgling Center many years ago, was only just published in June, 1993. It is one of the essential pieces in the problem identification and research agenda development process.

The evaluation team feels strongly that this study be extended to the other Provinces of the target area, to get a fuller understanding of baseline conditions. Furthermore, we believe that sondeos should then be carried out in each of the farming systems identified to get an in-depth understanding of the main problems farmers face. It is our understanding that the Center will undertake its second sondeo, this time in Safi Province, later this year.

We believe that the Aridoculture Center staff now have the ability to do this work without outside assistance, although limited, short-term technical assistance may be useful to facilitate the operation. This could be effected through a buy-in to an IQC or other central project. In any case, additional local funds will probably be required to get this essential work done in a timely fashion.

We suggest that funding for such an arrangement be handled directly by INRA-USAID/Rabat and USAID/Washington.

5 Additional research emphasis on sustainability and natural resource management issues

Given the worldwide importance of environmental issues, and the increased understanding by the agricultural community of the necessity to manage agricultural natural resources in a responsible and sustainable manner while at the same time increasing productivity, the Aridoculture Center has an opportunity to take a lead position nationally and regionally in the arid and semi-arid areas. We believe that the Center would benefit from linkages with other institutions with more experience in the area of sustainable agriculture and natural resources management. Funds for a linkage activity, either with the Sustainable Agriculture and Natural Resource Management CRSP, the Soil Management CRSP, a PVO/NGO with interest and expertise in agricultural sustainability, such as the World Resources Institute, or an international center doing work in this area is recommended.

We suggest that funding for such an arrangement be handled directly by INRA-USAID/Rabat and USAID/Washington.

Priority Two

6 Impact Assessment Program

Staff of the Socio-Economics Sub Program are in the process of developing methodologies to assess the impact of Aridoculture Center-developed technologies. This work will be crucial to the sustainability of the institution. Without a clear indication of the economic impact of the technologies developed, and the returns on investment, CRRA Settati will not be able to garner the resource flows required to insure its continued operation. The evaluation team suggests that

resources be made available to carry out impact assessments of all technologies considered to have been adopted by beneficiaries

We suggest that funding for such an arrangement be handled directly by INRA-USAID/Rabat

7 Integrated Pest Management (IPM) Research

Given the importance and efficacy of integrated pest management as an effective technology to combat pest losses and protect the environment and human health. An excellent start has been made in this area by the strong emphasis given to breeding for host plant resistance to major pests and diseases. This has been facilitated by the fact that the entomologists did their higher degree studies at Kansas State University, a leader in this field. However, there has not been sufficient contact with in-MIAC universities (such as the University of California and Texas A & M University) that are leaders in the broader IPM issues. The evaluation team suggests that linkages be forged with institutions working in this area. The Integrated Pest Management CRSP or the FAO would be suitable partners in this endeavor.

We suggest that funding for such an arrangement be handled directly by INRA-USAID/Rabat and USAID/Washington

8 Policy Analysis

Since the Aridoculture Center is the primary cereals research institution in the country, it should have the capability to monitor and assess the macro- and sectoral-level economic policy environment in Morocco. Cereal pricing policy, for instance, has a great impact on the area under cultivation, which in turn can have an effect on resource management issues. The evaluation team suggests that resources be made available to the Center to upgrade its capability in this area. This may take the form of training or short term technical assistance. A buy-in to the Agricultural Policy Analysis Project (APAPTA) would be appropriate.

We suggest that funding for such an arrangement be handled directly by INRA-USAID/Rabat

9 Stand-by Electrical Power

It has been noted that the lack of equipment to provide stand-by, emergency power to essential facilities, such as growth chambers, greenhouses and cold storage rooms, threatens the loss of experiments and materials when, as frequently occurs, there are power outages. The provision of such facilities is essential to the completion of the Center.

We suggest that a study be made as to the minimum requirements to provide for the most essential facilities. Such a study, and the procurement of the recommended equipment, could be handled directly by INRA-USAID/Rabat

Priority Three

10 Completion of the PBO process

As has been noted, the PBO process is incomplete. Further work needs to be done to prioritize projects and to link resource allocation to them. Since ISNAR is actively involved in this process, it may be possible for that institute, with GTZ funds, to help the CRRA complete

bring this important activity forward till it becomes fully functional. If, in the consultation between INRA and ISNAR on this subject, it is decided that continued involvement with Team Technologies is essential, funding from USAID/Rabat may be necessary.

11 Facilitation of Scientific Information Linkages and Procurement of Essential Publications

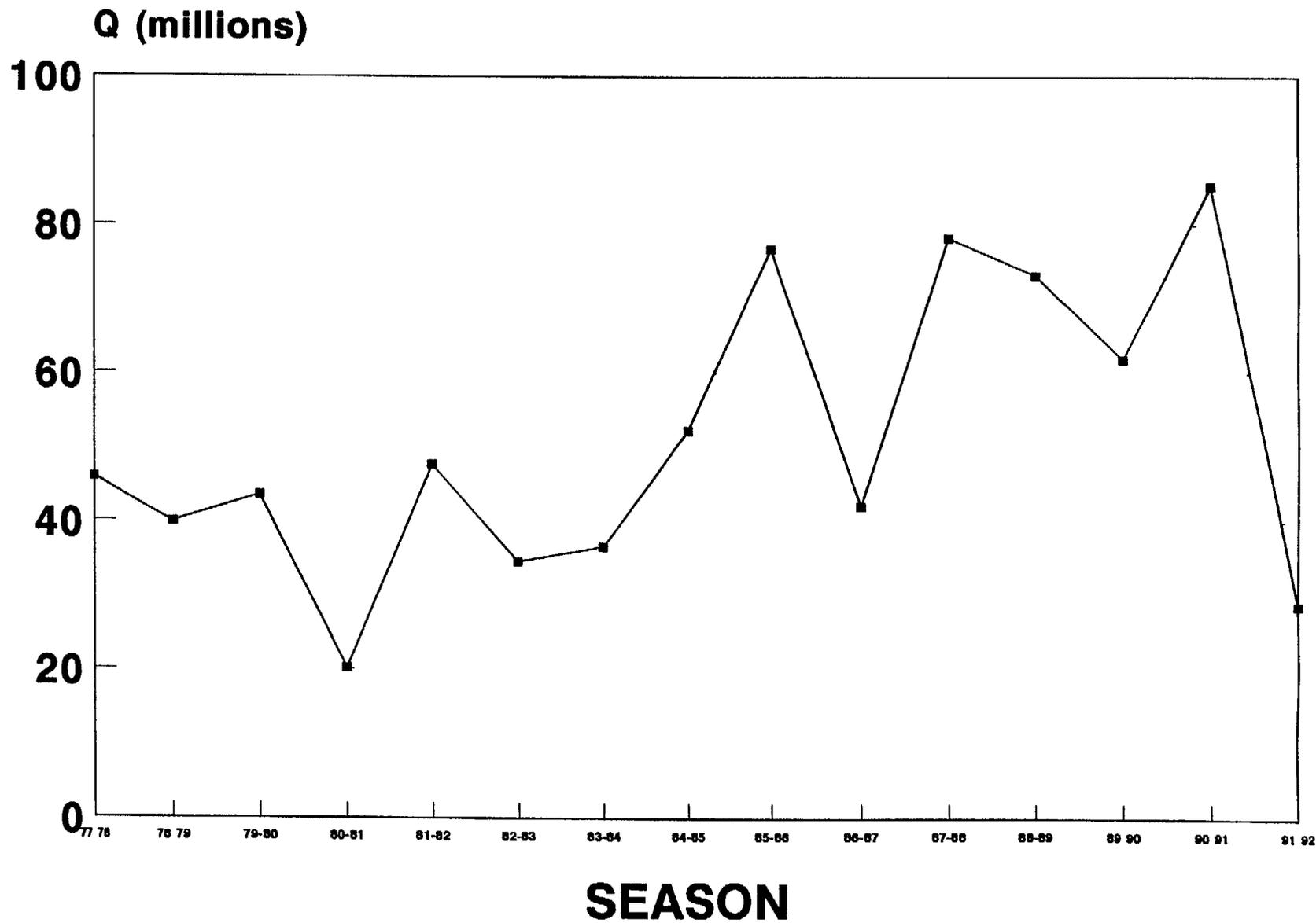
When the study suggested in item #3, above, has been completed, it seems most appropriate that provision of the equipment, publications and CD-ROM disks be achieved on a national basis through the World Bank Research and Extension project. It is hoped that the INRA budget can provide for the continuation of the dedicated telephone line, systems management and publication purchases for the CRRA Settati that are being provided for by the DAARP through 1994, so that the scientific information and communication needs of the Center, as well as its full participation in the national system, can be assured. It may be necessary for USAID to provide some funding for the latter, until these needs can be fully integrated into the INRA budget, so as not to lose momentum on this important development.

Recommendation #33 that, to the extent that funds obligated for the DAARP are available after PACD, and/or additional funds become available, USAID give highest priority for use of such funds to: 1) completion of course work by Ph D students still in the US, 2) facilitation of continued linkages between CRRA Settati staff and MIAC universities, 3) a study on the development of a national agricultural science documentation service, 4) additional diagnostic/appraisal work to identify problems and prioritize research, 5) collaborative research on sustainability and natural resources management issues, 6) an assessment of the impact of Center-developed technologies, 7) collaborative research on integrated pest management, 8) policy analyses, 9) provision of stand-by electric power facilities, 10) continued assistance in development of a research planning and monitoring system, and 11) procurement of publications and CD-ROM disks for the Center's Technical Reference Center and the national documentation service.

FIGURES

Figure 1

CEREAL PRODUCTION IN MOROCCO

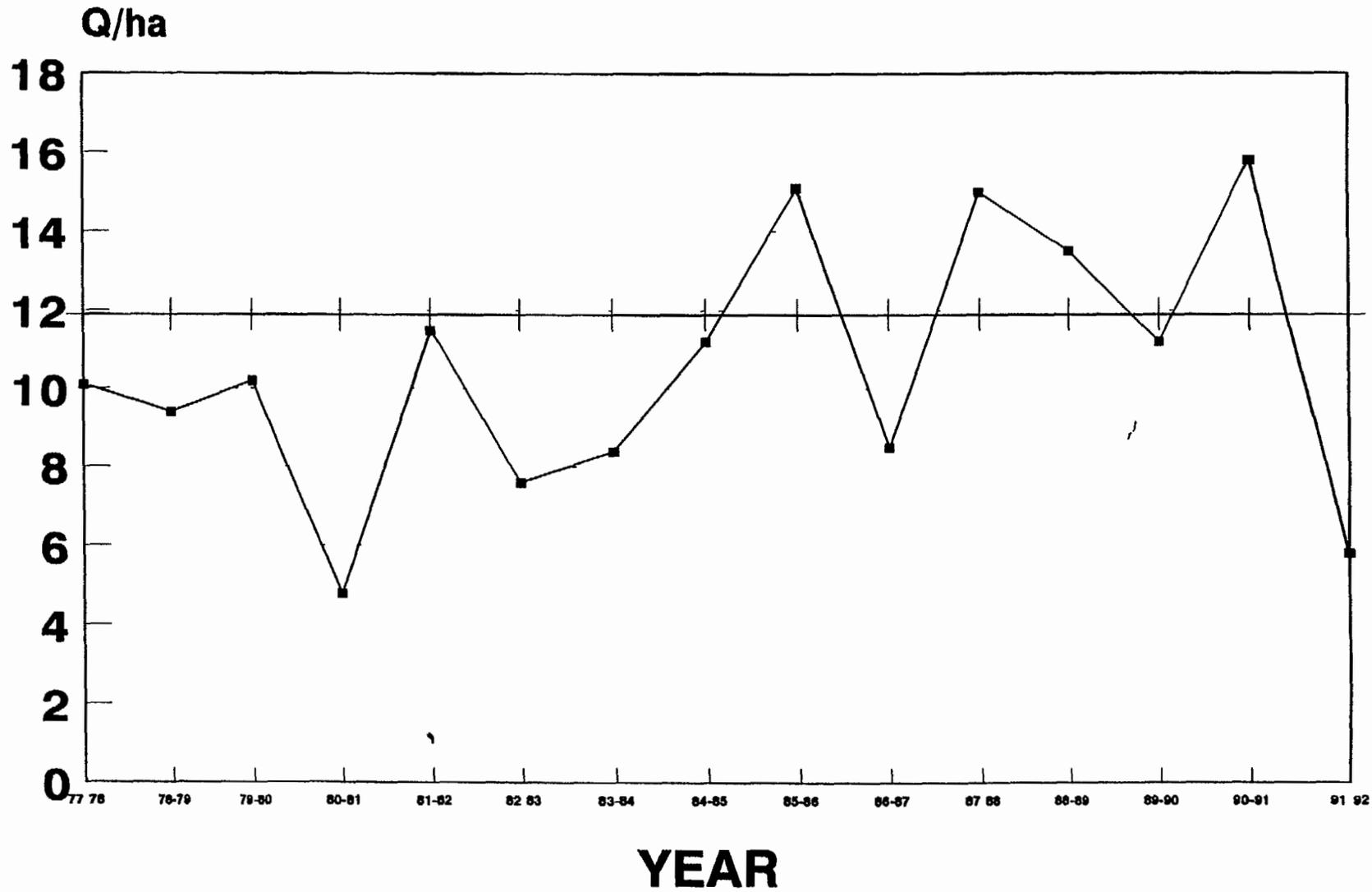


Note

13

Figure 2

CEREAL YIELDS IN MOROCCO



■ Yield + 81/82-90/91 mean

7/2



Figure 3

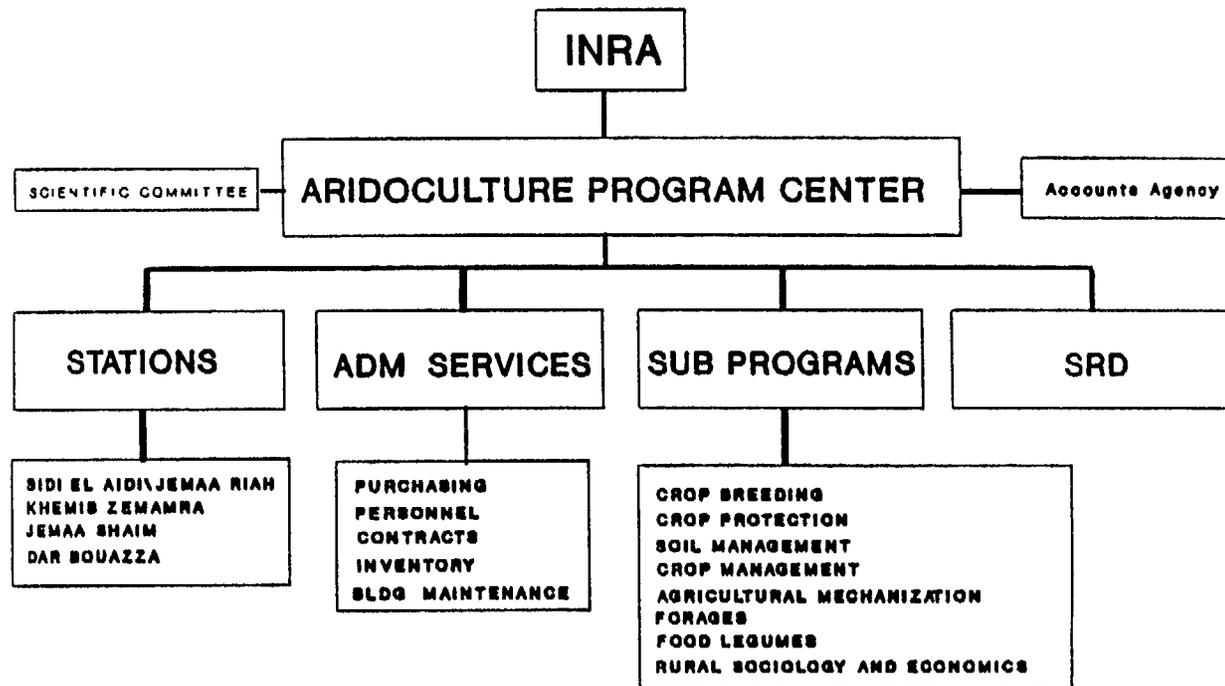
ORGANIZATION CHART OF INRA

15

Figure 4

ORGANIZATION CHART OF THE CRRA SETTAT

ARIDOCULTURE PROGRAM CENTER
ADMINISTRATIVE STRUCTURE



11

Figure 5

INRA SETTAT BUDGET

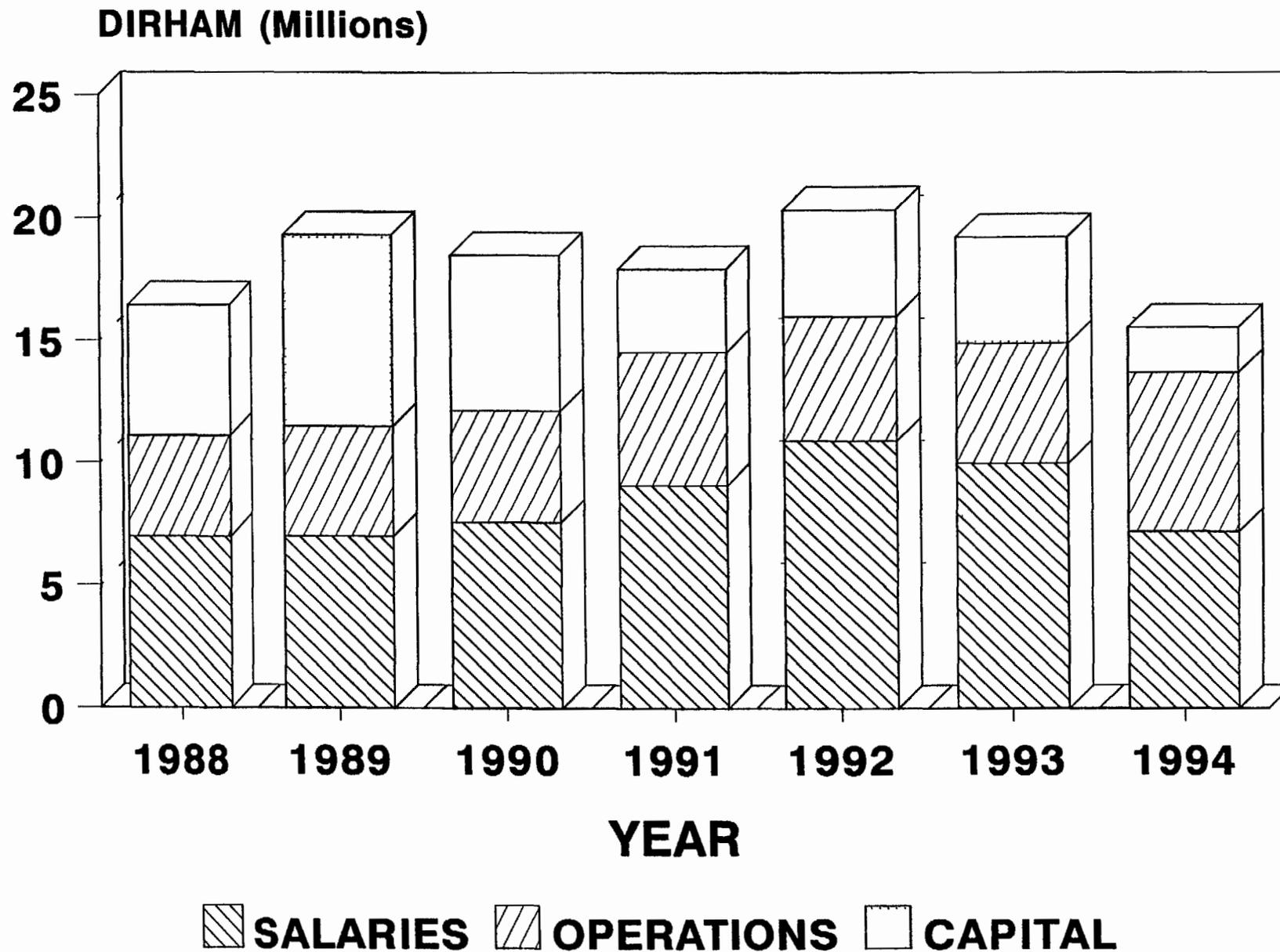
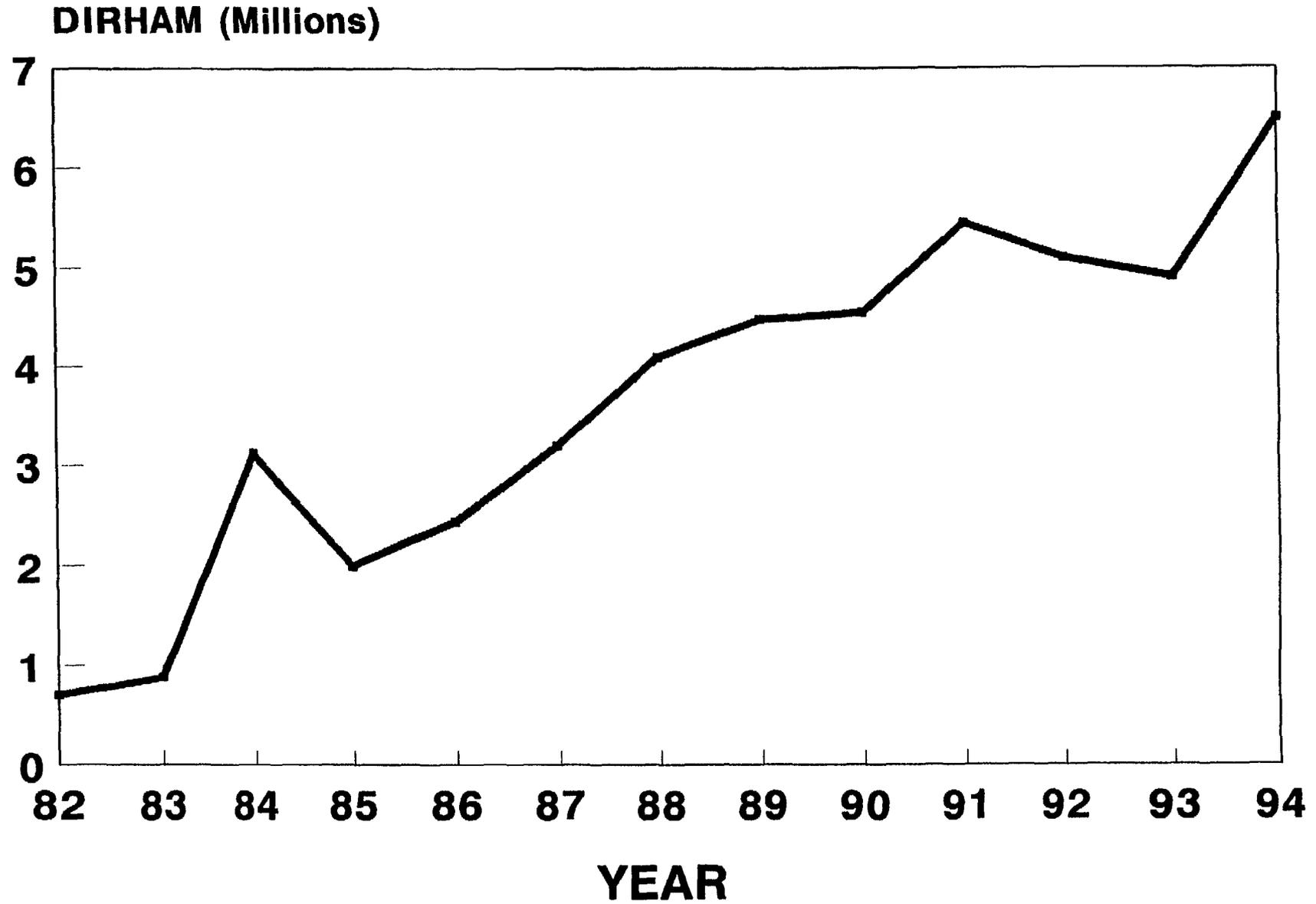


Figure 6

INRA SETTAT OPERATIONS BUDGET



18

Figure 7

INRA SETTAT CAPITAL INVESTMENT BUDGET

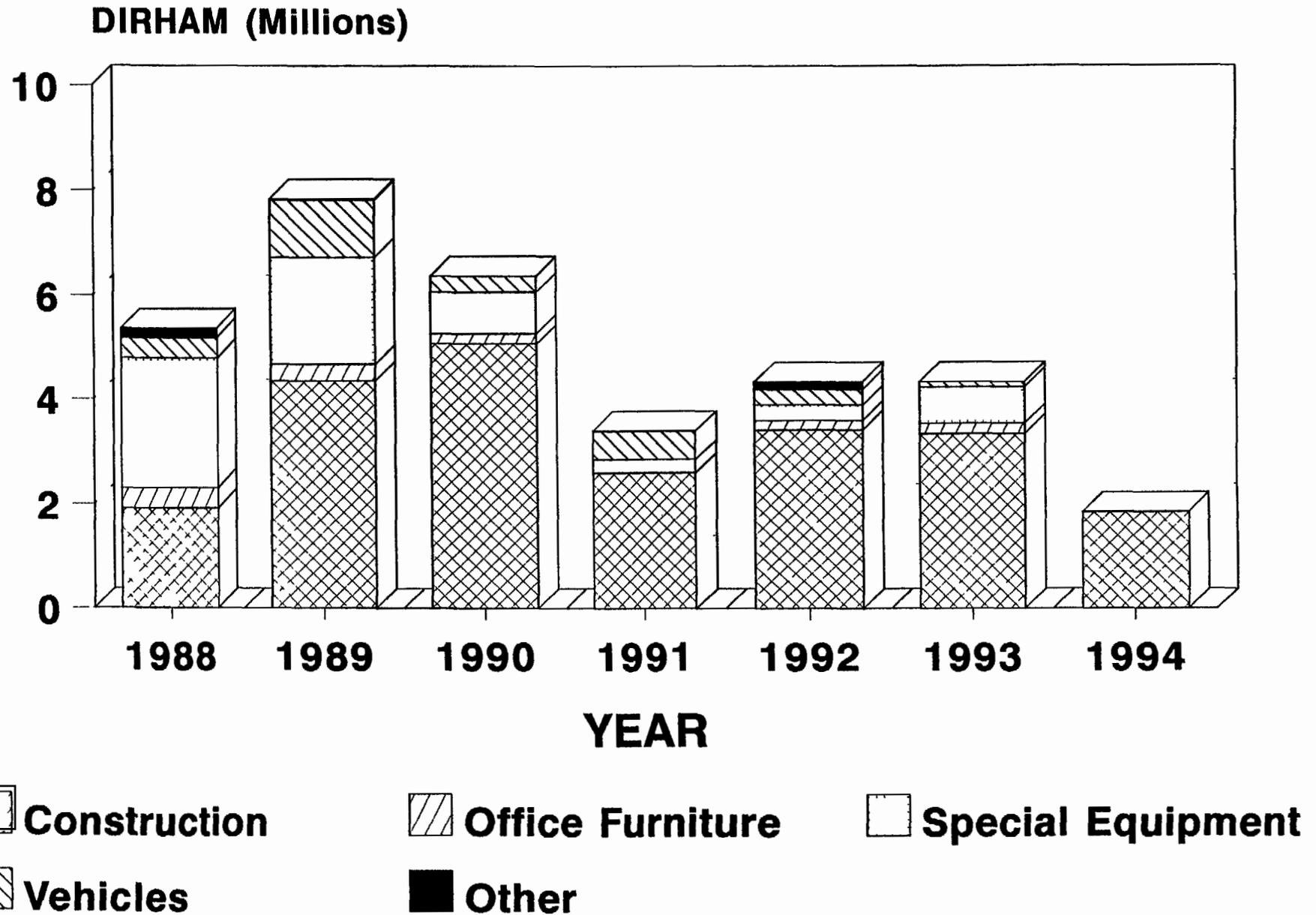
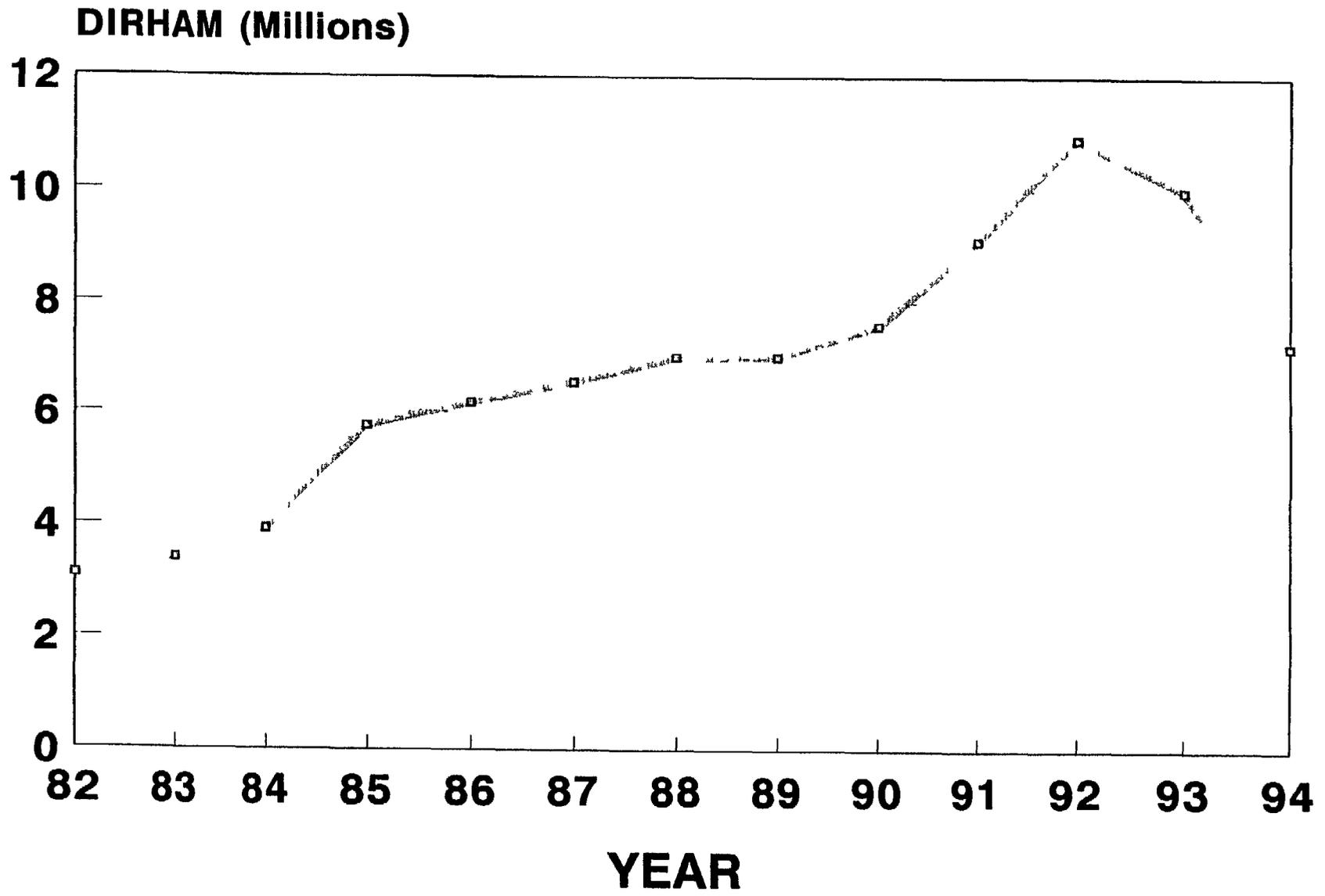


Figure 8

INRA SETTAT SALARIES



Paid by INRA Headquarters

17

Figure 9

FLOW CHART FOR RSA

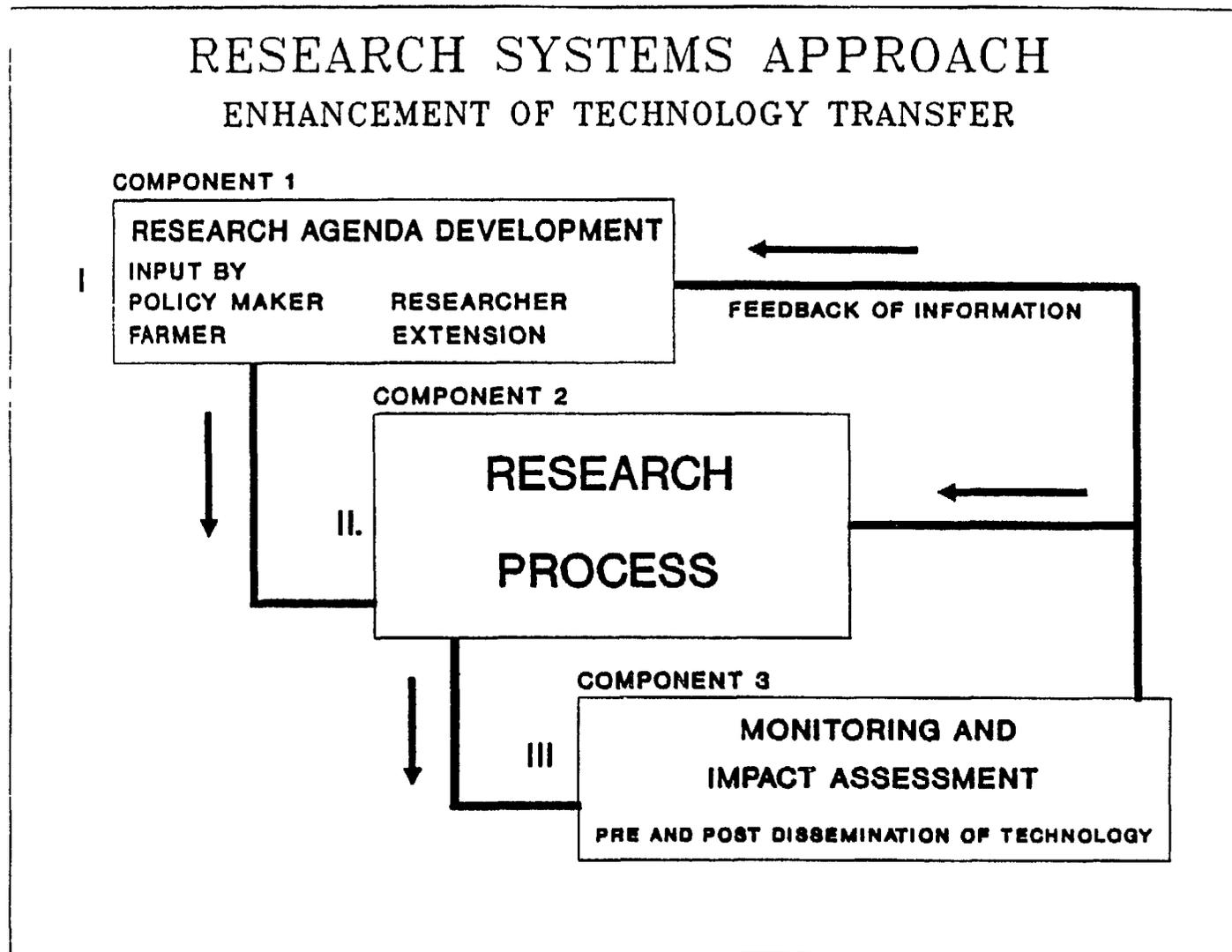
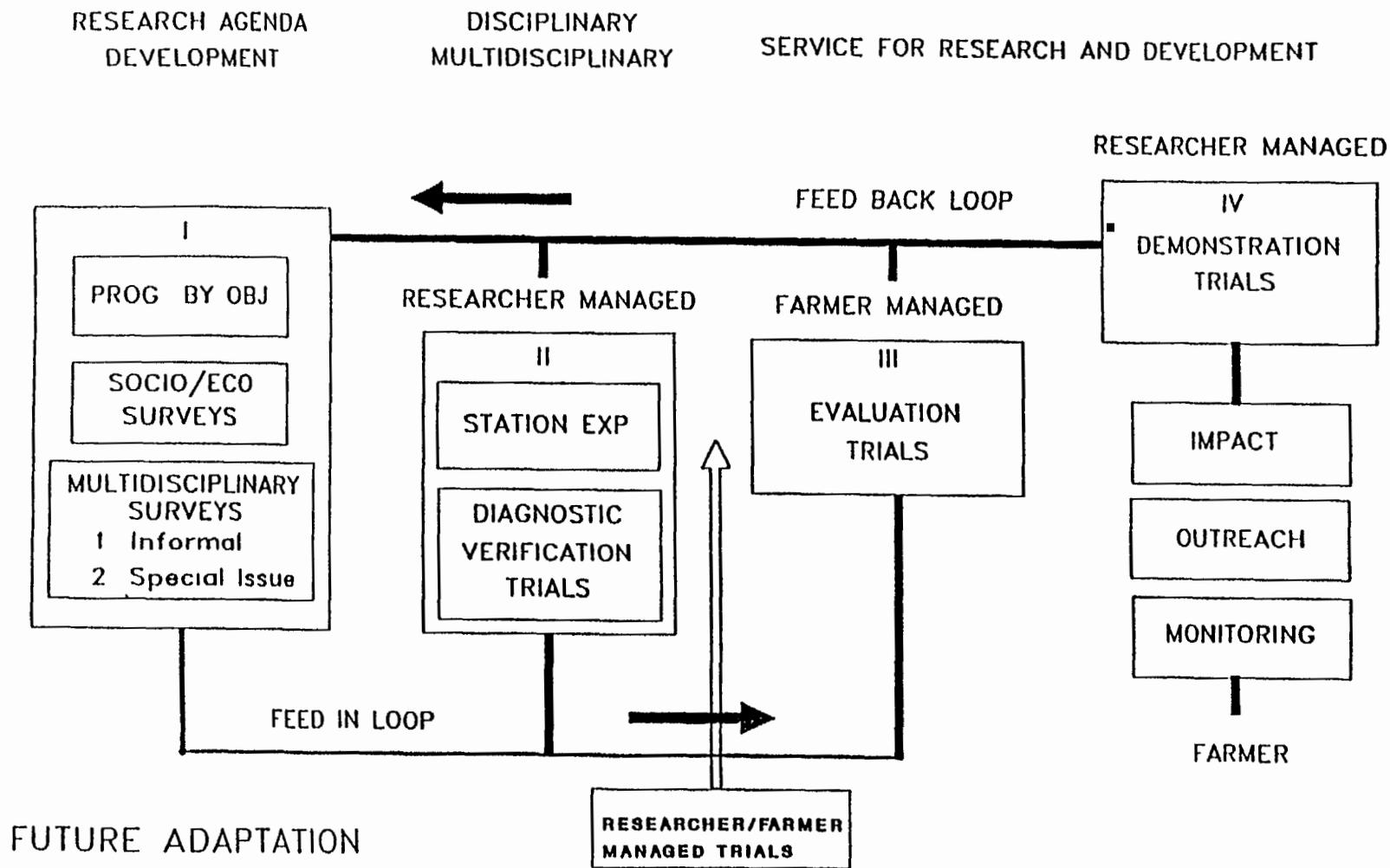


Figure 10 TECHNOLOGY DEVELOPMENT AND TRANSFER PROCESS



ANNEXES

ANNEX A
SCOPE OF WORK

ATTACHMENT 1

FINAL EVALUATION

MOROCCO DRYLAND AGRICULTURE APPLIED RESEARCH PROJECT (DAARP) (608-0136)

SCOPE OF WORK

I PURPOSE

The evaluation plan of the Dryland Agriculture Applied Research Project, as described in the Project Grant Agreement, amendment No 11 dated May 16, 1988, calls for two evaluations to be conducted in 1990 and 1994. These evaluations were designed to (1) assess progress made in both research produced and in the institutionalization of the research function, (2) assess progress made in initiating a technology transfer program at the Aridoculture Center, (3) measure progress made in institution building activities including staffing, facility construction, management, and budgeting, (4) measure the pace of the transition to Moroccan leadership at the Aridoculture Center, (5) measure the rate of technology adoption, and (6) make recommendations that would facilitate the successful completion of USAID assistance.

DAARP was the subject of a comprehensive mid-term evaluation in May 1986 (Winrock International, 1986), the recommendations of which were incorporated into the project redesign exercise in 1987 and 1988. The second mid-term evaluation, in June 1991, focused its attention primarily on the period since the last major amendment to the project in March 1988. Results were published as "Morocco Dryland Agriculture Applied Research Mid-term Evaluation, June 1991/CHEMONICS".

The present evaluation will focus on overall project impact on technology transfer and farmer productivity, examine the extent to which the Aridoculture Center at Settat Program has become a sustainable institution, derive lessons that can be useful to AID in the design of future research projects and, most importantly, make recommendations for future institutional linkages to enable the Settat Aridoculture Center (Officially called "Centre Regional de la Recherche Agronomique CRRA) to maintain and expand its research and outreach capabilities. This evaluation will also make recommendations for Government of Morocco actions in support of the Center's continued growth and development.

II PROJECT BACKGROUND

The DAAR Project is an institution-building operation to develop agricultural research and outreach capacities at the *Centre Regional de la Recherche Agronomique CRRA* of the *Institut National de la Recherche Agronomique (INRA)*.

It 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 twelve years. The Project has been implemented since its inception by the MidAmerica International Agricultural Consortium (MIAC).

A Project Goal and Purpose

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 Project Purpose is to establish a sustainable applied research capacity relevant to 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.

B Project Outputs

The seven major projected outputs from the project are

- 1) A functioning and sustainable Regional Research Center at Settat (CRRRA/Settat),
- 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 alternative technologies

The role of INRA, for this part, is to

- a) Mobilize well-trained personnel whose scientific and technical skills are relevant to national agricultural development needs of Morocco and who are actively contributing to such development,
- b) Produce scientific information and solve practical problems through research,

- c) Assist appropriate government and private agencies and institutions in disseminating such information,
- d) Involve itself in broad based agricultural development activities in Morocco, and
- e) Strengthen its linkages with research and extension organizations in the Moroccan public and private sectors and with US and other international agricultural research and agribusiness undertakings

C Background and History of Project

The DAARP was initially authorized in 1978 with an AID contribution of \$450,000. Under this initial authorization, AID and the GOM agreed to construct, staff and equip a regional dryland research institution at Settât. This Regional Center (CRRA/Settât) was to serve an area of ten provinces in Morocco: Safi, El Kelaa, Settât, Casablanca, El Jadida, Essaouira, Marrakech, Beni Mellal, Ben Slimane and Khouribga. The designated zone covered approximately 35,000 kilometers and had, at the start of the Project, an estimated population of 6,409,000 persons, representing about 27 percent of Morocco's total and 50 percent of its rural population. The region receives an average of 250-450 mm of rainfall per year and accounts for 36% of the total cropland planted in Morocco and about 34% of the country's cereal production.

At the time of initial project design, the goal of increasing basic food production in order to meet the needs of Morocco's fast-growing population and improve income of dryland farmers fit closely with USAID's strategy of increased food supply and associated cereals marketing reforms. To achieve this goal the project concentrated on establishing an applied agronomic, socio-economic and mechanization research program which would develop technologies for the region, and on training Moroccan staff to operate the program and transmit the technology to farmers.

The principal Moroccan agency charged with the implementation of the project is CRRA/Settât's parent institution, the *Institute National de la Recherche Agronomique* (INRA), a semi-autonomous agency of the Ministry of Agriculture and Agrarian Reform (MARA). INRA'S mandate is to conduct scientific, technical and economic research to develop and improve crop and livestock varieties, improved production practices and initiate appropriate mechanisms for transferring results to farmers. The technical assistance contractor, under a direct USAID contract, is the MidAmerica International Agricultural Consortium (MIAC), with the University of Nebraska at Lincoln as the lead institution.

The initial project provided \$4.5 million for financing three long-term resident scientific advisors, short term consultants, training, and equipment. However, the technical assistance contract was not signed until 1980, and effective project work did not really get underway until early 1982. Agronomic research activities were seriously affected by drought from 1982 to 1984, further setting back implementation.

The initial evaluation in 1983 recommended extension of the project and increased funding. As a result, the project was redesigned to extend it until 1988, funding was increased to 26.3 million dollars. The project was evaluated again in 1986 and 1991.

CRRA/Settat has served as the headquarters for the project, with laboratories, offices, stores and communications facilities. The actual field research has been largely undertaken at four substations located in the sea: Sidi El Aydi, Jemaa Riah, Khemis Zemamra and Jemaa Shaim. Major renovations under the project were undertaken at the Sidi El Aydi field research station. Limited renovation and equipment supply was also undertaken at the Jemaa Shaim field research station.

Between 1984 and 1992, there was a rapid evolution in project activities and accomplishments. Much of the construction at the Center headquarters and laboratories in Settat (none of which existed at the start of the project) was completed, a resident staff of American and Moroccan researchers was put in place (by 1984, the first Moroccan researchers had returned from their training in the United States), and progress was being made on identifying and extending improved technologies.

Over this period, fourteen laboratories were developed and equipped at the Aridoculture Center (including cereal breeding, weed science, entomology, food legumes, virology and mycology, plant pathology, forage agronomy, soil management, cereal agronomy/plant physiology and soil fertility), in addition to a computing facility for data analysis and word processing, and a Technical Reference Center (TRC) linked by telephone to an international data system. (As of July '93 the laboratories, micro-computer center and technical reference center (TRC) are eight to ninety percent complete.)

In addition to the three initial laboratory-office buildings, a soil and plant materials processing center, a headhouse for a greenhouse complex and an auditorium and training facility for the technology transfer program have been constructed. Other important facilities completed or near completion include an additional laboratory-office building, a scientific materials storage facility, a seedhouse, a machinery storage, and a vehicle repair shop. Construction of these facilities has been the responsibility of INRA. It is anticipated that all facilities construction will be completed by the end of 1993.

The March 9, 1988 PP supplement (based on the 1986 evaluation) extended the Project by six more years, until August 1994, and increased 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 DAAR Project by the Dirham equivalent of \$16,295,000 to bring its total LOP contribution to the equivalent of \$28,000,000. This 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 Center. The additional AID funding provided for additional long- and short-term technical assistance, additional long term (MS and PhD) and short term participants, and additional commodities.

The project had provided long-term and short-term U.S. advisors for assisting in the development of the institutional capability of the Center, and for advising Moroccan project participants undertaking their research in Morocco. The U.S. Technical assistance has also been responsible for commodity assistance, library and data processing needs. In the late eighties they were sixteen resident U.S. scientists and several short term consultants/Advisors visiting the project according to the needs. Gradually, the long term T.A. has been reduced, there will be no more than five resident U.S. scientists for the last year of the project.

The 1991 evaluation found that the project was successful in achieving the outputs expected, but was having difficulties in achieving its goal of increased agricultural production due to difficulties in achieving its goal of increased agricultural production due to difficulties in targeting and prioritising research, and deficiencies in technology transfer and management and administrative weaknesses. Since that time in the contractor (MIAC) has placed increasing emphasis on improving CRRA/Settat's capacity for planning and administering.

The project is now well on its way to achieving the major outputs related to creating and operating a dryland applied agricultural research program. One of the major direct results of the Project is that for the first time in Morocco, there is a major multidisciplinary research effort and physical facilities specifically targeted toward increasing agricultural production in the semi-arid zones of Morocco. CRRA/Settat is implementing six research sub-programs (cereal improvement, cereal production, forage improvement and production, food legume improvement and production, technology transfer, and sociology and agricultural economics) which are starting to produce useful results. Through the research sub-programs and the large support given to the training component of the project, linkages have been developed with U.S. institutions and Universities, a high level of understanding and interest in Morocco and in its development issues.

All major training activities are either completed or are well underway. The project has completed training of over 60 Moroccan scientists (MS and PhD level) in various research disciplines. The short-term training program for the CRRA staff has also been very active. The project also provided training in Morocco and at International Centers (e.g. ICARDA and CIMMYT).

In terms of related activities, since the late eighties the Center, with the support of the International Support for National Agricultural Research (ISNAR) has been utilizing the methodology called Planning by Objectives (PBO). This methodology, which attempts to orient organizational efforts to the achievement of clearly articulated goals, purposes and objectives, is proving useful in research programming and in prioritizing CRRA/Settat's research activities. Also, the World Bank is implementing a major national project designed to strengthen the Moroccan research and extension services. The DAAR project is complementary to this project, coordination has been acceptable. Finally, the project is financing a human resources study for all INRA staff which help relate staff resources to the overall system's present and future requirements.

CRRA/Settat is clearly one of the stronger agronomic research institutions dealing with dryland research of the African continent and, as such, constitutes a major resource for Francophone Africa. Further, the cereals genetic improvement and pest control measures identified under the Project have often been cited in support of the benefits to U.S. agriculture of international research-oriented projects of this nature.

Despite the progress, there are areas needing further improvement. Technology transfer, linkages, testing and release of technologies and information dissemination. For instance, the CRRA still lacks a sufficiently clear procedure for the testing and release of technologies. Generally there is no timetable for ongoing activities that indicates when it is anticipated that current work will result in the release of a usable technology. There is room for improvement in the

management of facilities and equipment, and in budgeting. A related issue is communication about project activities to the public. The Center has also been slow in creating a capacity for producing communications to farmers, the extension service and decision makers. Diffusion of information about ongoing activities is an important step in technology transfer.

Also, compared to the Settat Center (CRRA), the development and effective utilization of the field stations has been slower to develop, INRA is now in the process of assessing options for the optimal use of these facilities.

The institutional sustainability of the CRRA/Settat is progressing. The work focus under the Project continues to shift toward improving the Center's ability to plan, prioritize and target research, and to relate goals to budgets. The project had initiated an in-country training program in research design and planning, and is going forward with tests of alternative models for establishment of research priorities and for technology impact assessment. Within this context, the financial viability of the Center has been improved by the completion of arrangements for "off-budget" support, e.g. through the lease of INRA land to private firms and the licensing of INRA technologies.

CRRA/Settat is increasing its collaboration in programs of training and research with other Moroccan institutions such as the Agronomic and Veterinary Institute (IAV) Hassan II and the *Ecole Nationale d'Agriculture* (ENA) in Meknes. The most recent manifestation of this interest -- a move that USAID, in the interests of overall national research efficiency and effectiveness, has long encouraged -- has been the agreement between IAV and CRRA/Settat to collaborate on in-country research under two central AID projects: SANREM (Sustainable Agriculture and Natural Resource Management) and TSMM (Technologies for Soil Moisture Management), both of which will contribute to the formulation of a revised, more rational GOM strategy of addressing food security in a country characterized by periodic drought.

Linkages with International Research Centers are also being promoted, the most successful of which has been with ICARDA. Linkages have also been developed with national as well as International private groups, e.g. Bouchaib Seed Company (Moroccan) and Valmont Industries based in Nebraska. The linkage with private firms will permit the Center to develop a better technology transfer program and to use for revenue generation to the Center.

III STATEMENT OF WORK

A Specific objectives

- 1) Measure progress made toward the achievement of project outputs and purpose since the last evaluation,
- 2) Assess and document achievements and the impact of research and technology transfer carried out to date, including the rate of adoption of project-identified and recommended technologies among the target farmers and the impact of this technology dissemination,

- 3) Assess the long term sustainability and financial viability of the CRRA/Settat within the overall INRA context including overall funding requirements and resources (including extra-governmental), research programming and implementation, budgeting and financial management, human resource development, and facilities management,
- 4) Assess key lessons learned and recommendations, and
- 5) Formulate and prioritize recommendations to enhance the sustainability of the CRAA/Settat, including detailed assessment of post-project institutional linkage options

B Detailed discussion of objectives

■ Impact of CRRA/Settat programs on the Moroccan economy (objectives one and two)

Major social and economic transformations are now underway in Morocco, many of them stemming from the transition towards a more open, market-oriented economy. Dryland agriculture, while continuing to encompass the majority of the rural population, accounts for a declining percentage of agricultural GDP. Extensive dryland cropping and livestock raising is contributing to increased environmental degradation. Rural-urban migration, already an important trend, has been accentuated by the past two years of serious drought.

Do the research and the outreach programs of CRRA/Settat respond to these trends of the Moroccan economy? Are overall program goals clearly articulated and appropriate? To what extent are these programs fostering long-term sustainable development? What measures are necessary to make CRRA/Settat programs more relevant to Morocco's agricultural needs, considering social and economic along with the agronomic factors? Is the Center appropriately configured and oriented to meet these needs?

What are the key technological innovations introduced by the project? What has been their impact? What have been the problems inhibiting the identification and extension of improved technologies?

■ Sustainability (objective no 3)

Within the sustainability review, the team need to consider such questions as the following

Agenda Development. Does the Center have the capacity to define a well targeted research agenda this is economically justified, based on a defined clientele, responsive to clients needs and has well defined resource and temporal parameters?

Technology Transfer: Does the CRRA/Settat have a clearly defined and effective strategy for transferring research results to users

Promotion Are CRRA/Settat and INRA in general doing an adequate job of promotion and public relations, both in the interests of increasing political support and more effective technology transfer? What are means by which INRA and CRRA/Settat may be better able to present to clients (both general and specific) what are doing and why?

Personnel Since a uniform personnel code applies for all of INRA, this issue needs to be looked at in the overall INRA context Are salaries and benefits sufficient to retain the current number and level of the researchers? What measures are being taken to ensure the ongoing intake and training of new researchers? Are adequate research funds available? Are researchers given sufficient authority over their budgets? Support personnel? Is there an appropriate mix of research versus administrative responsibility and authority?

Administration A research program of some size and complexity is underway at CRRA/Settat, adequate coordination of actions requires management systems that are responsive and flexible to extract the maximum possible efficiency from resources used to produce the final products --a sustainable research and outreach system in Agriculture and technical information Are the management arrangements in place to support the proper functioning of the system following termination of the USAID-funded Project? Does the present CRRA/Settat management system respond to this need, and if not, how it can be improved?

Adequacy of Center-wide Support Services According to the June 1991 evaluation, the GOM is underfunding CRRA/Settat operations and research, and with the termination of USAID support there will be a large recurrent cost gap that will have to be filled Will CRRA/Settat be able to maintain its research and development activities in the absence of outsider-donor financing? What is an appropriate level of funding for CRRA/Settat over the coming years consistent with its mandate? How are CRRA/Settat and INRA progressing in developing financial mobilization strategies for research and development activities?

The evaluation team should examine recurrent costs, the outlook for GOM budget contributions, the possibilities for obtaining research grants and contracts and other funding options, and recommend strategies for generating additional revenues and/or reducing costs, either through reducing programs or facilities, if sufficient revenues are not forthcoming, including the possible consolidation of sub-stations

■ Lessons Learned (objective no 4)

Per standard AID evaluation procedures, the team will identify "lessons learned" that may be applicable to other, similar undertakings, or that would otherwise serve to advance the state of knowledge regarding institutional development of agricultural research institutions These, however, should be limited to the most important items, with obvious broader applicability

■ Linkages (objective no 5)

INRA is the centerpiece of a national system of agricultural research, and extension, with primary responsibility for producing research results for extension to farmers. However, coordination is required on several fronts to maximize the use of scarce resources. What can and should be done to coordinate INRA research efforts with IAV and ENA/Meknes and other research efforts? The evaluation team should look at linkages to other Moroccan institutions, with particular attention paid to the setting of national agricultural research priorities and the relative division of research program emphasis and responsibilities.

Agriculture development/extension The evaluation team should assess the effectiveness of the stated INRA mandate in extension, and linkages between INRA, Agricultural Extension Division (DVARA) of MARA, ENA private sector agro-Industries, and the Moroccan agricultural community. The team should make recommendations for strengthening the role of INRA in supporting extension activities where appropriate.

The team should look at the potential for increased linkages with the Moroccan private sector, including contract research. Would this unduly divert INRA from its primary purpose (however defined)? To what degree can INRA strengthen its ties (partnerships) with appropriate U S institutions?

The team should also assess the "marketing approach" of INRA, expand its network of productive contacts, both in and outside Morocco, through more aggressive publicizing of its services and accomplishments and its potential value to potential constituencies and clients.

After many years of collaboration, productive, positive relationships have been developed with numerous U S and international institutions. How can and should these be best maintained, while making certain that these linkages serve to advance INRA and CRRA/Settat's program mandate and goals?

USAID/Morocco has the authority to extend the PACD for approximately three years. Is a PACD extension warranted? If so, what should be the specific objectives and conditions for such an extension?

IV COMPOSITION OF EVALUATION TEAM

The team will consist of four individuals three of whom will be provided through a private contractor under a IQC work order. The fourth will be a career AID agricultural development officer.

The Team Leader should be an experienced agricultural research manager, with past operational responsibility for research programming, budgeting, human resources and physical plant management, and with overseas (developing world) experience. S/he will have overall

responsibility for directing the evaluation effort and preparing and editing the final report, and will have particular responsibilities in the areas of CRRA/Settat management and operations, and institutional sustainability (including recurrent cost financing)

A second individual should be prepared to address public-private agricultural research issues and relations i.e., what are appropriate roles for each, how can the two exist in symbiosis, providing mutual support and benefits. This individual would ideally have a combination of research and private sector (agricultural chemicals, seed industry, machinery) experience. Overseas experience is essential.

A third team member will be an expert on institutional linkages, both U.S. and international, with a background in agriculture, social sciences or communications and experience in international institutional development. This individual should be thoroughly familiar with U.S. land grant universities and the potential for collaborative relations between them and developing country institutions like INRA, along with alternative financing and implementation mechanisms.

The fourth individual, trained in agronomy or extension agronomy and with overseas agricultural research and extension experience, will focus especially on the conduct and impact of the research and technology transfer elements of the Project (objective no. 2). This individual will be provided directly by AID, but working under the overall direction of the Team Leader.

FSI 3/3 level French is desirable for the entire team, and required for the Team Leader and public/private sector relations expert.

V METHODS AND PROCEDURES

The evaluation team should plan a 2-3 day pre-departure meeting in Washington D.C. to review the SOW and other relevant documents, allocate work assignments, formulate a detailed implementation plan, and meet with key AID (R&D/Agriculture, University Center, CDIE) and World Bank agricultural personnel regarding past experience with similar projects, and national and world-wide agricultural research trends and activities and associated "institutional linkage" options. One or more of the team members should then plan to spend 2-3 days in Lincoln, Nebraska, reviewing project documents and activities with MIAC personnel. In addition, one team member should plan to spend a day en route to Morocco at ISNAR, in the Netherlands, to review the "Planning by Objectives" work undertaken between INRA and ISNAR.

The entire evaluation team should plan on spending at least three full weeks in-country. Depending on implementation and review scheduling, the team leader (at minimum) should plan on spending up to an additional week in-country to ensure that reactions to the draft report are received from all key parties.

The evaluation methodology will consist largely of reviews of project and other relevant documents (contractor work plans and reports, research and survey results, past evaluations), and interviews with key INRA and MIAC administrators and researchers, USAID staff, selected participants, and representatives from the Moroccan agriculture private sector. The Team will

also want to obtain input from the administration and faculty of the IAV Hassan II Agro-Veterinary Institute, the ENA/Mekness, and *Enseignement Agricole* and other Ministry of Agriculture personnel. Information obtained then will be reviewed in the light of evaluation objectives.

The team will have a three briefing sessions: one on arrival in country, a second approximately midway through the evaluation, and the third prior to departure. At the first briefing, the team will review the scope of work with USAID, INRA and MIAC staff, and present its plan for collecting the information to answer the questions and the criteria to be used to measure progress. At the second briefing, the team will discuss preliminary findings and obtain feedback from USAID, INRA and MIAC staff. The draft report should be ready by the end of the third week for review the following week.

USAID, INRA, and the MIAC team will provide written comments to the evaluation team regarding the draft report, the second draft will be submitted to USAID/Morocco within the two weeks of the receipt of these comments. The final report, in English and French (thirty copies of each), will be due within one month of the receipt of comments on the second draft.

A "collaborative" evaluation effort is envisaged, with the maximum possible participation of key individuals from INRA, USAID and MIAC. The USAID/Morocco Project Officer will work closely with the team, with assistance as necessary from the Mission Evaluation Officer. All arrangements for hotels, travel in country and other needs of the team (e.g. secretarial) will be the responsibility of the contractor and will be provided for under the contract.

VI REPORTING REQUIREMENTS AND TIMING

A draft report discussing the findings and recommendations of the evaluation will be prepared in English and distributed for review by INRA and USAID by the end of the third week in country. The final report will be in accordance with the reporting requirements contained in AID's Asia Near East Bureau Procedural Guidelines for Evaluations. A copy of the reporting requirements will be supplied to the evaluating of all issues cited in Section III above, and make recommendations when appropriate.

As noted above, the final report will be due within one month of the receipt of comments on the second draft. The contractor will be responsible for preparing the final report in French and English, thirty copies of each will be required.

ANNEX B
EVALUATION TEAM ITINERARY

EVALUATION TEAM ITINERARY

- | | | |
|------------------------|---|---|
| November 21, 1993 | - | Evaluation team arrives in Washington, D C |
| November 22, 1993 | - | Organizational Meeting of evaluation team |
| | - | Initial briefing at USAID/Africa and Near East Bureau and discussions with R Stryker, former DAARP Project Officer |
| November 23, 1993 | - | Evening Nelson travels to Lincoln, Nebraska |
| | - | Nelson Discussions with MIAC and University of Nebraska officials |
| | - | Rest of evaluation team Discussions in Office of Agriculture, USAID and World Bank |
| November 24, 1993 | - | Nelson Discussions with MIAC and University of Nebraska officials and meeting with Moroccan students |
| | - | Rest of evaluation team Discussion at University Center, USAID/BIFADEC, and Office of Agriculture, USAID |
| | - | Evening Nickel travels to the Hague, Netherlands and rest of team return to their homes |
| November 25 & 26, 1993 | - | Nickel Discussions at ISNAR |
| November 27, 1993 | - | Nickel arrives in Rabat |
| November 28, 1993 | - | Rest of evaluation team arrives in Rabat |
| November 29, 1993 | - | Discussions at Directorate of Research, Training and Development, MAMVA, INRA Headquarters, and USAID/Rabat |
| November 30, 1993 | - | Evaluation team travels to Settat |
| | - | Briefing session at meeting with entire professional staff of the CRRA Settat and discussions with INRA and MIAC officials |
| December 1, 1993 | - | Individual evaluation team members meet with coordinators and staff of sub-programs |
| December 2, 1993 | - | Organizational meeting with INRA and MIAC management to agree on schedule for remainder of visit |
| | - | Discussions with members of Scientific Committee of CRRA Settat |
| | - | Visit to CRRA Settat experiment stations at Sidi El Aidi and Jemaa Riah, and to DPA and CT near Settat, including discussions with client farmers |
| December 3, 1993 | - | Hurdus and Walls discussions with private sector companies in Casablanca |
| | - | Nelson and Nickel discussions with researchers and management at CRRA Settat |
| December 4, 1993 | - | Evaluation team visits Khemis Zehamra and Dar Bouazza experiment stations and travels to Marrakech |

- December 6, 1993 - Evaluation team travels to Safi and has discussions with Director and staff of Safi DPA, then travels to Rabat
- December 7, 1993 - Evaluation team presents initial report of findings at meeting of USAID/Rabat staff
 - Walls discussions with officials of SONACOS, Rabat
 - Rest of Evaluation team Discussions with M Hanafi on history of DAARP and schedule for remainder of mission
- December 8, 1993 - Evaluation team meets with officials of DPV, MAMVA
 - Evaluation team presents initial findings to officials of INRA
- December 9, 1993 - Visit to IAV and discussions with IAV officials
 - Luncheon meeting with University of Arkansas Human Resources Study team
 - Discussions with Houcine Faraj, former Director General of INRA
- December 10, 1993 - Meeting at USAID to discuss outline of Evaluation Report
 - Hurdus, Nelson and Walls travel to Meknes
 - Nickel writing of draft report
- December 11, 1993 - Hurdus, Nelson and Walls visit ENA, Meknes, and INRA
 - CRRA, Meknes
 - Nickel writing of draft report
- December 12, 1993 - Hurdus, Nelson and Walls travel to Rabat
 - Hurdus and Nickel stay in Rabat while Nelson and Walls travel to Settat
- December 13, 1993 - Hurdus and Nickel work on draft report and meet with USAID officials
 - Nelson and Walls follow-up discussions with CRRA Settat staff and writing draft report
- December 14, 1993 - Hurdus and Nickel, together with INRA and USAID officials, meet with Minister of MAMVA
 - Hurdus and Nickel travel to Settat
 - Nelson and Walls follow-up discussions with CRRA Settat staff and writing draft report
- December 15, 1993 - Evaluation team hold follow-up discussions with CRRA Settat staff and works on draft report
- December 16, 1993 - Evaluation team works on draft report
 - Hurdus and Nickel, together with M Mourid meet with Hassan Ouchen, Governor of Settat Province
 - Meeting of evaluation team with professional staff of CRRA to brief them on evaluation findings, then travels to Rabat
 - Evaluation team holds evening meeting to discuss report then completes writing of first draft

- December 17, 1993 - Evaluation team meets with USAID staff to present draft evaluation report
- Evaluation team meets with INRA officials to present draft report
- Hurdus, Nelson and Walls depart Rabat for U S
- December 18 & 19, 1993 - Nickel work on evaluation report
- December 20, 1993 - Nickel discussions with USAID officials
- Nickel and C Uphaus discussions with M Terrab at Royal Cabinet
- December 21, 1993 - Nickel meeting with T Gillard-Byers to discuss CRRA Settat and MIAC comments on draft evaluation report
- Nickel meeting with C Uphaus to discuss USAID comments on draft evaluation report
- December 22, 1993 - Nickel departs Rabat for U S

ANNEX C
LIST OF PERSONS CONTACTED

LIST OF PERSONS CONTACTED

Ministry of Agriculture and Agricultural Development (MAMVA)

Meziane, Abdelaziz	Minister
Firdawcy, Larbi	Director, Research, Training and Development
Abou Ayoub, Ahmed	Chief, Training and Research Division
Laazzoui, Mohamed	Chief, Research Coordination and Orientation Division
Guedira, Abdellatif	Director, Department of Crop Production (DPV)
Belhadfa, Hassan	Chief, Department of Crop Production, Cereals Forages (DPV)
Faraj, Houcine	Advisor to the Minister (former Director General of INRA)

Ministry of Finance

Bara, Said	Chief, Monitoring and Evaluation Division
Sefiani, Mohamed	Financial Controller for INRA
Lamzouak Thami	Accounting Agent, INRA

INRA National Headquarters

Arifi, Abdelaziz	Director General
Kamal, Mohamed	Secretary General
Khettouch, Moha	Inspector General
Benjamaa, Abdelkrim	Inspector General
Mouatadi, Sidi Mohamed	Director, Planning Department
Chahbar, Abdelhak	Director, Plant Improvement Department
Ambri, Abdelilah	Director, Food Technology Department
Kohen, Mohamed	Director, Information and Biometrics Department
El Houssni, Abdellah	Director, Animal Production Department
Rahim, M'barek	Chief, Regional Centers Division
El Idrissi Amari M A	Chief, Information and Training Division
Kassi, Ali	Chief, Programming Division
Zouttane, El Madani	Chief, Administrative Affairs Division
Sebbata, Otman	Information and Training Division

INRA CRRA Settlat and Associated Experiment Stations

El Mourid, Mohamed	Head of Center
El Bouhssini, Mohamed	Scientific Coordinator
Sefrioui Abdelilah	Head, SRD
Moussaoui, Mohamed	Head, Socio-Economics Department

Nasserallah, Nasserelhaq	Coordinator, Cereal Breeding Sub Program
Ouabbou, Hassan	Coordinator, Crop Management Sub Program
Chriyaa, Abdelwahed	Coordinator, Forages Sub Program
Meskine, Mohamed	Coordinator, Food Legume Sub Program
Lhaloui, Saadia	Coordinator, Crop Protection Sub Program
El Gharous, Mohamed	Coordinator, Soil Management Sub Program
Laamar, Abdelali	Coordinator, Socio economic Sub Program
Chaoui Mohamed	Coordinator, Agric Mechan Sub Program
Amri, Ahmed	Barley Breeding
Bendaoud, Hassan	SRD
Bendaoud, Mohamed	Socio-Economics
Boughlala, Mohamed	Agricultural Economics
El Mzouri, El Houssaine	Forages
Mazhar, Mohamed	Forages
Mergoum, Mohamed	Bread Wheat and Triticale Breeding
Herzenni, Ahmed	Sociology
Nassif, Fatima	Sociology
Farih, Ali	Plant Pathology
Toufiq, El Mostapha	Plant Pathology

INRA CRRA Settlat and Associated Experiment Stations

Hassani, Abdelmajid	Chief, Sidi El Aidi Station
Chouei, Mohamed	Chief, Jemaa Shaim Station
Mouktafi, Reddad	Chief, Khemis Zehamra Station
Babari, Bouchaib	Chief, Dar Bouazza Station

INRA CRRA Meknes

Abdourabih, Mohamed	Head, CRRA, Meknes
Jibene, Mohamed	Coordinator, Favorable Rainfed Lands Program
El Asri, Mohamed	Coordinator, Annual Oilseeds Program
Elfatima,	Coordinator, Food Legumes Program
El Edrissi,	Head, SRD
Mekni, Mohamed	ICARDA Barley Breeder, on assignment to Morocco

INRA Research Scientists in Participant Training

Five Students studying at University of Nebraska, Two studying at Iowa State University, and two studying at Kansas State University

Hurdus, Alan	Acting Director, Office of Agriculture, Global Programs Bureau
Bonner, Jim	Manager of SANREM CRSP, Office of Agriculture, Global Programs Bureau
Sloger, Charles	Manager of Soil Management CRSP, office of Agriculture, Global Programs Bureau,
Oweis, Jiryis	University Center (BIFADEC)
Johnson, Fred	University Center (BIFADEC)

USAID/Rabat

Dagata, V Martin	Director
Hradsky, Jim	Deputy Director
Uphaus, Charles	Chief, Agriculture and Natural Resources
Schamper, John	Deputy Chief, Agriculture and Natural Resources
Hanafi, M'hamed	Ag/Advisor/DAARP Project Officer
Mullenax, John	ADO (former DAARP Project Officer)
Scott, Frederic	Project Officer, Evaluation Office
Amundson, Ellsworth	Program Officer
Riley, William	Deputy Program Officer
Reynolds, Mary	Regional Contracting Officer
Allen, Jeffrey	ADO, Morocco Agribusiness Project Officer

The World Bank/Washington

Cole, John	Agriculture Operations Division, Europe, Middle East and North Africa Regional Office
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International Service for National Agricultural Research (ISNAR)

Perrault, Paul	Acting Director General
Goldsworthy, P	Senior Officer, Research Program Design and Management
Hoste, Christian	Regional Coordinator (A2) Collaborative Services
Kramer, Charles	Senior Officer, Management of Organization and Resources

Private Sector and Parastatal Agribusiness Contacts

Agribusiness Marketing Investment Project, Casablanca

Humpal, Donald	Chief of Party
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COMICOM (Compagnie Marocaine Industrielle et Commerciale), Casablanca (Private Farm Machinery Company)

El Amrani, Hassan	Chief of Agricultural Service Department
Elfatima, A	Director of Marketing

Ets Benchaïb Marosem, Casablanca (Private Seed Company)

Lancen, Abdane	Technical Director
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Pioneer Maghreb, S A , Casablanca (Private Seed Company)

Wenholz, Mark	General Manager
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SONACOS (Societe Nationale de Commercialisation de Semences), Rabat (Parastatal Seed Company)

Mekhtar, Bouanani	Director General
Sabik, Mohammed	Head of the Technical Department

Provincial Agricultural Directorates (DPA)

Sounni El Abed, A	Director, DPA, Settat
Benhiba, Mohamed	Director, DPA, Safi
Dakir, Mohamed	Chief of Agricultural Development, DPA, Safi
Abdelmalki, Mohamed	C T Ouled Said, Settat
Rabhi, J	C T Ouled Said, Settat

Others

Terrab, Mostafa

"Charge de Mission", Royal Cabinet, Royal Palace,
Rabat

Ouchen, Hassan
Serafini, Phillip

Governor of Settat Province
University of Arkansas/INRA Human Resources
Development Project

Danforth, Dona

University of Arkansas/INRA Human Resources
Development Project

ANNEX D
DOCUMENTS CONSULTED

DOCUMENTS CONSULTED

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ANNEX E

DISCUSSION OF THE USAID/INRA AGREED UPON
1991 PROJECT EVALUATION SUMMARY POINTS

DRYLAND APPLIED AGRICULTURAL RESEARCH PROJECT

(PROJET ADRIDOCULTURE)
USAID PROJECT No 608-0136

DISCUSSION OF THE USAID/INRA AGREED UPON
1991 PROJECT EVALUATION SUMMARY POINTS

BY,

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NOVEMBER, 1993

INTRODUCTION

When the Dryland Applied Agricultural Research Project (DAAR) began there was no INRA administrative capacity present in Settat, Morocco. There were no offices, INRA researchers, accounts agency, scientific committee, Service for Research and Development, administrative services of any type, Sub Programs nor a technology transfer capacity. In addition, there was little information available on which to develop agricultural research activities for the Abda, Doukkala and Chaouia dryland regions. During the short period of 12 years, there has been a transformation. With this transformation have come different demands from policy makers and different needs from scientists within the context of an evolving form of agriculture in the dryland area.

As a result of this transformation there has been adjustment in the ways which MIAC and INRA have been able to best facilitate the continued development of the Center toward a goal of sustainability. Since the 1991 evaluation, MIAC and INRA have worked toward this goal with renewed vigor.

Entering into the second phase (post project phase) the focus of activities must continue to emphasize increased efficiency in management and research, completion of long-term training, emphasis of short term, in-country training, toward specific Center needs which have yet to be realized, the culmination of construction and development of methods for procuring parts and equipment while ensuring high quality maintenance programs for expendable and many non-expendable goods.

Action in these areas will promote MIAC's and INRA's capability to meet and surpass the DAAR Project's goal and purpose.

Project Goal and Purpose

Goal **"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 size land holdings "**

Purpose **"establish a sustainable applied research capacity relevant to the dryland farming systems and natural resource constraints of the 250-450 mm rainfall region of southern Morocco and capable of providing technologies to improve farmer productivity "**

The Project goal and purpose are realized through the utilization of Project's resources to generate Project's outputs in the form of technologies and information for use by farmers producers, researchers and policy makers.

A successful Center is in place and operating now. By the end of the DAAR Project certain functions must be operable to ensure a sustainable Center. The Aridoculture Center must have the following:

- **An management and research base supported by the *Institute National de la Recherche Agronomique* and the Ministries of Agriculture and Finance**
- **A capability and process in place to develop and disseminate technologies.**
- **The capacity to measure intermediate and long term impacts of its technology development activities**

These functions must be complimented by the Center's ability to generate resources which will then be utilized through an efficient resource allocation process. This requires an effective resource management capability.

Given these challenges, it is useful to describe the Center as it is today and will be at PACD. How has and how will the *Centre Regional de la Recherche Agronomique de la Chaouia Abda et Doukkala* (CRRA at Settata, also referred to as the Aridoculture Center) move forward to address developmental issues which are still outstanding as it moves into the second phase? To accomplish this task it is necessary to review actions on behalf of the CRRA at Settata and MIAC during the period 1992 forward.

FISCAL YEAR 1992

The MIAC/INRA Integrated Plan of Work for Fiscal Year 1992 moved the DAAR Project into a consolidation phase. Having established a fully functioning applied agricultural research center, INRA and MIAC began to emphasize actions which would promote a sustainable institution.

This emphasis resulted in developing Project capabilities beyond focal points provided in the USAID Project Evaluation Summary of 1991. This was accomplished during the period 1991-1993 through addressing evaluation summary points within the context of the "Research System Approach" (RSA) which is described in Figure 1. The research system approach provided a framework for MIAC's and INRA's agricultural research strategy.

The RSA charted a course for the Life of Project which strengthened the development of:

- **The institutional base which had been established at the Aridoculture Center.**
- **The capability and processes necessary to develop and disseminate technologies generated by the Aridoculture Center**
- **The capacity to measure potential and/or actual impacts of technology development activities by the Aridoculture Center's scientists**

Addressing these broad issues was accomplished through dissecting the RSA. This allowed the RSA to be viewed as manageable elements which could be addressed sequentially but still be integrated into the complete system as particular objectives were met.

The "Research Systems Approach" is comprised of three components

- **The "Research Agenda Development" component**
- **The "Research Process" component**
- **The "Monitoring and Impact Assessment" component**

Within each of these components, action was taken to ensure the proper conceptualization, development and dissemination of technologies.

Figure 1 illustrates the process which has been introduced to support the efforts of Aridoculture Center scientists and promotes a fully functional National Agricultural Research Service. Research Agenda Development (I), Research Process (II) and Monitoring and Impact Assessment (III) of technologies designed, developed and/or disseminated by the Aridoculture Program Center are discrete parts of the RSA. They are complimentary and (see figure 1) not substitutes. Without one component, other components will be less efficient in the delivery of appropriate technologies to our clientele.

Specific actions for advancement of each of these components were identified. As actions were taken to introduce improvements in these components, methods for defining research priorities became more evident. This, by default, supported and complimented INRA's Programming by Objective activities. Several of these activities are listed below.

Research agenda development activities included

- **Sub Program Leaders' management training.**
- **Technology design and evaluation techniques which incorporated farmers' perspective**

The research process was strengthened through the

- **Utilization of socioeconomic baseline data information for feedback into research agenda development**
- **Incorporation of management training and agenda development techniques into the Spring Planning Conference agenda and subsequently, into the Plans of Work.**

Monitoring and impact activities have included

- **Development of methodologies for monitoring the flow of agricultural technologies from the Aridoculture Center to farmers**

- **Development of methodologies for the socioeconomic assessment of technology generated impact**

Administrative activities have focused on

- **Development of procedures for center acquisition, management and maintenance of capital resources**
- **Development of a plan for station management.**
- **Implementing plans for the generation of revenue by the Aridoculture Center**

These actions fed into and supported the research process component. The research process continued to be strengthened through the development of cohesive, interdisciplinary research projects, consultancies by specialists, additional short term and long-term training

To understand the issues in the context of the expected Project Activity Completion Date (PACD) status of the Aridoculture Center it is necessary to have a basic understanding of the administrative structure which exists today at the Aridoculture Center. The administrative structure provides the mechanism for implementing activities which have responded to Project Evaluation Summary points and will respond to future challenges faced by Aridoculture Center scientists

Figure 2 presents a brief description of the administrative structure in existence at the Aridoculture Program Center today

INRA and MIAC have actively utilized the Center's administration to support activities which address project evaluation summary points. Furthermore, activities have been supported which go beyond the PES points to ensure the sustainability of the Center. Some of these activities are listed below

PROJECT EVALUATION SUMMARY

Tables 1, 2 and 3 presents specific activities which address issues discussed in the USAID Project Evaluation Summary document or were deemed important for the Center by MIAC and INRA. These activities were planned for and executed during Fiscal Years 1992 and 1993, with expectations that activities proposed for Fiscal Year 1994 will also be implemented. All tables in this document provide overviews of activities presented in Fiscal Year Plans of Work which address directly, or go beyond the PES issues of

- 1 Research Prioritization,
- 2 Center Procedures,
- 3 Station Management/Revenue Generation, and
- 4 Training

Table 1 presents activities which were undertaken during Fiscal Year 1992. These activities provided direct response to needs identified in the PES document.

TABLE 1 FISCAL YEAR 1992 ACTIVITIES

ACTIVITY	DESCRIPTION
Setting Research Priorities -Research Agenda Development Activity 1 -Project Management Training	Introduce and utilize tools of management science for prioritization of applied agricultural research at the Aridoculture Center which provide bottom up support for PBO
Setting Research Priorities -Research Agenda Development Activity 2 -Techniques for Incorporating Farmers' Perspective	Advance techniques for design, Evaluation, and Dissemination of Results from On-station and On-Farm Verification Research
Setting Research Priorities -Monitoring and Impact Assessment Activity 1 -Development of Methodology for Impact Assessment	Introduction of methodologies for measuring socioeconomic impact of Aridoculture Center developed technologies
Setting Research Priorities -Monitoring and Impact Assessment Activity 2 -Utilization of Socioeconomic Baseline Data	Utilization of Rural Sociology and Economics Sub Program baseline data information in the development of Research Agenda
Aridoculture Program Center Administrative Services -Support Services Activity 1 -Center Procedures	Design and implement Aridoculture Center/stations procedures manuals to define policies governing acquisition and management of resources-Multi-year implementation schedule
Aridoculture Program Center Administrative Services -Support Services Activity 2 -Station Management	Development of a plan for station management including steps for generating and managing revenues and replacement of MIAC hired technicians
Aridoculture Program Center Administrative Services -Support Services Activity 3 -Revenue Generation	Inventory all options for the generation of revenue from Aridoculture Center and stations
Training Plan	Introduction of a training plan which promotes linkages between U.S. and Moroccan Universities, provides options for completion of training prior to PACD and/or mutually acceptable alternative in-country completion scheduling

RESEARCH PRIORITY AND RESEARCH AGENDA DEVELOPMENT

Effective research agenda development requires efficient and appropriate methods to prioritize research. This is dependent upon the inclusion of information from policy makers, researchers, secondary information sources, and clientele groups, i.e. farmers. The Aridoculture Center addressed these issues simultaneously through the in-country training activities.

MIAC contracted for training in "Project Management Systems" to improve the capability of the Aridoculture Center scientists to develop research plans within Sub Programs and at the Aridoculture Center administrative levels. This training was focused on agricultural research

project management and provided tools for use by researchers which incorporated "bottom up" support for national Programming by Objective efforts

Research Agenda Development In-Country Training Activity I

This activity focused on aspects of management science Specific components developed in the training program were the following

- Implementation of planning and management,
- Project implementation,
- Development of INRA human resource capabilities through training in the utilization of
 - A Objective Trees,
 - B Logical Frameworks for Sub Program project development,
 - C Gantt Charts for realistic planning,
 - D Responsibility Graphs for role clarification,
 - E Performance indicators for assessing success,
 - F Environmental Reconnaissance for adapting to unplanned events,
 - G Budgeting associated directly with logical framework activities,
 - H Development and use of flip charts as a management tool,
 - I Familiarization with software used to facilitate the use of the tools mentioned above
- Basic components for the development of trainers of trainers
- As part of the training activity a necessity existed to undertake
 - A Discussions on monitoring and impact assessment needs and goals
 - B Discussions on evaluations for planning and management

The RSA was strengthened through the management training activity outlined above The RSA was complimented by the implementation of a Rapid Rural Appraisal Survey (Sondeos) directly followed by Training Activity II "The Analysis and Design of On-Farm Trials" RRA activities have been utilized by the Aridoculture Center on two occasions The first as part of a training activity and the second on behalf of the Rural Sociology and Economics Sub Program in conjunction with the Service for Research and Development and Extension Prior to the implementation of Training Activity II , a RRA survey was undertaken in the Oulad Said area of the Chaouia Region for enhancement of the research agenda development component of the RSA This built upon the capabilities of the Aridoculture Center to implement multidisciplinary and multiagency surveys which incorporate the views of farmers more effectively This activity was complimentary to actions initiated by the Aridoculture Center and INRA-Rabat to develop mechanisms for the analysis of impact associated with Center generated technologies In addition, the results of the RRA was to provide immediate information flow for feedback to researchers and policy makers and for use in the design and evaluation of On-Farm Trial activities

Research Agenda Development In-Country Training Activity II

A second training activity was undertaken to develop the human resource capability within the SRD and among the Aridoculture Center scientists and administrative personnel. It supported programming by objective prioritization of research activities and required full incorporation of the farmers' perspective in the development of a research agenda. This training activity advanced the development of techniques to design, evaluate and disseminate results from on-station and on-farm verification research. It also addressed release mechanisms for use by different Sub Programs in the dissemination of technologies generated by the Center.

Farmer Participation and Research Agenda Development

Specific activities which were undertaken included the following

- A review of Farming Systems Research and Extension, Technology Evaluation and Acceptability criteria
- A focused RRA in two recommendation domains of Oulad Said
- Modified Stability Analysis (MSA) Methodology and Procedures were reviewed
- A review of Agronomic Analysis and Interpretation of Morocco Research Results for 1990-91 were implemented
- A Modified Stability Analysis using Moroccan Farmers' Criteria was developed
- A Research Program Design Activity for FY 1993 was undertaken for Station and On-Farm Trials with discussion of Policy Implications and Diffusion Practices

This training provided opportunities for strengthening research activities and the dissemination of information to interested parties. It also formed a basis for improved linkage between the DPA, the *Institut National de la Recherche Agronomique*, the *Centres de Travaux* and target farmers within specific recommendation domains.

The two training activities provided the opportunity for improvement in planning and better research priority setting of management functions undertaken by the Aridoculture Center's research and administrative personnel. The latter training program provided researchers at the Aridoculture Center, in extension and at the *Centre de Travail* at Oulad Said with a clear understanding of the basis for the development of technologies by the Aridoculture Center staff. Finally, these activities helped to promote enhancement of priority setting at the national and regional levels through programming by objective activities.

MONITORING AND IMPACT ASSESSMENT

The monitoring and impact assessment of technologies generated by the Aridoculture Center required immediate attention by the Aridoculture Center administrative and scientific personnel. Advances in capability to undertake monitoring and impact assessment had been hindered by manpower shortages in the economics section and the SRD.

The specific needs for monitoring and evaluation vary across Sub Programs. As a result, it was necessary to tailor the assessment techniques to the types of technology development programs existing within the Sub Programs. Coordination of monitoring and impact assessment activities were to be undertaken by the Rural Sociology and Economics Sub Program. A plan was presented in Fiscal Year 1992 and presented below which was not possible to implement until Fiscal Year 1993. This initiative will provide capability to monitor, evaluate and assess impact of technologies generated by the Aridoculture Center by PACD.

MONITORING AND IMPACT ASSESSMENT. Activity I

The Aridoculture Program Center must be able to measure the socioeconomic impact of Center developed and disseminated technologies. This must be preceded by the development of release mechanisms for technologies and monitoring techniques. Methodologies for undertaking these tasks are not homogeneous across Sub Programs. The human resource compliment was not available at the Aridoculture Center to undertake the development of economic impact assessment methodologies. Without this capability, accountability for research expenditures and economic value added from dissemination of technology was not monitored.

As a result of this realization the following plan of action was presented for implementation during the 1992 fiscal year.

- Three economists will be requested to participate directly with the following Sub Programs 1 Cereal Breeding, 2 Crop Management, 3 Agricultural Mechanization, and 4 Food Legumes
- The senior economist in the economics section, working in collaboration with one of the sabbatical economists and the SRD economist as the latter's time permits, will coordinate the activities of the economists working within Sub Programs. This coordination effort will ensure the development of monitoring and impact assessment methodologies which are consistent internally to the Sub Programs' needs and consistent with anticipated human resource levels in the economics section during the period 1994-1999.
- The sabbatical personnel will be requested to review and develop improved techniques for utilization in, 1) the development of release mechanisms and 2) monitoring the dissemination of technologies generated by the Aridoculture Center scientists.

- The Aridoculture Center sociologists will be requested to, 1) identify key social variables which may act to mitigate the economic impact of technologies and 2) provide the sabbatical personnel with social indicators which may be useful in monitoring technology acceptance during the post dissemination period

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MONITORING AND IMPACT ASSESSMENT Activity II

Sociology and economic information at the individual, household, regional and the national level provide a basis for research prioritization. Programming by objective initiative provides an opportunity for the incorporation of baseline information developed at the Aridoculture Center.

The Rural Sociology and Economics Sub Program has collected information which will be useful in the research agenda development component and the monitoring and impact assessment component of the RSA outlined in Figure 1. As a result, this information must be available prior to the implementation of in country training programs during the 1992 fiscal year.

ARIDOCULTURE CENTER ADMINISTRATIVE SUPPORT SERVICES

The development of the administrative support services at the Aridoculture Program Center and satellite stations has developed rapidly since 1988. Accounts personnel have been located in Settat to undertake fiscal control of the INRA activities at the Center. Personnel who participate in this component of the Aridoculture Center activities are now being formally trained by the MIAC Administrative Officer.

The training activity is a part of the development of accounting capability at the Center. MIAC has a role in generating the accounting capacity as a part of the implementation of programming by objective. MIAC provides technical assistance, software and hardware in the training of INRA's staff to develop their accounting activities. This will better support programming by objective research activities.

SUPPORT SERVICES CENTER PROCEDURES, Activity I

The USAID Evaluation Summary Part I (DAAR 608-013) presents agreement by USAID and INRA to take action to "Develop a plan and timetable for the development of a center/station procedures manual which will define the procedures to follow for the acquisition and management of all resources." In line with this agreement the following activities are underway or will be implemented in line with the timetable presented below.

INRA-Settat has begun the development of a plan for an Aridoculture Center and stations procedures manual. In support of action already having been implemented, the following actions should be taken to complete and implement the manual and procedures therein.

SUPPORT SERVICES· STATION MANAGEMENT; Activity II

The USAID Evaluation Summary Part I (DAAR 608-013) presents agreement by USAID and INRA to take action to "Develop a plan for management of the research stations including steps to generate and manage revenues and provide technicians for the stations to replace those currently employed by MIAC "

Station management efficiency can be increased. Generating revenue from stations which does not interfere with station research activities can increase sustainability for the Aridoculture Center and stations. Guidelines for station development will be based on results of the ARGICON Int. Canada consultancy report (1991), DAAR Project goal and purpose, and the USAID/INRA-Rabat A I D Evaluation Summary Agreement.

SUPPORT SERVICES REVENUE GENERATION, Activity III

Revenue generation from utilization of station excess capacity, laboratory testing, socioeconomic information, patented seed varieties, etc., must be considered as an option for providing an internal source of liquidity for sustainability of the Aridoculture Center and stations. Positive action on this issue will be taken in conjunction with INRA-Rabat and USAID during fiscal year 1992. The following actions must be taken to ensure that these opportunities are exploited to their fullest.

Since 1991 the institutionalization of Sub Programs and expansion of activities by the Service for Research and Development have resulted in a positive decentralization of decision-making authority. This enhanced opportunities for administration to focus on critical management factors.

Results from the implementation of the Fiscal Year 1992 Plan of Work by MIAC and INRA ensured increased short, intermediate and long run positive economic impacts.

However, additional tasks needed to be accomplished during Fiscal Years 1993 and 1994. Completion of these tasks would allow the CRRA at Settat to provide critical information which will be required by Moroccan policy makers. These included but were not limited to the following:

- **Improvements in the flow of information within and outside the Center**
- **Improved maintenance and inventory control for enhanced utilization of capital resources.**
- **Improved utilization of the human resource capital embodied in the scientist to ensure the proper mix of administrative versus scientific product. It should be kept in mind that the human resource is the key resource. This resource like others must be sustained and utilized in that way.**

- Dissemination of technologies should be evaluated under a standard criteria which incorporates a demand component.
- Private/Public affiliations should be emphasized for both development of new technologies and the adaptation of technologies "on the shelf" in the private sector.

Each of the items mentioned above falls into four broad categories for action These are the following

- Administrative and Research Management
- Procurement and maintenance.
- Technology Transfer
- Training

Activities which are addressed in the future should be targeted toward specific issues within each of the broader categories

FISCAL YEAR 1993 AND 1994

Table 2 presents activities which were planned and executed during Fiscal 1993 These activities built upon those which were undertaken during Fiscal Year 1992 They reinforced advances made during implementation of the RSA at the Aridoculture Center

TABLE 2 FISCAL YEAR 1993 ACTIVITIES

ACTIVITY	DESCRIPTION
Setting Research Priorities - Sustainable Administrative and Research Management	Introduce and utilize tools for improved budgeting and scheduling for PBO
Setting Research Priorities - Project Support Accounts for Portfolio Diversification	Utilization of Logframe Approach to project development and budgeting to generate funds from external sources after PACD
Aridoculture Program Center Administrative Services - Sustainable Linkage Development	Action by MIAC to develop sustainable international and national linkage programs
Setting Research Priorities - Baseline Data Utilization for Technology Transfer and Impact Assessment	Utilization of Rural Sociology and Economics Sub Program baseline data information in the development of Research Agenda
Aridoculture Program Center Administrative Services - Inventory Training for Station Management	Development of a computerized inventory system for use by the Center and Sub Stations
Setting Research Priorities - Introduction to Monitoring and Impact Assessment	Applied utilization and development of methods for monitoring and impact assessment
Setting Research Priorities - Audio/Visual Training for Technology Transfer	Development and expansion of Audio/Visual capacity of the Aridoculture Center

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Setting Research Priorities - Irrigation for Research and Revenue Generation,	Investigation of potential for use of Center Pivot and Linear irrigation systems in research and revenue generation
Aridoculture Program Center Administrative Services - Writing for Publication and Proposal Development,	Training program for the development of skills associated with research and proposal writing

1 Sustainable Administration and Research Management Training

This training will focus on budgeting and scheduling aspects of management science. There are \$49,000 budgeted for this in-country training activity. Trainers from a US based organization will present a follow up training program in budget management and scheduling. This will be directly related to FY 92 activities utilizing lessons learned from the introduction of the LogFrame Approach for Project Administration and Research Management.

Specific components envisioned in this training program follow:

- Review of model research projects logframes for use in budgeting and scheduling training
- Introduction of budgeting and scheduling tools utilizing TEAMup software to compliment LogFrame Approach Training
- Basic components for developing trainers of trainers in budgeting and scheduling activities

Administrative functions strengthened through the budgeting and scheduling training activity outlined above will compliment all actions undertaken by the Aridoculture Center.

2 Research Project Support Accounts

During FY93 MIAC and INRA will promote training in generation of funding for research projects. This will be accomplished through utilization of support accounts, which mirror actual budget accounts managed by a Project's principal investigator. Action will be taken by administration to provide managerial and financial support for a model which will stimulate:

- Competitive funding for projects or project operational protocols (as defined in the Logframe Approach) which are principal-investigator managed,
- Donor agency interest in funding INRA-Settat research projects or project activities,
- Development of mechanisms for implementing priority research,
- recognition of complimentary existing between project or project activities, and

- Support for research which provides a benefit flow across disciplines

Aridoculture Center and MIAC have several tools for improving efficiency through research priority setting in place at the present time. These include capabilities in the following areas

- Acquisition of human resources can fill gaps, new scientists can be hired and/or retrained in areas which are identified as high priority
- Assignment of funding to priority problems can direct research, training in the use of the logframe approach coupled with the PBO have provided an opportunity to focus funding of high priority research. Base funding continues for all researchers with emphasis from administrative support for competitive granting on high priority issues
- Administrative action can address research needs, administration can direct research, monitor implementation and track research results to judge future resource needs

Each of these tools are utilized either by management or scientists. However, as the DAAR Project moves toward completion it is necessary to promote the diversification of funding sources. This can be done through utilization of models which address objectives listed above. Therefore, Aridoculture Center and MIAC will take action to ensure that this opportunity exists. This opportunity requires accountability on behalf of researchers and provides the researcher with the utmost opportunity to undertake research unconstrained by the bureaucracy.

During FY93 up to \$50,000 will be provided in \$5,000 project support accounts to address these objectives. In FY94 these support accounts will continue if justified, plus an additional \$50,000 will be added for other promising research if such research exists. A MIAC/INRA committee will be set up to review projects for possible support. Initial competition for FY93 project support accounts will be judged on criteria listed below.

- Projects will be identified which are high priority for Aridoculture Center, MIAC and USAID and which complement PBO objectives
- Consideration will be given to the integration of multiple disciplines when advantageous to successful completion of the project activity
- Time frame feasibility will be considered. Projects or activities within projects must be completed prior to the Project Activity Completion Date (PACD) for the DAAR Project (August 31, 1994)
- Expected benefit flow to researchers and farmers must be delineated with expectations pertaining to time frame
- Technology adoption potential must be discussed

- All support accounts will be targeted for use in applied agricultural research. Research undertaken must target a direct application which reduces or removes a constraint which reduces productivity of the farming system.
- A task-oriented budget must be provided with the request for a support account.

Research projects with Logframe Approach tables and proposals will be considered and will provide the basis for selection. However, other projects addressing issues overlooked in the PBO process but of high priority will be considered on their merit. All project activities submitted must utilize the management tools which have been made available to the researcher through the Project Management Training programs.

4 Sustainable Linkage Development

MIAC will continue to develop linkages, both internally and externally to Morocco, which will enhance long term sustainability of the Aridoculture Center and INRA as an institution. Three activities will be undertaken during FY93 to build new international linkages with Universities and private enterprise.

United States Department of Agriculture/Washington State University Linkage,

Sustainable Agriculture and Natural Resource Management Collaborative Research Support Project,

Valmont Industries/University of Nebraska/Aridoculture Center

5 Baseline Data Utilization for Technology Transfer and Impact Assessment

Sociology and economic information at the individual, household, regional and the national level provide a basis for research prioritization. The Programming by Objective initiative provides an opportunity for the incorporation of baseline information developed at the Aridoculture Center into the RSA.

6 Inventory Training for Station Management

Training in development of inventory control mechanisms will be undertaken during FY93. This will provide an opportunity for the Aridoculture Center to address station management issues in a manner which will increase opportunities for sustainability. At the same time it will provide a basis for the introduction of new technology for research purposes into the stations' inventory of equipment as part of an integrated inventory control system. This addresses one of the serious issues facing the CRRA, how to manage scarce equipment and land resources, as the DAAR Project is completed. It also directly addresses one of the USAID Project

Evaluation Summary points which were agreed upon as priority issues by both USAID and INRA-Rabat

7 Introduction to Monitoring and Impact Assessment

The Aridoculture Center must be able to measure the socioeconomic impact of Center developed and disseminated technologies. This must be preceded by the development of release mechanisms for technologies and monitoring techniques. Methodologies for undertaking these tasks are not homogeneous across Sub Programs. Human resources are not available at the Aridoculture Center to undertake the development of economic impact assessment methodologies. Without this capability, accountability for research expenditures and economic value added from dissemination of technology can not be monitored.

- The senior economist in the economics section, working in collaboration with the sabbatical economist and SRD, will coordinate the activities. This coordination effort will ensure the development of monitoring and impact assessment methodologies which are consistent internally to the Sub Programs' needs and consistent with anticipated human resource levels in the economics section during the period 1994-1999.
- The sabbatical personnel will be requested to review and develop improved techniques for utilization in, 1) the development of release mechanisms and 2) monitoring the dissemination of technologies generated by the Aridoculture Center scientists.
- The Aridoculture Center sociologists will be requested to, 1) identify key social variables which may act to mitigate the economic impact of technologies, 2) provide the sabbatical economist with social indicators which may be useful in monitoring technology acceptance during the post dissemination period and 3) conduct an assessment of potential dissemination constraints within each Farming Systems type from secondary data.

8 Audio/Visual Training for Technology Transfer

The Aridoculture Center requires a capability to provide audio/visual support for ongoing research activities undertaken by research scientists. This capability will be developed under the auspices of the Service for Research and Development (SRD). The general objective of this training will be the improvement in communications capability of the Aridoculture Center with the specific objective of being able to more effectively disseminate CRRA generated technologies and information pertaining to such technologies. The specific objectives will be addressed through collaborative activities between the SRD and consultants specializing in technical journalism and communications techniques.

- Description of Audio/Visual Communications Actions
- Consultation with the Service de Recherche et Développement (SRD) and ENA Audio Visual Center to help develop a comprehensive plan designed to upgrade and

institutionalize an agricultural communication capacity This capacity will provide effective communications support systems required to facilitate two-way information flow among researchers, extension personnel and farmers

- The consultant will assist the *Institut National de la Recherche Agronomique* (INRA) at the *Centre Regional de la Recherche Agronomique de la Chaouia, Abda et Doukkala* (CRRA) located at Settat, Morocco in preparing a diagnostic analysis of the current agricultural communications capacity and pursue recommendations for inputs to improve these communication efforts This analysis will specifically address issues of sustainability of generated efforts beyond current project completion

The diagnostic analysis also would serve as the basis for a plan for future activities and document the communication capacities and needs as background information for potential donors

- The Audio/Video Communications plan will
- Investigate management strategies and alternatives for improved planning, training and equipment capacities to increase both the on time delivery and quality of agricultural communication outputs
- Recommend appropriate communication technology (equipment) to support a communication management plan
- Seek two-way emphasis on the flow of agricultural information for appropriate inputs into message development process
- Increase subject matter specialist and research specialist contact through cooperative planning and message development and updating (with emphasis on Extension/Research linkage)
- Develop and strengthen the agricultural communication capacity to design and conduct communication-related investigations, to pre-test materials in various media, and to interpret and utilize the results to improve program effectiveness and impact

9 Irrigation for Research and Revenue Generation

Development of irrigation for **research** and revenue generation on stations will be investigated This will be accomplished through the collaborative efforts of MIAC and Aridoculture Center with input from INRA-Rabat, USAID and the University of Nebraska at Lincoln Project Coordination Office Results of this investigation will provide, if justified on economic and/or research requirements, the basis for purchase and planning for implementation of irrigation equipment

10 Writing for Publication and Proposal Development

MIAC will attempt to identify appropriate consulting agencies which can provide capability in technical writing for research publication and proposal development. This activity will build upon actions taken by MIAC and Aridoculture Center to strengthen management efficiency at the Center.

ACTIVITIES TO SUPPORT DAAR PROJECT NEEDS

Specific activities to be addressed during Fiscal Year 1994 focus on training, administrative and research management, stations and linkage development. These activities will strengthen both research and administrative capacity to address farmer and policy maker demands. Each of the activities are described briefly in Table 1, and delineated within the text of this Plan of Work.

TABLE 3. FISCAL YEAR 1993 ACTIVITIES

SHORT TERM TRAINING IN MOROCCO	DESCRIPTION
Setting Research Priorities - Administrative and Research Management Training	Introduce and utilize tools for improved budgeting and scheduling for PBO
Aridoculture Program Center Administrative Services - Inventory Control Training	Development of a computerized inventory system for use by the Center and Sub Stations
Aridoculture Program Center Administrative Services - Editing Proposals and Publications	Training program in editing for the development of a set of editors on the Settat staff
Aridoculture Program Center Administrative Services - Data Base and Financial Management Training	Training in the development of data base information services and financial management tools for INRA administration
Aridoculture Program Center Administrative Services - Equipment Maintenance	Program to train INRA technical staff in the maintenance of scientific and refrigeration equipment
Aridoculture Program Center Administrative Services - Local Area Network Development (LAN)	Installation and training in the use of a LAN system for internal and external linkage development
Aridoculture Program Center Administrative Services - Electronic Mail Communications	Training in the use of electronic mail options and installation of services at INRA-Rabat and other institutions
Setting Research Priorities - Equipment Utilization	Short course in calibration of wintersteiger planters and harvesters
SHORT TERM TRAINING IN THE U S	
Setting Research Priorities - Scientific Techniques	Custom training in electrophoretic techniques for soil physics

Setting Research Priorities - Communications	Custom training which builds upon initiatives in the field of audio/video communication of Center's information
Setting Research Priorities - Project Management Training	USDA sponsored course which will provide additional capacity in project administrative management
Setting Research Priorities - Training of Trainers	Training of trainers program for development of training capacity in Project Management Systems
Aridoculture Program Center Administrative Services - Administrative Staff Computer Utilization	Training in the use of computers for data base development and typing for administrative staff
DEGREE BASED TRAINING	
- Advanced Degree Training	Course Work and Research
- Advanced Degree Training	Course work only
OTHER ADMINISTRATIVE INITIATIVES	
Setting Research Priorities - Research Project Support Assistance	Utilization of Logframe Approach to project development and budgeting to generate funds from external sources after PACD
Setting Research Priorities - Irrigation for Research and Revenue Generation	Enter into bidding process for purchase of equipment based on suggestions of the INRA feasibility study

DESCRIPTION OF PROJECT ACTIVITIES

The Dryland Applied Agricultural Research Project activities to be undertaken during FY 94 are necessary. They are broad in range and specific in target. A final opportunity exists to strengthen a few outstanding capabilities which will improve the overall performance of the Aridoculture Center and its sub stations located at Sidi El Aydi, Jemaat Rhia, Khemis Zememra and Jema Shaim.

SHORT TERM TRAINING; MOROCCO

1 Administrative and Research Management Training, Linkage

This training, which is the third program in a series of three, will focus on final budgeting and scheduling aspects of Project Management Systems training. This builds directly on FY92 and FY93 activities in the use of the LogFrame Approach and PCTeam/Up for scheduling and budgeting. Both project administration and research management benefit from this training. Internal and external linkage opportunities are improved through this activity.

Objectives

Three objectives for the work will be achieved. These include

- 1 The facilitation of budget and scheduling for research projects developed over the past two years,

- 2 Sensitization to and presentation of Project Management Systems approach and project proposals to external donor groups, and
- 3 Movement toward realization of opportunities for the Aridoculture Center to develop a Profit Center to generate revenue and augment scientists' capacity to train in Project Management Systems

2 Inventory Control Training

Training for inventory control will be undertaken during FY94. This training will be useful for coordination purchase activities by the Aridoculture Center across all stations.

Objectives

This activity will provide opportunities for development of a comprehensive inventory system to improve administrative efficiency on stations. This addresses one of the serious issues facing the CRRA, how to manage scarce equipment and land resources, as the DAAR Project is completed. It also directly addresses one of the USAID Project Evaluation Summary points agreed upon as priority issues by both USAID and INRA-Rabat.

3 Editing Proposals and Publications, Linkage

During Fiscal Year 1993 a writers workshop was undertaken at the CRRA. This was a successful training program for the development of proposals and publications. During the course it was observed that capability in editing was minimal.

Objectives

The one week workshop will focus on the development of a small cadre of individuals at the CRRA. This team will be able to provide services to other scientists and/or the scientific committee in preparation of written documents. The Specific objective of the workshop will be the provision of editing skills to this cadre to utilize in collaboration with CRRA scientists.

4 Data Base and Financial Management Training, Linkage

Capacity to utilize and modify data base and financial management information is limited within the Aridoculture Center administrative staff. This is due to two major constraints. The first is choice of software and the second is a limited common knowledge base amongst administrative staff. The latter is a result of individual training which only the individual can utilize if the benefits are not transparent to policy makers. The former is due to use of specific software by MIAC which complimented needs of the Coordinating Office, MIAC-Lincoln and associated universities.

Objectives

The objectives of this program are to introduce a flexible data base and financial management software which will more readily meet the needs of the Aridoculture Center in the

future Secondly, this data base system will be directly linked to station inventory control systems and the Local Area Network

5 Equipment Maintenance

Training in the maintenance of electrical equipment was undertaken in the United States and on site during the course of the MIAC contract However, training in repair and maintenance of refrigeration equipment was not part of this training

Objectives

Provide the on site capability to repair and maintain equipment which requires knowledge of refrigeration techniques and processes

6 Local Area Network Development, Linkage

This development and training program will provide opportunities for communication among scientists which do not exist today The technology is available to remove this constraint to technology development and dissemination activities

Objectives

Two objectives predominate the decision to introduce a local area network at the Aridoculture Center These are the following

- 1 Improved internal communication amongst scientists on research and administrative tasks
- 2 Improved, post project, opportunities to communicate with U S based colleagues, Morocco based collaborators, and institutional organizations via electronic mail services available at the desk

In conjunction with use of electronic mail services both internal and external linkage opportunities are improved through this activity

7 Electronic Mail Communications, Linkage

Electronic mail services can be widely available in Morocco This service can be utilized to send EMAIL, FAX and/or TELEX communications It provides a new opportunity to improve communication of scientific knowledge amongst institutions This may result in reduced negative competition between institutions and improve opportunities for collaborative and complimentary research

Objectives

Electronic mail capability will be developed at the Aridoculture Center to do the following

- 1 Improve capability to communicate externally within Morocco and outside of Morocco
- 2 Reduce costs associated with external communications
- 3 Improve sustainability of the Aridoculture Center through improved scientist to scientist and institution to institution linkages

8 Equipment Utilization

The FY 93 Scientific Panel proposed that training in proper calibration of equipment would enhance opportunities for improved research results. MIAC and INRA are responding to this proposal immediately to ensure that station managers are able to undertake high quality research activities.

Objective

The objective for this training is to provide the best possible support for upkeep and maintenance of equipment on station.

SHORT TERM TRAINING; UNITED STATES

9 Scientific Techniques

This is a custom designed program in electrophoretic techniques for use in soil physics.

Objectives

Develop on site expertise in electrophoretic techniques for support of soil physics laboratory activities.

10 Communication/Communications, Linkage

A sustained effort has been continuously implemented during FY 92 and FY 93 to ensure the Center's capability to deliver high quality technology and information messages. This will be improved during FY 94 through this customized activity to be undertaken at Colorado State University, with private enterprise in Denver, Colorado, and the University of Nebraska.

Objective

Improve the capability of the Director for the Service for Research and Development to integrate disparate aspects of the SRD's liaison activities with research, extension farmers and policy makers. This will, in turn, provide more opportunity for the SRD to emphasize its on farm evaluation program, a key component of future success for the Aridoculture Center.

11 Project Management Training, Linkage

During FY 94, two individuals will be trained in Project Management by the USDA in Washington, D C This training will provide management tools which will support research and project management training undertaken during the past three years

Objectives

This will provide a four person team with the Aridoculture Center who not only have research management training but also project management training The advantages of having a small cadre of individuals with a common basis of understanding results in greater likelihood of success in administrative initiatives

12 Training of Trainers, Linkage

Resources have been expended to ensure improved research project development and management of projects This has developed interest among other CRRAs in Morocco, INRA administration in Rabat and returning scientists In order to train in the use of Project Management Systems it is not sufficient to know how to apply its techniques It is necessary to be able to convey the ideas, concepts and techniques in a manner which meets accepted teaching standards Training of trainers is an instrumental step forward in the institutionalization, within INRA, of a project management capability which can be expanded to the entire National Agricultural Research Service

Objectives

Train two Aridoculture Center scientists in the techniques necessary for training in Project Management Systems effectively and efficiently This will provide expertise for training returning scientists and staff of other organizations who will be interested in emulating the successes of the Aridoculture Center program

13 Administrative Staff Computer Utilization

A concerted effort is underway to sensitize other agencies within INRA, while at the same time linking them through common activities, with the Aridoculture Center Training in administrative staff computer utilization will be undertaken on a small scale during FY 94 to ensure that this interaction is supported

Objectives

Provide computer software skills (data base, word processing, inventory control, etc) which support the goals of the Aridoculture Center while at the same time linking agencies through expertise

DEGREE BASED TRAINING

14 Course Work and Research

Emphasis throughout the DAAR Project has been placed on training in Sub Program specialty areas

Objective

At PACD in August 1994 advanced degree training will no longer be funded under the Dryland Applied Agricultural Research Project in conjunction with the MIAC contract Therefore, MIAC and INRA have emphasized efforts to finish up long term training activities on schedule

15 Course Work Only

During FY 1992 a program was developed to provide support for training to INRA and also support the newly developing capabilities at IAV-Hassan II University This program has progressed well, with course work only students having been placed in U S Universities During FY 1994 one additional student is planned for correspondence course work at an U S University It is understood by INRA-Rabat and the Aridoculture Center that this training opportunity does not require travel to the U S nor additional expenditures by MIAC or USAID under the DAAR Project Furthermore, this particular training activity is contingent upon authorization from all appropriate divisions in USAID

Objective

At PACD in August 1994 course work only advanced degree training will no longer be funded under the Dryland Applied Agricultural Research Project in conjunction with the MIAC contract Therefore, MIAC and INRA have emphasized efforts to finish up course work only long term training activities on schedule

OTHER ADMINISTRATIVE INITIATIVES

16 Research Project Support Assistance

During FY94 MIAC and INRA will continue to support proposal development for funding of research projects This will be accomplished through utilization of support assistance, managed by a Project's principal investigator

Objectives

Action will be taken by MIAC to provide managerial and financial support for implementation of a model which will achieve the following

- Provision of competitive funding for projects or project operational protocols (as defined in the Logframe Approach) which are principal-investigator managed,
- Stimulate donor agency interest in funding INRA-Settat research projects or project activities,
- Provide support for research which results in a benefit flow across disciplines

As the DAAR Project moves toward completion it is necessary to promote the diversification of funding sources. The project support activity requires accountability on behalf of researchers and provides the researcher with flexibility in the use of researcher managed resources

During FY94 up to \$50,000 will be provided in \$5,000 project support accounts. An INRA committee was set up during FY 93 to review projects for possible support. Competition for FY 94 project support accounts will be judged on criteria listed below

- Projects will be identified which are high priority for Aridoculture Center, MIAC and USAID and which complement PBO objectives
- Consideration will be given to the integration of multiple disciplines when advantageous to successful completion of the project activity
- Time frame feasibility will be considered. Projects or "stand alone" project operations must be completed prior July 1994
- Expected benefit flow to researchers and farmers must be delineated with expectations pertaining to time frame
- Technology adoption potential must be reviewed
- All support accounts will be targeted for use in applied agricultural research. Research undertaken must target a direct application which reduces or removes a constraint which reduces productivity of the farming system
- A task-oriented budget which utilizes Project Management Systems training must be provided with the request for a support account

All successful projects submitted will have utilized management tools made available to the researcher through training in Project Management Systems

Utilization of Funds Not Provided for Project Support Activities

Funds which have not been utilized for project support activities will be utilized for support of finishing Ph D and M Sc students This will continue a program begun during FY 1993 which provided students just returning to the Aridoculture Center the opportunities which existed at the beginning of the project rather than having to fight for scarce resources

17 Irrigation for Research and Revenue Generation

Development of irrigation for **research** and revenue generation on stations will be investigated This will be accomplished through the collaborative efforts of MIAC and the Aridoculture Center with input from INRA-Rabat, USAID and the University of Nebraska at Lincoln Project Coordination Office Results of this investigation will provide, if justified on economic and/or research requirements, the basis for purchase and planning for implementation of irrigation equipment

Figure 1

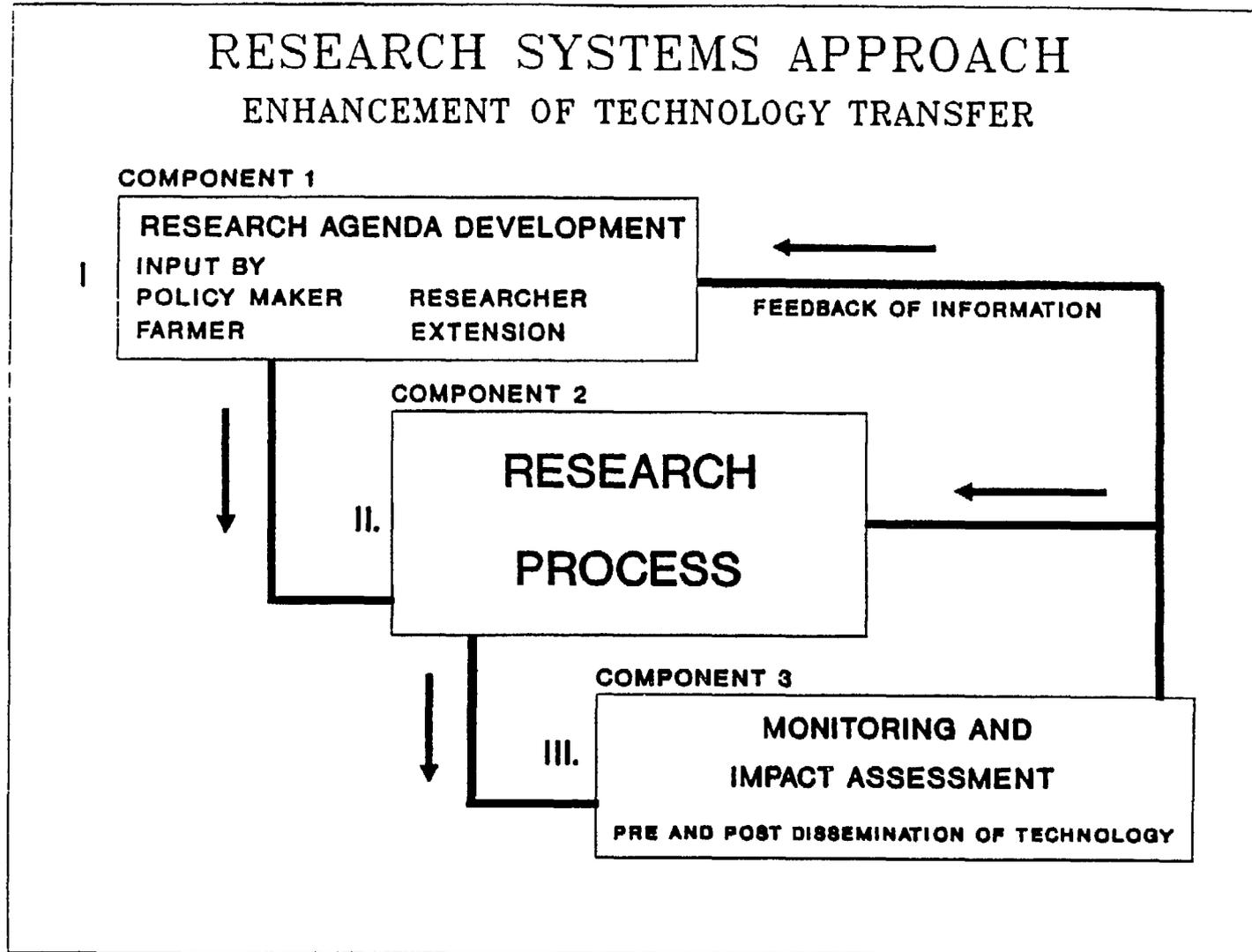
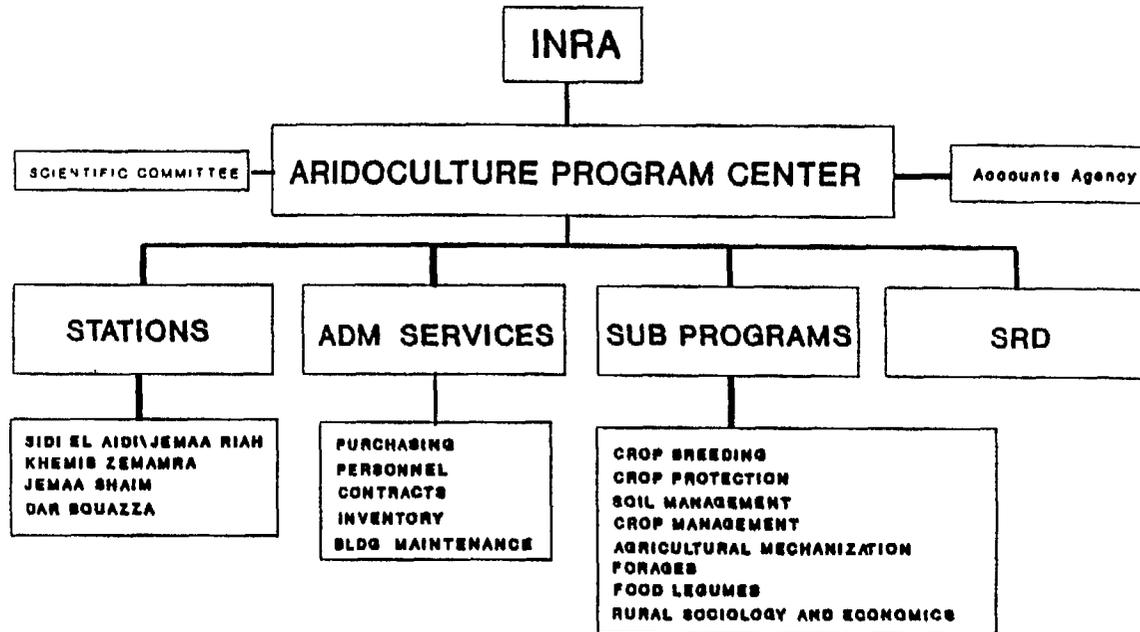


Figure 2

ARIDOCULTURE PROGRAM CENTER ADMINISTRATIVE STRUCTURE



ANNEX F

PROJECT TECHNICAL ASSISTANCE AND CONSULTANT VISITS

PROJECT TECHNICAL ASSISTANTS AND CONSULTANT VISITS

**TABLE F1 Distribution of Technical Assistants by
Sub Program Number and Person Months**

<u>Sub Program</u>	<u>No of T A s</u>	<u>Total Person Months</u>
Crop Breeding	5	144
Crop Protection	4	95
Soil Management	5	185
Crop Management	5	145
Agricultural Mechanization	7	237
Forages	4	137
Food Legumes	1	25
Rural Sociology/Economics	5	268
Team Leader	5	144
Total	41	1208

**TABLE F2 Distribution of Technical Assistants by
Number of Months on MIAC Contract**

<u>Months</u>	<u>No of T A s</u>
0-18	9
19-31	13
32-44	8
45-57	8
58 and over	3

Average length of time on contract = 29.46 months

TABLE F3**Number of Technical Consultants by
Program Area and Person Months**

<u>Program Area</u>	<u>Number</u>	<u>Person Months</u>
Rural Sociology and Economics	25	8 15
Plant Breeding	9	3 75
Food Legumes	5	3 95
Forages	17	5 15
Plant Protection	33	12 50
Agricultural Engineering	21	10 00
Crop Management	14	5 95
Soils	30	12 10
Seed Production	1	30
Greenhouses	5	3 00
Technical	3	73
Library	1	26
Computer	1	43
Biometrics	2	2 75
Extension	1	73
Management	1	1 00
Television	4	1 13
Sub Station Management	2	1 50
Communications	3	1 25
SRD	1	25
Total	179	73 78
Average Stay		41

TABLE F4

**Number of Advisor Consultants by
Sub Program Area and Person Months**

<u>Sub Program</u>	<u>No of Advisor Consultants</u>	<u>Person Months</u>
Rural Sociology and Economics	5	2 0
Plant Breeding	11	3 25
Food Legumes	6	1 85
Forage	8	2 33
Plant Protection	5	1 70
Soil Management	4	2 00
Agricultural Engineering	1	25
Crop Management	4	1 30
Total	44	14 78
Average Stay		34

ANNEX G
SCIENTIFIC REVIEW PANEL REPORT

SCIENTIFIC REVIEW PANEL REPORT

**CENTRE REGIONAL DE LA RECHERCHE AGRONOMIQUE
DE CHAOUIA, DOUKKALA et ABDA**

**MIDAMERICA INTERNATIONAL AGRICULTURAL CONSORTIUM
(INRA/MIAC)**

DRYLAND APPLIED AGRICULTURAL RESEARCH PROJECT

6 - 14 September 1993

USAID Project No. 608-0136

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Aridoculture Center
1993 Scientific Review Panel

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INTRODUCTION

This Scientific Review Panel reviewed activities undertaken by the INRA/MIAC team in the following functional areas administration and research services, Socioeconomic Sub Program, and the Service for Research and Development. The Panel's study was organized with the review of administration and research services by the two team members with special experience in research administration and management, the Socioeconomics Sub Program by the two team members with relevant disciplinary expertise, and all team members reviewing the Service for Research and Development

The Review Panel was charged by INRA/MIAC Administrators with the responsibility of reviewing the three CRRA functions and suggesting ways of increasing their integration and functional effectiveness. Specifically, it was suggested that the review of the "administration and research function should include but not be limited to:

CRRA at Settat management systems to determine how they can improve support to research activities. This review should consider financial support to scientists and ease of access It should focus on inventory control needs and maintenance of equipment at the Center and sub stations.

"Specific objectives for review of the Sociology and Economics Sub Program should include but not be limited to the following:

- 1 Make suggestions on what can be done to improve information flows to scientists, policy makers and farmers.
- 2 Suggest how socioeconomic information can best be introduced into daily use of the non social science researchers.
3. Provide supporting information and suggestions on how to proceed with the development of impact assessment and monitoring methodologies for varietal, cultural, mechanic and socioeconomic information technologies.
4. Review the processes in place for the incorporation of socioeconomic information into research agenda development activities and make suggestions for improving efficiency.
5. Review and discuss the appropriate utilization of human resources in the Rural Sociology and Economics Sub Program to provide basic information, information in support of

other scientists (pre and post trial) and information to administrative policy makers

"Specific objectives for review of the Service for Research and Development (SRD) should include but not be limited to the following

- 1 Review and discuss the appropriate utilization of human resources in the SRD to provide information to outside sources versus the utilization of human resources in the technology transfer component of the Aridoculture Center program
- 2 Identify additional human resource needs and methods for provision of these resources for future expansion of liaison and research activities
3. Review in detail, the technology transfer process, and identify needs for incorporation of any additional components to support adaption of Center developed technologies at the farm level."

In conducting the review and writing the report, an emphasis was placed on the following areas: current research priorities, programs and management procedures, plans of work, publications and reports, equipment/vehicle status and needs, current staffing and future needs, the on-farm development of technology (technology transfer), and sociology and economics program and contributions.

The recommendations are based on conversations with INRA/MIAC personnel and our review of the foregoing materials.

Background reports on INRA/MIAC programs included the Scientific Review Panel Reports 1989, 1990, and 1991; the DRRR Integrated Plan of Work for 1992 and 1993; 1991 Morocco Trip Report (Hannibal Muhtar), and Protocoles de recherche Campagne 92-93. Reports on the Sociology and Economics program, which were furnished, included the Aridoculture Baseline Study and Farming Systems Typology Report by Keith Moore; Annotated bibliography of the rural sociology section documents by Fatima Nassif; Aridoculture Center Agricultural Economics Bibliography by G. Rafsnider, L. Abdelali, and Moussaoui Mohammed; "Agriculture economics: strategic plan," "Agricultural economics research program linkages," "Agricultural economics at the Aridoculture Center: A 1985-1990 research program history" by G. T. Rafsnider, and "La socioeconomie en Aridoculture. du transfert de technologies a L'innovation institutionnelle" by Moussaoui Mohammed. Reports of the Service for Research and Development included "Topic Outline on SRD/TT," "Synthesis Draft Report on INRA/SETTAT Technologies," Identification des contraintes et propositions d'actions de developpment dans la zone d'action du

C T Ouled Said Rapport du SONDEO by A Ait Lhaj, H Benaouda, A Sefrioui, T Woldetatio, and M Abdelmalki, "Final Report, On the Training Workshop Analysis and Planning of On-Farm Trials" by Deborah McGrath, and "1992/93 maize variety evaluation trials" by T Woldetatio et al. These documents and the enthusiastic cooperation of the members of all sections assisted the Panel in assessing progress of current programs and in making specific recommendations that may facilitate directions and output. While the materials and presentations were detailed and frank, the short time available inevitably constrained the Panel's analysis and should be considered in evaluating its recommendations.

Acknowledgements

The Panel expresses appreciation for the hospitality and full cooperation of everyone of the INRA/MIAC team with whom we interacted during the visit. In particular the Panel thanks Dr. M. El Mourid and Dr. Tom Gillard-Byers for coordinating the review and providing an atmosphere that encouraged the free and open exchange of information essential for a meaningful review.

REVIEW PANEL SUMMARY

At this point, the major components of CRRA-Settat as a technology development center have been established and are functioning. There is already an impressive array of technologies which are in the production systems of farmers in the region and in pipeline for DPA transfer to farmers. Still, as with any institution, especially a new institution, there are developmental problems in fine tuning the organization to operate most efficiently in attaining the central goal of increasing food production and improving the incomes of farmers with small and medium sized farms.

MIAC/INRA has identified three particular areas in which improvements are desired. One is in increasing administrative control of research and the management of field station facilities. A second area in which improvements can be made is in the utilization of the knowledge and capabilities of social and economic scientists in the technology development process. And, the third area is the organization of activities of the Service for Research and Development which further develops technological innovations after work on the research station has been completed.

These three problem areas define the general foci of this Scientific Review Panel's work. The purpose was to review the ongoing administrative activities of CRRA-Settat, the Socioeconomic Sub Program, and the Service for Research and Development and to recommend actions that would increase the efficiency and

effectiveness in attaining program goals. The Panel's purpose thus was not evaluative in the sense of judging the level goal accomplishment but rather to indicate desirable changes in direction and execution of on-going activities

As indicated in the Introduction, the review is based on examination of a wide range of documents indicating the purposes, administrative operations, planning and research processes, and off-station technology development activities. It is based too on extensive conversations with administrators and scientists at CRRA-Settat. With the benefit of this background information, the Panel had developed the following recommendations.

I. Administration and Management

With respect to research priority setting, the panel recommends:

1. The Centre should participate in any agricultural research priorities study at a national level that would help it orient its own strategy and plans in the context of national development goals and research priorities.
2. The task of setting priorities within the Centre's own research program needs to be completed as soon as possible. If necessary this could be done selectively, on only part of the program to begin with, to gain confidence in the use of priority setting procedures.

The monitoring and evaluation begins at the planning stage which identifies the objectives, the criteria for measurement and the expected results. In this respect, the panel recommends:

3. In the present context the logical framework should be used by the Centre for a quite specific purpose, namely as a tool to assist the introduction of a procedure for the monitoring and evaluation of research, that is linked to the planning process, by making clear the vertical and the horizontal logic at the level of a single project.
4. A computer based program planning and budgeting system (PBS) needs to be developed. It will store and retrieve the information needed for monitoring and evaluation.

With interdisciplinary teams, the project management is an especially important task. The Panel recommends:

5. The development of a project mode of research management would greatly assist the Centre to reinforce interdisciplinary team work. Commodity and discipline programs would be retained as administrative units, but research would be conducted in projects that address

production system constraints Resources should be placed with projects rather than programs In this mode a computerized database is a key element in linking research plans with needed manpower and funds

The growing emphasis on natural resource and environmental issues presents INRA and CRRA with the need to bring these issues into the research agenda In this respect,

- 6 The Panel recommends that the Centre give more explicit emphasis in the strategic plan and successive annual work plans to the work that will improve the management of natural resources in dryland agriculture, and that the integration of NRM concerns into the research agenda should be one of the criteria used to evaluate research proposals.
- 7 The Centre should continue to give high priority to the characterisation of agricultural environmental and production systems, and to the development of procedure to include information on the economic and social environment in its natural resources databases.
8. There needs to be provision in the Centre's planning procedures that will help it to maintain a balanced approach between production oriented research and environmental concerns.
9. In addition to outside institutional links, it would be to the advantage of the Centre to seek opportunities to establish links with other national institutions that are responsible for aspects related to natural resources and environmental issues.

There is a critical disconnection between the research project program of work and the budgeting process which leaves the project investigator uncertain about the extent of support and the Centre management unable to use budgeting as a management tool. The Panel therefore recommends that:

10. It would help to overcome some of the scientists' concerns about the budget process if, once the Centre budget allocation is known, management made the subsequent process of allocation to programs more transparent. This could be done by indicating the extent of the resource gap and how in general it intends to allocate the available resources. Programs should then be given the task of indicating how they propose to adjust the work plan they submitted to match the resources available.
11. The Panel recommends that procedures are introduced to increase the awareness of scientists of the cost of services that are now provided to them free.

- 12 The Panel commends the initiatives that are being taken to encourage scientists to submit proposals that will attract additional sources of project funding. It would be an advantage if the proposals reflect the significant NRM component of the Aridoculture Centre's work. The initiative needs to be accompanied by clear agreement with INRA and the Ministry of Finance on the way these funds can be managed, and on the establishment of appropriate non-budget accounts.
13. The Panel recommends that the Centre commission an independent study by a competent individual or organisation of the potential and the trade-offs of different revenue generating activities, before engaging into these activities.

Successful management of systems-oriented project research depends on having an effective management information system (MIS). Therefore, the Panel recommends:

14. Further development of MIS capacity at the Centre needs to give high priority to the capability to relate staff time to research activities, quickly and easily. It should also take account of the probable needs in the future of a project management mode of operation; the introduction of a charge-back system to establish full costs (e.g., soils laboratory, and experiment stations); and the incorporation of NRM concerns into the research agenda, and the increased complexity that a wider agenda implies.

In as much as human resources are the largest asset of any research organisation, it is vitally important for research management to create the conditions for the research staff to perform effectively. In this regard, the Panel recommends:

15. It is important that the Centre's management keeps informed of progress in addressing human resource management issues in INRA, and that in turn the staff are kept informed. Also that special issues that affect staff at Settat are brought to the attention of INRA in Rabat.

II. Socioeconomics Sub Program

In as much as the flow of information is dependent on the strategy employed in creating knowledge and its dissemination, the Panel recommends that:

1. CRRA, including the Socioeconomics Sub Program, should develop and adopt a strategy for the production and delivery of appropriate types of information consistent with the overall aims of CRRA. In developing an appropriate strategy, the types of research activities: research policy, priority

setting, agenda setting, prototype development, and monitoring and evaluation, can be used as a guide to forming a strategy of informational outputs

- 2 The Socioeconomics Sub Program develops identifiable functional subgroups concerned with socioeconomic of research planning, socioeconomic of innovation and research, socioeconomic of the farm household, and socioeconomic of monitoring and evaluation
- 3 The Socioeconomics Sub Program develops identifiable program and/or project groups concerned with the major technology development systems, e g , wheat, barely, rangelands.

In that, the daily use of information is possible only through the concerted joint action of all concerned scientists, the Panel recommends that

4. CRRA-Settat administration should develop scheduled occasions when the policy, research problem, priority setting, and technological issues are discussed and resolved by scientist teams, including socioeconomicists.

The development of methodologies for monitoring and impact assessment depends on access to available literature and the development of appropriate methodological skills. Consequently, the Panel recommends that:

5. The budget of the Technical Resource Library should be expanded to acquire key socioeconomic journals and to support accessing scientific databases.
6. Support should be provided for short term training of socioeconomic scientists in the necessary quantitative methods.

In consideration of demands for socioeconomic information in resolving research policy, research priority, prototype development, farming system recommendation domain, and monitoring and evaluation issues, a substantial increase in the number of socioeconomicists will be required. The Panel therefore recommends that:

7. A minimum of 6 socioeconomicists, a statistician, and a computer technician be added to the present 7 scientist staff.

III. Service for Research and Development

Because the function of SRD's on-farm research activities are to generate farm level "software" that enables the prototype

"hardware" to function properly in the farmer's field, SRD's task is primarily technology development (rather than technology transfer)

Consequently, the Panel recommends that:

1. The overall purpose of SRD should be designated as technology development through on-farm research (OFR) and linkages with supporting agencies.

Due to the trade-offs in the comparative advantages of OFR at a single versus multiple sites where CRRA-Settat now has ongoing station research, the Panel recommends that:

2. CRRA-Settat undertake a study of the comparative cost-benefits of the single OFR site at Oulad Said versus multiple OFR sites at the several outlying stations.

Due to the diversity and continual expansion of the on-farm research and linkage responsibilities of SRD, there is need for greater management control of these activities. The Panel therefore recommends that:

3. All activities of SRD be integrated into a single overall, annual plan of work, which enables SRD management to monitor progress in the attainment of its objectives.
4. SRD initiate a process for transferring the final stage of technology demonstrations to DPA management with SRD providing advisory assistance. Such a shift is consistent with SRD's primary mission of technology development and the DPA's mission of communication and diffusion of technology among farmers.

To further integrate the technology development process between on station prototype development and on farmer's field management techniques, the Panel recommends that:

5. CRRA-Settat should plan to involve SRD scientists in the on station research process (OSR).
6. CRRA-Settat should locate SRD scientists administratively in station sub programs along with the research scientists. The line of administrative accountability would pass through the sub program head to the Director of SRD who has administrative responsibility for SRD program.
7. CRRA-Settat should plan to involve a designated percentage of selected OSR-scientists' time in OFR.

As CRRA-Settat's research and development agenda expands, SRD's technology development activities must expand correspondingly.

This will necessitate a proportionate increase in staff, and the Panel accordingly recommends that

- 8 INRA/CRRA-Settat should plan to increase SRD staff toward a goal of 6 scientists (sociologist, economist, forage scientist, agronomist, animal scientist, and communications) and two technicians.

In order to provide the revenue enhancement needed by SRD to support its linkage services, the Panel recommends that:

- 9 INRA-Settat should adopt a policy of full-cost pricing of services provided to both public and private agencies

IV Appendix on Station Management

The review of equipment inventory and maintenance at the Center and substations led to the following recommendations. In view of the critical importance of maintaining communication between outlying stations and CRRA-Settat, the Panel recommends that

1. The daily communication schedule needs to be rigorously followed. Station managers must have the confidence that at least once during the day of reliably getting through to the Center. This practice needs to be clearly communicated to all parties concerned both at the Center and on the stations. Furthermore, the follow-through of the practice needs to be monitored on a regular basis.

To improve inventory systems, the Panel recommends that:

2. The equipment, spare part, and pesticide inventories need to be computerized with the ability to make weekly updates at each station and annual updates at the Center. As materials are received at each station, they should be entered into the computerized inventory. A third party store accounting group should be able to set up such a system in a relatively short period of time. Also, they could advise on the proper organization and operation of secured spare part and tool areas.

Relative to Wintersteiger machinery, the Panel recommends that:

3. Due to the vital importance of a sustained and proper functioning of the Wintersteiger machinery for precision cereal experimentation, it is of urgency that station personnel be trained up in proper use and maintenance, that a reasonable spare part stockpile be carefully defined and procured, and that a clear client-supplier rapport between INRA and Wintersteiger be established. To do this, the author proposes that MIAC/INRA arrange for a 3-4 day working visit at the beginning of harvest season of a Wintersteiger technical representative to Morocco. During that visit the technical representative (TR) would conduct a thorough training on the proper use, calibration, maintenance, and simple repairs on the Wintersteiger planter and harvester models now in the CRRA equipment park. Participants would be appropriate technicians from all three stations. If possible, the technical representative (TR) would travel to all three stations and advise on the calibration and upkeep of the machines in situ. Finally, the representative could help draw up a spare part list and establish communicating/ordering procedures for future spare part furniture. The author understands that Wintersteiger precision machines are

being used on at least five other INRA research stations outside of the Aridoculture zone. The recommended training action could be extended to include technicians from those other INRA stations. This initiative could go a long ways to assisting INRA overall in addressing this difficult and critical issue.

With respect to Gandy planters, the Panel recommends that

4. Due to the level of the expense made on the Gandy planters, and their potential for use in precision planting/fertilizing, the proper use and care of those machines should be assured. The agricultural mechanization staff at the center are competent to demonstrate the proper calibration, field use, and upkeep of those machines. The author recommends that a training session be formally organized in-house involving appropriate persons. This action needs to be done within the next few weeks if it is to be effective yet this season.

As to the maintenance of the physical facilities at the various experiment station sites, the Panel recommends that:

5. MIAC/INRA management review the possibility of covering the financing of:
 - Overhaul of the Khemis large pumps/generators, purchase of a new auxiliary pump.
 - Purchase and hook-up of an electric motor pump at Sidi El Aydi.
 - Reconstruction of the 4km roadbed at Jemmaa Shaim.

The author is aware of the tentative plans to install extensive irrigation at Khemis Zemamra. The probability of those plans must be weighed against the rather modest investment of putting the present system back into full operation.

6. As additional funding possibilities become known to the director of INRA-Settat, the precarious future of the station office buildings should not be forgotten.

To generate income for maintenance purposes, the Panel recommends that:

7. INRA investigate the possibility of adopting either a leasing formula or a custom operating formula for all of the income generating productions on all of the four stations. Adoption of one or the other formula would greatly relieve the management load of station managers regarding farm

operations, and competition for meager human and material resources. It would also allow for a streamlining of the equipment inventory necessary to carry out precision operations such as experiments, catalogue trials, and seed production

In view of the potential use of the stations for OFR as well as OSR, the Panel recommends that

8. CRRA-Settat consider the basing of one SRD technician on each of the research stations for the purpose of conducting technology evaluations and demonstrations on nearby farms

To improve the accountability of station managers reporting to responsible officers, the Panel recommends that:

9. The CRRA director consider the nomination of an assistant at the Center who would be charged with overseeing the research station management coordination. Such a person could assure the timely coordination of communication, equipment and material requests, personnel questions, and the efficient use of the agricultural machinery group as a service to the maintenance function of the stations.

ANNEX H
PUBLICATIONS BY CRRA SETTAT STAFF

Note This is an un-edited extract of the information on publications provided in the draft document "Aridoculture Center Laboratories, Achievements and Perspectives, November, 1993" Papers presented in annual reports of the CRRA Settata and MIAC, as well as planning papers, have been excluded from this excerpt

AGRICULTURAL ENGINEERING

- Vlach, J and S Lundgren 1986 Tractor mounted soil cone penetrometer Agric Engr Design Report Univ of Nebraska, December, 1986
- Bahri, A 1987 Memoir descriptif du brevet d'invention pour construction outil de travail du sol Centre Regional de la Recherche Agronomique, BP 290, Settata, Morocco (Limited distribution) 15 p
- Bansal, R K , and O El Gharras 1987 A report on small farm mechanization Centre Regional de la Recherche Agronomique, BP 290, Settata, Morocco (Limited distribution) 46 p
- Bansal, R K , and O El Gharras 1987 Memoir descriptif du brevet d'invention pour construction semoir a traction animale Centre Regional de la Recherche Agronomique, BP 290, Settata, Morocco (Limited distribution) 13 p
- Bashford, L L , K VonBargen, O EL Gharras and D V Byerly 1988 Stationary thresher evaluation report USAID Project No 608-0136 Centre Regional de la Recherche Agronomique, BP 290, Settata, Morocco (Limited distribution)
- Benlamlh, S , A Gerouali, J Hossaini, M Oukessou, and R Zinefilali 1988 Etude sur les performances des animaux de trait dans la station INRA a Settata Department de Physiologie Animale et Therapeutique Institut Agronomique et Veterinaire Hassan II, Rabat (Limited distribution) 12 p
- Bansal, R K , El Gharras, O , and Hamilton, J H 1989 A roller-type positive-feed mechanism for seed metering J of Agricultural Engineering Research 43 23-31
- Bashford, L L , O El Gharras, K Von Bargen and D V Byerly 1989 Performance evaluation of stationary threshers Pages 1845-1849 in the Proceedings of the Eleventh International Congress on Agricultural Engineering, September 4-8, 1989 Dublin, Ireland
- Von Bargen, K 1988 Economic analysis of the modified MENA thresher report USAID Project No 608-0136 Centre Regional de la Recherche Agronomique, BP 290, Settata, Morocco (Limited distribution)
- Boulanouar, B 1989 Etude des performances animaux de trait Centre Regional de la Recherche Agronomique BP 290, Settata, Morocco (Limited distribution) 15 p

- Byerly, D V 1989 Tractor performance and implement energy requirements in semi-arid soils
Unpublished M S Thesis Univ of Nebraska, Lincoln NE, U S A
- Byerly, D V , L L Bashford, R D Grisso and K VonBargen 1989 Tractive performance and fuel performance of a 2-wheel drive tractor Presented at the 1989 ASAE Off-highway Vehicle Meeting September 1989 Milwaukee WI, U S A
- Bansal, R K , O El Gharras, and B Boulanouar 1990 Performance of draft animals at work draftability and power output AL AWAMIA 71 75-86
- Bansal, R K , O El Gharras, and H Benaouda 1990 An animal-drawn seed drill for cereals and food legumes in Morocco ASAE Paper No 90-5007 Presented at the ASAE International Summer Meeting 24-27 June 1990 at Hyatt Regency at Ohio Center, Columbus OH, U S A 10p
- Bansal, R K and B Sakr 1992 Development of a vertical conveyor reaper for harvesting chickpeas and lentils in Morocco Applied Engineering in Agriculture (ASAE) 8(4) 425-428
- Bansal, R K , L L Bitney, H Benaouda, and O El Gharras 1993 An economic evaluation of the animal-traction seed drill AL AWAMIA 78 67-87
- Diekmann, J , R K Bansal, and G E Monroe 1992 Developing and delivering appropriate mechanization for cool season food legumes Paper presented at the Second International Food Legume Research Conference 12-14 April 1992 Ramses Hotel, Cairo, Egypt
- Monroe, G E , R K Bansal and A Bahri 1992 Mechanization of Lentil Harvesting in Morocco A Progress Report ASAE Paper No 928008 Presented at the ASAE International Summer Meeting June 21-24, 1992 Charlotte, NC, U S A
- Monroe, G E , O G Merkle, R K Bansal, and H Farihane 1992 Cereal grain losses from custom combining operations Al Awamia No 78 55-66
- Bahri, A 1992 Furrow openers and presswheels evaluation for no-till wheat sowing Unpublished MS thesis University of Nebraska, Lincoln NE, U S A
- El Gharras, O 1992 A piezoelectric sensor for testing seed metering Unpublished MS thesis Oklahoma State University, Stillwater OK , U S A
- Bahri, A , and R K Bansal 1993 Evaluation of Different Combinations of Openers and Press Wheels for No-till Seeding Hommes Terre & Eau (Revue Marocaine des Sciences Agronomiques et Veterinaires) 22(86) 55-66

Bansal R K , A Bahri, and R Dahan 1993 Planter, row spacing, and plan population effect on chickpea yield in Morocco ASAE Paper No 931109 Presented at the ASAE International Summer Meeting June 20-23, 1993 Spokane WA U S A

Papers currently under the review process

Bansal, R K and O El Gharras ---- Progress and prospects of farm mechanization in dryland farming systems in Morocco Submitted to the J for Farming Systems Research-Extension

Bansal, R K , G E Monroe, R Dahan, O El Gharras, and A Bahri Mechanization of lentil harvesting in Morocco Submitted to Applied Engineering in Agriculture (J from the ASAE)

CEREAL BREEDING

Scientific papers	
Papers published in scientific journals	27
Scientific papers in press	15
Papers in progress	10
Abstracts	
American Society of Agronomy	43
Others	7
Newsletters	15
Reports	
Annual reports	46
Others	91
Manuscripts	
Dissertations and thesis	5
Others (including student's manuscripts)	29
Chapters in books (in progress)	7

NB Number of publications of both Dr Selmani and Dr Ouassou are not listed here (not available)

CROP PHYSIOLOGY

- Boutfirass, M , Belkedfir M , Ait Houssa, A 1988 Fertilité et fertilisation Potassique de certains sols du haoyzs de Marrakech Act 3, Seminaire de fertilité du sol Meknes 2-3 fev 1988, p 59-61
- Ben Aouda, H , B Boulanouar, S Lhaloui, and M ElMourid 1989 Hessian fly-resistance soft wheat and nitrogen application on-farm evaluation by researchers and farmers in the Abda and Chaouia regions of central South-West Morocco In Farming Systems Research/Extension Symposium Fayetteville, Arkansas (USA), October 9-12,1989
- Benichou, M , M ElMourid, et, E Elboustani 1989 Accumulation de l'acide Malonyl-aminocyclopropane carboxylique (MACC) en reponse au stress hydrique chez le ble (communication orale et abstract) In Seminaire "Photosynthese et croissance en milieu mediterraneen Influence de la secheresse et de la salinite Oeiras, Lisbonne, Mai 22-24, 1989 Portugal CIHEAM
- Benichou, M , M ElMourid, et E ElBoustani 1993 Accumulation de l'acide -1- malonyl aminocyclo-propane -1-Carboxylique (macc) par des varietes marocaines de ble en reponse au deficit hydrique Alwamia 81 107-124
- Benichou, M , ElMourid, M et ElBoustani, E 1993 Amelioration de la methode d'analyse chimique de l'acide -1-malonylamino-cyclopropane -1- carboxylique (MACC) dans un extrait brut de feuilles de ble Alwamia 81 125 - 140
- Boutfirass, M et M ElMourid 1992 Irrigation supplementaire et varietes de ble dans les zones semi-arides du Maroc S1-10 1-12, vol 1 In International Conference on "Supplementary Irrigation and Drought Water Management Sept 27- Oct 2, 1992 IAM, Valenzano, Bari, Italy
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- Derkaoui, M , et M ElMourid 1989 Alternative cropping systems for semi- arid zones of Morocco (under Press) In International Conference on soil quality in semi- arid agriculture Saskatoon, Sask, June 26 , 1989 Canada
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- ElMourid, M 1988b Performance of wheat and barley cultivars under different moisture regimes in a semi-arid region PhD, dissertation, Iowa State University, USA
- ElMourid, M , and D G Watts, 1989 Rainfall Patterns and probabilities in the semi-arid cereal production region of Morocco (pp 34) (under Press) In Symposium on the agrometeorology of rainfed barley- based farming systems Tunis, Tunisia, 6-10 March ICARDA/WMO
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- ElMourid, M , A Soufi, et E Rahim 1989 Fertilisation des cultures irriguees au Maroc (under Press) In Seminaire IFA sur le rôle des phosphates dans une fertilisation equilibree Marrakech, (Maroc), 24-27 Octobre 1989
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Environments INRA France, les colloques, n° 55
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The Agro meteorology of Rainfed Barley-based Farming Systems Proceedings of
International Symposion Tunis, 6-10 March 1989 ICARDA, Aleppo, Syria
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North African Region Marrakech 26 Oct - 4 Nov 1993 IFAD, Rome, Italy
- ElMourid M and T E Gillard Byers 1993 Implementation of Technology transfer in the Arid
and semi-arid regions of Morocco IFAD/ICARDA Projet and INRA/MIAC Project Third
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A Dissertations are published under agronomy and not under soil physics

B The soil physics laboratory have not been well managed to organize its publications

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