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MID-TERM EVALUATION PROJECT

The Dryland Agriculture Applied Research Project
USAID Project 608-0136
Morocco

Prepared for:

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LIST OF ACRONYMS

AID	Agency for International Development
AIRC	Agricultural Information Resource Center - Settat (Centre de Conjuncture)
ANAFID	National Association for Land Consolidation Irrigation and Drainage (Association Nationale des Ameliorations Foncieres de l'Irrigation et du drainage)
ANE/TR/ARD	Africa and Near East (Bureau) / Technical Resources (Office) / Agriculture and Rural Development
CDN	National Documentation Center (Centre de Documentation National)
CDSS	Country Development Strategy Statement
CIMMYT	International Maize and Wheat Improvement Center
CT	Extension Center (Centre du Travaux)
CRSP	Cooperative Research Support Project
DAARP	Dryland Agriculture Applied Research Project
DDR	Division of Development Resources (Direction du Development Rural)
DPA	Provincial Level Agricultural Office (Direction Provincial d'Agriculture)
FAO	Food and Agriculture Organization
FSIP	Farming Systems Infrastructure and Policy
FSR	Farming Systems Research
FSR/E	Farming Systems Research/Extension
GOM	Government of Morocco
GNP	Gross National Product
IANR	Institute of Agriculture and Natural Resources
ICARDA	International Center for Agriculture Research in Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
INRA	National Agronomic Research Institute (Institut National de la Recherches Agronomiques)
ISNAR	International Service for National Agricultural Research
IAV	National Agronomic and Veterinary Institute (Institut National Agronomique et Veterinaire - HASSAN II)
LOP	Life of Project
LDC	Less Developed Countries
MARA	Ministry of Agriculture and Agrarian Reform (Ministere de l'Agriculture et de la Reforme Agraire)
MIAC	Mid America International Agricultural Consortion
MOU	Memorandum of Understanding
PACD	Planned Assistance Completion Date
PE	Professional Engineer
PT	Participant Trainee
SR/CRSP	Small Ruminant/Cooperative Research Support Project
TA	Technical Assistance
TRC	Technical Resources Center
UNL	University of Nebraska, Lincoln
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

The Dryland Agricultural Applied Research Project (DAARP) was first implemented in 1980 to increase basic food production and establish an applied agricultural research program. It was redesigned and expanded in 1984 to more fully meet the needs of dryland farmers in the 250-450 mm precipitation zone. The DAARP is essentially an institution building project. The primary project components are technical assistance, research, training, funding and facilities. The GOM provides the physical facilities, operational inputs and participant trainees and MIAC provides the technical assistance (TA) staff, equipment, and training for long and short-term participants.

Physical facilities provided by INRA include buildings for offices, laboratories, workshops, a mechanization center and greenhouse headhouse at the Aridoculture Center. In addition, INRA provides four satellite research stations.

The MIAC staff supervises the academic and research programs of PTs. The PTs complete their course work in U.S. universities and dissertation research in Morocco. M.S. level degrees will be awarded by U.S. universities and doctorate degrees by IAV.

Since implementation of the redesigned project in 1984, the project has made excellent progress. All MIAC TA positions are filled and the staff is actively engaged in research and in providing advice to participant trainees. Research is being conducted by INRA and MIAC staff in Aridoculture Center laboratories, at three satellite research stations and on private farms. The on-farm research trials provide an opportunity to conduct research under a broad range of environmental conditions. Research projects involve cereal breeding, food legumes breeding and management, crop management, soil and water conservation and management, forages, agricultural engineering and mechanization, socio-economics research and plant pest management. The research program is generally developmental oriented. Exceptions are in cases where PTs are doing thesis research of a more fundamental nature to meet dissertation requirements.

The direction of the research work is generally on target. However, additional support is needed in plant pathology and agricultural economics. The forage component should also be strengthened and a livestock component added later when the project is extended. While good progress has been made with diagnostic trials at the farm level, the focus to date is largely on production components without much integration of the components into farming systems. The farming systems research and extension approach has been initiated but needs further development, much of which can only be implemented in an extension of the project.

In addition to the long-term TA, MIAC has also provided in excess of six person years of short-term assistance. Short-term consultants provide guidance and advice to PTs, evaluate research plans, support MIAC research and administrative staff.

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The DAARP calls for cooperation among INRA, MIAC and IAV staff. IAV faculty members were to serve as co-advisers to INRA PTs and serve on graduate committees. To date and for reasons not well understood by the Evaluation Team, cooperation has been minimal. The problem should be solved, in part at least, as the PTs move through the process of completing Doctor of Science requirements at IAV.

The project is now established and moving deliberately to meet its goal and purpose. However, the institution building process is long-term. It is the judgement of the evaluation team that another ten years of assistance will be required before the Aridoculture Center can stand alone.

The importance of agricultural mechanization has become apparent as new technologies become available and more farmers progress from subsistence toward commercial agricultural production. However, in some areas, particularly those with sloping to steep and/or shallow, stony soil, animal traction is utilized. The agricultural mechanization research program now in progress places major emphasis on farm equipment to meet the needs of the farmer with small or mid-size land holdings. Tractor power for this size equipment is readily available in Morocco but there is a need for improved tillage, planting and harvesting equipment. The need for new technologies to accommodate the small-scale farmer is also being addressed. Additional emphasis will be given to the mechanization needs of the small-scale farmer with the assignment of an animal traction mechanization specialist from International Center for Research in Semi-Arid Tropics (ICRISAT) to the project.

The place of forages in the cropping system has been given relatively little attention by the project. Further, despite the fact that 70 percent of the livestock production in Morocco is associated with cereal crop production, the project has had no livestock component. In order to more fully utilize available land and moisture resources and optimize farmer income, livestock must be fully integrated into the farming system research program.

The current project related research of the PTs is designed primarily to meet dissertation requirements and tends to be single discipline oriented. The research conducted by the TA staff tends to have a broader focus. Both PTs and MIAC staff are aware of the need to develop fully integrated multidisciplinary research programs that address the agricultural development of the semi-arid lands of Morocco.

A better understanding of the needs of the small farmer is required if appropriate technologies and strategies are to be developed to meet their needs. Thus, a socio-economics component is essential for project success. The socio-economic component is being addressed by MIAC TA and through a MOU with IAV. The MIAC socio-economic studies have started only recently but appear to be providing some useful information and guidance for the technical MIAC staff. However, to date the value to the project of the socio-economic contributions from IAV appears limited. Indications are that the potential value of future contributions is questionable.

The Drylands Project has made significant progress since 1984 in the development of facilities, training of Moroccan staff and advancing the applied research program. The research program is well focused but programs

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need more time for development, and the project should be extended for at least another ten years. Areas that need additional inputs are socio-economics, livestock, food legumes and the development of a systems approach to research and extension. This will require additional expatriate and Moroccan personnel, further planning and implementation to increase coverage of on-farm trials, more on-farm testing and integration of production components with more participation of the Extension Service and farmers. The organization of Farming Area Research Teams is recommended.

INRA has expressed the intention to improve research management by further developing the concept of management by objective. Properly implemented, this should result in more effective research management and research directed to some agricultural development problems in Morocco. The placement of a Management by Objective/Research Administration and Management Specialist in INRA to further develop and consolidate the concept is suggested.

The farm machinery program should study alternative tractor powered equipment for land preparation and seeding as well as improvement of animal traction equipment for small farmers.

Technical assistance should be considered for planning and management of extension and research on a national and regional basis to improve budget handling and administrative services and to decentralize planning and execution of research programs.

We believe that the Aridoculture Center should be physically and administratively separate from INRA regional headquarters.

I. BACKGROUND

The Dryland Agriculture Applied Research Project was designed to increase basic food production to meet the needs of Morocco's rapidly increasing population and improve the income of traditional small dryland farmers. This was to be accomplished through a program of training, technical assistance and institution building which would create and sustain an environment in Morocco in which these goals could be reached.

Given the economic and social conditions existing when the project was designed, the goal was formidable. When coupled with the severe drought that embraced the project area during the 1981-84 period, the tasks were magnified and the likelihood of success within the projected time period reduced.

Agriculture is critical to Morocco and is expected to continue to be so for the forseeable future. There are approximately two million households in Morocco dependent on agriculture. It is estimated that 51 percent of these depend on rainfed agriculture which also includes livestock production (6).

Despite the importance of agriculture to Morocco, the rural people do not share equally in the wealth and income of the country. The current GNP per capita in Morocco is $760 and the absolute poverty level is estimated to be $238 for rural areas. It is further estimated that 45 percent of the rural population fall below that level (6). While malnutrition is not considered critical at this time in Morocco, the general plight and economic condition of the rural population is obvious.

Cereal grains constitute a major portion of the Moroccan diet. The primary production area for cereal grain falls within the 250 mm to 450 mm precipitation zone. While agricultural production in this zone is limited due to a shortage of moisture and poor farming practices, there are opportunities for significant increases. It is generally accepted that a combination of improved practices including mechanization, tillage operations, pest control, variety improvement, soil moisture conservation and the use of fertilizers in some areas would result in economic production increases. However, technologies adapted to the ecological and cultural environment must be developed and transferred to the farmer in order for production to be increased and the socio-economic status of the farmers strengthened.

It is within this setting that the Dryland Agriculture Applied Research Project was developed. The project started in 1980. However, a combination of start-up problems and drought severely limited progress in the initial stages. The project was redesigned in 1983 in order to correct problems which had contributed to lack of project progress. The redesigned project was implemented in 1984. The revised and expanded project benefitted from a break in the drought beginning in 1984 and has since made considerable progress in meeting its intended project objectives.

II. EVALUATION SCOPE OF WORK

This mid-term evaluation is consistent with requirement of the amended Project Paper (4).[1] Its purpose is to determine progress toward meeting project purposes and goals and the likelihood of their achievement within the present life of project (LOP). The objective of the evaluation is also to identify project needs and additional research activities or adjustments that may be required to meet the project's goal and purpose. The objective of the evaluation also provides an analysis of, and need for, project adjustments and extension beyond the present LOP. (Appendix A)

III. EVALUATION METHODOLOGY

The evaluation was conducted by an experienced multidisciplinary team whose expertise included all factors called for in the evaluation scope of work (Appendix A). The team was assembled in Washington D.C., provided briefings by the Contractor and AID/Washington and then proceeded to Morocco. Five weeks were spent in Morocco conducting the evaluation and preparing of the evaluation report. Information on which the evaluation and analysis are based was obtained by review of pertinent documents, interviews and discussions with GOM officials and staff, USAID staff, Contractor (MIAC) staff and Moroccan farmers and through observation of facilities, field trials and agricultural activities in the areas of travel in Morocco. Observations made and analyses of information and data from project activities were continuously tested as to their appropriateness and fit with the expected outputs and assumptions of the logframe. There was close interaction among evaluation team members with continuous analysis and feed-back into the evaluation process. The evaluation was a dynamic process, formally ended only by time requirements and the need to complete an evaluation report. (Appendix C)

IV. PROJECT STRUCTURE AND INSTITUTIONAL COMPONENTS

A. USAID

1. The Dryland Agriculture Applied Research Project is administered by USAID/Rabat through a contract with MIAC. Project direction and monitoring is provided by a USAID/Rabat Project Committee which reports to mission management.

2. AID/W supports the project at the Washington level through a backstop officer in ANE/TR/ARD.

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1. Refers to Appendix D, Bibliography of materials consulted.

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B. GOM/MARA

1. The National Institute for Agronomic Research (INRA) is the research arm of the Ministry of Agriculture and Agrarian Reform (MARA). INRA is the GOM implementing agency for the project. Project activities are centered at the Aridoculture Center in Settat and at INRA research stations located at Sidi El Aydi, Jemma Shaim, Tessaout and Annoceur and to a lesser degree at the Guich Station. The Aridoculture Center is administered by the Regional Research Director at Settat who also serves as the INRA Project Director. Moroccan research and support staff are responsible to the INRA Project Director.

2. The Provincial Director of Agriculture (DPA) is the Provincial representative of the Minister of Agriculture and Agrarian Reform. The Aridoculture Center is located in Settat and, as such, is under the general jurisdiction of the DPA. The DPA is not directly involved with the Center research program. The extension function of the MARA is implemented at the local level through the Extension Centers (CT) which administratively are under the DPA. The Aridoculture Center staff work with the CTs in on-farm research trials. The CTs will assume a more important role related to the Aridoculture Center function as research is developed, adapted and extended to the farmer.

3. The Agronomic and Veterinary Institute (IAV) is a major academic institution, under the MARA, with the responsibility for developing and conducting programs in teaching, research and extension. The institute has a faculty of approximately 350 and serves around 2300 students in several agriculture related academic disciplines. IAV has two primary avenues for cooperation with the Aridoculture Center. First, IAV faculty are to serve as co-advisors to INRA participant trainees doing dissertation research in Morocco following academic course work in the U.S. The institute is also to develop and implement procedures for convening a jury, examining doctoral candidates and awarding the Doctor of Science to successful candidates. Opportunities exist for further cooperation and collaboration between the Aridoculture Center research staff and IAV faculty. However, relatively little has been accomplished in this regard.

The second major area of cooperation between IAV and the Aridoculture Center is made possible through a memorandum of understanding (MOU) (5) between USAID/Rabat and the Division of Development Research (DDR) of IAV. This MOU calls for DDR to conduct a program of socio-economic research in the project area, develop an Agro-Economics Information center (AIRC) which is also known as the "Centre de Conjorture" and provide the INRA/MIAC research staff with socio-economic information. This information is to provide guidance for development and implementation of appropriate research technologies and to contribute to the extension of adapted technologies to the farmer level. This MOU is funded and administered outside of the MIAC contract.

C. MIAC

1. MIAC is a consortium of five universities formed to utilize technical, scientific and administrative expertise to address problems of agricultural development in less developed countries (LDC). The five

universities are: the University of Nebraska, Kansas State University, Oklahoma State University, Iowa State University and the University of Missouri.

2. Technical services to the GOM are provided through a contract between MIAC and USAID/Rabat. The University of Nebraska is designated as the MIAC Lead University. As such it is responsible for administering the contract and meeting contract requirements. The MIAC team in Morocco is provided backstop support by MIAC and University of Nebraska staff located in Lincoln, Nebraska. MIAC provides the technical assistance (TA) component of the contract by providing long-term research, administrative and support staff and short-term consultants from MIAC universities.

3. The MIAC Team Leader in Settat (Morocco) is responsible for the in-country aspects of the contract between MIAC and USAID/Rabat. He is administratively responsible for all MIAC expatriate and local hire staff. The Team Leader is the primary liaison between USAID and MIAC. He is also responsible for assuring cooperation and collaboration with IAV, DPA, INRA and other appropriate agencies and institutions in Morocco.

4. MIAC cooperates in the selection of participant trainees and in their assignment to MIAC or other appropriate U.S. universities. MIAC has responsibility for supervising and monitoring the progress of PTs doing their course work in the U.S. and dissertation research in Morocco. The MIAC advisor will also serve on the jury when the PT submits his dissertation to IAV.

V. PROJECT STATUS, ANALYSIS AND RATIONALE

A. Agronomy Plant Protection and Soil Science

A research team of eight MIAC scientists and nine Moroccan graduate degree candidates (Appendix K, Table 13) are focusing on the most important constraints which limit agricultural production in the project area. These constraints and needs include: A high frequency of soil moisture stress during the growing season; a need for cereal varieties, particularly of durum wheat and barley which will give satisfactory yields under a wider range of moisture conditions than varieties currently in use; insufficient available soil nutrients, particularly in soils of the better rainfall areas, and in years of good rainfall; crops and cropping sequences which do not provide an adequate supply of good quality feed and forage for livestock; crop-damaging insects, pests and diseases endemic in the area; persistent noxious weeds which frequently contribute to lower yields; and varieties of food legumes, particularly of chick peas and broad beans, that are highly susceptible to certain plant diseases.

1. Validity of the Log Frame

a. Inputs

The research team provided by MIAC together with the INRA graduate candidates (Appendix K, Table 13) are engaged in on-station and some on-farm

research on the constraints and problems identified above. We believe that the composition of the MIAC team is adequate in number and quality of the scientists in the discipline of cereal breeding, cereal and forage agronomy, soil fertility, soil management, weed science and entomology (Appendix K, Tables 6, 7). However, there are two important disciplinary gaps in the team; plant pathology and food legumes. In the case of plant pathology, the cereal breeder, cereal production agronomist and the Moroccan food legumes agronomists need the backstopping that can be provided only by an experienced plant pathologist. A long-term plant pathologist would: work closely with the cereal breeder (variety section) to insure that varieties under test in the project area are adequately screened for disease resistance; provide the Food Legumes Agronomist with needed assistance in his evaluation and testing of new varieties of food legumes particularly of chick peas and lentils for suitability with respect to disease resistance; and serve as the on-site advisor for the two Ph.D. and the M.S. candidates who returned to Morocco late in 1985 and are now engaged primarily in thesis research. Forty-eight months of long-term services by a U.S. Plant Pathologist is recommended (Appendix F, Table 4).

The project area provides more than one-fourth of Morocco's total food legume production. Food legumes are a very important source of much needed protein in the Moroccan diet, particularly for low income people. In addition their inclusion in the crop rotation can significantly increase the yield of the succeeding cereal crop through biological nitrogen fixation. One Ph.D. candidate who returned to Morocco only one year ago is carrying the full responsibility for food legumes research in the project area, while at the same time he is engaged in thesis research. He needs help. A second participant, is still studying in the U.S. and is not expected to return to Morocco until 1988.

We recommend that an U.S. Agronomist (Food Legumes Production) position be added to the team for a total of 48 months (Appendix F, Table 4). In addition to research on the agronomic aspects of incorporating food legumes in improved cropping systems for the different ecological zones of the project area, he would serve as on-site graduate advisor to the Ph.D. candidate now on the project and the M.S. candidate when he returns in 1988.

With respect to the professional qualities of the technical assistance team members, there is nothing in the research review reports and evaluations, which we have read nor in our contacts with them, which revealed weaknesses in professional competence (14) (15) (16). Also, we have been impressed by their seriousness and enthusiasm for the research in which they are engaged. The focus of their research is on priority production problems of the dryland zone.

Two kinds of consultants have contributed importantly to the present momentum of the project in the agronomic, soil science, and plant protection disciplines. The most frequently used consultants are U.S. University professors who come to advise and assist the Ph.D. and M.S. candidates in the planning and execution of theses research which they are doing in the project area. Research by the graduate candidates is an integral part of the problem solving search for new technology and improved farming practices, and graduate candidate advisors are a valuable scientific resource for the project. Consultants are required to submit reports of

their visits to the MIAC Project Director (20) (23) (24) (25). Appendix K, Tables 9, 10, 11, 12 gives the number and kinds of consultants, the time they spent in the project area and their disciplinary specializations.

Project consultants who have had long and successful experience working on similar projects in similar ecological and cultural conditions can provide valuable guidance and suggestions in project organization, priority areas for research, and how to make the host country/U.S. scientist relationship more effective. Such a report is that submitted by the Assistant Dean, International Programs, Oklahoma State University, dated October 17, 1985 (21). We suggest that the recommendations in this report be given most serious consideration.

The schedule of professional visits in Appendix K, Tables 10, 11 show that most U.S. faculty advisors are making the required number of visits during the candidates' thesis research. However, the Ph.D. candidate in food legumes breeding, may not be receiving as much advice and guidance from his major professor as desired or as initially planned. His professor has visited the project only once, in May 1983, almost two years before he returned to Morocco in early 1985 for his thesis research.

Twenty-six of the 32 planned participants have gone to the U.S. for graduate level studies. Of this group, 17 have returned (Appendix K, Tables 2, 3). Nine are doing thesis research for their Doctorate degree and 8 for the M.S. degree (Appendix K, Tables 2, 3). The participant selection progress has been very competitive. Scholarship, initiative and industry figured prominently in the final selection. Consequently, none have dropped out for academic reasons. One participant, not funded by this project, who married an American while at an American university, left the project and returned to the U.S. for personal reasons.

The distribution of participants between the different disciplines could have been a bit different to give a better balance. For example, six cereal breeders all at the Ph. D. level may be unbalanced when one considers the entire range of problems constraining and affecting crop production in the project area and in Morocco (Appendix K, Table 2). An additional one or two participants in weed science (M.S.level) would seem to be justified. Likewise, a number of subject matter areas are yet to be benefitted by U.S. graduate level training. These include but are not limited to; soil and water conservation and use, agricultural-meteorology, animal science, agricultural engineering, farm machinery operation and maintenance. Specialized training should be provided for maintenance and repair of scientific laboratory equipment.

One U.S. soil fertility specialist and two M.S. graduate candidates are focussing on soil test calibration research on the major cultivated soils of the project zone. Soil moisture, in dry years, is the first factor limiting production, but when rainfall is good, yields are substantially below potential because of inadequate levels of soil fertility, particularly of nitrogen and phosphorus. In recent years new varieties have been developed, in some countries, that yield as well as the old ones under limited rainfall, but have a much higher yield potential when soil moisture and fertility are adequate. Past research in Morocco to develop fertilizer recommendations with wide applicability has not been satisfactory. In some

areas of the project money spent for certain fertilizer nutrients, potassium for example, is money wasted. In other areas the amount of nitrogen used may be much below optimum, and response to phosphorus, according to initial trials, seems to be highly variable.

We believe, as did the Scientific Review Panel, (15) that the soil test calibration work is urgently needed and that research in progress and planned will provide a technically sound basis for setting up a soil testing program.

Three Moroccans are being trained in soil fertility, one to the Ph.D., and two to the M.S. level (Appendix K, Table 2). If the two M.S. candidates successfully complete their degrees, they may eventually return to the U.S. for Ph.D. studies.

b. Outputs

Numerous start-up problems in the first years of the project and a series of disastrous droughts has severely limited the amount of research results available for on-farm generalization.

The 1986 harvest, if good weather conditions prevail during the remainder of the growing season, will be only the second satisfactory harvest since the current project began. Since a minimum of three years of testing and verification trials are required before a simple practice or production input can be recommended with confidence, and four or five years are needed for testing and on-farm verification of cropping sequences and systems, it is too soon to expect that complete packages of new technologies and practices would be applicable for on-farm application. However, weed control research and testing and the testing of some cereal varieties, has provided sufficient results to support a limited set of extension recommendations.

Applied research and verification trials designed to generate valid data for eventual use in extension programs are being actively pursued in 1986. Some 150 research trials, focussing on selected crops production problems, have been placed on research stations. In addition, more than 40 on-farm diagnostic and verification trials, and demonstrations have been installed.

Of the 32 planned (17 Doctorate and 15 M.S.) graduate level participants, 26 have been sent to the US for graduate course work (Appendix K, Table 2). All are in agronomic, plant protection and soil science disciplines. Assuming that no more long-term participants are sent for training and that those in the U.S. and those doing thesis research in Morocco successfully complete graduate requirements, the planned number of Ph.D.s will have been achieved but the number of M.S. participants will be six less than planned. Appendix K, Table 2 contains a complete list of graduate degree candidates, their specialization and present status.

As of this date the status of the graduate degree program is as follows:

	On Project	In U.S.	Total
Doctorate Candidate (No).	9	8	17
M.S. Candidate (No).	8	1	9
			26

None of the returned candidates have completed thesis researc requirements. We believe that in the case of the Doctorate PTs, the prescribed procedures for supervised research and preparation of a dissertation are not being adequately followed. This problem is examined in more detail elsewhere in the report (Paragraph V, A, 3, a).

It is anticipated that by the end of the current project enougl field data on fertilizer response will have been accumulated to construct valid fertilizer recommendations for cereals grown on the major kinds of soil in the more humid parts of the project area. The ultimate objective is to develop a soil testing program that will provide specific fertilizer recommendations to farmers based on the kind of soil, current nutrient content of the soil cropping history, crop to be grown and expected moisture regime.

2. Progress toward Achievement of Purpose and Goal

a. An Established Applied Dryland Research Program

Substantial progress has been made toward achieving this element of the project paper purpose. An aggressive program of applied research on important production problem in the project area is in progress. The research was planned and is managed by a very qualified staff of U.S. specialists, in concert with their Moroccan colleagues, the graduate degree candidates. The focus of the applied research is clearly in accord with GOM national policy; increasing food and feed production and farmer incomes.

A set of well prepared workplans for 1985-86 (9) document research progress in prior years, summarize program components and describe in adequate detail the research trials, tests, etc. to be undertaken by each of the research personnel in his/her area of specialization during the current crop year.

Full achievement of the project purpose includes the development of a motivated well-trained Moroccan staff of professional researchers capable of conceiving, planning and carrying out the agronomic and related research needed to increase farmer productivity in the project zone. This part of the project purpose will be only partially achieved by the end of the current project. We estimate that because of time limitations, only 20 of the planned 32 participants, (Appendix B) or 62 percent, will have completed their degree requirements during the current LOP. For example, three of the five cereal breeders studying in the U. S. will not complete their course work until July 1988, and one will return in September 1987, only one year before the end of the current project (Appendix K, Tables 2, 3, 4). Following their return to the project they will require, based on the record of current returnees, at least two years to complete their dissertation research and prepare and defend their theses. In soil science two participants will not complete course work before June 1988 (Appendix K, Table 2). So it is safe to say that a nucleus of Moroccan research staff will be in

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place and functioning by August 1988 but that shortages will be felt in cereal breeding and soil science.

Reports indicate that the U.S. and Moroccan scientists are more and more working as a team toward a common goal. To this end the MIAC Team Leader has proposed the formation of joint committees for inter-team discussion and critique of research plans, a joint committee for review and editing of reports and publications, joint research projects that are not a part of thesis reseatch, frequent seminars, and organization of an INRA/MIAC workshop.

Two soil maps (1:100,000 scale) of the Chaouia and the Abda regions prepared by IAV soil scientists show the major kinds of soil and some of their properties important for fertilize responses. Field fertilizer response trials have been established on three major kinds of soil. Soil maps of other regions are needed to assist in the selection of sites for additional fertilizer trials on other important kinds of soil.

A total of 24 trials including nine on-farm sites were established in 1985-86 (9).

b. Moroccan Research Staff

As noted above 17 of the 26 degree candidates are now doing thesis research in the project area (Appendix K, Table 2, 4). Until now none has completed a graduate degree. It is expected that until degrees are completed the major portion of their research efforts will be on their individual research problems.

With the return of the six participants still in the U.S., the project will still be six short of the number planned.

The MIAC staff recommends that the six remaining participants be in the following specializations if the training program is continued: soil fertility, water conservation (soil physics), water conservation (agri. meteorology), weed science, and agricultural machinery. All but the agricultural machinery participants would be at the Doctorate level.

An additional Doctorate in soil fertility and two Doctorates in soil and water conservation and agrometeorology can be justified on the basis of the complicated and highly variable nature of the soils and water resources of the project area. Most crops respond to nitrogen in years of good rainfall. However, in the drier parts of the project, economic responses to fertilizer are less likely. There is a problem of maximizing water infiltration and storage in the soil profile in some of the southern parts of the project area. The use of water diversions and water catchment structures to provide water for better soils down-slope need further study and research by water conservation and management specialists. Development of adequate human resources to operate the program and transmit the results to farmers as specified in the log frame (Appendix B), is going well with respect to course work. However, it will require several more years before an effective team of Moroccan researches is in place.

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3. Performance and Problems

a. Graduate Degree Program

The MIAC contract specifies that course work for the Doctorate degree and required qualifying examinations will be accomplished in the U.S., and that thesis research will be done in Morocco and that the degree awarded by the IAV.

A successful graduate degree program is critical to the achievement of the project purpose: to train adequate Moroccan staff to operate the program and transmit the results to farmers. Until now, no degrees have been awarded, although the participant training program began in 1980 when two M.S. level and one B.S. level candidate began their studies in U.S. universities. In 1982 two M.S. level participants began studying for Doctorate degrees (Appendix K, Table 2).

In depth discussions with the Doctorate candidates and the MIAC Team Leader revealed that IAV faculty members have not contributed to the planning of graduate research or provided advisory assistance during the course of the research. This was confirmed, in the case of agronomy and soils science, in conversations with the Chairmen of those Departments at IAV. A document "Participant Procedures," prepared by MIAC (10) in Lincoln, Nebraska specifies that for Doctorate level training:

(1) A U.S. major professor and advisory committee as well as an IAV advisor, will be appointed.

(2) The major professor will discuss possible research directions with the IAV advisors.

(3) A request will be made for courtesy appointments for the IAV advisor to the U.S. advisory committee and for the MIAC advisor to IAV for the purpose of supporting a specific participant.

(4) The MIAC and IAV advisors will provide guidance in the preparation of the dissertation in Morocco.

(5) When the major professor, with the concurrence of the IAV Advisor, approves the dissertation, the participant will present it to the IAV for review and defense.

(6) The IAV will conduct a review of the dissertation by an international jury.

(7) If successful, the participant will receive the Doctorate of Science from the IAV.

The concerns of the participants regarding the lack of input by IAV faculty and the requirement that IAV will award the Doctorate of Science degree, are strong enough that project progress and future achievements could be threatened by the apparent breakdown in participant training procedures.

b. Future Provision of MIAC Research Staff

Incumbents of the following positions will complete their assignments in mid 1987: cereals agronomy, senior plant breeder, forage agronomist, weed scientist, and sociologist. The long-term cereal breeder (variety selection) and the entomologist, who is on a one-year sabbatical program, are scheduled to depart soon, as shown in Appendix K, Table 8. We understand, that the entomologist position may be filled by another professor on sabbatical leave. With respect to the other four positions, MIAC should not attempt to fill them if the project is not extended.

c. Installation, Maintenance and Repair of Scientific Equipment

The project has received, or plans to order laboratory, and related equipment valued at over $630,000 (Appendix F, Table 2). Early in the project it was recognized that a skilled technician experienced in assembling, installing, calibrating and repairing laboratory instruments and equipment would be required. A full-time American was recruited for this purpose (Appendix K, Table 6). He is scheduled to leave later this year and whether he will return is uncertain. During his stay he did not receive a Moroccan counterpart adequately qualified to be trained in the technical skills required. Thus there will be no one in that position if he does not return. Although one can argue that the project was overly generous in providing certain sophisticated laboratory equipment, the responsibility for its proper installation, care and maintenance remains with MIAC as long as the project continues. MIAC is also responsible for training a Moroccan technician in this area once a qualified person is provided by INRA.

4. Assumptions

The diverse activities of the DAARP include much research which is single discipline oriented, but beginning this year more and more of the projects are multidisciplinary. One specialist of the MIAC team has been designated as Research Coordinator and his responsibilities include coordination of research activities among research personnel, and where feasible integration of research into a multidisciplinary approach.

With respect to rainfed agriculture the GOM remains committed to support a strategic emphasis on that very important segment of agricultural production. This is evidenced by the World Bank loan to increase rainfed agricultural production by integrated agricultural development projects in eleven rainfed areas, including Settat province (26). In addition GOM pricing policy for inputs (fertilizers, seed, and herbicides) and prices received by farmers for cereals and food legumes are more favorable to farmers than in former years.

There is no evidence that Moroccan agricultural researchers are reluctance to adopt improved research and research and assessment methods. All researchers on the project have been trained in the U.S. and in so far as we could learn fully accept and follow research methods and procedures recommended by their U.S. research advisors.

Of the 18 participants who have completed course work in the U.S. only one has left the project. The remaining 17 are doing thesis research in the project area to meet graduate degree requirements (Appendix K, Table 3).

B. Agriculture Engineering and Mechanization

1. Validity of the Log Frame

a. Inputs

The Professional Engineer and his American assistant are particularly well qualified to design and test new equipment and to modify existing machinery to meet requirements imposed by soil and crop management conditions (18). Equipment and supplies costing some $177,000 have been requested for use in farm machinery studies, design, and testing.

Although the Professional Engineer has been in Morocco little more than one year, he has made excellent progress in identifying and establishing priority research and development needs in agricultural engineering and mechanization and in planning basic research facilities. Both short and long-term objectives have been set forth by the agriculture engineering staff (Appendix G, Tables 1, 2).

Experience in other countries of the Mediterranean basin in dryland cereal production has clearly demonstrated that an appropriate level of mechanization can contribute to increased dryland production (25). This fact was recognized in 1978 by those who designed the first phase of the project. It was also recognized that smaller scale Moroccan farmer will not be able to afford a full, or even partial, line of equipment just for their own operations.

Even though small farms make up a substantial portion of the arable land area of the project, there has been a rapid increase in the level of mechanization in the project area in recent years. For example in 1985 in the Settat province there were 3,556 farm tractors and 669 combines. The same census enumerated 4,967 animal-drawn plows, 6,175 horses and 2,070 camels. These numbers indicate that, even though the use of tractors and combines is increasing, animal traction is still an important source of farm power in the project area.

Substantial numbers of small farmers have access to engine-powered equipment through hire arrangements or by becoming members of a machinery cooperative. Pressure on farmers to use powered machinery is increasing due to seasonal labor shortages particularly during harvest, relatively low labor productivity, and the need for timely land preparation. It was reported that the cost of hand harvesting of wheat and barley in one area was four times that of combine harvesting.

A study was made of 48 farms in the Chaouia region by the DDR (29) (30) (31) of how the several operations were performed for seed bed preparation, planting, covering and harvesting of durum wheat and barley. The universal method of seeding by hand broadcasting, (36) indicates that that method of seeding may be a fertile field for research. Similarly,

there may be a need for appropriate engine or animal-powered harvesting equipment on medium to small farms in some areas to replace the hand sickle.

The Agriculture Engineering/Farm mechanization segment of the project focuses on the perceived problems of: tractor-drawn primary tillage implements of proper design for good seedbed preparation, moisture conservation, and maintenance of good subsoil structure; the need for improved tractor and animal-drawn grain drills of proven design; and the need for a range of improved animal-drawn implements (Appendix G, Tables 1, 2).

b. Outputs

To address the problem of inadequate primary tillage equipment for seedbed preparation, the agricultural engineering section has developed a prototype tractor-drawn sweep implement. The project engineer anticipates that the new tillage tool will have undergone field tests and, if proven successful, will be ready for manufacture in Morocco by the PACD. If field and on-farm performance of the sweep fulfills expectations, it will be an important contribution toward the solution of primary tillage and moisture conservation problems in an important part of the project. If following successful testing the sweep is manufactured in Morocco that will be an additional boost to the presently depressed economy.

The sweep is expected to perform most effectively on the moderately-deep and deep vertisols (dark-colored, self-mulching soils that are high in clay) of Settat and Safi provinces. It is designed to work in both dry and moist soils conditions. These kinds of soils occupy a relatively small but very important portion of the project area. They are inherently the most productive soils in the project area for cereals, food legumes and forages. And, most importantly, they probably have the best potential for additional yield increases from improved technology, improved seed, use of optimum amount of fertilizers and weed control.

Considering the highly variable soil conditions including depth, slope, degree of stoniness and compaction, and behavior when moist within the project area it is unlikely that one kind of primary tillage tool will be generally adapted. There are many areas where the chisel type of tractor drawn tillage implement would seem to be more effective that the sweep type because of stoniness, uneven soil surface, degree of compaction, etc.

A broad selection of animal-drawn and small engine-powered equipment suitable for small farmers is on order from certain Asian countries. It is expected that they will undergo field and laboratory testing and evaluation in late 1986, under the supervision of an agricultural engineer from ICRISAT who has experience with small farming implements.

2. Progress toward Achievement of Project Purpose

a. Extension of New Machinery Technology to Farmers: It is too early to have had on-farm testing of new prototype farm machinery. Research and development of new designs usually requires several years and the current design activity is barely one year old.

If station and on-farm testing of animal drawn and small engine-powered machines reveals superior implements it is expected that the lag time before the new tools are available to farmers will be minimal. Any new animal-drawn implements of improved design suited to conditions in the project area could be produced in Morocco by existing manufacturers. To encourage farmer purchases, the GOM has eliminated all import taxes on engine-powered equipment and tools and qualified farmers may obtain loans on favorable terms for purchase of farm machinery.

Two primary operations essential for optimum yields of cereals are good seedbed preparation (primary tillage) and the use of seed drills with fertilizer placement features. Proper placement of fertilizers at seeding time insures early and efficient mineral nutrition of the crop. It is suggested that with the arrival of the small equipment for testing, high priority be given to the testing and/or development of seed drills with fertilizer attachments for use by medium and small farmers.

3. Performance Problems

The farm mechanization program has only one college level Moroccan, an "Ing. d'Application" (B.S. equivalent) graduate of the IAV. We agree with the Scientific Review Panel of 1986 (18) that additional Moroccan agricultural engineers should be added to the program as soon as feasible. The engineers would be involved in tillage, seeding and harvesting studies employing machines of different designs and power sources, including tractor and animal power. We recommend that two additional "Ing. d'Application" graduates from the IAV be assigned to the project. And that M.S. degree training be provided for the Moroccan engineer now on the project.

When the IAV agricultural engineering program is sufficiently upgraded to grant the "Ing. d'Etat" degree (six years of college training and equivalent to the M.S. degree) there will be no further need for U.S. training of Moroccan agricultural engineers.

4. Linkages: The agricultural engineering team should be commended for the cooperative relationships it has established with the Department of Mechanized Agriculture at IAV, and it's efforts to promote the organization of a professional agricultural engineering society in Morocco. The relationship with IAV could involve the exchange of data and information and the assignment of IAV undergraduate students to carry out research in the project area for their "memoire" requirement.

C. Forage Program

1. Validity of Log Frame

a. Inputs

The applied agronomic research activity is intended to address all aspects of rainfed production systems used by farmers in the Aridoculture project zone. This includes developing an integrated grain and forage production system to provide cash income, food, and livestock feed in the project area.

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Inputs allocated to development of a forage program capability in the project include the use of short-term MIAC forage consultants (Appendix K, Tables 10, 11)to provide direction in research and advise Moroccan participant trainees, a resident U.S. forage specialist in Settat (Appendix K, Tables 6, 7), and support for three INRA participants in the forage research program (Appendix K, Tables 2, 3). Research trials are in progress at different research stations on weedy fallow/crop rotations and in evaluating production of medics, other legumes, cereal/vetch mixtures, and some perennial grasses from the standpoint of fertility requirements, seeding rates, nutritive offtake and survival. Presently, nutritional evaluations of forages are based only on laboratory analyses. Some sheep grazing trials are reported to be conducted on small station plots. However, no livestock scientist inputs or training in animal science are currently included in the program.

Inputs to the forage research program are also provided by the weed science and cereal breeding groups. An experiment is underway in weed science to comparing the trade off of using weeds pulled from wheat for livestock feed with the additional yield of wheat grain and straw if weeds were controlled with herbicide treatment. The MIAC agricultural economist indicated that he intended to compare the economics of this trade off. The cereal breeder reported that he was including the amount of straw in selecting cereal varieties for improved yield. No inputs are known to be provided by the agricultural engineering group for forage harvest or handling. Some farm data on livestock production and forage use are being collected in the socio-economic surveys in progress. Forage trials are being conducted on farm sites as well as on stations. Other research data are also available in Morocco that may contribute to the forage program of INRA/MIAC (27) (44) (45). The Morocco Range Management Improvement Project (28) includes medic variety testing at the Plant Material Center that shows native medics compare favorably with imported medics. The Small Ruminant-CRSP includes animal nutrition studies of different forages and crop residues.

b. Outputs

Outputs of the livestock forage research program include the training of three Moroccans for Doctorate level degrees in forage agronomy that should be completed by 1988 (Appendix K, Tables 2). Testing of imported medics and other forage species has shown major differences in their performance under Moroccan dryland conditions. However, the forage testing program does not appear to include a comparison of imported plant materials with local plant species, such as with native medics which grow profusely throughout the region. Triticale imported by MIAC agronomists has performed very well so far in research trials and may be an alternative to barley as a livestock feed crop. However, no forage production program has yet been defined that is proven superior to fallow in the cereal crop rotation system. The socio-economic survey of farms in the region is accumulating data on annual forage utilization by animals that will contribute to better understanding of interactions between cereals and livestock in the production system (31) (22).

c. Assumptions

No reference to forage is included in the log frame (Appendix B). The present evaluation of the livestock forage program is based on available written reports including the Scientific Panel report on forages (16) supplemented with follow-up personal interviews with INRA/MIAC researchers and IAV faculty. Minimal attention was given by the Evaluation Team, to details of experimental design or to laboratory equipment use as these items were addressed in scientific panels (14) (15). High priority during the remaining LOP is assumed to be given to completion of training of Moroccans. However, the research program followed by both the MIAC scientist and INRA participants should address relevant dryland forage production problems in Morocco. It is also assumed that all INRA/MIAC researchers should be cognizant of the close interrelationship between cereal and livestock production in the dryland study region. The Evaluation Team was informed that 70 percent of the livestock production in Morocco is in conjunction with cereal production. The importance of livestock forage production must be given proper consideration in future research programs.

2. Progress toward achievement of goal and purpose.

There is some concern that the participants in the forage research unit complete their dissertation requirements as soon as possible. Two of the participants returned in 1985 and 1986 and are expected to complete dissertation requirements before the project is scheduled to terminate in 1988 (Appendix K, Table 2). The Moroccan trainees are under some pressure from the INRA administration to participate in other research related activities besides their dissertations and will have to establish more strict priorities in time allocation to allow time for completion of dissertations.

The research activity in forage appears to be appropriate for achievement of goal and purpose, given the constraint on training requirements. The level of output achieved by the forage team is considered acceptable given the amount of resources presently allocated to forage research and the need to finish training requirements. It may be desirable to have greater research attention focused on the value of weedy fallow in cereal crop rotation and on comparisons of local versus imported forages. However, the training requirement is considered of a higher immediate priority. Research comparing the trade-off of weed control in wheat versus utilizing pulled weeds for livestock feed by the weed science group is considered very useful to the livestock forage research program (9). Contributions of other agronomists, in particular, cereal breeders, in improving barley and corn production, and introducing triticale as a potential feed crop (possibly to replace barley in some areas) are also considered valuable. The soil group is understood to be collaborating on the fertilization of weedy fallow to improve forage production from this source. This research is considered appropriate considering the importance of weedy fallow in the present crop rotations.

3. Performance and Problems

As indicated above, the performance of the INRA/MIAC forage team appears acceptable except for some concern about finishing the graduate training

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requirements. The forage team only includes one MIAC scientist (Appendix K, Table 6). The three Moroccan participants (Appendix K, Table 2) will likely continue to be primarily occupied with dissertation work for the remainder of the PACD. Given the importance of livestock in the study zone, the allocation of resources to forage work seems limited and the research program does not provide for a livestock input. Contributions of research to the forage program by other groups including weed science, cereal breeding, soils and socio-economics is considered very appropriate and illustrates interdisciplinary team work in research (9). The forage group, in particular, could have benefited greatly from prior socio-economic work on the interaction of crop/livestock systems if results were available when the forage research program was initiated. However, the socio-economic data available from IAV (31) (33) (35) (36) (37) (38) (39) (40) (41) (42) (43) were evidently not very helpful in guiding the research, and MIAC has only recently started its own socio-economic research program (9).

Without good information on the socio-economics of the region, the farmers in the area are understood to be traditionally livestock producers that have only recently begun growing crops. Cereal production is considered a high risk operation in the limited rainfall study zone and farmers continue to rely on livestock as a source of ready cash for family expenses, and in drought years, to finance the next years crop. Crop residues including weeds and cereal straw, are valued highly as a source of forage. The price system also favors livestock production, with cattle and sheep meat prices in a range of 15 to 20 times the price of barley grain per kilogram. Weedy fallow is a long established and important component in the annual forage program for livestock after the fall rains begin and needs to be further evaluated in comparison with possible alternative forage programs.

D. Farming Systems Research and Extension Program

1. Validity of Log Frame

a. Inputs

Most of the inputs since 1983 (expatriate staff, participant trainees, development of facilities, consultants) have been of high quality, and managed effectively when viewed within the limitations of the environment. A strong technical base is being developed for generating and adapting technology to the dryland area and for using a systems approach to research and extension (9).

(1) In case of the IAV Chaouia activity for collecting socio-economic data and information, which was planned to contribute information for implementing the systems approach to research and extension, the input has been over-whelmingly sociological. The personnel located at Settat are young, with little experience and much less training than the research personnel. We were favorably impressed by the interest and dedication of this young group. However, it's leadership and continuity has not been on a par with the agronomic research group. It also reported that transportation has not been adequate. In addition, this activity also lacks analytical and reporting capability, both from the standpoint of personnel and equipment.

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(2) The MIAC input to sociological information and data gathering has been focused principally upon Abda, and the time span will have been too short to establish the activity institutionally. The situation is aggravated by the absence of INRA Moroccan staff and participant trainees. Also this work is being done with little if any, direct participation by the biological scientists. To understand the results of the sociological research one must rely on reports and discussion. However, the discussions and interchange between the sociologist working in the Abda area and the bio-scientists has been much more dynamic and, in our opinion, much more effective, than in the case of the DDR work at Chaouia.

(3) Input into on-farm research has been low, although some very good on-farm work has been done. This has been based on four points of strategy:

(a) There has been a lack of adequate scientific technical information pertinent to the drylands area, and which needed to be developed first.

(b) Priority was being given to training scientific Moroccan staff, several of whom were participant trainees studying outside Morocco, or doing thesis work.

(c) Sufficient Moroccan staff was not available (a major level of Moroccan participation is necessary because of language and culture and the importance of their training).

(d) On-farm research is a dispersed activity which adds to management problems and may increase the difficulty of forming a coordinated group among disciplines, and between and among expatriate personnel

The same arguments can be used for explaining the low input into working with extension agents of the CTs, although, as in the case of on-farm research, some work with extension has occurred and relations with extension are good.

Up to this stage of the project we accept the low priority given to on-farm research as logical strategy, which we believe should be continued until some of the participant trainees have finished their degrees and/or additional resources including Moroccan personnel are available.

b. Outputs

The main outputs of the Project related to the farming system research/extension have been:

(1) The output of the problem solving research conducted by commodity and discipline research program.

(2) On farm trials by the researchers stationed at the Aridoculture Center. These have been in the areas of: soils, cereal agronomy, forages, weed control and food legumes.

(3) The data and information collection in Chaouia by the DDR of IAV. From these studies eight reports have been written: one in 1984 (36), six in 1985 (37) (38) (39) (40) (41) (42) and one (43) in 1986.

(4) The collection of information and data by the expatriate sociologist of MIAC in the Abda region with the aid of MIAC hired Moroccan assistants. Two reports have been written, one on cultural practices in Abda for the crop year 1985-86 (22) and one of weeds and weeding practices in Abda (21). The time interval between making the observations and reporting has been short. The subjects of these brief publications are of direct interest to the researchers.

(5) Creation of an environment in which the awareness and sensitivity of the staff (both Moroccan and expatriate) to farmer problems is evident.

(6) The training of Moroccan participants in basic scientific skills that will form a firm base for greater on-farm research activities in the future.

(7) Contact with personnel of the CTs (Extension Agents) through collaboration in the location of on-farm trials as well as specific training exercises for extension agents in weed control.

c. Assumptions

With reference to technology generation and transfer (FSR/E) the major exception to the assumptions made about conditions related to this Project is "salary levels competitive with private industry" (Appendix B). There is considerable doubt that this condition is being met. Low salaries for Moroccan researchers have adversely impacted the project to an unknown degree at this time. If salaries of the Moroccan research staff in relation to personnel of other government activities, are excessively low and not corrected, research staff may be lost and the institutionalization of the proposed research/extension system will not occur.

The assumption that "GOM agricultural researchers will adopt improved research and research assessment methods" (Appendix B) is valid and good progress has been made. The objectivity of the research for development should continue to improve as the thesis work is completed by the PTs.

2. Progress Toward Achievement of Goals and Purpose

This project was re-designed and extended starting in 1984. New staff was recruited. Since 1984 the Project has made impressive progress. While a systems approach to agricultural research and extension has not been consolidated a good base for using the systems approach is being formed (Appendix I, Items 1, 2).

a. Attitude, Concepts and Understanding of FSR/E

Attitudes important to development of a systems approach appear good in both the Moroccan and expatriate staff. The general attitude is one of pragmatically solving technical production problems but is combined with

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good comprehension that meeting specific farmer needs and desires are important when selecting research priorities and determining methodologies.

b. Participant training and FSR/E

While we believe that participant trainee thesis work at Settat is very good overall strategy, we also feel that the trainees dedication and attention to thesis work is of a nature that at times detracts from development objectives. It keeps them in the laboratory or the station. The trainee must give considerable attention to meeting academic requirements. Efforts have been made to relate thesis work to practical problems of the agriculture of the area through visits of major professors to the project for discussion of thesis topic and design. In discussions with staff there was no consensus (Appendix C). Some thought thesis work detracted from work to solve important problems while others found no problem in relating to both objectives. Thesis work does delay the development of a systems approach to research and extension. We view this as a small price to pay for the training received and an unavoidable sacrifice.

c. On-farm trials in relation to FSR/E

There are a considerable number of on-farm trials (9) which should result in information pertinent to farmer problems as well as experience in farm level work. These trials, however, are largely discipline or crop oriented (e.g. weed control), designed and managed by personnel responsible for specific technological areas. This is not a criticism of such trials. They are important and necessary. However, new technologies must be integrated into the farmers systems and this integration process should be done, not only with a technological program in mind (such as e.g. weed Control) but in the best interest of farmers as presented in phases 4 and 5 of Appendix I, Item 1.

While the researchers are conscious of the importance of integratin technologies into farming systems it is too much to expect the weed control program, for example, to conduct all of the integration when there are multiple problems such as soil types, fertilizer, variety, insect control etc. to be integrated into the farming systems. Also unless the extension agents are well trained in integration of technologies, which in our opinion they are not, receiving component technologies from several discipline programs may result in poor use of production components. Therefore we suggest some new strategy be devised to integrate technologies and select among alternatives, such as suggested in phases 4 and 5 of Appendix I, Item 1.

d. Learning about farmers and characterizing farming areas

Characterization of farming areas, to date, has had a heavy sociological input without much biological input. Some of this sociological work has not been designed to be easily integrated with the biological work. There is some recent attempts to do this through collaboration of the DDR group in on-farm field trials. They describe this collaboration as monitoring field trials which are installed by Aridoculture Center staff (29) (30). This monitoring seems to be a weak linkage with the researchers.

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Their work includes "on-farm trials" which seem to be largely demonstration type, also dictated from above in the organization. The CTs in the Safi Province have a total of 80 trials conducted by the three centers during the current growing season. Trials include hard wheat, soft wheat, barley, forage, chick peas and faba beans. Area size of trials is one-quarter to one-half hectare.

The Extension Agents usually have one of two levels of training: Adjoint Techniques have a training roughly equivalent to US high school plus two years of technical training. The Agente Techniques may have a high school education and short term technical training.

The relations between the DPAs and the personnel of the CTs with the researchers seems to be good. We did not find much indication that researchers consider themselves superior to the CT personnel. DPAs in two Provinces expressed strongly the need for technical help and their willingness to collaborate with the group at Settat. The one case where we visited the head of a CT he also indicated the need for help and the willingness to collaborate. In this case the head of the CT knew the location of a major on-farm "diagnosis" trial being conducted by Aridoculture Center personnel and took us to see it. Evidence is good that collaboration between the CTs and research can be obtained. However, since the CT personnel receive work plans from superiors this collaboration may not be obtained as easily as it seems. Also, there was some indication that they will need additional manpower and resources such as transportation. However agents are already collaborating on a minor scale, especially in finding collaborative farmers on whose farms trials may be located. Going through the CTs seems to be standard protocol for the researchers at Settat when establishing on-farm trials.

The World Bank Ag Sector loan document of 1985 (26) recommends, subject matter specialists for the Extension service. This is the usual strategy to improve technical capacity of an extension service. However, where research can, and we have suggested it, assign Farming Area Research Teams to specific areas we believe these on-farm research teams can better support CTs with integrated technology than subject matter specialists (Appendix I, Item 1). Subject matter specialists usually function as technical liaison linkages between research and extension and may be little more than another layer of insulation between the two.

h. Regional Research/Extension Office

The regional headquarters of INRA have offices called "Service de Recherche et Developpment." This office at Settat is planned as a liaison linkage between research, extension and the farmer. This is a regional office under the INRA Regional Director, and is not a part of the Aridoculture Center. The office is small, with two technicians trained at the vocational level. INRA hopes to employ a professional with M.S. level training to head up this office.

The "Service de Recherche et Development" reports 66 on-farm trials established in 1985 on 51 farms. There is no way for the present personnel of the office to attend and manage this many trials so it is assumed that they are demonstrations, perhaps in collaboration with personnel of the CTs.

The IAV DDR group personnel has had little experience and training in agronomic work and no supervision by experienced people and their monitoring seems to be observational. The Aridoculture Center staff is limited in the amount of time spent on field trials. The IAV group is serving as a means of contact with farmers in the Chaouia area. Also a young staff member with training in farming systems at the M.S. level in the U.S. has recently joined the DDR staff. It has been proposed that he be located at Settat but at present he is located in Rabat.

Exploratory trials to learn about farmers, their families and farming, to set broad parais for technology potential and to identify best currently used (available) technologies are a means of contributing to characterization of farming areas. Such trials can be a practical means of gaining important data to characterize farms, identify problems and help determine research priorities as well as offering a methodology that would be more compatible with collection of sociological information. Such on-farm trials also are a means through which researchers become better acquainted with farming areas, farmers and extension agents. They also serve as a means of orienting sociologists about the role of technology and contribute to interpretation of the sociological information and vice versa. Trials of these kinds should be conducted by trained personnel and it is strongly suggested that this kind of work be the responsibility of the Aridoculture Center research program.

To date there has been little interaction between biological aspects and sociological aspects as they pertain to the characterization of farming areas.

e. Sociological Studies

The kind of sociological studies conducted by the IAV DDR are not as easily integrated or coordinated with agronomic trials as the more rapid and dynamic work at Abda being done by MIAC personnel. It appears that the DDR studies have been academic sociological research and that a great deal of data have been collected without knowing its purpose. Such data are difficult to analyze and interpret. Reporting also has been slow. There was one report in 1983 covering the period 1977-1982 (37), one in 1984 covering the period 1981-82 (36), five in 1985 (38) (39) (40) (41) (42) covering diverse topics and one in 1986 (43). The 1985 reports may be an indication of effort to keep reporting more current, but reporting has been late with considerable lapse of time after data were collected. The research program needs more rapid reporting; it also needs to be "close to" and integrated with the data collecting process.

The studies made by the MIAC sociologist at Abda in 1986 (21) (22) on farming practices have been published in a more timely fashion with two papers on specific topics. Weeds and Weeding Practices in Abda (21) and Initial Cultural Practices in Abda (22) are of immediate interest to agronomists. As indicated above two sociological strategies of learning about farmers have been used in the Drylands project area; the slow process of detailed information gathering of the IAV group and the rapid, more specifically focused studies and quick summary in Abda. Both are intended to support research but in a different manner. The first can be conducted independently of the technology development research program and results

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made available. The second, in our opinion, should be an integral part of the research program.

f. "Centre de Conjoncture" and FSR/E

This center has also been called the Agriculture Information and Resource Center (29), the Experimental Agro-Economic Information Center (1) and (5). It is commonly called "Centre de Conjoncture." This was established, in June, 1984, by the DDR of IAV, through a MOU signed with USAID (5). The Project Paper Amendment No. 3 of August 1983 (4) gives the objectives of this center as "Dissemination of information about specific events, activities and problems concerning the functioning of agricultural enterprises in the semi-arid zone." Also, "The Center will gather precise, quantifiable, and qualitative information about a small number of parameters (this number will be increased over time), on price variations for inputs and outputs, changes in climatic, crop, and soil conditions, ..."

The DDR conducts their sociological research at Chaouia under this name, but there is very little, if any, specific dissemination activity. In other words the sociological research and data collection continue as prior to the establishment of this unit, the "Centre de Conjoncture" (and the other aliases) being just a new name for continuing work previously initiated. Neither the name nor the objectives of this Centre are clearly stated. It was stated by members of the DDR group at Settat, and we were also informed at IAV, Rabat that the goal was to develop a new prototype for extension, but this has not been found documented.

It has been noted that the professional staff at the Aridoculture Center is aware of the importance of sociological and economic aspects of technology development. The work of the IAV group, as well as of the work done in Abda by Aridoculture Center personnel may have contributed to this awareness, which should contribute to further development of the farming system concepts and implementation of more on-farm work.

g. Relationships with the Extension Service

Agents are located in CTs which are administered by the Provincial Head of Agriculture (DPA). We do not have a complete picture of the Extension Service but some examples give an idea of its coverage. (The 1985 World Bank Ag Sector Loan document, Part II discusses Extension in considerable detail (26) In the Settat area there are five Centers. In Safi there are three, in Marrakech five. In the three CTs of Safi there are 16 sub-centers. There are 30 Extension Agents for an average of ten agents per center. Each center is headed by a university degree agronomist with agents under him located in the sub-centers.

The agents have multi-activity programs but one of their major functions is to serve as liaison between commercial outlets and farmers for fertilizer, seeds and other inputs. They also help farmers obtain credit, by helping with the required paper work. There is a top down arrangement for determining the program of activities of the agents. They are told what to do.

Their work includes "on-farm trials" which seem to be largely demonstration type, also dictated from above in the organization. The CTs in the Safi Province have a total of 80 trials conducted by the three centers during the current growing season. Trials include hard wheat, soft wheat, barley, forage, chick peas and faba beans. Area size of trials is one-quarter to one-half hectare.

The Extension Agents usually have one of two levels of training: Adjoint Techniques have a training roughly equivalent to US high school plus two years of technical training. The Agente Techniques may have a high school education and short term technical training.

The relations between the DPAs and the personnel of the CTs with tl researchers seems to be good. We did not find much indication that researchers consider themselves superior to the CT personnel. DPAs in two Provinces expressed strongly the need for technical help and their willingness to collaborate with the group at Settat. The one case where we visited the head of a CT he also indicated the need for help and the willingness to collaborate. In this case the head of the CT knew the location of a major on-farm "diagnosis" trial being conducted by Aridoculture Center personnel and took us to see it. Evidence is good that collaboration between the CTs and research can be obtained. However, since the CT personnel receive work plans from superiors this collaboration may not be obtained as easily as it seems. Also, there was some indication that they will need additional manpower and resources such as transportation. However agents are already collaborating on a minor scale, especially in finding collaborative farmers on whose farms trials may be located. Going through the CTs seems to be standard protocol for the researchers at Settat when establishing on-farm trials.

The World Bank Ag Sector loan document of 1985 (26) recommends, subject matter specialists for the Extension service. This is the usual strategy to improve technical capacity of an extension service. However, where research can, and we have suggested it, assign Farming Area Research Teams to specific areas we believe these on-farm research teams can better support CTs with integrated technology than subject matter specialists (Appendix I, Item 1). Subject matter specialists usually function as technical liaison linkages between research and extension and may be little more than another layer of insulation between the two.

h. Regional Research/Extension Office

The regional headquarters of INRA have offices called "Service de Recherche et Developpment." This office at Settat is planned as a liaison linkage between research, extension and the farmer. This is a regional office under the INRA Regional Director, and is not a part of the Aridoculture Center. The office is small, with two technicians trained at the vocational level. INRA hopes to employ a professional with M.S. level training to head up this office.

The "Service de Recherche et Development" reports 66 on-farm trials established in 1985 on 51 farms. There is no way for the present personnel of the office to attend and manage this many trials so it is assumed that they are demonstrations, perhaps in collaboration with personnel of the CTs.

Range in size of on-farm trials was from 240 sq. m. to 90,000 sq. m. We saw none of these trials. We did receive unsolicited comments that these trials do not receive enough care and attention.

While these trials are not a part of the work of the Aridoculture Center, they do compete with the Center for personnel, office space, transportation etc. They were also viewed by DDR personnel as Aridoculture Center trials.

One function of this office was described as collaborative in arranging meetings of researchers and farmers and as a general go-between and expediter. The establishment of these offices in the Regional Headquarters of INRA is understood to be a strategy of INRA to demonstrate collaboration with Extension and may be useful to show Extension that something is being done to link research more closely with them. The principal function of this office may be to serve as the eyes and ears of the Regional Director of INRA so that he can more readily have representation at meetings and other events and so that he be better informed.

The trials carried out by this office may play a role by creating awareness among farmers of the INRA work. They may be of some value to Extension. We do not see how these trials are very important to the research program of the Aridoculture Center since there was no indication that they furnished researchers useful information. And to the contrary, if they are not of high quality they could detract from the good image the Center wishes to create.

i. Technical Reference Center (TRC)

A TRC is now being established at the Aridoculture Center. There are plans to include a minimum of basic books, some abstract journals, a few key scientific journals, and hopefully a computer connection to a data base; the full nature of the library probably has not been decided.

The systems approach, requires, in addition to traditional research reference materials, current information not found in traditional libraries. Much of the helpful information is found in miscellaneous publications such as mimeographed material. This kind of information should be included in the TRC.

We suggest that the TRC serve as an information and documentation unit. The main functions would be: to file and store information; and to make information available to researchers and others. The information would consist of relatively few books, abstract journals, very few scientific subscription journals, and technical/scientific agro-socioeconomic data and information, including the socio-economic data collected by the DDR and the scientific, technical biological data generated by the Aridoculture Center. Information would be available from the files and hard copies on hand as well as from other documentation centers by computer.

This could replace the "Centre de Conjuncture" as an information Center and support both on-station and off-station research, as well as Extension and others. Most of the files should be available to other organizations.

3. Performance and Problems

a. Performance of MIAC during the last two years has been good. There is still a long way to go to complete the activities of a well rounded and complete systems approach to the research and extension. This is due not so much to problems as it is to a set of circumstances (See items c. and d. above under Progress Toward Achievement of Goals and Purpose). A major problem to further field work has been time required in other duties and start up time of expatriate personnel, the lack of flexibility in determining field programs because counterpart participant trainees are conducting thesis work and the shortage of technicians.

b. A future problem in rounding out the systems approach will be the shortage of field personnel. Many of the present Moroccan staff will be needed in commodity and discipline programs, which may be given a higher priority than the need to organize Farming Area Research Teams.

Hiring has been frozen for some time thus it has been impossible to name the additional personnel needed and train them in field work. A few new positions are now available for filling but these may not be assigned to work that completes the other phases of systems research.

E. Socio-Economic Program

1. Validity of log frame

a. Inputs

Primary responsibility for providing socio-economic input in the Dryland Agriculture Applied Research Project in Settat Province has been vested with the IAV since the project was initiated. The Department of Social Sciences of IAV outlined a proposed research program in socio-economics as part of the original project paper in 1978 (2). The program was prepared in consultation with USAID and a MIAC sociologist of the Dryland Agriculture Applied Research Project design team.

The stated purpose of the IAV socio-economic research program was to: identify types of farming systems; develop a list of their most important characteristics; and draw implications of decision-making behavior. The proposed time frame for implementing the above socio-economic program at the outset of the project was two years in the Chaouia Region. Part of the work had apparently been started earlier, under Dryland Farming Project 608-0134. More specific tasks in the assigned study included: study of socio-economic history; collection of data and production practices; survey of different types of farming units; survey of markets, and analysis of all data. The above work was contracted with IAV by USAID in a Memorandum of Understanding (5) separate from the contract of work with MIAC.

The MOU (5) specified that a 50-farm survey and market price study in the Chaouia Region be expanded and replicated in other areas of the DAARP zone, and that a pilot Agro-Economic Information Center (AEIC) would be located in Settat to evaluate data on local climate, agricultural inputs, market prices, new techniques and other agricultural data, and to publish an

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information bulletin to be made available to farmers. Other continued activities included special studies related to dryland agriculture for third cycle IAV students and senior research staff, and periodic seminars. However, the primary purpose of the IAV research program in socio-economics was to contribute to timely development of an effective applied agricultural research program for the DAARP administered at the Aridoculture Center in Settat. Since IAV was responsible for the socio-economic research component of the overall Aridoculture Center research program, the IAV staff was expected to collaborate with INRA staff in socio-economic research design, field studies, data analysis and overall sub-component evaluation to ensure compatibility with the development of an effective applied agricultural research program.

Input from USAID to finance the socio-economic work by IAV staff was set at a maximum of US $637,900 for the LOP from 08/31/78 to 08/31/88 or about US $ 60,000 per year (5). IAV was asked to contribute US. $200,000 during the LOP. MIAC has also provided some additional funding to IAV for short term training and support of a U.S. graduate student in rural sociology in Rabat.

In addition to the continued socio- conomic input of IAV, MIAC has started its own socio-economic research program at Abda with a different group of farmer contacts, to develop a better understanding of farmers' attitudes regarding the high risks in rainfed agricultural production (9). More specific tasks of the MIAC program include: description of different production systems, farm production cost analysis; and identification of social and cultural factors that influence the adoption of technology. Only a small part of the current work by MIAC socio-economic researchers is being done in collaboration with IAV socio-economic researchers, (e.g., some food legume on-farm trials). The current MIAC staff at Settat includes a U.S. agricultural economist and a U.S. sociologist as senior scientists, two direct hire Moroccan research associates, and a U.S. Ph.D. candidate in sociology stationed at IAV (Appendix K, Table 13). The personnel input of IAV is difficult to determine, as many students are periodically involved and some IAV staff are only doing part time research on this project. The 1984-85 IAV (29) workplan included 13 on the staff, including 4 in Settat.

AEIC, also called "Centre de Conjoncture," has recently been established in a laboratory room at the Aridoculture Center (Appendix J, Figure 1) and is staffed with four technicians hired by DPA under direction of IAV in Rabat. The "Centre de Conjoncture" is discussed in detail in Section V, D, 3, f.

b. Outputs

Outputs of the socio-economic research program of IAV include eight reports in French on results of the farm survey and market study in the Chaouia Region, and on other special studies generally conducted by cycle three students. The reports appear to be primarily descriptive in nature with minimal quantitative analysis. They are mostly based on the same 50-farm sample in Chaouia initially developed in 1978 (36) (37) (38) (39) (40) (41) (42) (43). The total number of third cycle students supported by involvement in the socio-economic research program since its inception is reported to be 23. Aside from the above reports, the student training , and

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some evidence of periodic seminar activity, there are no other known measurable outputs generated from the project by IAV staff since it was initiated. The MIAC staff reported that they had obtained some useful background information on farmers operations from the IAV project but there was no clear evidence that the survey data were used for designing research trials. Only minor assistance was provided by IAV to MIAC in initiating new MIAC socio-economic research.

The socio-economic research program at Settat initiated by MIAC did not start until the latter half of 1984 following the arrival of a U.S. sociologist (Appendix K, Table 6). Some results on the land tenure structure on 25 farms in the Abda Region were reported in the 1984-85 INRA/MIAC Annual Report (11). Other reports prepared by the U.S. sociologist and INRA co-workers include a copy of the livestock data interview form used in the survey, a weed report on Abda (21), and a report on cultural practices in Abda (22). One report has been completed by the Agricultural Economist. The MIAC socio-economic research program does not include any INRA participant training. The annual work plans show evidence of collaboration in some research work between the MIAC socio-economic group and other INRA/MIAC researchers at the Aridoculture Center (9). The primary current activity of the MIAC Economist is to conduct a survey of cereal production in the Jemaa Shaim Area to evaluate the economics of production and assess the impact of mechanization. Recommendations for MIAC economic research are contained in a report by an Economics Program Review Panel (17).

c. Assumptions

No assumptions pertaining to socio-economics are given in the log frame.

The primary basis for assessment of the activity and contribution of the socio-economic program is the file of available reports furnished to the evaluation team. Meetings were also scheduled with researchers at IAV and with MIAC to follow-up on the reports and to find an explanation for apparent gaps in the time table for preparing reports and initiating scheduled activities. Some discrepancies were noted in the explanation provided by IAV versus MIAC/INRA staff, particularly on the extent of their collaboration and contribution to research. An effort was made to investigate possible problems by relying on other contacts in Morocco that were associated with the two organizations.

2. Progress towards achievement of goal and purpose

Information obtained by the evaluation team from reports prepared by IAV and from communication with INRA/MIAC research staff and IAV staff indicates that the socio-economic research program of IAV has not, to date, been effective in guiding agronomic research at the Aridoculture Center or providing a basis for an effective extension program. In addition, the program has not yet reached the collaborative stage. The socio-economic program of DDR is being strengthened, at least in regard to improving the level of collaboration between IAV and INRA/MIAC scientists at the Aridoculture Center and in establishing an outreach extension information center at Settat called "Center de Conjoncture". IAV has employed four technicians from DPA at the level of inge'nieur d'application and adjoint

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technique that are posted at the Aridoculture Center. DDR is in the process of recruiting a leader for this group of technicians with a strong agronomic and farming systems background. It is reported that the four technicians at Settat are currently continuing to monitor socio-economic data on the 48-farm sample in the Chaouia Region and are also attempting to extend research to members of their farm sample by establishing on farm demonstration trials. Even so, it appeared to the Evaluation Team that the DDR is not in tune with the needs of the agronomic researchers.

The concept of establishing a "Centre de Conjoncture" to serve as a prototype for modifying the existing CT extension system could serve a very useful purpose if successful. However, there is little evidence that progress is being made in this regard or that DDR has the capability to accomplish the task. The present staff of technicians is also not capable of interpreting and applying agronomic research results from the Aridoculture Center without strong technical backup. As indicated above, the rest of the socio-economic research program operated by IAV since 1978 has not achieved its goal and purpose due to a probable combination of lack of leadership and appropriate training, plus failure of MIAC and DDR to collaborate in applying findings to research.

A separate socio-economic research program was established in 1984-85 at Settat with a MIAC sociologist and agricultural economist to work in the Abda area. The MIAC sociologist has produced some reports on farm surveys and has collaborated with other technical scientists to provide a useful contribution to the socio-economic research program. The agricultural economist is understood to be doing a farmer survey with a sampling technique that should produce useful results; however, no data have been assembled to allow an evaluation of the results.

3. Performance and Problems

The institution, IAV has made rapid progress in achieving status as a well qualified university in general with a relatively young staff having strong academic training. However, there appear to be some major deficiencies in the research capability of the IAV department charged with providing the socio-economic input to the INRA/MIAC research program. The research technique followed in the program from the beginning was to periodically send out a team of interviewers from Rabat to complete a questionnaire on the socio-economic structure of farms in a sample area. The reported selection of the original sample appears to be somewhat arbitrary in relation to use of good sampling procedures. A considerable amount of data have been collected since 1978; however, they are largely of a descriptive nature and not properly organized for quantitative analysis. Some tables prepared by DDR from the data for reports to USAID are incomplete, indicating some problems in the survey that were never corrected. The death of Dr. Pascon and another senior member of the DDR staff in 1985 caused a major setback to DDR capability and there is little hope of improvement in the work effort until a new effective leader is found. The present research staff of DDR currently lacks basic skills in quantitative methods of research and survey techniques as well as leadership. The funding support by USAID and experience in socio-economic research since 1978 has not developed a discernible improvement in institutional capability of the DDR staff as they have continued to follow the same survey approach to gathering data that was

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started in 1978. The provision of micro computers to evaluate data will not correct the problem if the staff does not learn how to apply new quantitative techniques to improve their analysis of survey data. Some problems in collaboration between MIAC and DDR were also detected that may have prevented achievement of goal and purpose.

The newly organized socio-economic program of MIAC has not yet resulted in sufficient data to allow an evaluation of program performance (17). The sociologist appears to have a good rapport with other scientists and is activity engaged in collaborative. The agricultural economist has begun to do some collaborative work and together with a PT presented a paper at the International Wheat Conference held in Rabat in May. An Agricultural Economics Panel (17) has reviewed the agricultural economics component of the Project and has helped in providing a research focus and in setting priorities. A major weakness of the MIAC socio-economics research program is that there is no provision made to train other Moroccans in the research techniques used. This problem should be corrected when additional participants are provided by INRA.

F. Institution Building and Research Management

The DAARP was designed essentially as an institution building project. As such, it has two major components, physical and human. The physical component includes, but is not limited to the building, laboratories, field stations, equipment and supplies essential for project success. The human component includes professional, technical, administrative and support personnel who are involved with the project. The importance of the physical component is recognized, but it is the human component that "drives the machine" and upon which success is dependent. Competent, imaginative and stimulated people can progress even with less than optimum physical facilities. However, the best of facilities can produce no valuable results without the human component.

1. Validity of the log frame

a. Inputs

(1) Generally satisfactory progress has been made by the GOM in providing the required physical structures. Facilities which have been completed at the Aridoculture Center include an office/administration building, laboratory and technical office buildings, soil and plant sample processing facility and a head house for the greenhouses.

Despite the progress in construction of buildings for offices and laboratories, space remains critical at the Aridoculture Center. In many cases, two or more professionals share an office. This practice frequently interferes with the concentration required for research planning and analysis.

It is the understanding of the team that the Aridoculture Center was developed to accommodate the INRA and MIAC staff directly involved with the DAARP. However, some offices and laboratory space are occupied by others (Appendix J, Figure 1). The difficulty of finding office space in Settat is recognized. The space requirements of the INRA/MIAC staff should

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be addressed in order not to disrupt the primary function of the Aridoculture Center.

(2) Six prefabricated greenhouses are on the dock in Casablanca. The greenhouses will be brought to the Aridoculture Center and assembled following construction of foundations, utilities, and floors by the GOM. The delay in greenhouse construction is the result of a misunderstanding caused by a poorly worded statement in the Proag (1). Both the GOM and MIAC interpreted the Proag as placing full responsibility for the greenhouses, including necessary foundations and floors, on MIAC. However, USAID/Rabat has a policy of "no bricks or mortar." Thus, completion of the greenhouses is delayed until the GOM can complete the architectural and funding procedures. Based upon present estimates, the greenhouses will not be completed until the winter of 1986-87, resulting in the loss of use of those critical facilities.

(3) Mechanization facilities have been developed at the Sidi El Aydi Station by remodeling and modifying old buildings on site. Included are machine shops, a fabrication shop, a carpenter shop and limited office space. Funds have been allocated by the GOM for construction of an additional building during the summer of 1986. This structure will provide space for woodworking, sheet metal, welding and forge fabrication and will be primarily a research facility.

(4) MIAC is progressing satisfactorily with the development and equipping of scientific laboratories and research facilities. For the most part, scientific and analytical equipment has been installed and the laboratories appear to be well equipped.

(5) The need for, and importance of, adequate and well equipped labs is recognized. Some laboratory research is necessary to support field research. At this stage of project activities, many participant trainees are utilizing laboratory space to conduct dissertation research. This research may be more fundamental than that which will be necessary upon completion of the dissertation. Care must be exercised to assure the continuation of an applied research focus and not allow the well equipped labs and highly trained scientists to divert undue attention to research that is not focused on production problems. The fact that this is an applied research project with a primary purpose of assisting agricultural development and increasing dryland crop yields should be kept clearly in mind.

(6) The GOM provides land facilities for five research station areas away from the Aridoculture Center. These five stations, Sidi El Aydi, Jemma Shaim, Tessaout, Annoceur and Guich provide research opportunities under varying soil and moisture combinations, thus permitting research to be conducted in the major ecological zones within the scope of the Aridoculture Center. The station Ain N'Zigh surrounding the Aridoculture Center is of little value for field research due to soil heterogeniety.

Sidi El Aydi and Jemma Shaim are the main research stations utilized by the research staff. All researchers have work at Sidi El Aydi and an estimated 90 percent have work at Jemma Shaim. Presently research is limited at the Tessaout Station. The Annoceur Station was to be used as a summer season cereal breeding nursery but is not being used as irrigation

water is not available. Work at the Guich Station is limited to components of the cereal breeding program.

In addition to the research stations, a considerable amount of research is conducted on-farm through cooperation with farmers, the DPAs and CTs. On-farm research is important as it allows the researchers to conduct field trials under a broad range of environmental conditions.

(7) The human element is essential to the development, function and sustainability of an institution. Contributions to the human component of the institutions building process have been made by both GOM and MIAC. These contributions will continue to some degree throughout the life of the project. The project is intended to establish a Moroccan institution, staffed, managed and operated by trained and competent Moroccans. If the institution is to persist it must rest firmly on a Moroccan foundation with a Moroccan scientific, administrative and support staff and be accepted and supported by the GOM.

(8) According to the Proag (1) the GOM through INRA, was to provide 32 Moroccans for graduate level training in U.S. Universities. Details of the participant training functions are presented in Section V, A, 1, b of this report.

The 26 participants being trained is six less than planned (Table 1). This shortage is the result of a hiring freeze by the MARA. All participant trainees are employees of INRA and must have two years experience prior to being nominated as a trainee.

(9) Plans were to provide short-term training for up to 200 Moroccans (Appendix J, Table 5). To date, 28 Moroccans have completed short-term training and six are still in training. Short-term training to date has included grain storage, soils and forages, field station management, administration, data analysis, cereal breeding, plant protection and professional development. Thirty eight Moroccans have also received English language training (Appendix J, Table 5).

Table 1. SUMMARY OF ALL PARTICIAPNT TRAINING PROVIDED BY THE PROJECT (Through March 31, 1986)

Level	Number Persons Planned	Number Persons Actual	Person Months Planned	Person Months Actual	Course Work Completed #	Course Work In Progress #
Ph.D.	32	17*		379	9	8
M.S.		9		172	7	2
Short-term	Up to 200	28		64.5	22	6
English Lg.		38		299	38	-
TOTAL		92		914.5	76	15

*Does not include Berrada since he was not originally on this contract.

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Short-term training of professional, as well as technical, staff is essential to the development, functioning and sustainability of the Aridoculture Center. It is desirable to keep professionals in contact with other professionals, keep them up to date with scientific developments and theory and provide technicians with state-of-the-art technical developments, methods and procedures critical to the function of the Aridoculture Center and related experiment stations.

Short-term training will continue as needs arise and trainees are identified. However, the plan for providing short-term training for 200 Moroccans will not be realized within the scope of PACD (Table 1).

(10) The GOM and INRA should be commended for the high quality and competence of the Moroccans selected as trainees. Generally, they are highly motivated, intelligent and committed to the Aridoculture Center and to the development of agriculture in Morocco. It is logical to assume that the burden of operation and long-term success of the Aridoculture Center and all that it represents will fall on the shoulders of these people. They will be responsible for providing the direction and thrust of agriculture research of the Center and conducting the scientific research which will provide the basis for agricultural development and increased production. If this is to happen, this staff must be retained and provided with a work environment in which they can grow professionally and be equitably compensated for their contributions.

(11) Lengthy discussions with participant trainees revealed two factors for which they have concern and which appear to be diverting energy from their research. These are related to the awarding of the doctorate level degree and perceived inequities in compensation.

It is understood by USAID/Rabat and MIAC that the doctorate level participant trainees will do course work in the U.S., complete dissertation research in Morocco, defend their dissertation and be awarded a Doctor of Science from IAV. Subsequent to receiving the Doctorate from IAV trainees are to be provided a research grant to allow travel to the U.S. university to prepare the dissertation research for publication in appropriate scientific journals. It was reported that some U.S. universities will permit the trainee to defend the dissertation and be awarded the Ph.D. degree subsequent to having received the Doctor of Science from IAV. These procedures were presented in the mid-term Review Supporting Documents (10). While this may be a firm and established fact as far as USAID/Rabat and MIAC are concerned, it is not clearly stated in either Amendment 3 of the Project Paper (4) or the Proag (1). Doctorate-level trainees would all prefer to be awarded the Ph.D. degree by a U.S. university, either in lieu of or in addition to the Doctorate of Science. The problem of degree granting procedures, perceived or actual, requires immediate resolution and explanation to the trainees. Uncertainly concerning this issue is having an adverse impact on participant trainee performance.

The M.S. trainees, like the doctorate trainees, complete their course work at a U.S. university and the thesis research in Morocco. However, these students will then return to the U.S. to present the thesis

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and receive the M.S. degree. A potential problem exists if any of these trainees are subsequently selected for doctorate level training. It is now a policy of IAV not to accept doctorate level candidates unless they have received the M.S. level training (Ing. d'Etat) or completed third cycle examinations at IAV. In essence, this policy refuses to recognize the M.S. earned in a U.S. university.

IAV is also receiving institutional support from USAID. This support is intended, in part, to strengthen the university and assist it in developing a strong graduate program. Recognizing the intent and the critical need for cooperation between INRA and IAV, both of which are within MARA, and the accepted quality of the M.S. degree from a U.S. university the position of IAV appears obdurate. If continued, the policy may well have adverse impacts on both INRA and IAV and detract from their long-term contributions to agricultural development in Morocco.

(12) The second factor causing concern among INRA participant trainees has to do with perceived equitable and expected compensation. The INRA participant trainees stated categorically that their net income (annual salary plus prime) is 30 to 40 percent less than others with equal education, training and experience in MARA and IAV. In addition they stated that assistance with housing was offered by INRA as an incentive for moving to Settat. Discussions with participant trainees reveal that concern for just compensation is detracting from the level of effort at the Aridoculture Center. It appears likely that, if this issue is not equitably resolved, the INRA staff presently at the Aridoculture Center will seek other employment upon completion of their academic training. If this should happen it would represent a real set-back for the institution and a major segment of INRA research capability would be lost.

It is understood that proposals for new statutes to correct this problem have been developed by INRA and forwarded to the MARA. The status of the proposal is unknown to the evaluation team.

In view of information provided to the team it is clear that the GOM has been unable to increase available budget funds for salaries and salaries in INRA do not appear to be competitive with private enterprise or even other units within MARA. Thus, the assumption of the log frame in this regard lacks validity (Appendix B). While to date all trainees have returned to work on the project, indications are they will not stay unless compensation equivalency is reached.

MIAC is contributing significantly to the human component of the institution building process. MIAC research staff is conducting research, developing information, and training INRA participant trainees. It is assisting with the development of a solid base of research results and with the training of INRA staff which will provide the foundation of a functional Aridoculture Center.

(13) At this time MIAC has 14 full time professional staff providing assistance to INRA. The TA staff research is working in the following disciplinary areas: agricultural engineering and mechanization, cereals, forages, plant protection, socio-economics, soil science and administration. There are an additional four people providing support to

the INRA/MIAC team in facilities operation and maintenance, the Technical Reference Center, the Computer Center and Soil Chemistry and Laboratory development (Appendix K, Table 6).

To date, MIAC has provided about 45 of the approximately 100 person years of technical assistance called for in the Proag (1). The planned level of TA input is about on schedule and should be realized within the planned PACD.

According to the two Scientific Panel Reviews (14) (15), the research program is generally addressing the correct topics and is making acceptable progress. Research results were limited during the first four years of the project as a result of drought and project start-up problems.

The progress now being made in field and laboratory research is reflected in the number of activities being conducted in 1985-86 as compared to past years. Research activities for the 1985-86 cropping season are over 2.5 times greater than in 1984-85, which in turn was triple that of the 1983-84 season. There are over 90 research activities in place this year, as compared to less than 10 in 1983-84 (Appendix J, Figure 2).

In addition to conducting research, MIAC staff is providing on-the-job training and advice to INRA participant trainees and serving on graduate committees. The level of technical assistance being provided by MIAC staff in the disciplines covered is generally of high quality.

(14) In addition to the long-term technical assistance, MIAC is also to provide approximately 13 person years of short-term assistance. The short-term assistance is to advise participant trainees in conducting their dissertation research in-country and to resolve specific project needs (1). According to the information provided, MIAC has now utilized in excess of six person years of short-term consultants (Appendix K, Table 11). Consultant time has been utilized for all subject matter areas provided by MIAC. However, in excess of 30 percent of consultant time has been for administrative service (Appendix K, Table 11). While the importance of sound planning and administrative support in the institution building process is recognized, this appears to be an inordinate amount of resources for that activity. The project is now functioning reasonably well and proportionately less administrative consultant time should be required between now and the PACD. The small amount of consultant time devoted to food legumes is also noted (Appendix K, Tables 10, 11). Considering the importance of food legumes in the project area and that one Moroccan is carrying the burden of food legume work without long-term technical assistance, additional consultant support to this phase of the program should be provided.

(15) The Evaluation Team did not attempt a detailed budget analysis. However, according to information provided MIAC spending is about on track across major budget categories. Through March 1986, $10,048,785 or 44 percent of the $22,935,491 budgeted had been spent (Appendix J, Tables 1, 2).

The team was unable to obtain complete information regarding GOM contributions to the project. However, we were provided a budget summary

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for the years 1984, 85, 86 and salary information for INRA staff at Settat, Ain N'Zigh and Sidi El Aydi (Appendix J, Table 3). Exclusive of salaries, the INRA operations budget expenditures for the years 1984, 85, 86 totaled DH 4,287,460. Salaries plus bonus for INRA staff at the three locations mentioned above for 1984 and 85 totaled DH 4,326,187 (Appendix J, Table 4).

While the GOM has been able to meet major project commitments, there have been problems of budget shortages or cash flow in several instances. In some cases MIAC is paying operating costs (including gasoline, diesel fuel, technician and field labor wages and travel expenses) to keep the project going and prevent disruption of critical research activities. The team did not determine the amount of these MIAC expenditures.

b. Outputs

(1) The institution building aspects of the project have been significant despite drought and start-up problems. Major building components have been completed at the Aridoculture Center. Laboratory equipment is mostly in place and laboratories are being utilized by INRA and MIAC research staff. INRA research staff, consisting of nine doctorate and eight M.S. level candidates and 12 MIAC scientists, are conducting research at the Aridoculture Center, three satellite research stations (Sidi El Aydi and Jemma Shaim and Tessaout) and on selected farms. INRA and MIAC research staffs are working together closely as the participant trainees move from the role of trainee toward the position of fully qualified research scientists. Researchers are supported by 12 field and laboratory technicians. However, technician support is inadequate. While some technicians are well trained and motivated, others are technically unqualified and lack the discipline and motivation desired to function effectively in a research environment.

(2) The Aridoculture Center is linked to six INRA research stations; Ain N'Zigh, Sidi El Aydi, Jemma Shaim, Tessaout, Annoceur and Guich. Annoceur, which is to be used as a summer plant breeding nursery is not being used due to a lack of irrigation water. In addition, minimal research is carried out at Tessaout by Aridoculture Center staff. The magnitude of the research being conducted on the research stations, in the laboratories, and on farms is considerable and, according to the Scientific Panel reviews (14) and (15) generally appropriate to solving agriculture production problems in Morocco.

(3) An additional indication that the Aridoculture Center is maturing as an institution is the establishment of contacts and linkages with other outside institutions. These include ICARDA, CIMMYT, ISNAR, ANAFID, USDA, SR/CRSP, IAV and FAO. These linkages provide for the exchange of information and allow the Aridoculture Center to take advantage of the skilled and experienced staff at these institutions. Strong administrative support is provided by the MIAC team leader and support staff. The INRA staff functions under the administrative direction of the INRA Project Director who also serves as the Settat Regional Center director.

(4) In order to optimize the institution building aspects of the project, the MIAC Team Leader and INRA Project Director should work in close

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concert. Problem identification, research priorities, annual work plans and guidance of the Aridoculture Center activities should be the result of close collaboration. The INRA project director, functioning as a counterpart to the MIAC team leader, should capitalize on the opportunity to learn about research station development, operation and management. Observations of the evaluation team were that cooperation was less than optimal for effective Aridoculture Center management. The ability of the Aridoculture Center to stand alone and function effectively following the departure of the MIAC Team will be dependent upon strong and capable leadership. INRA should make every effort to assure that such leadership is developed and in place before the project ends.

c. Assumptions

(1) The assumptions that the project would develop diverse research program that would be integrated into the farming system is generally valid (Appendix B), with some exceptions. Diverse research programs are being integrated, as the interdisciplinary nature of the research effort is recognized. This aspect should become more evident as the research program moves from an emphasis on dissertation research to addressing a broader range of research needs in the project area. The MIAC staff recognizes the need for integrated research and is making a concerted effort to instill this philosophy in the minds of the participant trainees with whom they work.

(2) The INRA research staff studied improved research and research assessment methods during their training in U.S. universities and through their association with MIAC advisors and staff in Morocco. In the long-run the validity of this assumption will depend upon whether the INRA staff continue to critically evaluate agricultural research needs in the project area and to develop research designed to meet those needs.

(3) The GOM continues to recognize the importance of rainfed agriculture production to the economic well being of the farmers in the region and to the nation. Within its means it continues to support research efforts at the Aridoculture Center and has met major GOM project responsibilities. The GOM has not maintained competitive salary levels for the INRA staff. The Evaluation Team was made aware of significant salary and other compensation discrepancies which are of concern to participant trainees. If the trained research staff is to be retained at the Aridoculture Center after the trainees receive their graduate degrees, the problem must be resolved. In our judgement, the problem is significant and is having an adverse affect on research activities at the Aridoculture Center.

2. Progress Toward Achievement of Goal and Purpose

a. Goal

The project goal (Appendix B) is to increase basic food production in order to meet the needs of Morocco's fast growing population; and improve income of traditional small dryland farmers.

Progress has been made toward attainment of the project goal, but, at this time, it is not reflected in increased food production for Moroccan

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farmers. New technologies are being developed on research stations and through on farm trials. However, sufficient data are not available to assess research results or to determine if the technologies being developed are economically viable or socially acceptable. The socio-economic component of the MIAC staff is developing information which should provide guidance concerning the acceptability of new technologies.

b. Purpose

The project purpose (Appendix B) is to establish an applied agronomic research program which will adapt existing technology to local conditions in order to increase the productivity of the dryland farmers, train adequate Moroccan staff to operate the program and transmit the results to farmers, and develop a program whereby suitable farming equipment can be made accessible to small farmers and to establish a collaborative socio-economic research program with INRA and IAV that will give a better understanding of the behavior of the dryland farmers and thus provide a basis for reflective extension programs.

(1) Progress toward achievement of project purpose has been considerable and is discussed in more detail in sections V-A,B,C,D and E. These achievements have contributed to the development of the research institution represented by the Aridoculture Center, its related facilities and activities. Technology is being developed and evaluated under local conditions, a Moroccan staff is being trained, farming equipment is being developed. The contribution of DDR to the latter item to the research program of the Aridoculture Center is questionable and the MIAC sociologist and Agricultural Economist have no INRA counterparts.

(2) Other GOM agencies such as the Extension Service and Parastatals are interested in the Center and express a willingness to cooperate. More active cooperation will become evident as additional information and technology is developed by the Aridoculture Center.

In view of the short time period during which it has been possible to collect field research data, the project has made satisfactory progress toward attainment of project purpose.

3. Performance and Problems

a. MIAC

Following a slow start resulting from drought and start-up problems on the part of all parties involved, MIAC is now performing well and moving the project forward vigorously and deliberately. MIAC has all agronomic technical assistance positions filled with Ph.D. level researchers. This staff is involved with research and is providing guidance and counsel to participant trainees. In addition, it is moving ahead with the development of a Technical Reference Center and a Computer Center. These two facilities are staffed by local hire American staff without Moroccan counterparts. In view of the long-term importance of these facilities, this situation should be rectified.

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MIAC has assigned a senior staff member (a cereal breeder) to the position of Research Coordinator. He is providing guidance to the overall research program, expediting efforts to institutionalize integrated research procedures and providing mature counsel to participant trainees. This has removed part of the burden or the MIAC Team Leader and has allowed him more time for overall project management and administrative duties. However, it has reduced the input to cereal breeding.

b. MIAC and INRA share responsibilities for project management through the MIAC Team Leader and INRA Project Director. Both appear to be hard working and committed to the project. However, due to work pressures, management style or other factors, there appears to be a less that desired direct collaboration between these individuals. This problem is evident in space allocations, research work plan development, budgeting, operational matters, utilization of technicians and in other areas. MIAC is to be commended for the strong leadership provided by the Team Leader. INRA should give guidance to the Project Director as to methods for assuring a more effective collegial and professional relationship between these positions which are critical to project success.

c. MIAC and INRA share responsibility for the educational program of participant trainees. The issue concerning awarding of the Doctorate degree discussed above requires early resolution. Responsible parties from INRA, MIAC, IAV and USAID should meet with the participant trainees and provide, in writing, a clear policy statement.

d. DDR and USAID/Rabat

In the judgement of the Evaluation Team contributions of DDR to the research project have been minimal. The activities of DDR are carried out under a MOU between USAID/Rabat and DDR/IAV (5). The minimal contributions of DDR appear to be, in part, a function of the low level of guidance and monitoring of DDR activities by USAID/Rabat. A leadership vacuum has existed at DDR since the death of the Director in 1985 and the research activities have suffered. Contribution of DDR to the project may have been greater with additional direction by USAID/Rabat and further clarification of expectations.

e. MIAC/UNL project backstop and support

Subsequent to the field review in Morocco the Evaluation Team visited the UNL to meet UNL and MIAC administrative personnel, faculty and staff and to discuss project support facilities, procedures and activities. Project backstop and coordination at MIAC/UNL is headed by a Project Coordinator and Assistant Coordinator with a capable three person support staff. Office space is provided in the agronomy building (Kiem Hall) which places the support staff in daily contact with UNL Institute of Agricultural and Natural Resources (IANR) faculty.

The Coordinating Office appeared to be well equipped and staffed to provide all necessary services to the field mission in Morocco. The Coordinating Officer has responsibility for staff recruitment (long- and short-term); staff orientation, travel arrangements, purchasing, shipping, budgeting and accounting. Following a review of facilities and procedures

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it is the judgement of the Evaluation Team that these responsibilities are being handled expeditiously.

There is ample evidence of the strong administrative support, of both MIAC and UNL, for the project. The UNL Vice Chancellor, UNL Dean and Director of International Programs and MIAC Executive Director were available to the Evaluation Team, participated in discussions and voiced their continuing support for the project.

The Project Coordinator is supported by a Project Administrative Advisory Council consisting of the Heads of the Agronomy and Agricultural Economics Departments and the Dean and Director of Agricultural Research. This Advisory Council meets regularly with the Project Coordinator to provide advice and counsel. In addition, the Advisory Council, MIAC Board and UNL administrative officials have visited the project in Morocco to gain first hand knowledge of the project and to better understand the conditions under which the field staff is working.

There is some evidence that UNL, and other MIAC universities, have not yet completely resolved the issues concerning staff evaluation, promotion and tenure of members of their faculties serving overseas or desiring to serve overseas. Administrative staff indicated these issues were being addressed and credit for overseas work is fully recognized in faculty review, promotion and tenure procedures. However, discussions with some faculty members indicated that in their opinion the issues were not resolved and that for the sake of their professional careers they were reluctant to take an overseas assignment. This problem is not unique with MIAC. It is a problem that tends to plague many universities that are involved in international development programs. It appears that UNL and MIAC are addressing the problem. However, the administrative support, in regards to promotion and tenure for the faculty serving overseas should be better articulated and demonstrated.

In the opinion of the Evaluation Team, all considered,MIAC and UNL are doing a good job of providing backstop and support to the field mission.

4. Capability of GOM to Support Broader Program Focus

a. Manpower requirements

A program broadened to encompass anticipated needs of the Aridoculture Center would require the addition of four to six additional Moroccan researchers for discipline and commodity programs and appropriate support staff plus additional staff for on farm research. Subject matter areas to be considered include; animal science and production, agriculture economics, agroclimatology and agriculture Engineering. However, according to ISNAR there is a critical shortage of qualified scientist in INRA (32). It is apparent that the Moroccan selection system is capable of providing capable people as participant trainees and potential researchers. Following the lifting of the present hiring freeze in MARA, sufficient participant trainee candidates should be available. The apparent restrictions on hiring of technicians to support research staff should be reviewed.

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Technician support is essential if a professionally trained researcher is to utilize his/her time and talents effectively. There are now 13 MIAC researchers (Appendix K, Tables 6 and 7). According to information provided to the Evaluation Team there are 12 technicians assigned to support the needs of the 30 research scientists. This is less than one-half technician per researcher. Even allowing for sharing of technicians among researchers this is considered to be woefully inadequate.

There appears to be some discrepancy between information presented above and that provided by the INRA Regional Office. Information from which Appendix J, Table 2, was derived listed 31 technicians attached to the Regional Center in support of the Aridoculture Center. Our field observations and discussions with INRA and MIAC scientists confirmed that only 12 technicians were available to support their research work. This discrepancy should be resolved and efforts made to make adequate technician assistance available to optimize the effectiveness of project research staff.

In the judgement of the evaluation team, Morocco has an adequate supply of capable people that could be trained to meet foreseeable manpower requirements of a broadened program. The manpower would have to be trained and integrated into the project over a time frame of five to ten years.

b. Management structure of INRA

(1) Except in the case of the Aridoculture Center, management is from the top down and national protocols are formulated in Rabat and forwarded to the Regional Centers for implementation. Budgets are developed in Rabat and funds are then allocated to field locations, often following considerable delay. This results in operational problems at the field level. Research priorities set in Rabat may not address important production problems at regional levels. If the concept of management by objectives, suggested by ISNAR (32), was adapted and implemented, resources at the national level could be more effectively applied to agricultural development problems. In order to integrate management by objective into the INRA research program technical assistance would be required from a skilled and experienced person assigned to the central INRA staff in Rabat.

(2) The Aridoculture Center is a part of INRA and the Moroccan component is dependent upon funding from INRA in Rabat. However, research plans and budget proposals are developed by Moroccan and MIAC staff at the Aridoculture Center. This helps to assure that research efforts and the limited financial resources are directed to finding solutions for agriculture production problems in the geographic area for which the Center is responsible. The Aridoculture Center is a part of INRA and as such is an integral part of the national research effort. Thus, it is essential that Center research fall within national priorities and that close collaboration exists among all Moroccan research units.

(3) Research at the Aridoculture Center should be directed strongly to solving the agricultural production problems and development in the 250-450 mm precipitation zone. The research effort should be problem oriented, rather than subject matter discipline oriented. This process would fit well within the concept of management by objectives as espoused by INRA. However, it will be necessary to clearly define objectives directly

applicable to agricultural development, some of which may not be the most attractive to staff now interested primarily in scientific research. As pointed out in the Scientific Panel Review (14) research appropriate to the region and conducted at the Center should be good science even though it is not of a fundamental nature.

c. Financial resources of GOM: The GOM is undergoing a financial crisis. Despite this problem it has managed to meet its major financial obligations to the project. Within the context of its presently limited financial status the GOM appears to be committed to the project. The need for a strong applied research program to guide agricultural development is recognized. Within this context, it appears that the GOM could make available additional financial resources for modest program expansions.

VI. MODIFICATIONS WITHIN PRESENT LOP

A. Agronomy and Soil Science

1. ICARDA recently assigned a cereal breeder to the National Cereals Program, in Rabat. MIAC, INRA and USAID should review the need for a Senior Plant Breeder posted in Rabat following the completion of the current incumbents contract.

2. INRA and MIAC should begin planning for an extensive soil testing program which when initiated will be based on knowledge and data obtained during the current soil test calibrations studies. Planning should be done jointly by INRA, DPA, MIAC and USAID. Items which should be discussed and agreed upon include: how the program should be organized; administrated and financed where the testing will be done; facilities and equipment needed and estimated costs; who will be responsible for maintaining the quality of the tests performed and fertilizer recommendations made; personnel requirements; who will train personnel and responsibilities for maintenance and repair of equipment. Consideration should also be given to the adequacy of the fertilizer distribution systems to farmers.

3. Arrangements should be made to complete the soil surveys required for soil fertility research and soil test calibrations. Priority for surveys should be given to the better rainfall areas, and if adequate resources are available, reconnaissance type soil surveys of the drier areas and areas of rough topography might be useful for characterizing the different kinds of range and pasture lands and identify the limited areas of soils suitable for planted crops.

4. Cereals and food legumes are critical to meeting food demands of the Moroccan population. These crops are now infested with numerous diseases which reduce yields and result in economic losses to the farmers and the nation. A long-term senior Plant Pathologist is needed to provide scientific support, leadership and direction to the plant pathology component of the project. The plant pathologist should provide technical assistance across all crops being utilized in the research program.

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5. Food legumes are important food sources within the project area. The food legume research is now being conducted by one participant trainee with no long-term technical assistance and limited short-term consultant input. Under the circumstances the trainee is doing an excellent job. However, he needs help to meet the needs of the project and the nation. Long-term food legumes technical assistance should be provided for this program as soon as it can be obtained. In the interim the program should be supported by short-term consultants who could review the work being done and offer advice and direction to the trainee.

B. Agricultural Engineering and Mechanization

1. Continue the design, testing and evaluation of improved primary tillage (seed land preparation) implements but broaden the inquiry to include other non-inversion types of implements such as the chisel.

2. Give relatively high priority to the testing, evaluation and modification of imported seed drills which have fertilizer placement features. These should include both medium size tractor-drawn and animal-drawn implements.

C. Livestock and Forage Program

Additional socio-economics research is needed to guide future forage research. Emphasis should be placed within the present LOP on completing training of Moroccan participants so that they will be available to contribute more effectively to the overall livestock forage program. The present MIAC forage scientist is scheduled to return to the U.S. before 1988 (Appendix K. Table 8) and may need to be replaced to continue leadership of the livestock forage program. Given the above priorities and conditions, no modifications of the present forage program are recommended within the current LOP. However, the weed science group should consider extending the weed evaluation study to crops besides wheat.

D. Farming Systems Research and Extension

1. With respect to modifications during the PACD related to Farming Systems and Extension, we suggest none unless the project is to be extended. If project is to be extended, start with follow on activities and complete as much as possible with resources available within the PACD.

E. Institution Building and Research Management

1. Implementation of the project is generally consistent with terms of the Proag (1) and the contract with MIAC (10). Project outputs are occurring at a pace that will allow most objectives to be reached within the PACD. However there are opportunities for project modifications which would strengthen the project and move it farther toward achieving project purposes (see Section VI-A, B, C, D, F). These modifications are consistent with present thrust of the project and are essentially strengthening of existing weaknesses.

2. The research laboratories are generally well equipped with scientific and analytical instruments. However, to keep them functioning

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We are not making any judgement on the advisability of continuing funding from USAID to IAV but are simply pointing out that, in our opinion, this organization is not providing an acceptable socio-economic component to the INRA/MIAC project. There appears to be no doubt that IAV needs additional development of research capability in agricultural economics and rural sociology. The socio-economic program recently started by MIAC is considered justified in view of the non performance of DDR/IAV in supplying the socio-economic component needed to guide the research effort of INRA and MIAC in the Dryland Agriculture Applied Research Project. However, there is an urgent need to begin training of Moroccan participants in socio-economics so that they can form part of the socio-economics team at Settat and benefit from the fact that a U.S. rural sociologist and agricultural economist are currently available to provide training. High priority should be placed on getting this training program started within the present LOP.

VII. FOLLOW-ON ACTIVITIES/PROJECT EXTENSION

In order for the project to reach its goal and purpose, it will have to be extended for a period of at least ten years. That amount of the time will be required for the Aridoculture Center to mature and develop stature based upon research results and their extension to farmers in the project area. It would also provide sufficient time for INRA research leadership to develop and assume direction of the Aridoculture Center. Technical assistance would increase somewhat in the near term but would then be reduced and phase out during the last five years when only a cadre of TA would be retained to provide guidance and advice to the Moroccan staff.

A. Agronomy (Appendix F. Table 4)

1. The follow-on project should continue to develop cropping systems using the best known technology to increase yields: including new varieties, weed control, fertilizer use, improved tillage and cultural practices. The highly promising research on Hessian Fly resistant wheat varieties and varieties with higher yield potentials in years of limited rainfall should be continued.

2. The forage research program should concentrate on improvement of the cereal rotation through the introduction of forage legumes. Forage research in cooperation with the entire cereals research group will be necessary to evaluate the place of forages in the cropping system.

3. The next phase of the project should include a specific and clearly defined thrust to get improved technology transferred to farms. Transfer of technology to farmers is more likely to happen if research scientists devote a portion of their time, say up to 20 percent, to extension or tasks directly related to extension.

The kind of activities which would be considered as extension should include:

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a. Interpreting research results and preparation of extension materials in cooperation with extension personnel for use by extension services.

b. Assisting extension personnel in the installation and follow-up of an on-farm result demonstrations.

c. Participation in extension field days.

d. Participation in planning extension program.

4. The suggested TA team composition and major areas of focus of their research work for the period 1986-1997 is given in Appendix F, Table 4. Although it may be desirable to add additional specializations later, the following major disciplines are included; agronomy, soil science, agricultural engineering, plant protection, and agro-methodology. The Phase out of long-term technical assistance in 1992 (Appendix F, Table 4) is based on the following assumptions:

a. The remaining six long-term participants will be nominated in 1986 and commence M.S. level study in 1987,

b. The graduate degree candidates now doing research on the project, or pursuing course work in the U.S., will complete the requirements for degrees by 1989, and remain with the project.

c. That after long-term technical assistance is phased out the project will continue to make available short-term consulting services for special studies, appraisals, or problem analysis as needed.

d. That the weather in the project area will be generally favorable for crop production.

5. Other considerations which figured in the construction of the proposed phase out schedule (Appendix F, Table 4) included;

a. Long-term technical assistance should be terminated as soon as local staff are capable and qualified to plan and carry out research projects, and to interpret the results for use in extension programs.

b. New technical assistance staff should be added in other disciplines only after Moroccan counterparts have returned to do their dissertation research.

c. Technical assistance should continue for at least one year beyond the date the graduate candidate completes his degree requirements. There is a problem in the application of this criteria in that none of the candidates to date have completed degree requirements.

6. It is recommended that after the phase out of technical assistance, the project continue until 1997 focussing on activities which will further strengthen the Aridoculture Center and its research/extension program. Major lines of activity might include:

a. Continuation of a degree training activity to fill needs that may develop or the project matures

b. Develop or strengthen linkages between INRA, the Aridoculture Center and U.S. Land Grant Universities through: support of sabbatical leave research programs of American professors, support of Moroccan researchers for one year research programs in the U.S. on problems of joint interest to the U.S. University and to the center, exchange of publications, and attendance at seminars in Morocco by U.S. scientists and in the U.S. by Moroccan agricultural scientists.

c. Provision of short-term training to develop specific skills.

d. Arranging for attendance of Aridoculture scientists at international seminars, professional meetings or conventions.

7. Plant Pathology

There is a need for a full time plant pathologist on the team to work with the cereal breeder, cereal agronomist and food legumes agronomists.

8. Soil Science

a. Soil and Water Conservation: In view of the critical importance of soil moisture throughout the project area, it is suggested that any project extension provide for a soil and water conservation component. The details of project components would be developed by the design team but the focus should be on-farm research on practices to increase moisture availability to crops. The particular research or demonstration undertaken will vary from place to place depending upon the nature of the soils, expected rainfall, vegetative cover, cropping history etc. For example the water harvesting and water diversion practices currently employed in the southern part of Morocco may have some applicability in parts of the project area.

b. Soil Fertility

The principal focus of the soil fertility program will logically be the development and installation of a active soil testing and fertilizer recommendation program based on the results of the soil test calibration research now in progress. Planning for this program should have been largely performed during the remaining LOP. The project extension should provide the U.S. professional personnel required to implement the program.

B. Agricultural Engineering (Appendix F. Table 4)

1. Agricultural Implement Development: The priority focus of the Agricultural Engineering Section should be the development or adaptation of improved farm machinery for the medium and small farmers. It is likely that continuing research and testing will be required to develop improved primarily tillage and seeding implements, and that more than one set of implements will be needed to satisfy the requirements across the entire project because of differences in soil, cropping systems, rainfall patterns, etc.

Improved harvesting and threshing equipment both engine and animal-powered for the medium and small farmer including designs for use on sloping lands are needed and should be subjects of future research.

2. Joint research and development programs between INRA and IAV as well as graduate student participation in research on the project should be promoted.

C. Livestock Forage Program

Livestock should be given increased emphasis if the project is extended beyond 1988. Attention needs to be focused on the rationale for use of weedy fallow in cereal rotation, alternative methods of breaking the disease cycle with continuous cereal cropping, providing a replacement forage supply for weedy fallow, improving the forage nutrient composition of weedy fallow, and applying economic analysis of alternatives to weedy fallow. An animal science component needs to be incorporated into the livestock forage program to evaluate such factors as palatability and animal rates of gain on alternative forage systems that are difficult to determine in laboratory analysis. The interaction of animal diseases, management and nutrition should be investigated.

Animal production in the study region is dependent on the use of cereal straw, food legume crop residues and corn stalks which have relatively low nutritive value. The livestock forage research program should give more consideration to the use of those roughages. Methods of treatment to enhance nutrition, e.g., sodium hydroxide; better utilization of feed supplements, e.g., poultry litter and molasses supplementation; supplementation with protein or energy banks, e.g., and research on increased yield of these roughages should be considered. Forage harvesting systems should be investigated. Additional Moroccans should be trained in forage production and animal science. Although IAV has animal science research capability in Rabat some animal science capability should be developed in INRA to provide an effective interdisciplinary livestock-forage research team.

Consideration should be given to use of the PMC facilities at El Jadida for forage research trials by the INRA/MIAC scientists group at Settat, particularly for forage research trials requiring irrigation.

Staffing in the forage group at the Center currently includes a U.S. scientist (Ph.D. in forage agronomy) and three Doctorate candidates Moroccan participants (Appendix K, Table 13). There is a need to add an animal science component to the forage group because of the great importance of livestock in the region and interaction with cropping. Livestock are traditionally fed the weeds from cereal crops, as well as on crop residues, on fallow grazing and on corn thinnings. Animal performance is low due to problems of management and disease as well as poor nutrition.

The proposed addition of an animal science component to the forage group would include expatriate animal science/feed specialist and two Moroccan participants to be trained in this field. More support may be needed for extension work. It is possible than some animal science input could be obtained from IAV. However, it is considered desirable to develop this

capability within INRA at the Aridoculture Center to assure an interdisciplinary team research effort.

D. Farming Systems Research and Extension

1. Elaborate plans to increase farm level work (Appendix I, Items 1 and 2) in order to further develop the systems approach to agricultural research and extension.

2. Implement the plans as soon as resources can be assigned to the planned activity.

3. Develop the TRC to meet the needs of the on-farm research and the systems approach. Much of the material needed is found only in mimeographed form and in miscellaneous publications which are not usually found in libraries.

4. Continue the "Centre de Conjoncture" as an IAV activity only if IAV will raise the technical level of the personnel, assure adequate leadership, and redirect program to improve effectiveness.

5. Develop a training program for increasing capacity for on-farm research and for improving technical capacity of Extension (Appendix I, Item 2).

6. Develop farming area research teams.

Within the present LOP a plan of strategy and general scope of work should be elaborated for further advancing the system approach. (Include plans for organizing teams of farm level researchers. We have called these teams Farming Area Research Teams (Appendix I, Item 1).

a. Considerations important in the establishment of farming area research team include:

(1) Give needed specific attention to defined geographic farming areas by assigning responsibility to a group (team) of capable personnel.

(2) Develop a capability that can respond to the area; the team will know people of the region (farmers, extension agents, input suppliers, governmental officials); the team will develop understanding of the region, as well as know the status of development of new possible technologies for their region. For example the team will be knowledgeable about a new wheat variety that is under development by the wheat program.

(3) Sharpen the focus with reference to region and client. Definition of the region and the resources assigned to it will influence the degree and intensity of the work.

b. The plans for forming area teams must be in harmony with strategy and general plans of work. Some of the important items that require attention when planning include:

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(1) Identification of the specific farming areas, to be later delimited geographically.

(2) Location of the teams within the farming areas. The team does not require immediate access to an experiment station. They do need a place to store tools and inputs. They need a location at which they can be reached as easily as possible. Travel time should be minimized as much as possible. They should be located in close proximity to the CTs.

c. Support for teams. Teams usually require a lot of supervision by a research coordinator to be certain that there is collaboration and coordination between Farming Area Team and Commodity and Discipline Teams.

(1) Resources needed. The teams must be mobile; transportation is important. They need equipment that is in agreement with current farming practices; this may be available from farmers. They will require some special equipment such as small plot equipment. They will need equipment such as tape measures, scales, notebooks etc. Can (will) labor be arranged through farmers, perhaps the farmers themselves or will the labor be institutional labor assigned to the team. Team members should do most of the work themselves until they learn the process. The team must give consideration to the inputs that they will need, how they will be furnished to them, how they will analyze their data, and will they need some help with the analysis.

(2) Moroccan vs. expatriate participation. The nature of the work will require mostly Moroccan personnel. Therefore the first thing to do during the life of the present LOP is to develop a work strategy and the work in a general way.

d. Scheduling the Development

Implementation of plans will require additional resources, especially Moroccan personnel. They will also require training (Appendix I, Item 2). Teams can be trained while working if there is adequate supervision.

Since the Moroccan personnel component will be critical for development of the thrust, and just when adequate personnel might be available the scheduling is nothing much more than a guess, but it might look something like this:

(1) 1986-87

Develop plans (strategy, resources needed, areas to be covered, relationships with extension). Plan to establish two teams the following year.

(2) 1987-1988 Cropping season

Establish two teams (Teams A & B), perhaps one near a CT in Settat Province and another in Safi.

Plan to establish a third team (Team C) the following year.

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(3) 1988-1989

Establish one more team (Team C).

Make preliminary long-term plans based on experience to date.

Make plans for an internal training course for on-farm work.

(4) 1989-1990 Cropping season

Establish a training course that would function in collaboration with Team A and B (Appendix I, Item 2).

Develop a long-term plan for the farm level work.

(5) 1990-1995

Implement long-term plan for on-farm work.

e. Estimates for Personnel for Farming Area Research Teams and Training Course

The following plan is for Moroccan personnel. Expatriate personnel would help with planning, and one would serve as Research Coordinator or Research Director. Discipline and commodity program personnel, both expatriate and Moroccan personnel would collaborate and support, technically, the farming area research teams.

(1) 1987-1988 cropping season.

Team leaders	2
Other team members	8

(2) 1988-1989 cropping season

Total team leaders	3
Total other team members	12

(3) 1989-90 cropping season

Total team leaders	3
Total other team members	12
Director training	1

Trainees (Based on estimate of future needs)

(4) After 1990

Expand the activities according to needs, as well as estimated opportunity for making contribution. Expansion may be brought about in different manners. For example geographic coverage by the Area Research Teams by increasing the area covered by a team by extending into adjacent areas and/or reducing the size of teams and re-grouping into a new team to cover a new area.

Avoid expansion without adequate resources, leadership and supervision.

By 1989-1990 there should have been enough experience gained to make good estimates of expansion requirements. To start we have estimated that each team should have a leader with four additional team members. The area that may be covered by one team should be estimated based on experience. At the start each team member may be able to manage 10 simple farm trials. The number might well increase to 15 or 20 as a team member gains experience and if furnished with adequate assistance such as labor.

Organization and strategy should be adapted to local conditions Therefore during the first few years of experience, attention should be given to learning how best to proceed.

E. Institution Building and Research management

1. Follow-on activities should be continued for an additional ten year after PACD. The major thrust of follow-on project activities should contribute to maturation of the Aridoculture Center as an institution and the development of capable INRA research scientists. At the INRA level the concept of management by objective should be strengthened to provide for more effective research planning, management and budgeting. Consideration should be given to locating an additional person in the INRA Rabat office that has experience and expertise in management by objective and in agriculture research management.

2. At the earliest possible time a capable and respected Moroccan research Scientists should be installed as Director of the Aridoculture Center. To accomplish this two or three likely candidates from among the present PTs should be identified by INRA and the MIAC Team Leader. These candidates should be "groomed" and evaluated as to their suitability for the position. When a likely candidate is identified he should be assigned part time as a counterpart to the Team Leader so that he can gain experience and training in research station management. He should also be provided additional short-term training in research management and budgeting in the U.S.

3. Follow-on activities should also include strengthening of the Computer Center and the Technical Reference Center. Each of these facilities requires the services of a qualified TA to provide guidance during development of these facilities and training for Moroccan counterparts. Two moroccans should also be identified to receive long-term training in the U.S. in these subject matter areas.

4. Use institutional management to extend project benefit

a. A major objective of the project is to build Moroccan institutions, first to serve and develop Moroccan agriculture of the project area, then extend its benefits to other areas.

To arrive at this broader impact some attention, in addition to the technological focus, should be given to institutional management and administration. Otherwise the work pattern, and institutional changes

established in the Drylands Project will be slow to be adopted for other areas.

b. It is recommended that a major follow-on activity be the further development of the systems approach, and include further participation with Extension Agents in the generation, identification and dissemination of technology. This is logical inasmuch as the generation and dissemination of technology should not be two processes, but one. Therefore it would be logical to include extension organization, administration and management along with research.

5. Training

Expansion of the impact targets of the work of the Aridoculture Center will require human, physical and financial resources, the most important one being human. Therefore training should be a major component of follow-on.

Since use by farmers of technological output is key to the success of an agricultural research effort, extension personnel should be included in the training program. Since it would be a questionable strategy to broadly train extension personnel it is suggested that only those extension people with whom the Aridoculture Center works closely would be trained. Also we propose that these extension personnel be trained principally in the sciences directly related to technology (economics, engineering, management areas and the biological fields) and to a much lesser degree in communications and the traditional extension disciplines.

Not all training needs to be done outside of Morocco, and not all needs to be at the graduate level. We propose that follow-on include structured hands-on training programs. For example, training in the evaluation and integration of technology components could be developed in conjunction with the Farming Area Research Teams. This can be effective training for young B.Sc. level scientists for on-farm research and for those who will study at the graduate level later, as well as for extension agents. Since extension agents frequently have a lower level of training two courses might be given. We are not thinking of short courses but a training program over a complete cropping season.

F. Socio-economic Research

Staff currently assigned to socio-economic research at the Aridoculture Center include one MIAC Ph.D. U.S. agricultural economist with a M.S. level direct-hire Moroccan assistant, and a MIAC Ph.D. U.S. sociologist with one M.S. level direct-hire Moroccan assistant plus a B.S. level direct hire Moroccan assistant (Appendix K, Table 13). No INRA participants are currently working in the MIAC socio-economics research program at Settat.

Projections of staff requirements for the program include starting two INRA participants in agricultural economics and one in rural sociology as soon as possible to take advantage of the two U.S. scientists as advisors presently available in Settat. To work on an inter-disciplinary research team with major emphasis in agronomy research, it is considered desirable to select participants with strong undergraduate degree in agronomy animal science and preferably with prior agricultural experience. Use of under-

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graduate students with economics or sociology undergraduate degrees from IAV is not recommended because they would not likely have the background to appreciate the work of agronomists and animal scientists or to communicate effectively in identifying research needs from socio-economic research. Also, the socio-economics training at IAV is not "farm-management oriented" as compared to U.S. training. The participants with undergraduate degrees in agronomy or animal science could take a few leveling courses at a U.S. university and be accepted for a M.S. degree in Agricultural Economics or Rural Sociology. This type of agricultural background should help them work more effective in an interdisciplinary environment at a regional research/-extension center with a strong emphasis on agronomy. M.S. level training should be adequate.

In addition to the three Moroccan participants listed above, the INRA/-MIAC socio-economics team would need to include one or two U.S. agricultural economists and a rural sociologist until the Moroccans complete training and are ready to accept leadership roles. The U.S. sociologist may only be needed a short time until a good extension program is underway at the Aridoculture Center. Short-term U.S. consultants could then be utilized if needed for backup. IAV could also contribute if collaboration is improved and present problems of leadership and technical competence are resolved.

The shortest expected time frame to develop a Moroccan socio-economics capability to meet the requirements of the dryland farming project in Settat is ten years. It will take a minimum of three years for the first participant to complete English training and course work. A mixture of both M.S. and Doctorate level training is considered desirable. Given the added burden of providing training to Moroccan participants as well as ongoing research, the MIAC socio-economics unit would likely have to be strengthened to two U.S. agricultural economists. However, the sociology component should not need to be increased. The number of trained Moroccans required is considered to be at least three for the socio-economics research program plus others to work in extension.

G. Projected Stages of Research Development (Appendix L)

1. A questionnaire was developed by the evaluation team to formally solicit the views of the present INRA/MIAC research in Settat team on the projected ten-year time table for:

a. participant training on-station
b. on-station research
c. on-farm trial research
d. on-farm test or verification of research results
e. expected public release or adaptation of research results
f. the timetable for Moroccan participants to assume supervisor roles
g. use of extension training and extension dissemination

2. Questionnaires were received for projected future programs in:

a. agricultural economics
b. agricultural engineering

c. development of new cereal varieties for Morocco with Hessian Fly resistance
d. drought tolerance and disease resistance
e. adapted food legumes with disease resistance
f. new cereal production systems for improved grain and forage yields
g. improved forage production and storage systems
h. animal grazing and feeding trials on forage
i. soil testing and fertilizer analysis, and
j. rural sociology.

Members of the INRA/MIAC scientist team were also asked to project the expected benefit or impact of their respective research effort, e.g., in terms of increased yield per hectare (Appendix L. Tables 1-7).

3. Projected activities in Appendix L, Table 1 for agricultural economics research include farm enterprise budgeting (to be continued on an annual basis), evaluation of optimal wheat varieties, farm record keeping analysis, and economic evaluation of farm equipment and weed control. The projected program anticipates Moroccan training in agricultural economics and eventual development of Moroccan leadership in this research about four years after training is started. A more detailed description of the projected activity is shown in Appendix L, Table 1. Development of socio-economic capability in INRA is recommended in this report and at least one participant should be provided as soon as possible to benefit from working with the MIAC agricultural economist and becoming involved with the socio-economics research program at Settat.

4. The program projected for agricultural engineering shown in Appendi L, Table 2 includes a general ten-year operating plan, development of a prototype tillage "sweep" implement (1986-1989), testing of animal-traction implements (1987-1990), planting equipment development (1986-1991), assistance for private sector manufacturing (public release by 1990), instrumented tractor testing (1988-), and training (1987-). Benefits of the agricultural engineering program are thought to increase yield per hectare by up to 100 percent, however, we think this is very unlikely (Appendix L, Table 2). Extension training is included in the proposed agricultural engineering program to start in 1988. The projection includes training graduate students from IAV on an exchange program from 1987 through 1996. The agricultural engineering section of INRA/MIAC has established good communication with the agricultural engineering department of I ' and they plan to share responsibility in testing equipment. This should contribute to training at IAV as well as INRA.

5. The cereal breeding projection by the INRA/MIAC team for developing Hessian Fly resistant wheat varieties and drought tolerant varieties of barley and wheat with resistance to prevalent diseases and Hessian fly includes participant training, on-station research and forming a cooperative variety development program among breeders, entomologists and pathologists over the period 1986 to 1990. Participants from INRA are expected to assume supervisory roles in this research by 1990. The expected benefit of this research is 15-20 percent increase per hectare for developing fly resistance in wheat, and 10-25 percent for increased drought tolerance (Appendix L, Table 3). Seed multiplication should start by 1990.

6. The pathology program includes an evaluation of diseases on crop yields and to the identification of disease resistant genotypes for incorporation into variety development. The latter is thought to increase yields by 20 percent. Moroccans are expected to assume research leadership responsibility by 1990 (Appendix L, Table 3). Extension training is also scheduled to start in 1990.

7. Projected work in food legumes includes the identification of winter chick peas for disease resistance and development of adapted varieties and production systems for food legumes. The winter chick pea work is thought to potentially increase yield by 100 percent and the work on adapted food legumes ~~and~~ production systems to increase yield by 30 percent (Appendix L, Table 3). Extension training is projected to start by 1989. Moroccans should start assuming supervisory responsibility in 1989. Additional support including a U.S. scientist input for 4 years is recommended for the food legume research program in this report.

8. The cereal agronomy program shown in Appendix L, Table 4 includes evaluation of wheat, corn and barley production systems to generate potential yield increases of 50, 40 and 60 percent, respectively. Wheat research identified above is projected to continue through 1997, while the corn and barley research is projected through 1991. Extension training is expected to start for the above applied research in 1988 and Moroccans are expected to assume leadership responsibility starting in 1990. Research results are expected to be released by 1987 for application in the region.

9. Other research activities in the cereal agronomy program include improved tillage and rotation systems for wheat and physiology of water and nitrogen use for improved variety development. Expected yield benefits are 20-30 percent per hectare for the above activity. On-farm adoption of this new technology is expected to start in 1989 (Appendix L, Table 4). Research activity is projected through 1997. The cereal agronomy program also includes further development of labs, research stations, and greenhouses, through 1991.

10. The projected forage research program in Appendix L, Table 5 includes continuation of work on ley farming, medic testing, animal grazing and feeding trials, forage storage, forage trees and forage laboratory development. Moroccan participants are expected to assume leadership roles about 1988 in some areas of work. Benefits are estimated at 5 to 20 percent yield increase per hectare. Extension training for the research application is projected to start in 1990. The program requirement for animal grazing and feeding trials projected by the forage team supports the need for an animal science input to the forage research as recommended in this evaluation report. Animal science participants and a U.S. animal science/forage specialist should be added to the forage team. The importance of livestock in the region is discussed in Appendix

11. The soil fertility program shown in Appendix L, Table 6 includes soil test calibration work for making fertilizer recommendations, continued soil and plant laboratory analysis on station, and development of a mobile lab system to analyze farm soil samples and make fertilizer recommendations in the field. The latter extension-related activity is scheduled to start

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in 1989. Moroccans are not expected to assume a leadership role in soil research until 1993. Benefits of soil calibration work to improve fertilizer recommendations are estimated at a 30 percent increase in yield. Recommendations in this report include an emphasis and expansion of the soil testing program. Use of the mobile lab system should be very useful for extension application, and to improve communication of researchers with farmers.

12. The projected sociology research program shown in Appendix L, Table 7 includes on-farm research trial monitoring of triticale, farming systems analysis in Abda, evaluation of animal-traction and small equipment, and evaluation of temporary posture (weedy fallow) fertilization. Research activity in sociology is only projected through 1987. We also feel that the sociology component needs strong emphasis now but the team could be phased down in the next few years after more experience with extension application and a better rapport is established with farmers. However, the agricultural economics component will need to be continued to evaluate new technology applications as they are developed at the center.

13. The above projected research activity data provided by the INRA/MIAC team were very helpful to the evaluation team in determining needs of the project if it is extended beyond 1988. The potential contribution of several research components of the project to Moroccan agriculture appears to be very substantial on a per hectare basis, if the research effort is successful and farmers utilize the technology. It is noted, however, that a major part of the research in plant breeding is related to development of resistance to Hessian Fly and diseases. New varieties to combat the problem may not continue to be effective in the future if new strains of the disease or Hessian Fly emerge. Thus, the research effort will need to be a continuing process, at least for certain lines of research. On the other hand, some parts of the research such as in socio-economics, agricultural engineering and soils should result in a relatively permanent solution or program once the initial investment is made and activity should begin to taper off after a period of development.

14. Future research activity projected by the INRA/MIAC staff at Settat in Appendix L includes a timetable for Moroccan participants to assume greater responsibility in leading research and to become more involved in extension application of the research results. We think that this type of forward planning is very important and will help to keep the program on track.

VIII. LESSONS LEARNED

Not all of the "lessons learned" are totally from this project but our observations of this project tend to confirm prior observations from other projects and from overall experience.

A. Team leadership is important. Just what these qualities should be in order to be successful is not easily defined. However a balance of several talents to make decisions, to select compatible staff, to act timely in case

of problems etc. all show up as being important. Change of team leadership seems to have resulted in a dramatic change in effectiveness of the project.

B. Scheduling participant training so that the PTs returned to the project in time to work with and receive further training from the TA staff has contributed significantly to project progress.

C. The use of outside scientific panels to review, evaluate and advise on research planning and design has helped to provide the proper focus to the research.

D. The policy of having participant trainees complete their course work in U.S. universities and research work in Morocco should result in well-trained scientists while contributing to research needs of Morocco.

E. Recruitment procedures utilized by MIAC, including bringing the TA candidate and spouse to Morocco has resulted in a high quality TA team and minimized family discontent.

F. The recognition of professional needs of TA staff by providing for attendance at professional society meeting during their tour of duty has contributed to their professional growth, recognition and job satisfaction.

IX. CONCLUSIONS

Based on the review and analysis of the Dryland Agriculture Applied Research Project we conclude that:

A. Pertinent to the Performance and Project Progress of the Contractor and the GOM

1. The performance of the MIAC team is generally very good and reasonable progress is being made toward meeting project goal and purpose.

2. If the Drylands Project is not continued beyond the life of the present project it will not leave much of an imprint on Moroccan agricultural research and extension organizations or production.

3. The GOM has, with some exceptions, met its contractual project responsibilities despite the critical budget situation.

4. The Dryland Agriculture Applied Research Project is generally viewed as a MIAC project rather than a Moroccan project.

B. Pertinent to INRA Graduate Degree Candidates and Degree Training

1. The INRA participant trainees generally are of high quality and have the potential to become competent scientific researchers.

2. The research now being conducted by participant trainees is skewed toward meeting dissertation requirements but should become more development oriented as academic programs are completed.

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3. INRA participant trainees are dissatisfied with compensations received and unless the problem is rectified will leave the project as other opportunities are found following completion of their academic training. Compensation, based on comparable experience and training is lower than at MARA or IAV.

4. Doctorate level participant trainees are reluctant to accept the idea that the doctorate degree will be awarded by IAV and this attitude is adversely affecting the project.

5. Gaps in long-term participant training schedule include; agricultural machinery, agricultural economics, animal science, soil physics (water relationships) and agro-meteorology.

C. Research Activities and Research Personnel

1. The need for multidisciplinary, integrated research is recognized by MIAC and INRA staff and thought is being given to moving the research program more in that direction as participants complete their training.

2. The project is focusing on important constraints such as the susceptibility of wheat varieties to Hessian fly, which if resolved, can accrue large benefits to Moroccan agriculture.

3. The forage research project is making good progress toward achieving its basic goal and purpose with present resources and support given to the project. However, the impact of forage research will be severely limited if it is not strengthened with an animal science component when the project is extended..

4. Livestock are an important enterprise in the project area and should be included in any program designed to improve productivity and farmer incomes.

5. There is little evidence that the DDR of IAV has been effective in providing socio-economic information to guide research and extension.

6. There is a need to strengthen the socio-economics component in the dryland research program. MIAC has started to develop a capability but is likely to have only limited success because no training is being provided for Moroccans to effectively participate in the effort.

7. The soil test calibration program is about on schedule and enough information and data on the fertilizer responses of different kinds of soil should be available by the PACD to serve as the basis for an extensive soil testing program.

8. Both INRA and MIAC staff of the Aridoculture Center have an awareness of the importance of socio-economic considerations in the development of biological and mechanical technologies. They seem to have a good orientation for working with farmers and with extension agents.

9. A good technological base of resources for implementing a farming systems approach to research and extension is being developed, but the systems focus needs to be further developed and institutionalized.

10. It is important to further plan the strategies to be followed in implementing additional steps of farm level research. There is need to establish better working linkages with extension and to determine the resources that will be needed for expanded on-farm research.

11. The Agricultural Machinery section has a good program to develop or adapt improved primary tillage/seeding/fertilizer application and animal traction equipment. There is a need to develop or adapt harvesting machinery for food legumes, and other specialized equipment for small farmers.

D. Cooperation and Collaboration Between Contractor and GOM Agencies

1. There is a close, cooperative and collaborative relationship between MIAC technical assistance team members and INRA research staff.

2. Cooperation and collaboration between the INRA Project Director and MIAC Team Leader is insufficient to fully exploit opportunities to optimize project outputs and effectiveness.

3. Many opportunities exist for cooperation and collaboration between INRA/MIAC research staff and the IAV faculty but with the exception of the farm machinery groups collaboration is minimal.

4. The IAV has made an impressive record in both education and in agricultural research. IAV administration has expressed it's intent to play an innovative role in developing a new focus for extension. However, it's capability to do so has not been demonstrated.

E. Management and Operations Facilities

1. Future maintenance and repair of laboratory and other equipment will be a very serious problem unless steps are taken soon to develop Moroccan capability.

X. RECOMMENDATIONS

Based upon the preceding evaluation and conclusions it is recommended that:

A. Short Term (within LOP)

1. USAID/Rabat move immediately and deliberately to extend the Dryland Agricultural Applied Research Project for an additional ten years beyond the present PACD. Likewise USAID/Rabat proceed to amend the contract with MIAC to assure a logical transition and phasing of staffing and training to assure continuity in project activities.

2. MIAC add a Plant Pathologist to the present staff.

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3. INRA administratively and physically separate the Settat Regional Center of INRA from the Aridoculture Center.

4. USAID, IAV, INRA and MIAC agree upon and take measures to assure effective cooperation and collaboration among all administrative, academic and research units involved with the Aridoculture Center.

5. USAID, INRA, IAV, MIAC review and restate purpose, goals, and expected contributions to the research program of the DDR Chaouia project.

6. INRA/MIAC develop strategy and plans for consolidating the systems approach to agricultural research and extension.

7. MARA resolve issues of compensation inequities in INRA and that INRA respect any housing commitments made to staff to relocate at Settat, or make compensation.

8. INRA/MIAC AND USAID review the procedures for INRA participant trainees receiving graduate degrees, revise if needed, then issue a document stating the procedures to be followed.

9. MIAC train Moroccan technicians in the skills needed to maintain and repair laboratory equipment and farm machinery.

10. The INRA/MIAC agricultural machinery program continue to strengthen research on implements for improved seedbed preparation and planting, particularly for medium and small farmers.

11. INRA and MIAC complete arrangements as soon as possible to send the additional six participants to U.S. universities.

12. INRA, MIAC, and USAID review the functions, contributions and operation of the "Service de Recherche et Developpment", its value to INRA, and to the Aridoculture Center.

13. INRA/MIAC provide field training for new or inexperienced researchers and extension agents.

14. INRA/MIAC plan and prepare for an extensive soil testing and fertilizer recommendation program, to be implemented under Project extension.

B. <u>Longer Term (Beyond present PACD)</u>

1. USAID/INRA and MIAC develop a strategy to strengthen INRA management at the national level and institutionalize management by objective by placing a management by objective/research management specialist in the INRA office in Rabat. It is further recommended that this specialist be apart of the MIAC team.

2. INRA/MIAC strengthen the forage research program by adding a livestock component.

3. INRA/MIAC further develop the systems approach to agricultural research and extension.

4. The INRA/MIAC livestock forage group consider utilizing part of the Plant Materials Center for forage research purposes.

5. INRA/MIAC implement a soil testing service as a basis for fertilizer recommendations to farmers.

6. INRA/MIAC provide graduate level training in socio-economics, agricultural engineering, soil physics, agro-meterology, animal sciences, soil physics, soil and water conservation, and computer center operation.

APPENDICES

XI. Appendix

A. The Evaluation Scope of Work

B. The Logical Framework

C. Evaluation Methodology

D. Bibliography of Materials Consulted

E. Evaluation Team Schedule

F. Agronomy, Plant Protection and Soil Science

G. Agriculture, Engineering and Mechanization

H. Livestock Forage System

I. Farming Systems Research and Extension Program

J. Institution Building and Research Management

K. INRA-MIAC Technical Staff, participant trainees and schedules, advisory staff and consultant visits

L. Projections by MIAC staff of time required to achieve results and expected impact on Moroccan agriculture.

A P P E N D I X A

THE EVALUATION SCOPE OF WORK

APPENDIX A. THE EVALUATION SCOPE OF WORK

PIO/T 608-0136-3-50054

I. PROJECT TO BE EVALUATED

The Dryland Agriculture Applied Research project (608-0136) has been designed to establish a long-term institutional agricultural research capability directly serving the needs of dryland farmers in the semi-arid region of Morocco (annual rainfall between 250 and 450 mm). The project goal is to increase basic food production in order to meet the needs of Morocco's fast growing population and to improve income of traditional small dryland farmers. The project purposes are (1) to establish an applied agronomic research program which will (a) adapt existing technology to local conditions in order to increase the productivity of the dryland farmers; (b) train adequate Moroccan staff to operate the program and transmit the results to farmers; and (c) develop a program whereby suitable farming equipment can be made accessible to small farmers; and (2) to establish a socio-economic research program which will give a better understanding of the behavior of the dryland farmers and thus provide a basis for effective extension programs.

The project was originally approved in 1978 with a $4.5 million grant provided by AID. Because of implementation delays compounded by drought and contractor difficulties, the project was evaluated and substantially redesigned in 1983. The amended project increased the LOP costs from $4.5 to $26.3 million and extended the Project Assistance Completion Date (PACD) to August 31, 1988. The host country (GOM) contribution is $11.9 million, making an estimated total project cost of $38.2 million.

The implementing agency is the Ministry of Agriculture and Agrarian Reform (MARA) acting principally through Institute National de Recherche Agronomique (INRA) and to a lesser extent through the Institut National Agronomique et Veterinaire-Hassan II (IAV). A direct AID contract with Mid-American International Agriculture Consortium (MIAC) provides the technical an managerial inputs for implementing the project. In addition, a Memorandum of Understanding (MOU) between USAID and IAV is utilized to implement a portion of the socio-economic program in the project.

II. PURPOSE OF EVALUATION

This evaluation is a scheduled mid-course evaluation consistent with the Evaluation Plan of the amended project paper signed August 13, 1983. The next evaluation is scheduled for late 1987 or early 1988, prior to the PACD.

The purpose of the current evaluation is to determine the extent to which the project's purposes and goal are currently being achieved and are likely to be fully achieved within the Life of Project (LOP) timeframe. This information will be utilized by USAID, as a basis for scheduling or

altering remaining activities and if needed, estimating long range commitments, beyond the current PACD.

Evaluation issues were identified at the time of Project redesign (NEAC reporting cable, Aug. 1983; see Attachment No. 3) these are incorporated into this Scope of Work.

The evaluation will assess in depth the following items:

A. Validity of the logframe including inputs, outputs, and assumptions and the extent to which implementation activities have contributed to achievements consistent with the purpose and goal of the project.

B. Need for additional program activities or adjustment of existing program activities within current LOP. Special attention will be given to the areas of agricultural mechanization, integration of a livestock/nutrition component with the forage program, and overall integration of existing disciplinary research programs with a farming systems focus.

C. Need for AID to consider follow on activities and/or a Phase II Project after the PACD. This will be based on analyses of A and B above and evaluation of potential pay-off to continue AID investment in the program.

III. BACKGROUND

In 1978, the USAID signed a Project Grant Agreement (PROAG) with the Government of Morocco (GOM) for the implementation of an applied agricultural research program in the semi-arid regions of Morocco. AID's $4.5 million project fund provided inputs to strengthen applied research in agronomy, varietal selection, farm mechanization, agricultural economics and rural sociology. The project provided support for professional development and training of Moroccan research personnel. The applied research focused on technology development to increase farm production of major cereals (wheat and barley), edible legumes and grain/forages in regions receiving less than 450 mm of average annual rainfall. This region is responsible for an estimated 70% of national barley production and 45% of all wheat production. Increased forage production is a critical variable for increasing cereal production due to the role weeds currently play in animal nutrition and it is also a major research problem for the semi-arid region of Morocco.

The PROAG stipulates that U.S. Technical Assistance and other project inputs will be utilized to develop improved technologies and cultural practices which will be socially acceptable, economically feasible, and financially profitable for adoption by small and medium-scale farmers within this semi-arid region, and to assist in building the institutional base required to maintain a dynamic applied research program. This applied agronomic research should be closely integrated with a socio-economic research program.

AID's initial project implementation plan called for implementation by a contractor to begin in FY 1979. The implementation plan required that a U.S. scientific team be fielded to begin development of a multi-disciplinary applied research program and that a cadre of Moroccan personnel be simultaneously enrolled in advanced-degree programs in the U..S. during the initial year of the project. This time phasing was critical to the achievement of project objectives within the LOP timeframe. Implementation was disrupted by slow performance of all parties. The U.S. technical assistance contractor initially failed to field an appropriately qualified team of French-speaking scientists and the GOM construction of facilities at the Aridoculture Center experienced extremely slow initial construction progress. The selection of Moroccan personnel to be enrolled in advanced-degree programs was seriously delayed by the institutional reorganization of MARA and establishment of an semi-autonomous INRA. In addition, the first three years of the Project's field work (1981-1983), excessive drought conditions resulted in limited data from the research experiments established.

Under the redesigned project in 1983, the primary scope of work for technical assistance remained as originally proposed. However, Project Amendment No. 3 recommended additional technical assistance and related funding to enable a more complete treatment of the identified constraints to increasing agricultural production and improving productivity in the semi-arid zone. The Project's implementation difficulties experienced prior to the 1983 redesign demonstrated the need for broadening U.S. technical assistance, in order to provide the variety of scientific disciplines required to initiate a multidisciplinary approach to problem identification and resolution. Without the interaction provided by breadth of scientific perspectives, it was anticipated that field experiments would be too narrowly focused to generate acceptable results. The identified production constraints illustrate that a relatively complex farming system exists in this semi-arid zone. Therefore the redesign proposed that seven persons be added to the resident scientific team: (1) a forage agronomist; (2) a senior plant breeder/advisor;/ (3) a farm machine tillage specialist; (4) a pest management/crop loss appraisal specialist; (5) rural sociologist; (6) an additional soil/water systems specialist; and (7) a production economist. These positions were added to the existing positions of cereals agronomist, water management specialist, soils scientist, variety selection specialist and equipment maintenance engineer. Currently, a thirteen member U.S. professional team is in place at the INRA Aridoculture Center in Settat. In addition, nineteen returned INRA participants are actively engaged in research at the Aridoculture Center and will be receiving Master of Science or Doctorate degrees from the Institut National Agronomique et Veterinaire Hassan II in Rabat. The initial project was originally designed in a collaborative assistance mode among Title XII institutions. MIAC was awarded the contract for the initial project design and subsequently has been the implementation contractor. It should be noted that the 1983 redesign was undertaken by IAV.

The original project paper stated that although the project could take up to ten years, it was being designed for vie years (Phase I), during which time contractor input was critical. However, although the Project Agreement was signed on August 31, 1978, the contract with MIAC

for $4.5 million was not signed until February, 1980. Because of the late signing of the contract, the initial inability of MIAC to field French-speaking agronomists, the slow GOM response to nominate candidates for Ph.D. training in the U.S. and a severe drought which yielded almost no field trial data for the first few years of the program, progress was initially very slow. Moreover, the MIAC performance came under substantial criticism in a 1982 AID audit report. As a result of AID insistence, changes were made and the MIAC performance has improved considerably. Since then, well prepared INRA-MIAC work plans are being implemented and progress has been generally excellent.

IV. STATEMENT OF WORK

In order to assess the items identified in section II (Purpose of Evaluation), the evaluation team will review and analyze the following:

A. Validity of the logframe and project design, including inputs, outputs and assumptions, and the extent to which implementation activities by both MIAC and the GOM have contributed to the project purpose and goal.

1. Inputs

a. Quality, disciplinary focus and composition of the resident research technical assistant team.

b. Quality, disciplinary focus, timeliness and overall contribution of consultants.

c. Quality, and timely selection of counterpart Moroccan research and support personnel (including technicians and administrative personnel).

d. Adequacy of participants and appropriate placement into short-term and degree training programs

e. Pace and adequacy of other support facilities, particularly the computer center, technical reference center and greenhouse complex.

f. Developmental effort (equipment, facilities and other infrastructure) at the four sub-stations.

2. Outputs

a. Extent to which appropriate agronomic technologies and farming equipment are being developed.

b. Extent to which the socio-economic component and Agricultural Information Resource Center is producing useful data for farming systems research (MOU between USAID and IAV) and to target beneficiaries.

c. The level of Moroccan staff development and management systems at the national level to sustain institutional program focus.

d. Institutional status of the Aridoculture Center and leadership capabilities to sustain and continue development.

e. Sustainability of linkage mechanisms to extension programs and effectiveness of technology transfer to farmers.

f. Effectiveness of internal research program reviews (e.g. Scientific Panel).

3. Assumptions

a. Quality and usefulness of contractor annual work plans for defining inputs in relation to need.

b. Ability and willingness of GOM to contribute and integrate budgetary funds for salaries and operating costs.

c. Ability to integrate diverse research programs.

d. Strategic emphasis by the GOM to continue efforts on rainfed agricultural production.

e. Ability and willingness by GOM research system to adopt improved research assessment methodologies.

B. Progress made toward the achievement of the Project's Purpose.

C. Progress made toward the achievement of the Project's Goal.

D. Need for additional research program activities or adjustment of existing activities within current LOP.

Special attention will be given to the areas of agricultural mechanization, integration of a livestock nutrition component with the forage program, and overall integration of existing disciplinary research programs with a farming systems focus. The team will base its analysis primarily on existing research programs reviews which have been completed: The Scientific Panel review, the Agricultural Mechanization review, the Socio-Economic review and the Forage Program review. The team will not be required to analyze on a first hand basis the scientific methodology, experimental research results nor on farm trials for this assessment, but will discuss issues with individual research staff as required. The analyses should also include:

1. Breadth and relevancy of existing disciplinary programs in relation to the regional needs and broader national needs.

2. Importance and adequacy of external linkages with other national programs and international agricultural research centers.

3. Capability of INRA and the GOM to support a broader program focus.

a. Availability of manpower requirements.

b. Management structure of INRA, planning by objective, and administrative support.

c. Financial resources of GOM.

4. Level of effort and importance of expanding the technology transfer role of the center to include greater emphasis on farming systems and/or extension activities.

5. Level of effort and importance of expanding the agricultural mechanization program particularly in relation to the private sector.

6. The level of effort and importance of expanding the existing forage program to include relevant integration with livestock nutrition as it relates to the farming system of the project region.

E. Need for AID to consider follow-on activities and/or a Phase II project after the PACD.

This will include a rationale based on analyses of A, B, C, and D above and provide specific recommendations which can be utilized by USAID to plan effectively prior to the PACD.

1. The rationale will be based upon examination of the current pace and adequacy of implementation activities and will provide estimates of project activities required to reach the goal level of the project. The estimates should state what level of effort would be required by all parties to attain a desired set of outputs within a given timeframe.

2. The recommendations will describe, if necessary, the need to change focus, the anticipated level of effort and the potential program areas which would enhance the role of the Aridoculture center on a national and/or international scale. Additional institutional emphasis involving other INRA research stations could be considered.

V. METHODS AND PROCEDURES

A. Duration: The evaluation will take place from approximately March 31 through May 15 for a total of 40 working days. The team will work six day work weeks.

B. Method: The evaluation will be conducted in three parts:

Part One: For three working days at the University of Nebraska, Lincoln, Nebraska, the evaluation team will interview MIAC backstop personnel, meet with participants and assess the Project's status, as well as review critical project documentation such as INRA-MIAC Annual Work Plans, Annual Reports, Participant Advisor's Trip Reports, and the $22.3 million MIAC-AID/NE-C-1666 Contract with nine amendments.

Part Two: For twenty-two working days, the evaluation team will conduct an in-country project assessment. They will meet with USAID, MIAC, INRA, IAV and MARA personnel. Additional interviews and discussions with other Moroccan officials and beneficiaries will also be performed and required. Approximately 7 working days will be in Rabat and 15 working days will be in Settat Province and possibly other relevant areas of Morocco.

Part Three: For fifteen working days, the team will for synthesize collected information and draft the report, preparing the Executive Summary and debrief USAID, INRA, MIAC and IAV. Approximately seven working days will be in Rabat and eight working days in Settat (ARidoculture Center).

1. The team will rely heavily on existing documentation of project activities and should therefore be fully familiar with documents indicated in Part 1 of V.A. above.

2. In addition, a number of internal research program reviews and consultant reports have already been completed and will provide the basis for analyzing the research program. The "scientific panel review," the "Agriculture mechanization review", the "socio-economic review" and "forage program review", in particular will be fundamental to the evaluation team scope of work.

3. Discussions, interviews and on-site visits will elicit the remaining information required for the evaluation.

4. The team will discuss the outline of major sections of the report with USAID during the first two weeks in-country.

C. Secretarial/Word Processing/Office Space: The preparation of the draft and final evaluation report will be in English and is the responsibility of the evaluation team leader. Local secretarial assistance is available through the Embassy Cooperative Association but must be requested in advance. Bilingual secretarial assistance is less readily available. Funds have been included in the budget for this purpose.

Mission will make available electric typewriters and office space. Use of word processing equipment (WANG) during working hours cannot be assumed although after hours access to this equipment can be arranged.

D. Language: Although many senior level Moroccan officials can speak English, the team should include at least one member (preferably team leader) with S2, R2 French capability if possible. Translators are available locally, should the team require them.

E. Local travel requirements will be the responsibility of the team with assistance from USAID and/or MIAC.

F. Small 8(a) Minority and Women Owned Farms:

Although Mission has no knowledge of small 8(a) minority and women owned firms that may be qualified and available to provide the technical assistance service requested in this scope of work, such 8(a) participation would be welcomed if fully qualified firms can be identified. If more than one such firm is available, the Mission would strongly prefer to select among those interested on the basis of experience qualifications of proposed team members, etc.

VI. TEAM COMPOSITION

A. The evaluation team will consist of four persons having broad U.S. and international experience in agricultural research program development needs under semi-arid conditions. Specifically, the team must have a collective experience in the U.S. and in developing countries which will provide them with the capability to effectively analyze this project within the given context of resource constraints and opportunities unique to Morocco. Team members should be able to make independent judgments on progress of the project and assess programmatic needs for the future. Synthesis and articulation of the results and recommendations both orally and in the evaluation report and recommendations to USAID and the GOM prior to the team's departure. The individual team members should have the following qualifications:

1. Agricultural Research Management Specialist/Institutional Specialist (Team Leader) should have a Ph.D. in his/her field and 10-15 years experience including international and in the U.S. managing institutional development of agricultural research and/or related programs. Knowledge of agricultural research station development in the U.S. and experience with international agricultural research centers would be highly beneficial. French language capaiblity at S-2, R-2 is preferred but not mandatory assuming at least one other team member has french capability.

2. Agronomist/soil scientist should have at least 10 years U.S. and international experience beyond the Ph.D. working with applied research programs. Knowledge and experience of applied cropping systems, soil/water management and soil fertility program development in marginal rainfed agriculture is required. An understanding of agricultural research stations in the U.S. and AID agricultural research efforts in developing countries is preferred. Any related experience with agricultural mechanization/tillage in semi-arid conditions would be useful.

3. Forage agronomist/livestock specialist should have at least 10 years U.S. and international experience beyond the Ph.D. working with applied research programs. Knowledge and experience of forage/food legume production and the relationships to livestock nutrition required. Capability to understand and analyze complex inter-relationships between forage crop production and livestock systems under semi-arid conditions is essential.

4. Farming systems/extension specialist should have at least 10 years experience beyond Ph.D. preferably overseas working with the entire range of farming systems components including on farm research, cropping systems, and livestock. The specialist should understand the relationship between applied agricultural research programs and extension of technology related to increased national output.

B. The USAID project manager and USAID evaluation officer will participate in the evaluation to provide guidance, advice to the team. The USAID representative along with a MIAC representative will assist in meetings as required.

C. USAID/Rabat would welcome additional participation from AID/W either from ANE/TR, ANE/PD subject to availability of travel funds. USAID also suggests that the at least one member of the team be recruited from one of the International Agricultural Research Center's such as ICARDA, ICRISAT or ISNAR.

VII. FUNDING

USAID will finance the evaluation under the project with funds earmarked for that purpose. The estimated cost including salaries, per diem, international travel, domestic travel, car rental/ground transportation, secretarial/translation services, and contingencies is $96,000. A total of 40 person/days will be funded as noted in Attachment Two.

VIII. REPORTING REQUIREMENTS

A. Report Format: The evaluation team will prepare a written report that conforms to the Asia/Near East Bureau Guidelines for Evaluation. A set of these guidelines is available in AID/W. The report will contain the following sections:

1. Basic Project Identification Data Sheet. One page.

2. Executive Summary. Three pages, single spaced using the AID Evaluation Summary format and directions found in the aforementioned guidelines.

3. Body of the Report. The report is to include a description of the country content in which the project was developed and carried out, and provide the information (evidence and analysis) on which the conclusions and recommendations are based. The body of the report should not exceed 40 pages in length although the evaluators may include details in appendices.

4. The report should end with a full statement of conclusions and recommendations. Conclusions should be short and succinct, with the topic identified by a short sub-heading related to the questions posed in the statement of work. Recommendations should correspond to the conclusions.

Whenever possible, the recommendations should specify who, or what agency, should take the recommended actions.

5. The evaluators will clearly distinguish between their findings, their conclusions (that is, their interpretations of the findings), and their recommendations that follow from the findings and conclusions. This information will be expressed schematically in a matrix in the evaluation report. "Lessons learned" and "unintended consequences" from project activities will be included in this section.

6. Appendices. These are to include at a minimum the following:

a. The evaluation scope of work;
b. The logical framework, together with a brief summary of the current status/attainment of the original inputs and outputs (if these are not already indicated in the body of the report);
c. A description of the methodology used in the evaluation (e.g. the research approach or design, the types of indicators used to measure change of the direction/trend of impacts, how external factors were treated in the analysis). Evaluators should offer methodological recommendations for future evaluations; and
d. A bibliography of documents consulted.
e. Other appendices may include more details on special topics and a list of agencies consulted.

B. Submission of Report and Asia/Near East Evaluation Summary

1. The team will submit an outline of the draft report fifteen days before the team's departure and a preliminary draft will be presented to USAID at least 7 days prior to their departure from Morocco. This draft will be reviewed by the Mission and any changes made at the recommendation of the Mission at least 2 days prior to their departure.

2. Ten copies of the final report will be due in USAID/Morocco four weeks following receipt of comments from USAID. The contractor will submit a translation in French of the Executive Summary along with the final report.

3. The team will also be required to complete the Asia/Near East Evaluation Summary (both the abstract and Part II) for submission at the same time as the report.

C. Debriefing

1. Prior to departure from Morocco, the evaluation team will conduct a debriefing for the USAID Mission Director, or his designee, AID staff, and for GOM officials, and the MIAC team leader.

A P P E N D I X B

THE LOGICAL FRAMEWORK

APPENDIX B. LOGICAL FRAMEWORK

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: To increase basic food production in order to meet the needs of Morocco's fast-growing population, and improve income of traditional small dryland farmers.	Measures of Goal Achievement: - Increase in food production. - Reduction in basic food imports in absolute terms or in relation to population increase. - Increase in consumption in dryland areas. - Increase in income of small farmers	GOM Statistical and other reports.	Assumptions for achieving goal t The GOM will: - effect program and price polic changes so as to encourage greater farmer productivity.
Project Purpose: To develop a permanent applied research program aimed at increasing farmer productivity.	Conditions that will indicate purpose has been achieved: End of project status. - A unit in MARA with adequate staff facilities, and budget is conducting production-oriented research. - Production technology that is economically applicable is being developed. - Improved technology is being made available to farmers.	- GOM reports - Annual and Special Evaluations	Assumptions for achieving purpos - MARA is committed to establish a permanent applied dryland research program. - MARA will assign qualified ingenieurs and adjoints techni ques in agree-upon numbers and a timely basis. - Adequate resources—funds, equ ment and land-will be provided on a timely basis.
Outputs: 1. Improved technology. 2. Trained Moroccan scientists and technicians. 3. Relevant information from the socio-economic research. 4. Analytical report on dryland mechanization	Magnitude of Outputs: 11 Scientists trained to PhD in the U.S. 11 Scientists trained to M.S. in the US. 18 Technicians trained on-the-job 8 Socio-economic study reports 1 Report on mechanization	- Annual Project Evaluations - Special Evaluations	Assumptions for achieving output - MARA will assign qualified ingenieurs and adjoints techni in agreed-upon numbers and on timely basis. - Adequate resources—funds, equ ment and land—will be provide on a timely basis.
Inputs: U.S. 1. Research Team 2. Consultants 3. Commodities 4. Training GOM Land, buildings, equipment and machinery, agricultural and social scientists and technicians, laborers and administrative personnel. Operating Budget.	Implementation Target (Type and Quantity) U.S. $4.5 million Man-Years 15 3 Research Scientists 6 1/2 Consultant Services 60 (22 Trainees) Vehicles (4), Harvesters (2), Agricultural machinery equipment, Agricultural chemicals (including pesticides, fertilizer & herbicides) plant materials and laboratory equip. GOM Capital budget $ 900,000 Operating budget $2,000,000	- USAID and GOM records - On-site visits	Assumptions for providing inputs - AID inputs will be provided on timely basis. - Contractor staff will have proficiency in French and Arab - GOM will provide inputs on a timely basis. - GOM will provide adequate budg for operating costs.

Best Available Document

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
PROJECT GOAL: To increase basic food production in order to meet the needs of Morocco's fast-growing population; and improve income of traditional small dryland farmers.	MEASURE OF GOAL ACHIEVEMENT: Technologies introduced with under farmer fields trials increased yields by at least 30% and are economically viable and socially acceptable.	GOM data, project evaluations, other AID project reports/records, project annual reports, on-site inspection tours, and other donor reports.	Production inputs which are identified to be critical to increasing yields will be available on a timely and reasonable basis. Market incentives will be favorable for the production of subject crops given increased cost of production associated with adoption of improved inputs.
PROJECT PURPOSE: To establish and applied agronomic research program which will a) adapt existing technology to local conditions in order to increase the productivity of the dryland farmers; b) train adequate Moroccan staff to operate the program and transmit the results to farmers; and c) develop a program whereby suitable farming equipment can be made accessible to small farmers; and 2) to establish a collaborative socio-economic research program with INRA-IAV that will give a better understanding of the behavior of the dryland farmers and thus provide a basis to effective extension programs.	Conditions that will indicate purpose has been achieved: End of project status. - A unit in MARA with adequate staff facilities, and budget is conducting production-oriented research. - Production technology that is economiically applicable is being developed. - Improved technology is being made available to farmers.	GOM annual reports, project evaluations, other AID project reports, on-site inspection tours, and other donor reports.	GOM agricultural service agencies such as the extension service, parastatals, seed multiplication/distribution authority, credit banks, and cooperatives make improved production inputs known and available to farmers throughout the semi-arid region.

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NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
PROJECT OUTPUTS: 1. Adapted agronomic technologies and cultural practices appropriate to Moroccan dryland farming; 2. Adapted farming equipment suitable for small and medium-scale farmers; 3. Socioeconomic data collected and analysed allowing a better understanding of the socio-cultural and economic environment in which dryland farmers operate, yielding baseline information needed for establishing farming systems research/extension programs and for project evaluation; 4. A functioning Agricultural Information Resource Center providing timely information to project staff, GOM personnel in the DPA's and CT's in the project area, and to farmers; 5. INRA staff development and management systems designed for an effective applied research program; 6. INAV-RZ and INRA staff development and research systems designed for an effective socio-economic applied research program; 7. A functioning National Aridoculture Center; 8. Functioning satellite research stations for the National Aridoculture Center.	**MAGNITUDE OF OUTPUTS:** 1. Fully equipped and functioning National Aridoculture Research Center with linkage to satellite research stations. 2. 15 MSc and 17 Ph.D. participants to form the research scientist cadre at the National Aridoculture Center. 3. 120 INRA support staff trained in improved technical and administrative skills. 4. A trained cadre of 3 social scientists to provide support at IAV for INRA applied research. 5. Improved agronomic technology and agricultural equipment developed in collaboration with INRA and provided to farmers through GOM extension facilities. 6. 30 socio-economic research study reports plus numerous monthly agricultural information reports. 7. 2 reports on appropriate agricultural mechanization for low rainfall crop production.	GOM reports, Project records, evaluations and on-site inspection tours.	Diverse research programs can b closely integrated. GOM will continue current increa strategic emphasis on rainfed a cultural production. GOM agricultural researchers wi improved research and research ment methods GOM will maintain salary levels itive with private enterprise.
INPUTS: **A.I.D.** 1. Research Technical Assistance Team 2. Consultants 3. Commodities 4. Training 5. Other Costs **GOM** Land, buildings, equipment and machinery, agricultural and social scientists and technicians, laborers and administrative personnel. Operating budget.	**IMPLEMENTATION TARGET** Personnel LT Tech. ST Consult. Commodities Training 32 LT Part. ST Part. Other Costs Construction GOM Salaries Subtotal A Inflation Subtotal B Total Project PT / U.S. $000 / GOM $000	GOM approved annual budgets and expenditure reports, Project records and evaluations, on-site inspection tours.	GOM willing to increase availab funds for salaries and operatin of Aridoculture Project in a ti basis. All Project trained participant to work on Project. U.S. TA Contractor completes w commodity procurement and repo timely basis plus provides appr TA staff on a timely basis.

A P P E N D I X C

EVALUATION METHODOLOGY

APPENDIX C. EVALUATION METHODOLOGY

The mid-term evaluation of the Dryland Agriculture Applied Research Project was conducted by a multidisciplinary team with broad experience in developing countries and with expertise covering all components addressed by the scope of work (Appendix A). The purpose of the evaluation is to determine the progress made toward achievement of project goal and purposes and the likelihood they will be fully achieved within the present life of project (LOP). The evaluation is to be utilized by USAID as a basis for rescheduling or altering remaining project activities if required and for estimating long range project commitments beyond the current Project Assistance Completion Date (PACD).

The evaluation began with the assembling of the team in Washington D.C. Briefings covering project background, the Moroccan situation, scope of work and reporting requirements were provided for the team by the IQC contractor, Winrock International, and ANE/TR/ARD. The team was in Morocco from April 3 through May 10, 1986. This period was spent in Rabat, at the Aridoculture Center in Settat and in the field within the project area. A schedule of activities is presented as Appendix E.

The team was organized to function as a team. While each was assigned primary responsibility for specific components of the evaluation (consistent with his expertise and the scope-of-work) all members shared responsibility for general observations and analysis of the entire project. In other words, each team member concentrated primarily on his assigned component of the evaluation but also took a broader look at all aspects of the project.

A phased approach was utilized in the evaluation process. However, the various phases were not discrete in time and in many instances were going on simultaneously. There was close interaction with continuous exchange of ideas among team members and feed back into the evaluation process.

The phases of the evaluation process were: Phase 1, Project Familiarization; Phase 2, Information collection and organization; Phase 3, Information evaluation and analysis and Phase 4, Evaluation of alternatives and report preparation.

Phase 1. Project Familiarization: Project documents were provided to the team by the IQC contractors, AID/W, USAID/Rabat, and MIAC. These included the Project Paper, with amendments; the Proag, with amendments; and the contract between USAID/Rabat and MIAC. These documents established the scope of the project, what the project was to accomplish and when it was to be accomplished, who was responsible for various project components and the project budget. Also included in these documents is inputs, expected outputs and assumptions upon which the project is based.

A review of these documents provided the team with the project information background necessary for an evaluation. These documents

presented the project objectives and purposes to be used as a measuring stick to determine accomplishments.

Phase 2. Information Collection and Organization: Additional pertinent documents relating to the project were provided to the team. These documents included but were not limited to: reviews by various scientific panels and teams, project reports, annual reports, annual work plans, policy statements, staffing patterns, participant training schedules etc. These documents were provided by AID, MIAC, INRA, IAV and others.

This documentation provided specific information regarding project activities, accomplishments, plans, problems, projections, needs etc. A study of these documents provided information that when integrated with observations and discussions allowed the team to assess project accomplishments, needs and problems.

Interviews, observations and field visits were also utilized extensively by the team in this phase. Detailed interviews where held with MIAC staff, individually and in groups; with INRA staff individually and in groups; IAV administrators and faculty; other MARA agency staff including DPAs and CTs; and other USAID contractors in Morocco.

The team inspected and reviewed project facilities including buildings, laboratories, workshops and offices. It also reviewed laboratory equipment at the Aridoculture Center and farm equipment and vehicles at the mechanization center. Research work was observed at research stations and at on-farm trials. Facilities and equipment were also observed and reviewed at INRA and IAV in Rabat.

Phase 3. Information Evaluation and Analysis: This phase of the evaluation was processing concomitantly with other phases. It was a continuing process. As information was gathered through discussing, reading, interviews and observations it was tested against and compared with project objectives, goals and expected outputs. If problems, inconsistencies or questions appeared they were resolved by further questions, observations and interviews. Thus, constant feed-back into the system and continuing reanalysis was an integral part of the evaluation process.

Due to the nature of this evaluation the analysis tends to be more qualitative than quantitative. The evaluation is intended to be objective. However, an analysis of qualitative data of necessity is somewhat subjective.

During this phase of the evaluation the team utilized the objectively verifiable indicators of the logframe as a basis for measuring change or progress toward achievement of project goal and purpose. For example 32 participants are to receive training and graduate degrees during the PACD. To date only 26 are in training and will have received degrees in the LOP. The hiring freeze in the MARA brought on by critical budget problems in the GOM was the external factor responsible for this shortages. Progress and problems in achieving project goals and purposes were examined in the light of not only programmed project inputs but external factors as well.

External factors included, but were not limited to: GOM activities, weather/climate, market prices, personnel problems and farmer response.

Phase 4. Evaluation of alternatives and report preparation: Followin evaluation and analysis of informative alternatives for project activities, modifications, conclusions and recommendations were surfaced and examined by team members. All were examined from the stand points of reasonableness and consistency with information upon which they were based.

Subsequent to a final review of information and analysis, recommendations were considered and finalized by consensus of the team. The final report was prepared to present results of the evaluation and conclusions and recommendations of the Evaluation Team.

In the judgement of the Evaluation Team the methodology utilized is logical and should provide a sound and fair project evaluation. However, it would contribute to the evaluation process if the mission provided more guidance as to the form expected in the final report. In addition the information and analysis phase of the process would be strengthened if team activities were scheduled to allow one or two day breaks in the field review process to permit the team to consolidate finding to date, make some preliminary analysis and plan for the remaining time to be spent in-country. Scheduling difficulties are recognized as well as the fact that other things are also going on in the mission and in-country. However, it should be kept in mind that the team was brought to the country to evaluate, analyze and make sound recommendations. The ability of the team to meet these responsibilities in influenced by scheduling.

A P P E N D I X D

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APPENDIX D. BIBLIOGRAPHY OF MATERIALS CONSULTED

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A P P E N D I X E

EVALUATION TEAM SCHEDULE OF ACTIVITIES AND INTERVIEWS

APPENDIX E. EVALUATION TEAM SCHEDULE OF ACTIVITIES AND INTERVIEWS
APRIL 2 - MAY 22, 1986

April 2, 1986

8:30 a.m. - Briefing at Winrock International, Arlington, Virginia
- Garland Christopher
- Guner Gery

9:30 a.m. - Briefing USAID, NEA/Bureau, Washington D.C.
- Jim Lowenthal, ANE/TR/ARD
- Ed Rice, Agriculture Research Projects
- Trid Mukherjee, Economist

2:00 p.m. - Briefing at Winrock International, Arlington, Virginia
- Garland Christopher, Winrock, Evaluation Team backstop
- Guner Gery, Evaluation Team backstop

6:45 p.m. - Depart Washington D.C. (Dulles) enroute to Paris

April 3, 1986

8:40 a.m. - Arrive Paris, De Gaulle

7:50 p.m. - Depart Paris, Orley

8:30 p.m. - Arrive Rabat

April 4, 1986, USAID Rabat Office

8:30 a.m. - Briefing USAID/Rabat
- Malcolm Purvis, Food and Agriculture Office (FAO)
- Ron Stryker, Deputy FAO
- Randall Thompson, Evaluation Office
- Hanafi, Project Management

2:00 p.m. - Briefing USAID/Rabat
- Robert Chase, Mission Director
- Charles Johnson, Deputy Director

3:30 p.m. - INRA
- H. Faraj, Director
- M. Zouttane, Deputy Director, INRA

April 5, 1986, USAID/Rabat Office Review documentation

April 6, 1986, Sunday

April 7, 1986

8:30 a.m. - Depart Rabat for Settat

10:45 a.m. - Arrive Settat, Briefing by MIAC
- Darrell Watts, MIAC Team Leader
- Lavoy Croy, MIAC Research Coordinator

2:30 p.m. Briefing, review Aridoculture Center Facilities
- Darrell Watts, MIAC Team Leader
- Lavoy Croy, MIAC Research Coordinator

April 8, 1986, Aridoculture Center

8:30 a.m. - Review facilities, discussions, Sidi El Aydi Research Station
- Darrell Watts, MIAC Team Leader
- Lavoy Croy, MIAC Research Coordinator
- John Hamilton, Agriculture Engineer
- Abdel Bahri, Agriculture Engineer
- Wally Swanson, Mechanization, Station Development
- Ed Smith, Cereal Breeder
- Dave Keith, Entomologist

3:00 p.m. - Briefing, review Weed Science work
- Dave Regehr, Weed Science

6:30 p.m. - Discussions, Forage Agronomy Staff
Loren Rossmann, Forage Agronomist
Mohamed Mazhar, Forage Agronomist
Mohamed Derkaoui, PT, Forage Breeding

April 9, 1986, Field trip to Jemma Shaim, review off station research and on-farm trials
Darrell Watts, MIAC Team Leader
Lavoy Croy, MIAC Research Coordinator
Ed Smith, Cereal Breeder
George Primov, Sociologist
Mustapha Hamida, Research Associate, Agri-Econ
Ismail Said, Research Associate, Sociology
Giles Rafsnider, Agricultural Economics
Ron Stryker, Deputy FAO

April 10, 1986, Aridoculture Center
8:30 a.m. - Discussions Mechanization Center Group
John Hamilton, Agricultural Engineer
Wally Swanson, Mechanization, Station Development
Abdel Bahri, Agricultural Engineer
10:30 a.m. - Briefing, Weed Science Group
Dave Regehr, Weed Science
Abbes Tanji, PT, Weed Science
Azzedine El Brahli, Weed Science
2:30 p.m. - Discussions, Cereal Agronomy and Soils Management
Lavoy Croy, Cereal Agronomist and Research Coordinator
Mohamed El Mourid, PT, Cereal Agronomy
Mohamed Karrou, PT, Cereal Agronomy
Kenneth Brengle, Soils Management
Abderrahman Bouzza, PT, Soils Management

April 11, 1986, Aridoculture Center
9:00 a.m. - Discussions, Sociology Group
George Primov, Sociologist
Ismail Said, Research Associate in Sociology
Richard Riddle, Sociologist
10:30 a.m. - Discussions, Agricultural Economics Group
Giles Rafsnider, Agricultural Economics
Mustapha Hamida, Research Associate in Agri-Econ
12:00 a.m. - Discussions with Entomology Group
Dave Keith, Entomologist
Saadia Lhaloui, PT, Entomology
Mustapha El Bouhssini, PT, Entomology
3:30 p.m. - Discussion with INRA Project Director
Elmadani Zouttane, INRA Regional Director, Director of Aridoculture Center

April 12, 1986, Return to Rabat
April 13, 1986, Sunday, Rabat
April 14, 1986, USAID/Rabat Office
8:40 a.m. - Status report to USAID/Rabat
Ron Stryker, Deputy FAO
H. Hanafi, Project Management
Randall Thompson, Evaluation Officer

11:00 a.m. - Discussions with Director of Scientific Department, INRA
Dr. Ezzahrauoi, Chief Division Research and Experimentation
Dr. Moutaid, Animal Science
Dr. Bennani, Plant Pathology
Dr. Osrhiri, Ecology
2:35 p.m. - Visit INRA facilities
Dr. Ezzahrauoi, Chief Division Research

April 15, 1986, USAID/Rabat Office
8:30 a.m. - Discussion with USAID/Rabat
Randall Thompson, Evaluation Officer
9:30 a.m. - Visit to INRA Guich Station,
Rabat Ed Smith, Cereal Breeder
Abdellah Ouassou, Cereal Breeder
Turkmani, Seed Control and Registration
Kaouki, Seed Multiplication (FAO)
3:00 p.m. - Discussions with IAV, Hassan II Director Deputy
Mohamed Firdawcy, Deputy Director
5:20 p.m. - Discussions with IAV, Hassan II, DDR Group
Richard Riddle, Sociologist
Larbi Zagdouni, Acting Director DDR
Driss Benatya, Economist
Abdelfatah Elbehri, Agronomist

April 16, 1986, USAID/Rabat Office
8:30 a.m. - Malcolm Purvis, FAO
12:00 - Hotel Tom Hassan, (Security), Reviewing documentation

April 17, 1986
Travel to Settat
10:30 a.m. - Discussions with Soil Fertility Group
Parris Soltanpour, Soils
Lavoy Croy, Research Coordinator
A. Azzaoui, Soil Fertility
M. El Gharous, Soil Fertility
3:00 p.m. - Discussions with Plant Pathology Group
M. El Yamani, Virology
A. Lyamani, Mycology
E. Toufig, Plant Pathology
Dennis McGee, Plant Pathologist (Consultant/Advisor)

April 18, 1986, Aridoculture Center
9:00 a.m. - Discussions with MIAC Technical Staff
Parvis Soltanpour, Soil Fertility
Loren Rommann, Forage Agronomy
John Hamilton, Agriculture Engineering
Dave Regehr, Weed Science
Arden Campbell, Cereal Breeding
George Primov, Sociologist
Giles Rafsnider, Agricultural Economist
Wally Swanson, Agricultural Mechanization
Leonard Bashford, Agriculture Engineer, Consultant
Ken Brengle, Soils Management
John Snyder, Soil Chemistry and Lab Development
Lavoy Croy, Research Coordinator
Dave Keith, Entomologist (sabbatical leave UNL)

3:00 p.m. - Discussions with INRA staff
Mustapha Bouchoutrouch, PT, Cereal Agronomy
Mohamed El Mourid, PT, Cereal Agronomy
Mohamed Karrou, PT, Cereal Agronomy
Mohamed Kamel, PT, Food Legumes
Mohamed Derkaoui, PT, Forage Breeding
Mustapha El Bouhssini, PT, Entomology
Abderrahman Lyameni, PT, Plant Pathology
Mohamed El Yameni, PT, Plant Pathology
El Mustapha Toufig, PT, Plant Pathology
Abdelmalek Azzaoui, PT, Soil Fertility
Mohamed El Gharous, PT, Soil Fertility
Abderrahman Bouzza, PT, Soil Management
Mohamid Boutfirass, Director, Sidi El Aydi Station
Abdeljabar Bahri, Agriculture Engineering

April 19, 1986, Settat Team meeting, work on documentation and report

April 20, 1986, Sunday, Settat

April 21, 1986, Settat, Discussions with DPA and CTs
9:00 a.m. - Dr. El Hemiur, Director Settat DPA
2:30 p.m. - Abderrahman Rabhi, Director
Oulad Said CT

April 22, 1986, Settat
8:30 a.m. - Discussions with MIAC staff
Darrell Watts, Team Leader
Lavoy Croy, Research Coordinator
2:30 p.m. Field review with Forage Group, Sidi El Aydi
Loren Rosman, Forage Agronomist
Mohamed Derkaoui, Forage Breeding

April 23, 1986, Aridoculture Center, Discussions with DDR Group, Centre de Conjuncture
9:15 a.m.
Richard Riddle, Sociologist
Abdelfatah Elbehri, Agronomist
Sedrick El Moula, Technician
Mohammad Agandou, Technician
Kadour Elmajdaoui, Technician
Ahmed Chgoubi, Technician
11:00 a.m. - Discussions with Director, Aridoculture Center
El Madani Zouttane, Project Director, INRA
1:30 p.m. - Meeting with Cereal Breeder
Arden Campbell, Cereal Breeder
3:30 p.m. - Meeting with Food Legume Breeder
Mohamed Kamel, P.T., Legume Agronomist
5:00 p.m. - Meeting with Director Aridoculture Center
El Madani Zouttane, Project Director, INRA

April 24, 1986, Settat
9:00 a.m. - Discussion with MIAC Team Leader
Darrell Watts, MIAC Team Leader
Ron Stryker, Deputy FAO
3:00 p.m. - Depart Settat enroute to Rabat

April 25, 1986, USAID/Rabat Office
9:00 a.m. - Meeting with USAID
Ron Stryker, Deputy FAO

5:00 p.m. - Ken Young and Bob Waugh meeting with USDA-PASA,
Agriculture Statistics
Wally Tyner, Agricultural Economist

April 26, 1986, USAID/Rabat Office, Information analysis, drafting report

April 27, 1986, Sunday - Rabat

April 28, 1986, USAID/Rabat Office, Report preparation

April 29, 1986, Rabat, Meeting with staff at IAV

9:30 a.m. - Fouad Guessous, Animal Production

11:30 a.m. - Don Johnson, Minnesota Project
Dr. Firdawcy, Director General, IAV

2:45 p.m. - Dr. Mostafa Agbani, Head Department of Agronomy and Plant Breeding
Dr. Mohamed Oussible, Tillage

3:45 p.m. - Dr. Aziz Merzouk, Head Department of Soil Science

April 30, 1986, USAID/Rabat office Report

8:45 a.m. - Status Report, Malcolm Purvis, FAO

9:30 a.m. - 6:00 p.m. - Report Preparation

May 1-5, 1986, USAID/Rabat Office, Report Preparation

May 6, 1986, USAID/Rabat Office

7:00 a.m. - Report Preparation

8:30 a.m. - 10:30 - Presentation of draft Evaluation Report to Agriculture Office
Malcolm Parvis, Food and Agriculture Officer (FAO)
M. Hanafi, Project Management
Paul Crawford, Agricultural Economics
Randall Thomas, Evaluation Officer

2:00 p.m. - 4:00 p.m. Continue presentation of report

May 7, 1986, USAID/Rabat Office

9:00 a.m. - 11:30 a.m. - Debriefing report to USAID/Rabat
Charles Johnson, Deputy Director
Malcolm Parvis, FAO
Randall Thomas, Evaluation Officer
Paul Crawford, Agriculture Officer
Stacy Rhodes, Program Officer
John Giusti, Program Office
Mohamed Hanafi, Project Management
Pamella Callen, Acting Comptroller

1:00 p.m. - 6:30 p.m. - Report Preparation

May 8, 1986, USAID/Rabat Office

7:00 a.m. - 12:00 a.m. - Report Preparation

3:00 p.m. - 4:00 p.m., INRA
H. Faraj, Director INRA
Malcolm Parvis, FAO
M. Hanafi, Project Management

May 9, 1986, USAID/Rabat Office

7:00 a.m. - 12:00 noon - Report Preparation

1:45 - 3:00 p.m. - Debriefing MIAC
Darrell Watts, Team Leader
Lavoy Croy, Research Coordinator

3:00 p.m. - 5:00 p.m. - Seminar DDR of IAV
Larbi Zagdouni, Acting Director DDR
Abdelfatah Elbehri, Agronomist
Richard Riddle, Sociologist (MIAC)

May 10, 1986

8:15 a.m. - Depart Rabat

8:22 p.m. - Arrive Lincoln, Nebraska

May 11, 1986, University of Nebraska (UNL) Lincoln, Nebraska

May 12, 1986, UNL

7:15 a.m. - Breakfast meeting University officials

Roy Arnold, Vice Chancellor, IANR
Wendell McKinsey, Executive Director, MIAC
Irvin Omtvedt, Dean and Director, Agricultural Research
Darrell Nelson, Dept. Head, Agronomy
Carl Mueller, Fiscal Manager, Grants and Contracts
Dan Bigbee, Coordinator, Morocco Project
Larry Schulze, Asst. Coordinator, Morocco Project

9:30 - 12:00 noon - UNL Morocco Project Office

Dan Bigbee, Project Coordinator
Larry Schulze, Asst. Project Coordinator

12 noon - 1:30 p.m. - Discussion with Project Consultants/Advisors

Dan Bigbee, Project Coordinator
Don Sanders, Soils
Bill Splinter, Agricultural Engineering
Leonard Bashford, Agricultural Engineering

2:00 p.m. - 5:00 p.m., UNL, Project Officer

Dan Bigbee, Project Coordinator
Larry Schulze, Asst. Project Coordinator
Lois Erickson, Purchasing/Accounting
Peggy Newguist, Purchasing/Accounting
Olivia Ernest, Secretary

May 13, 1986, UNL

7:00 a.m. - 8:30 - UNL, Project Administration Advisory Council

Dan Bigbee, Project Coordinator
Darrell Nelson, Head, Dept. of Agronomy
Bill Miller, Head, Dept Agricultural Economics
Irvin Omtvedt Dean & Director, Agricultural Research

9:00 a.m. - 3:00 p.m. - Report Preparation

3:30 p.m. 5:00 p.m. - UNL, MIAC Exit Interview

Roy Arnold, Vice Chancellor, IANR
Glen Vollmer, Acting Dean and Director, International Programs
Dan Bigbee, Project Coordinator
Larry Schuluze, Asst. Project Coordinator

May 14, 1986, Team Leader travel to Winrock Offices, Rosslyn, Virginia

May 15 - 22, Winrock Offices, Report preparation

A P P E N D I X F

AGRONOMY, PLANT PROTECTION AND SOIL SCIENCE

APPENDIX F. AGRONOMY PLANT PROTECTION AND SOIL SCIENCE

Table 1. Range of percentages of the planted area of four different groups of farmers in the Chouaia Region for several operations

Table 2. Cost of capital equipment for laboratories and other facilities

Table 3. Suggested completion dates for U.S. trained participant trainees assigned to the Aridoculture Center showing discipline, number of participants and training schedule through 1992

Table 4. Suggested areas of research focus and U.S. Technical Assistance showing discipline, focus of research and projected time schedules through 1992

TABLE 1. RANGE OF PERCENTAGES OF THE PLANTED AREA OF FOUR DIFFERENT GROUPS OF FARMERS IN THE CHOUAIA REGION FOR SEVERAL OPERATIONS

Soil Preparation	Durum Wheat	Barley
Tractor and Cover Crop	28.5% - 54.9%	3.5% - 58.8%
Traditional Plow	7.8% - 23.1%	0.4% - 0.9%
Seeding		
Broadcast by hand	100.0%	100.0%
Covering Seed		
Cover Crop*	45.0% - 91.1%	35.4% - 79.1%
Harvesting		
Combine	27.0% - 98.6%	13.9% - 81.6%
Sickle	1.4% - 73.0%	7.4% - 84.1%
Hand pulling	0% - 39.9%	0.6% - 41.0%
Grazing	- -	0.5% - 10.4%

* The name used in Morocco for a heavy 2-section offset disk.

Table 2. COST OF CAPITAL EQUIPMENT FOR LABORATORIES AND OTHER FACILITIES

Discipline or Facility	Cost
Cereal Agronomy	$ 95,760
Soil and Plant Analysis	$ 31,650
Plant Pathology	$191,500
Forage Agronomy	$ 4,900
Food Legumes	$ 25,300
Cereal Breeding	$ 14,550
Weed Science	$ 2,500
Agri. Eng. & Mechanization	$176,850
Soils & Plant Materials	$ 22,660
Processing Center	
Headhouse of Greenhouses	$ 44,125
Communications & AudioVisual	$ 14,915
Giuch Station	$ 9,700
Total	$634,410

TABLE 3. SUGGESTED COMPLETION DATES FOR U.S. TRAINED PARTICIPANT TRAINEES ASSIGNED TO THE ARIDOCULTURE CENTER SHOWING DISCIPLINE, NUMBER O PARTICIPANTS AND TRAINING SCHEDULES THROUGH 1992

DISCIPLINE	NO OF TRAINEES	DATES OF RETURN		DATE OF RETURN + X YEARS 1/	SUGGESTED COMPLETION OF U.S. TA
Agronomy:					
Cereal Breeding	6	3-6/88	Doc.	6/91	
		1-10/85	Doc.	10/88	end 1991
		1-1/87	Doc.	1/90	
		1-9/87	Doc.	9/90	
Cereal Agronomy	4	1-6/88	Doc.	6/91	
		1-8/85	Doc.	8/88	end 1992
		1-7/83	M.S.	7/85	
		1-1/85	M.S.	1/87	
Forage Agronomy	3	1-11/83	Doc.	11/86	
		1-10/85	Doc.	10/88	mid 1991
		1-2/86	Doc.	2/89	
Weed Science	1	1-2/85	M.S.	2/87	mid 1989
Plant Pathology	3	1-8/85	Doc.	8/88	
		1-12/85	Doc.	12/88	end 1990
		1-9/85	Doc.	9/87	
Entomology	2	1-8/85	M.S.	8/87	mid 1989
		1-8/85	M.S.	8/87	
Soil Management	2	1-3/83	Doc.	3/86	mid 1990
		1-6/88	Doc.	6/91	
Soil Fertility	3	1-5/85	M.S.	5/87	
		1-2/85	M.S.	2/87	mid 1992
		1-6/88	Doc.	6/91	
Food Legumes	2	1-3/85	Doc.	3/88	end 1990
		1-8/88	M.S.	1/90	
Agri. Engineering 2/					end 1992
Soil and Water Conservation 2/					end 1992
Agri. Meteorology 2/					end 1992

1/ M.S. Candidates, X = 2 years; Doctorate candidates, Y = 3 years.
2/ No participants in training as of the date of this report.

Table 4: Suggested Areas of Research Focus and U.S. Technical Assistance showing discipline, focus of research and projected time schedules through 1992.

DISCIPLINE AND FOCUS	YEAR						
	86	87	88	89	90	91	92
Agronomy							
Cereal Breeding (Advisory Services) Cereal Breeding (Varietal Screening)	Cereal Breeders						
- Yield stability under moisture stress	Cereal Breeders (variety selection)						
- Hessian fly resistance - Disease resistance - High Yields with adequate moisture							
Crop and Soil Management							
- evaluation of rotations, tillage and cropping systems	Cereal Agronomist						
- Cereal production in relation to soils and rainfall	Agronomist (Soil Mgt)						
Forage Agronomy							
- Forage production systems - Variety testing and evaluation - Improvement of weedy fallow - Improvement of permanent pastures	Forage Agronomist						
Weed Science							
- Evaluation of present weed control methods - Evaluation of herbicides - Cultural practices for weed control	Agronomist (Weed Science)						
Food Legumes							
- Screening for disease resistance in chick peas - Drought tolerance - Winter sown varieties of chick peas		Agronomist (Food Legumes)					

Table 4 (cont)

DISCIPLINE AND FOCUS	YEAR						
	86	87	88	89	90	91	92
Plant Protection							
(Entomology)							
- Develop crop management strategies to reduce insect damage.							
- Work with cereal breeder to incorporate Hessian fly resistance in cereal varieties.	Entomologist						
- Evaluation of chemical products for insect control.							
(Plant Pathology)							
- Evaluation of cereal lines and varieties for resistance to rusts and other diseases (in cooperation with cereal breeders).		Plant Pathologist					
- Evaluation of the importance of viral diseases.							
- Evaluation of the relationship of soil moisture stress to crop losses due to diseases.							
Soil Science							
(Soil Fertility)							
- Soil test calibrations.							
- Soil testing service for farmers.	Soil Scientist (Soil Fertility)						
- Evaluation of fertilizer needs in cropping systems which include legumes							

Table 4 (cont.)

DISCIPLINE AND FOCUS	YEAR						
	86	87	88	89	90	91	92
(Water and Soil Relationships)							
- Soil and Crop Management Practices for increasing water infiltrations, storage and controlled use by crops.							
- Practices for reducing evaporation from the soil surface.							
- Water spreading and water "harvesting" by use if small diversions.				Soil Scientist (Soil and Water) Conservation			
- Investigate desirability of land modification (terracing for example) for promoting water infiltration and reducing soil erosion.							
Agricultural Eng. and Mechanization							
- Design testing and evaluation of primary tillage implements.	Agricultural Engineer (Design/Eval.)						
- Evaluation of seed drills, both tractor and animal powered.							
- Evaluation of threshers for cereals and food legumes.	Agricultural Engineer (Farm Mach.)						
- Joint research and development program with IAV focused on farm machinery needs.							
- Technical assistance to private industry in manufacture of farm machinery better suited to Moroccan conditions.							

Table 4 (cont.)

DISCIPLINE AND FOCUS	YEAR						
	86	87	88	89	90	91	92
Agri. Meteorology							
- Relating agronomic practices to meteorological records and forecasts.				Agri. Meteorologist			
- Drought detection, early warning and impact assessment.							
- Meteorological records and interpretation of agronomic data.							
TOTAL PERSON/YEARS:	120	132	132	144	90	84	66

A P P E N D I X G

AGRICULTURAL ENGINEERING AND MECHANIZATION

APPENDIX G. AGRICULTURAL ENGINEERING AND MECHANIZATION

Table 1. Agricultural Engineering objectives/goals at project completion - August 1988

Table 2. Agricultural Engineering objectives/goals if the project is extended five years

TABLE 1. AGRICULTURAL ENGINEERING OBJECTIVES/GOALS AT PROJECT COMPLETION - AUGUST 1988

Arid Region Sweep Tillage Machine Design and Test Finalized.

Other tillage machine possibilities evaluated, approved or disapproved. such as chisel plows.

"Small and Large Grain" planters or grain drills - designed and/or recommended for use in arid region agriculture.

A series of animal traction/small farms equipment will have been purchased, tested, modified if necessary, and introduced to the Moroccan farmers.

Grain harvesting machines and threshers will have been evaluated with recommendations for local manufacture or import.

An engineering research building, fully equipped, will be available for researcher plot and arid region agricultural machine development.

An instrumented tractor will be operational to assist other INRA/MIAC scientists by providing definitive, precise engineering information. The system will be computerized for information gathering "In the Field" and transferring to the in-house computer system.

TABLE 2. AGRICULTURAL ENGINEERING OBJECTIVES/GOALS IF THE PROJECT IS EXTENDED FIVE YEARS

Strong activities and accomplishments in institution building and agricultural engineering professionalism. Creation of a Moroccan Society of Agricultural Engineers and membership in The International Standards Organization to Permit International Communication in the field of agriculture.

Joint research and development programs with IAV (Hassan II University), INRA and the Ministry of Agriculture.

Design and establishment of a Moroccan Agricultural Equipment Testing Station.

Design and establishment of a Technical Information Dissemination Center to carry viable research information to farmers and other institutions.

Graduate Student Exchange Programs in agricultural mechanization and engineering. This will be the future strength for INRA and IAV.

The introduction of agricultural engineering into the private (manufacturing) sector:

1. Manufacturing techniques and inspection systems
2. Value analysis, value engineering and product "cost reduction techniques and systems
3. The science of QUALITY CONTROL and instrumentation
4. The introduction of "Industrial Engineering" to control product cost for competitive EXPORT markets.

Attain a stance of agricultural engineering technical leadership in North Africa.

Teach and train applied agricultural engineering and machine (shop) technology.

ASSUMPTIONS: ADEQUATE FUNDS AND MANPOWER (INRA) ARE AVAILABLE

A P P E N D I X H

LIVESTOCK FORAGE SYSTEM

APPENDIX H. LIVESTOCK FORAGE SYSTEM

Item 1. Current Livestock Situation

Table 1. Comparison of 1983-84 rainfall with average rainfall over the previous six crop seasons

Table 2. Livestock parameters for Settat Province current livestock feed situation

Table 3. Feedstuffs deficit in 1984 (million FU)

Table 4. Feed balance sheet for 1981-85

ITEM 1. CURRENT LIVESTOCK SITUATION

The national livestock population of Morocco was recently estimated at 2.4 million cattle, 12.6 million sheep, 4.9 million goats, 1.9 million horses and 0.3 million camels (Report of the FAO/WFP Mission, May 1984) (27). Although recent poultry numbers have not been recorded, national production of poultry meat and eggs from the modern industrial sector in 1981 was 113,000 tons of poultry meat and 1,000 million units of eggs. The modern sector was estimated to account for 80 percent of poultry meat and 60 percent of eggs in 1981.

Livestock numbers other than poultry vary considerably between good rainfall and drought periods. Average annual rainfall declined 24 percent in the 1983-84 season compared with the previous 6-year average of 248 mm. (Table 1) the associated decline in national animal numbers between 1980 to 1983 was: cattle (-28 percent), sheep (-24 percent), and goats (-20 percent). Impact of the drought was most severe in the more arid areas. Figures for Settat Province for the same period and livestock classes were: cattle (-63 percent), sheep (-38 percent), and goats (+13 percent). The effect of drought on livestock has been dampened to some extent by the provision of subsidized feed including imported grain in the most severe drought areas by the Livestock Directorate (LD) of the Ministry of Agriculture.

Although the study zone serviced by the Aridoculture Center project in Settat is important for crop production including about one third of all wheat and barley, 83 percent of the maize and 29 percent of food legumes, the area is also important for livestock production. The four provinces served by the project account for 17 percent of all sheep (2,174,894 hd.), 17 percent of all cattle (409,000 hd.) and 3 percent of all goats (135,788 hd.).

Estimated national meat consumption is 392,000 tons red meat and 145,000 tons white meat. Red meat includes over 50 percent beef, 27 percent from sheep, and 13 percent from goats. Dairy herds contribute 41 percent of beef supply. Demand for red meat is projected to increase 5.4 percent per year from 1985 to 2000 (Report of the FAO/WFP Mission, May 1984) (46). Although Morocco is currently self-sufficient in red meat, it will be difficult to sustain self-sufficiency with a projected doubling of consumption by 2000 unless the production system is improved.

Livestock productivity is currently low due to problems of nutrition and disease, but also low fertility, high mortability and an excess number of non-productive animals associated with poor management. Current average productivity per female is estimated to be only 119 Kg. meat and 1000 L milk for cattle, 11 Kg. meat and 2.1 Kg. wool for sheep, and 9 Kg. meat for goats. A program to improve livestock productivity would need to encompass all of the above factors affecting productivity; however, the nutrition aspect will likely be the greatest constraint in expanding production.

The study zone for the INRA/MIAC Dryland Agricultural Applied Research Project includes Settat Province, the location of the Aridoculture Center office, plus parts of three other provinces: Kharibga, El Jadida and Safi.

TABLE 1. COMPARISON OF 1983-84 RAINFALL WITH AVERAGE RAINFALL OVER THE PREVIOUS SIX CROP SEASONS

DATA BY PROVINCE

PROVINCE	6-YEAR AVERAGE RAINFALL m/m	83-84 SEASON m/m	DEFICIT OR SURPLUS IN m/m	DEFICIT OR SURPLUS IN %
AGADIR	115.6	94	-21.6	-19
AL HOCEIMA	170.3	156	-19.3	-11
AZILAL	200.3	165	-35.5	-18
BENI-MELLAL	296.6	206.3	-90.3	-30
BEN SELIMANE	259.3	213	-46	-18
BOUJDOUR	-	-	-	-
BOULMANE	134	159.7	+25.7	+19
CASABLANCA	326	154	-172	-53
CHAOUEN	493	848	+355	+72
EL JADIDA	308	253	-55	-18
EL KELAA	164	105	-59.0	-36
ERRACHIDIA	67	9.64	-57.4	-86
ESSAOUIRA	301	181.7	-119	-40
FES	390	185.5	-204.5	-52
FIGUIG	67	23.9	43	-64
GUELMIM	56.7	52.8	-3.8	-7
KINITRA	493.7	480	-13.7	-3
KHEMISSET	389	205.3	-183.6	-47
KHENIF	357	184	-173	-48
KHOURIBGA	236	137	-99	-42
LAAYOUNE	-	-	-	-
MARRAKECH	205.6	90	-115.6	-56
MEKNES	427	337.7	-39.3	-21
NADOR	131	106.9	-24.1	-18
OUARZAZATE	87	33	-54	-61
OUED EDDAHAB	-	-	-	-
RABAT-SALE	251	191	-60	-24
SAFI	247	147.5	-99.5	-40
SETTAT	274	154.8	-119.2	-44
ESMARA	-	-	-	-
SIDI KAGEM	329	250	-79	-24
TANGER	521	492	-29	-6
TAOUNATE	336	340	+4	+29
TAN-TAN	50	26.5	-23.5	-47
TAROUDANTE	49	63	+14	+29
TAZA	426	227	-201	-47
TETOUAN	480	374	-100	-21
TIZNIT	102	64.1	-38	-37
IFRANE	325	253	-72	-22
TATA	32	2	-30	-94
TOTAL	248	189	59	24

SOURCE: FAO Report of the FAO/WFP Mission, Assessment of the Food, and Livestock Situation, OSRO: Report 11/84/E, Rome, May 1984.

The current livestock population of Settat Province is estimated at 700,000 sheep, 70,000 cattle, 55,000 goats, 2,520 camels, 30,000 horses, 90,000 chickens raised primarily for meat, and 62,000 chicken layers.

An area study on 240,000 hectares within Settat Province conducted by UN/FAO (47) provided additional information on the livestock system and feeding program. Some estimated livestock production parameters are shown in Table 1.

TABLE 2. LIVESTOCK PARAMETERS FOR SETTAT PROVINCE

Item	Cattle	Sheep
Birth Weight (Kg.)	20	2
Weight at 6 months (Kg.)	80	13
Age at Weaning (months)	4-5	2-3
Fecundity rate (%)	60	85
Death rate (0-1 year, %)	8	(0-6 mo.: 12) (6-12 mo.: 6)
Milk yield per lactation (Kg.)[1]	600	
Offtake per animal unit per year (Kg.)	93.6	11.2

[1]Improved dairy cattle (Holstein-Frieson) produce 1200 Kg. milk per year. Source: UN/FAO (27).

The selling age of cattle and sheep is estimated as follows: (1) cattle less than 6 months (0%), 6-12 months (20%), 12-24 months (40%), and greater than 24 months (40%); and (2) sheep less than 6 months (20%), 6-12 months (60%), and 12-24 months (20%). Animals sold are older than in most developed countries indicating a probable slower rate of growth because of poorer feed and management conditions.

Data presented in Table 2 indicate that the UN/FAO study area in Settat Province may have livestock of less productivity than the average of Morocco, eg., 93.6 Kg. offtake per animal unit for cattle versus 119 Kg. for the national average. This difference is attributed to the low rainfall of the area and higher susceptibility to drought compared to the national average. This comparison also indicates the extreme shortage of feed supply in the region to support livestock production. Information on the national feedrtuffs deficit in 1984, a recent drought year, is shown in Table 3. The deficit in 1984 was 5,052 million forage units (equivalent to barley units) equal to 44.5 percent of requirements.

Current Livestock Feed Situation

A national feed balance sheet for the period, 1981-1985, is shown in Table 4 comparing livestock feed requirements with sources of feed supply. Rangelands contribute about half of the feed on a national basis and straw, 20 percent. However, the contribution of rangelands is very minor and cereal straw and fallow much more important in the Aridoculture Center study zone. Settat Province has a usable agriculture area of 717,000 hectares including production of durum wheat (142,000 ha.), bread

wheat (114,00 ha.), barley (183,000 ha.), corn (40,00 ha.), grain legumes (125,000 ha.), forage and weedy fallow (97,500 ha.), forest land (27,000 ha.), rangeland (202,000 ha.), collectively-owned range and wasteland (212,000 ja.), and government and church land (64,000 ha.). The normal annual cereal yield (grain) is 5 to 6 million quientils. representing

Estimated feed utilization in a 240,000 ha. UN study region in Settat Province referred to earlier in this section was as follows: straw (225 UF/ha. providing 22.1 million UF or 33.5%), weedy fallow (175 UF/ha. providing 3.1 million UF or 4.7%), rangeland (125 UF/ha. providing 10.4 million UF or 15.8%), forest land (150 UF/ha. providing 2.5 million UF or 3.9%), forage barley (1000 UF/ha. providing 3.3 million UF or 5%), barley grain (providing 5.4 million UF or 8.2%), and purchased feed (providing 19 million UF or 28.9%). Distribution of feed use over the calendar year is as follows: straw (October-April), crop residue-stubble (May-September), weedy fallow (December-June), permanent posture (January-April), forest grazing (February-July), forage barley grazing (January-March), and barley grain feeding (July-January). Some cattle are fattened on barley grain, faba beans, plus purchased bran and beet pulp for a short period prior to slaughter.

TABLE 3. FEEDSTUFFS DEFICIT IN 1984 (million FU)

TYPE	NORMAL YEAR 1/	1983/84 2/	DEFICIT U.F.	DEFICIT %
CEREALS	994	680	-314	31.6
LEGUMES	200	20	-180	-90.0
FORAGE CROPS	402	760	+358	+89.0
FALLOW	420	300	-120	-29.0
BY PRODUCTS	2 318	2 220	-118	-4.0
AGRO-INDUS-TRIAL BY-PRODUCTS	585	600	+15	+2.6
MISCELLANEOUS	227	200	-27	-10.0
SUB-TOTAL	5 123	4 780	-343	-6.7
RANGELANDS	6 209	1 500	-4 709	-75.0
TOTAL	11 332	6 280	-5 052	-44.5

SOURCE: 1/ ISCDD/IMDS, FAO 1981
2/ "Programme de sauvegarde du cheptel" (project) 15 March 1984, Direction de l'elevage, MARA.

TABLE 4. FEED BALANCE SHEET FOR 1981-85

REQUIREMENTS			RESOURCES		
TYPE OF ANIMAL	1 000s head	millions FU	Feedstuffs	Quantity '000t	Millions FU
Cattle - local breed	2 500	3 005	Barley (grain)	759	759
- cross-bred	838	725	Maize (grain)	89	96
- purebred	123	322	Oats (grain)	59	47
Sheep	14 146	3 245	Sorghum (grain)	11.6	92
Goats	5 096	1 125	Legumes (grain)	200	200
Horses	340	510	Carob	27	27
Mules	360	440	Forage Crops		402
Donkeys	1 200	960	Straw		2 200
Dromedaries	200	400	Beet leaves and tops		50
Poultry		600	Fallow		420
			Legume tops		118
			Bran	656	426
			Dried sugarbeet pulp	108	86.4
			Molasses	31	23.3
			Oilcakes	27	21.6
			Draff	10	7.5
			Fish meal	19	20
			Miscellaneous		200
			Sub-total		5 123
			Contribution of rangelands		6 209
TOTAL		11 332	TOTAL		11 332

SOURCE: ISCDD/IMDS Report, FAO, 1981.

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A P P E N D I X I

FARMING SYSTEMS RESEARCH AND MANAGEMENT

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APPENDIX I. FARMING SYSTEMS RESEARCH AND EXTENSION PROGRAM

Item 1. The Systems Approach to Agricultural Research and Extension

Item 2. Structured, hands-on, in-house training

Figure 1. Farming Systems/extension, Client Oriented Agricultural Development Research

ITEM 1. THE SYSTEMS APPROACH TO AGRICULTURAL RESEARCH AND EXTENSION

In our opinion the systems approach to agricultural research and extension embodies sound principles for contributing to the development of the agriculture of the Drylands Project area.

However concepts about the nature of FSR/E vary considerably. The purpose of this brief treatise is not to define all of the aspects and variations of what FSR/E might consist, but rather to state some of the purposes and qualities of the systems approach as viewed by the authors of this report. We believe that any research strategy must be implemented in terms of local conditions: Culture, climate, nature and degree of development of the agriculture, the technical level of the clientele, organizations and institutions, infrastructure and resources.

The systems approach to agricultural development should embrace at least two broad areas: Technology generation and its use and (b) infrastructure and policy. The first may be designated Farming Systems Research and Extension (FSR/E) and the second Farming Systems Infrastructure and Policy (FSIP). The Drylands Project and the development of the Aridoculture Center is a FSR/E project. The institutional development aspect does have some relation to FSIP but will not be discussed here.

The principal clients of FSR/E are farmers and the extension service but can include training activities and other entities such as those of industry, especially where industry deals with farming inputs. Also since FSR/E develops information that can contribute to elaboration of policy and planning of infrastructure, FSIP should be kept in mind as a user of FSR/E output.

Major activities of FSR/E may be grouped under six steps or phases. These phases are usually sequential, iterative and overlapping (Figure 1).

1. Information gathering and planning. Social, economic and technical information and data as related to farming are gathered and analyzed.

2. Researcher managed commodity and discipline research, usually but not exclusively on the experiment station and laboratories. This is component research, but oriented to specific problems and to a considerable extent to specific clientele and/or specific farming areas. This is research conducted to develop production components.

3. Researcher managed commodity and discipline research at the farm level. This phase is usually conducted as an integrated part of step 2. In part, it may be carried out with the cooperation of groups responsible to specific clientele within specific farming areas such as on-farm researchers or extension agents. (In the U.S., and within some states more than others, Extension Agents or Subject Matter Specialists play a

major role at this point.)

In developing countries extension agents do not collaborate much a this phase because of lack of training and their load of other duties. These trials are of principal interest to and the responsibility of the commodity and discipline research programs. A major purpose of these trials is to study productions components over wider ecological zones. Most aspects of farmer inputs are controlled (weeds, fertilizer, insecticides and disease control). Uncontrolled factors are usually climatic and soil factors. Management across a group of trials is standardized and controlled.

4. Study of the integration of component technologies and alternative uses of technologies in farmer systems in on-farm, researcher managed trials, conducted within targeted farming environments. This is the study of use of components. Farmer developed components may be used along with researcher components. The studies (trials) are located on more farms than phase 3. Trials are kept simple as possible for easier management, analysis and interpretation, and hopefully for easier comprehension by farmers and extension agents, admittedly this is not always possible. Hopefully extension agents will collaborate, and at least understand the nature of the trials. Farmer collaboration becomes important, especially as an observer, and hopefully as a general caretaker, and adviser.

5. Further testing and evaluation in farmer managed, researcher an extension supervised trials. Transfer of information to collaborative extension agents and to farmers, as well as to commodity and discipline researchers is important.

6. Broader transfer to farmers by extension, by industry and through the communication channels of the society. Phases 4, 5 and 6 are backstopped by component researchers (commodity and disciplines such as plant improvement, entomology, soils, weed control etc.).

We suggest that Farming Area Research Teams be assigned to specific and delimited farming areas.

Team composition should vary to meet the needs of the region but it should be kept in mind that most of the work is grunt agronomy. The team leader should have had some experience at the farm level doing research. Other members of the team could have less experience in which case work loads may have to be reduced so that the team leader can supervise the work closely and make the experience a learning process as well as a research activity

Consider three to five additional team members. One or two people do not make a team. Select team members so that they can support each other even though they are not specialized. One member may know more about, and have greater interest in, soils, another member entomology, another statistical analysis. Team members should not specialize in the kinds of trials that each conduct.

Sociologists and economists do not need to be permanent members of these field teams, although serving with a team is good experience, and may profitably work with a team during the early stages of the activity in a region. Later most of the work is biological trials. Team members should collaborate with the discipline and commodity programs, including Socio-economics. This is further argument for developing a Socio-economic program within the Aridoculture Center.

The principal activities of the team could be:

1. Conduct exploratory trials and work with Socio-economics to further the characterization of farming areas. (Figure 1, No. 1).

2. Conduct on-farm experiments (Figure 1, No.'s 3 & 4), some in collaboration with discipline and commodity programs.

3. Train extension agents to participate in supervising farmer (Figure 1, No. 5)

4. Backstop Extension in the use of technologies (Figure 1, No. 6).

ITEM 2. STRUCTURED, HANDS-ON, IN-HOUSE TRAINING

A possible strategy to improve capacity for on-farm research would be for the Aridoculture Center to develop a structured, internally managed, hands-on training course. The objective would be to train young staff of research and extension, to identify staff for future graduate level training both for discipline/commodity programs as well as for farm level work. Training might be conducted within specific farming regions and include both field and a lesser amount of classroom exercises.

Field work could consist of farm level research surveys in collaboration with socio-economics, exploratory trials, collaborative trials with discipline programs, trials for the evaluation and integration of technological components, trials to study alternative uses of technologies and supervision of farmer managed trials. These could contribute to the overall objectives of the Project; not exercises exclusively for training but serious research.

The classroom work could consist of practice in use of visual aids, practice in oral presentation, teaching of institutional policy and goals, and governmental policy. Statistics could be taught, along with exercises in analyzing research data, interpretation of research findings and report writing.

A course director could manage and direct the training. The course could be located with a Farming Area Research Team and trainees could work in the field as assistants to Farming Area Research Teams.

Members of the Farming Area Research Team would be the principle supervisors of field exercises, as well as teaching according to their capabilities. Members of commodity and discipline programs could teach in their program areas.

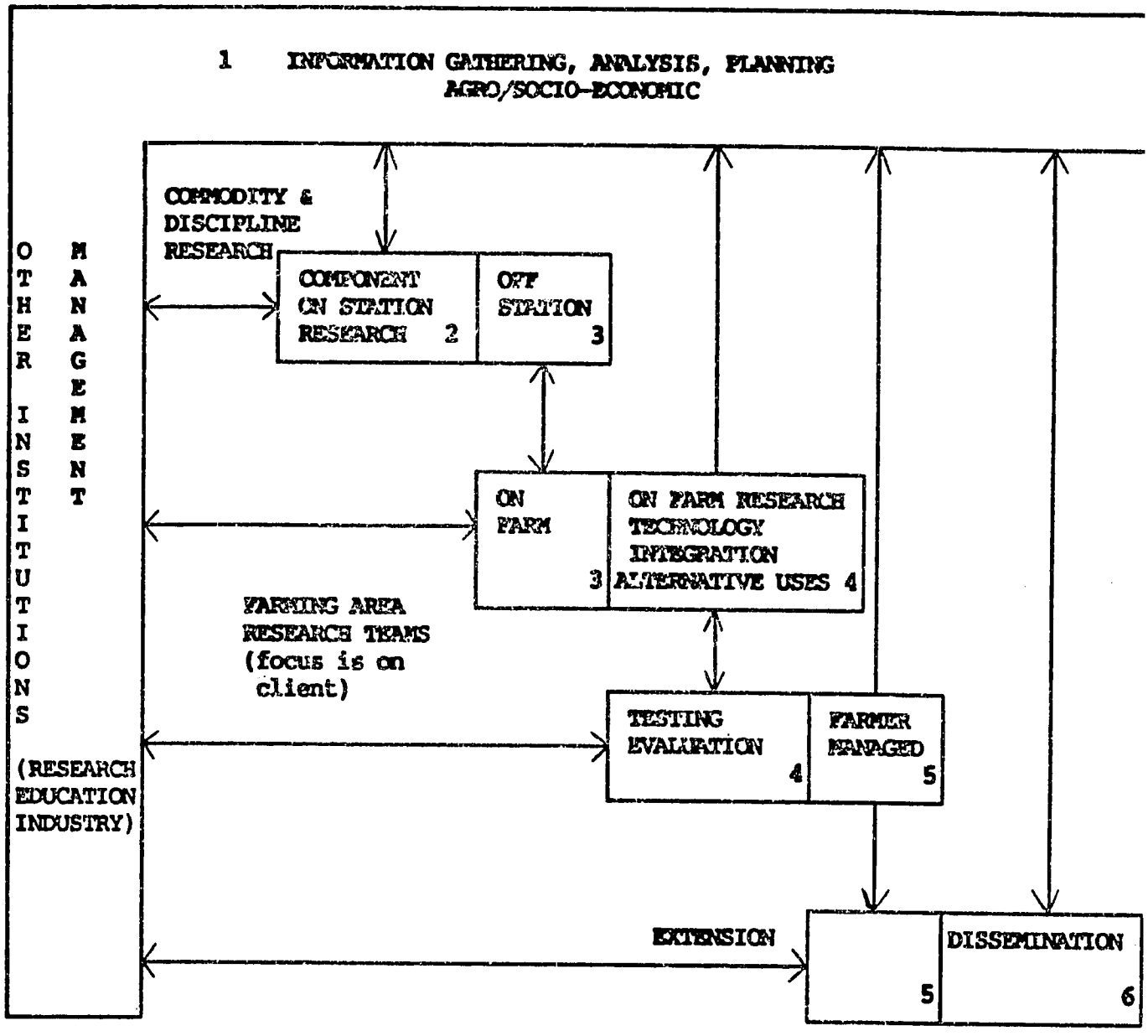
The course should cover an entire cropping season so that trainees would experience all phases of farm level research, including analyzing data and writing reports.

Candidates for the training might be young INRA staff, recent college graduates and extension personnel. Courses might well be of different levels if there are large differences in experience and level of prior training of the course participants.

Such a course should not be attempted until a Farming Area Team has at least one year of experience.

FIGURE 1. FARMING SYSTEMS/EXTENSION

CLIENT ORIENTED AGRICULTURAL DEVELOPMENT RESEARCH



At this time the activities of the Dryland Project fall largely in 2 and 3, some in 1. Activities 4 and 5 have not been developed.

A P P E N D I X J

INSTITUTION BUILDING AND RESEARCH MANAGEMET

APPENDIX J. INSTITUTION BUILDING AND RESEARCH MANAGEMENT

Table 1. Summary of MIAC Expenditures through March 31, 1986

Table 2. MIAC Budget Information, February 1980 - March 1986

Table 3. Summary of INRA Expenditures (from materials supplied by Project Director)

Table 4. Summary of INRA salary expenditures for 1984-85-86 for Settat, Ain N'Zigh and Sidi El Aydi (from materials supplied by Project Director)

Figure 1. Space allocations in the Aridoculture Center

Figure 2. Field and laboratory research activities showing number of research trials from 1981 through 1986

TABLE 1. SUMMARY OF MIAC EXPENDITURES THROUGH MARCH 31, 1986

Category/Input	Budgeted	Cumulative to Date	Percent of Budgeted
Technical Assistance	$ 7,576,204	$ 3,140,161	41
Commodities	4,408,702	2,611,834	59
Training	1,479,944	733,831	50
Other	9,470,641	3,562,959	37
TOTAL	$22,935,491	$10,048,785	44

TABLE 2. MIAC BUDGET INFORMATION, FEBRUARY 1980 - MARCH 1986

Item	Allocation	Cost	Incumbered (3/86)	Total Cost	Balance	PM Allocation	PM Used	Allocation Cost/P.M.	Cost/P.M. U
Salaries & Wages	$5,933,968	$2,248,189	$99,856	$2,348,045	$3,585,923	796	778	$4,695	$3,018
Consultants	472,410	78,929	9,193	88,122	348,288	100	46	2,953	1,916
Overhead	3,487,904	1,296,064	94,205	1,363,269	2,124,635				
Travel	3,280,142	845,956	11,496	857,452	2,422,690				
Allowances	1,169,826	677,514	26,480	703,994	465,832	568	551	1,297	1,278
Participants	1,479,944	707,213	26,618	733,831	746,113	442	603	2,108	1,217
Commodities	4,408,702	2,402,949	208,885	2,611,834	1,796,868				
Other Direct Cost	1,494,140	848,162	62,042	910,204	583,936				
G & A	1,208,455	416,460	15,547	432,034	776,421				
Total	$22,93591	9,494,436	$554,349	$10,048,785	$12,886,706				

*Persons Month (2/80 - 3/86)
**Life of Project (2/80 - 8/88)
***Total Cost to Date is 30% under prorated allocation.

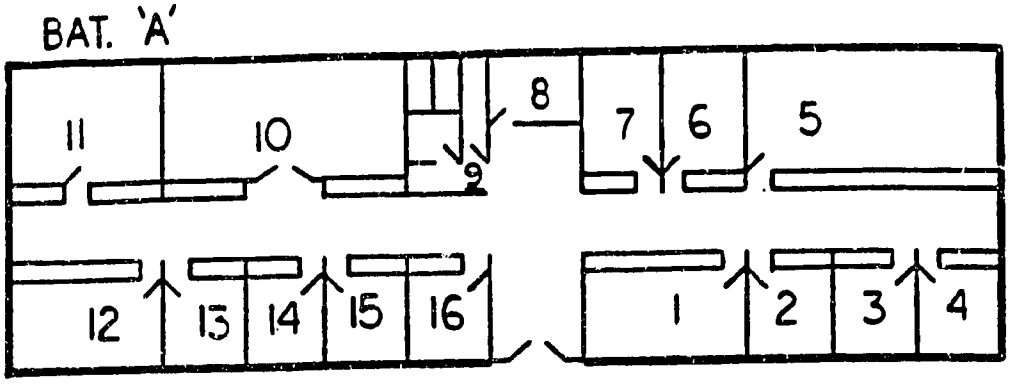
TABLE 3. SUMMARY OF INRA EXPENDITURES (from materials supplied by Project Director)

	1984 (DH)	1985 (DH)	1986 (DH)	Total (DH)
Operated Budget	1,323,900	1,483,910	1,479,650	4,287,460
Salaries/Prime	2,007,418	2,318,768	—	4,326,187

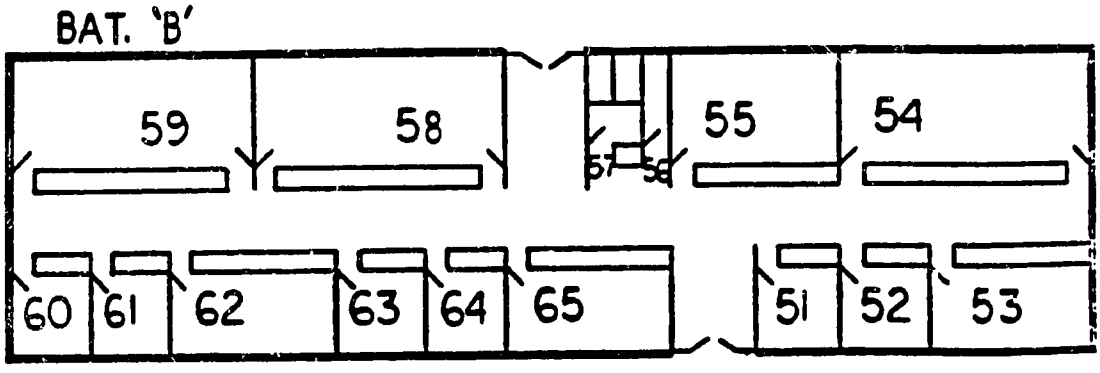
TABLE 4. SUMMARY OF INRA SALARY EXPENDITURES FOR 1984-85-86 FOR SETTAT, AIN N'ZIGH AND SIDI EL AYDI (from materials supplied by Project Director)

		1984 (DH)	1985 (DH)	Total (DH)
Settat	Salary	1,730,171	1,730,171	3,460,342
	Bonus	—	302,686	302,686
	Total	1,730,171	2,032,856	3,763,028
Ain N'Zigh	Salary	110,665	110,665	221,330
	Bonus	19,940	—	19,940
	Total	130,605	110,665	241,270
Sidi El Aydi	Salary	146,642	146,642	293,284
	Bonus	—	28,605	28,605
	Total	146,642	175,247	321,889
				4,326,187

FIGURE 1. SPACE ALLOCATIONS IN THE ARIDOCULTURE CENTER

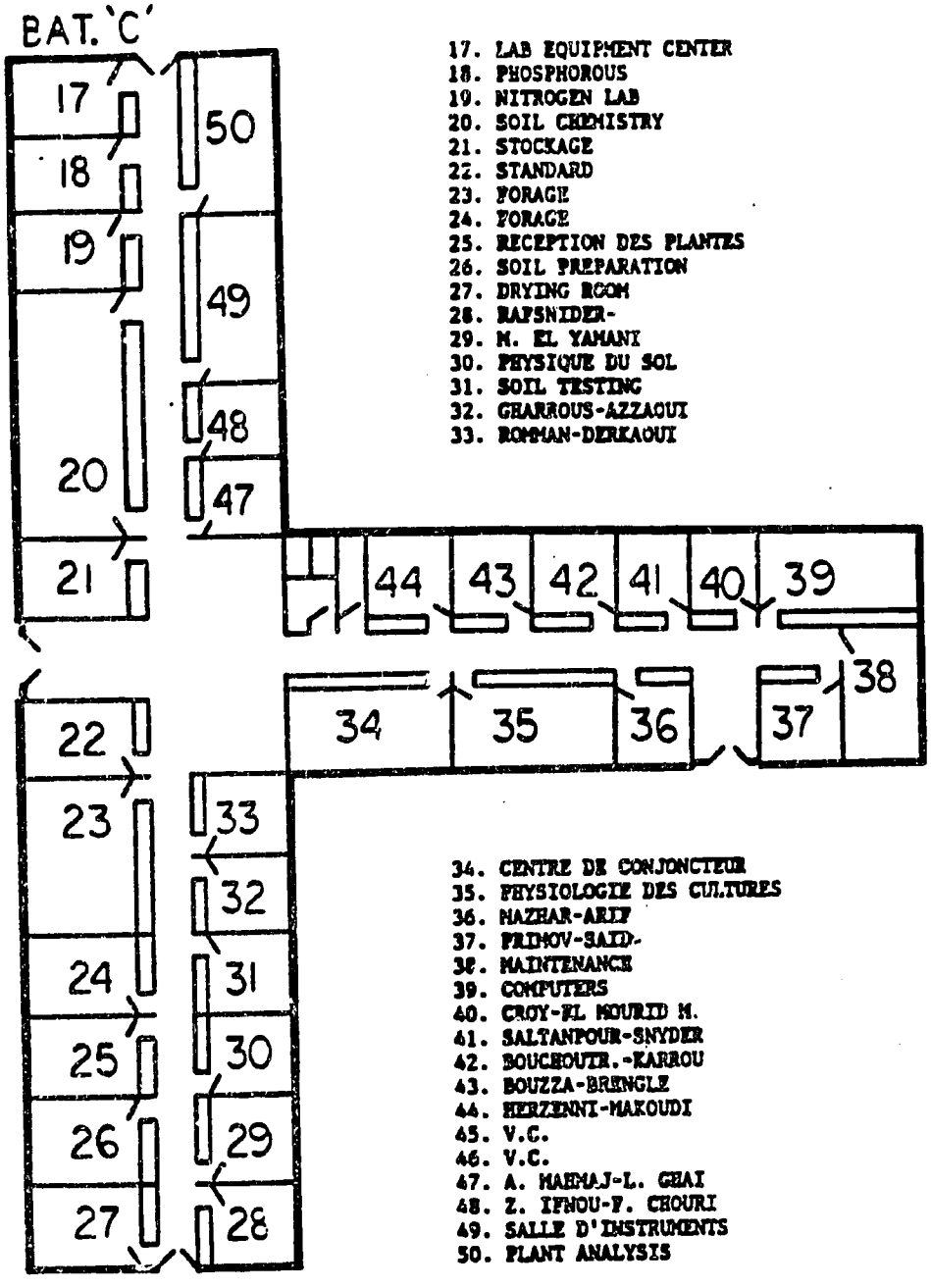


1. BUREAU MIAC
2. CHEF ADMINISTRATIF MIAC- MR. CARTIER
3. TELEX
4. REGIE
5. BIBLIOTEC
6. CHEF DE PROJET MIAC- DR. WATTS
7. SECRETARIAT-INRA
8. SALLE DE TIRAGE
9. V.C.
10. SALON DE REUNION
11. BUREAU DE COMTABILITE
12. CHEF DE CENTRE- MR. ZOUTANE
13. SECRETARIAT
14. BUREAU D'ADMINISTRATIF
15. BUREAU DE RECHERCHES
16. BUREAU D'ORDER



51. PATHOLOGIE
52. LYAMANI-TOUYIQ
53. PATHOLOGIE
54. LEGUMINEUSES ALIMEN.
55. PHYTOPATHOLOGIE
56. V.C.
57. V.C.
58. MALHERBOLOGIE
59. CEREALS
60. REGHER
61. BRAHALI-TANJI
62. ENGINEERING
63. KAMAL-CAMPBELL
64. KIETH-EL BOUHSSINI-LHALOUI
65. ENTOMOLOGIE

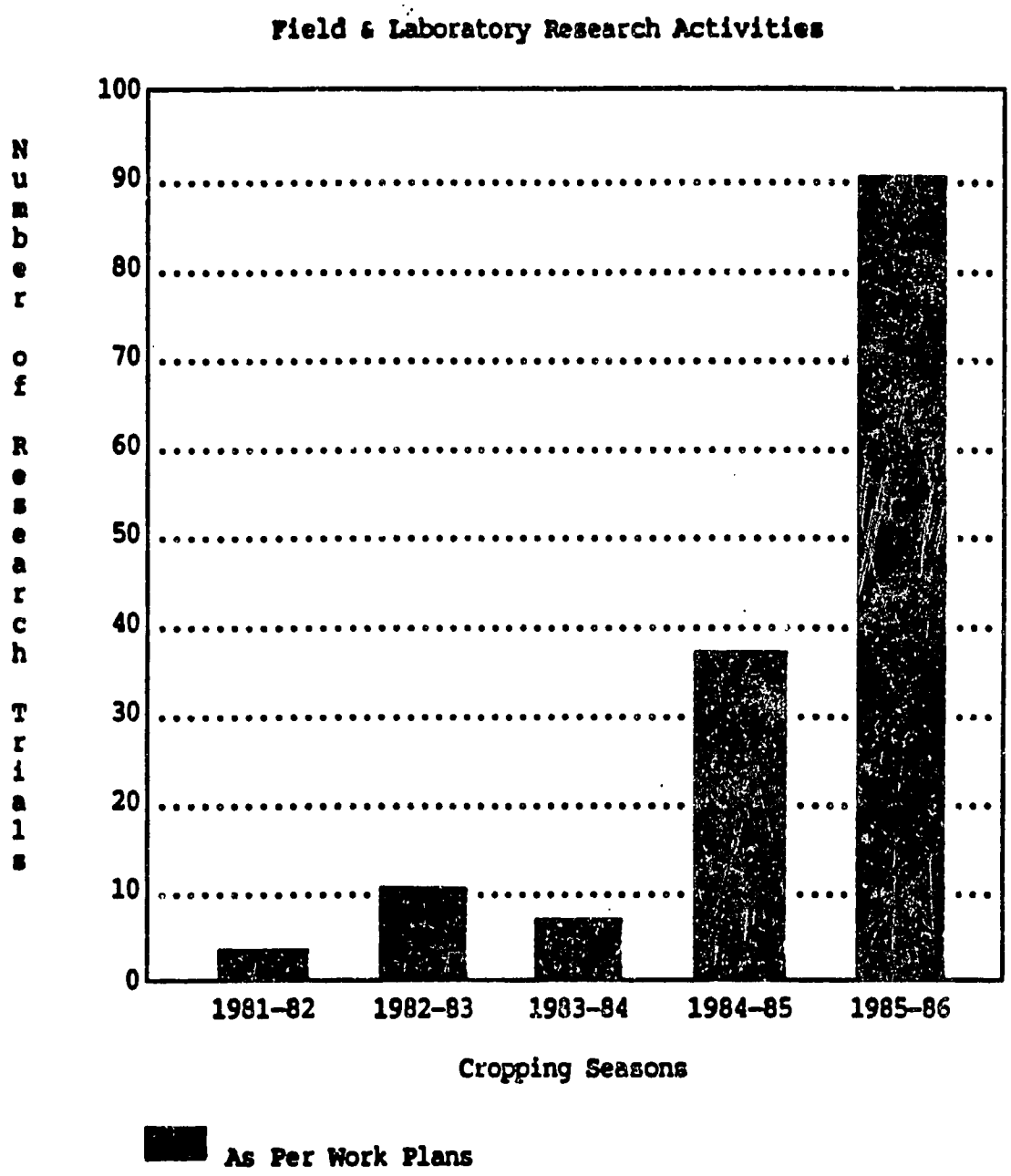
FIGURE 1 (con't)



17. LAB EQUIPMENT CENTER
18. PHOSPHOROUS
19. NITROGEN LAB
20. SOIL CHEMISTRY
21. STOCKAGE
22. STANDARD
23. FORAGE
24. FORAGE
25. RECEPTION DES PLANTES
26. SOIL PREPARATION
27. DRYING ROOM
28. RAFSNIDER-
29. M. EL YAMANI
30. PHYSIQUE DU SOL
31. SOIL TESTING
32. GHARROUS-AZZAOUI
33. ROMMAN-DERKAOUI

34. CENTRE DE CONJONCTEUR
35. PHYSIOLOGIE DES CULTURES
36. MAZHAR-ARIF
37. FRIMOV-SAID-
38. MAINTENANCE
39. COMPUTERS
40. CROY-EL MOURID M.
41. SALTANPOUR-SNYDER
42. BOUCHOUTR.-KARROU
43. BOUZZA-BRINGLE
44. HERZENNI-MAKOUDI
45. V.C.
46. V.C.
47. A. MAHMAJ-L. GHAI
48. Z. IFNOU-F. CHOURI
49. SALLE D'INSTRUMENTS
50. PLANT ANALYSIS

APPENDIX J. Figure 2. FIELD AND LABORATORY RESEARCH ACTIVITIES SHOWING NUMBER OF TRIALS FROM 1981 THROUGH 1986.



A P P E N D I X K

INRA-MIAC TECHNICAL STAFF, PARTICIPANT TRAINEES AND SCHEDULES, ADVISORY STAFF AND CONSULTANT VISITS

Appendix K. INRA-MIAC TECHNICAL STAFF, PARTICIPANT TRAINEES AND SCHEDULES, ADVISORY STAFF AND CONSULTANT VISITS

Table 1. Summary of INRA staffing pattern showing disciplines and time on the project (Through March 31, 1986)

Table 2. Long-term participant training showing name, academic degree, specialty, university and status of training

Table 3. INRA participant training showing name, discipline and project participation

Table 4. Participant trainees showing discipline, degree sought, university advisor and time of training

Table 5. INRA short-term participant training showing discipline training schedule

Table 6. MIAC field staff showing disciplines, home institution and date of arrival on project

Table 7. MIAC staffing pattern showing discipline, type of service provided and time provided for each discipline

Table 8. MIAC field staff showing discipline, time on project and expected termination date

Table 9. Visits to Morocco by graduate candidates advisors showing names, home universities and dates of visits

Table 10. Summary of project consultant and participant advisory visits, 1983-31 March 1986

Table 11. Summary of consultant visits showing discipline and length of visit (through March 31, 1986)

Table 12. Consultant visit list showing consultant name, discipline, home organization and length of visit to project (through March 31, 1986)

Table 13. INRA-MIAC staff list showing name, degree, discipline and location

Table 14. Summary of INRA-MIAC staff showing disciplines, number of staff and academic degree

Table 15. INRA-MIAC field staff showing name, discipline and time on the project

TABLE 1. SUMMARY OF INRA STAFFING PATTERN SHOWING DISCIPLINES AND TIME ON THE PROJECT (THROUGH MARCH 31, 1986)

	LONG TERM			
	Number		Person Months	
	Planned	Actual	Planned	Actual
Discipline				
PROFESSIONAL				
Ag Engineering & Mechanization		1		12
Cereals				
Agronomy		5		90
Breeding				5
Food Legumes		1		12
Forages		3		23
Plant Protection				
Entomology		2		10
Plant Path		3		12
Weed Science		2		50
Socio-Economic				
Ag Econ				
Sociology				
Soil Science				
Fertility		3		47
Management		2		62
Water Management				
Administration		1		48
Total Professional		23		371

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TABLE 2. LONG-TERM PARTICIPANT TRAINING SHOWING NAME, ACADEMIC DEGREE, SPECIALTY, UNIVERSITY AND STATUS OF TRAINING

NAME	DEGREE	SPECIALTY	UNIVERSITY	DATE	DATE	STATUS
1. BOUCHOUTROUCH, Mustapha	M.S.	Cereal Agronomy	University of Nebraska	8/80	7/83	Thesis Research - M
2. EL MOURID, Mohamed	Doc.	Cereal Agronomy	Iowa State University	1/83	8/85	Thesis Research - M
3. KACEMI, Mouloud	Doc.	Cereal Agronomy	Colorado State University	1/86	6/88	Course Work - U.S.
4. KARROU, Mohamed	M.S.	Cereal Agronomy	University of Missouri	8/83	1/85	Thesis Research - M
5. MEKGOUM, Mohamed	Doc.	Cereal Breeding	Colorado State University	1/86	6/88	Course Work - U.S.
6. NSARELLAH, N.	Doc.	Cereal Breeding	N. Dakota State University	1/86	6/88	Course Work - U.S.
7. OUASSOU, Abdellah	Doc.	Cereal Breeding	University of Nebraska	1/83	10/85	Thesis Research - M
8. SELMANI, Abdelazziz	Doc.	Cereal Breeding (corn)	Kansas State University	1/86	6/88	Course Work - U.S.
9. JLIBENE, Mohamed	Doc.	Cereal Breeding	University of Missouri	1/84	1/87	Course Work - U.S.
10. AMRI, Ahmed	Doc.	Cereal Breeding	Kansas State University	1/85	9/87	Course Work - U.S.
11. SAKAR, Bouazza	M.S.	Food Legumes (Agronomy)	Washington State Univ.	1/86	1/88	Course Work - U.S.
12. KAMEL, Mohamed	Doc.	Food Legumes (Breeding)	Washington State Univ.	8/82	3/85	Thesis Research - M
13. MAZHAR, Mohamed	Doc.	Forage Agronomy	University of Missouri	8/80	11/83	Thesis Research - M
14. ARIF, Abderrahman	Doc.	Forage Agronomy	University of Nebraska	1/83	2/86	Thesis Research - M
15. DERKAOUI, Mohamed	Doc.	Forage Breeding	Oklahoma State University	8/82	10/85	Thesis Research - M
16. LHALOUI, Saadia	M.S.	Entomology	University of Nebraska	8/83	8/85	Thesis Research - M
17. EL BOUHSSINI, Mustapha	M.S.	Entomology	Kansas State University	8/83	8/85	Thesis Research - M
18. LYAMANI, Abderrahman	Doc.	Plant Pathology	Iowa State University	1/83	8/85	Thesis Research - M
19. EL YAMANI, Mohamed	Doc.	Plant Pathology	Iowa State University	8/83	12/85	Thesis Research - M
20. TOUFIQ, El Mostapha	M.S.	Plant Pathology	University of Minnesota	8/83	9/85	Thesis Research - M
21. TANJI, Abbes	M.S.	Weed Science	Kansas State University	8/83	2/85	Thesis Research - M
22. AZZAOUI, Abdelmalek	M.S.	Soil Fertility	University of Missouri	1/83	5/85	Thesis Research - M
23. EL GHAROUS, Mohamed	M.S.	Soil Fertility	Oklahoma State University	1/83	2/85	Thesis Research - M
24. EL MEJEHAD, Khalil	Doc.	Soil Fertility	University of Nebraska	1/86	6/88	Course Work - U.S.
25. BOUZZA, Abderrahman	Doc.	Soil Management	University of Nebraska	8/80	3/83	Thesis Research - M
26. TIKDIRENE, Ali	Doc.	Soil Management	Oklahoma State University	1/86	6/88	Course Work - U.S.

M - Morocco
U.S. - United States
Doc. - Doctor of Science

Summary:
9 Doc. Thesis Research Programs - M
8 M.S. Thesis Research Programs - M
8 Doc. Course Work in the U.S.
1 M.S. Course Work in the U.S.

TABLE 3. INRA PARTICIPANT TRAINING SHOWING NAME, DISCIPLINE AND PROJECT PARTICIPATION

	1979	1980	1981	1982	1983	1984	1985	1986
	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J
Cereals								
Bouchoutrouch, M. (Agronomy)			═══	═══	═══	+++++	+++++	+++
El Mourid, M. (Agronomy - Physiology)				xxxxx	═══	═══	++++	++
Kacemi, M. (Agronomy - Cropping Systems)							xxxxx	═══
Karrou, M. (Agronomy)				xxxxx	═══	═══	++++	++
Amfi, A. (Breeding)							═══	═══
Jlibene, M. (Breeding)						═══	═══	═══
Mergoum, M. (Breeding)							xxxxx	═══
Nsarellah, N. (Breeding)							xxxxx	═══
*Ouassou, A. (Breeding)					═══	═══	++++	++
Selmani, A. (Breeding - Corn)							xxxxx	═══

*Stationed in Rabat
xIntensive English training; =Training in U.S. university; +On project.

TABLE 3 (con't)

	1979	1980	1981	1982	1983	1984	1985	1986
	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J
Food Legumes								
Sakar, B. (Agronomy)							xxxxxxx	
Kamel, M. (Breeding)				xxxxxxxx				
FORAGES	- - -

TABLE 3. (con't)

	1979	1980	1981	1982	1983	1984	1985	1986
	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O
SOIL SCIENCE								
AZZAOUI, A. (Fertility)				xxxxxxxxxx	═══	═══	++++++	
EL GHAROUS, M. (Fertility)				xxxxxxxxxx	═══	═══	++++++	
EL MEJAHED, K. (Fertility)					++++	++++	xxxxxxxxxx	═══
BERRADA, A. (Management)	═══	═══	═══	═══	++++	++++	++++	
BOUZZA, A. (Management)		xxxxxx	═══	═══	++++	++++	++++	++++
TIKDIRENE, A. (Management)							xxxxxxxxxx	═══

xx Intensive English training ═══ Training in U.S. university ++ On project

TABLE 4. PARTICIPANT TRAINEES SHOWING DISCIPLINE, DEGREE SOUGHT, UNIVERSITY ADVISOR AND TIME OF TRAINING

NAME	SPECIALTY	DEGREE	UNIVERSITY	ADVISOR	DEPARTURE DATE
-CEREALS-					
1. BOUCHOUTROUCH, Mustapha	Cereal Agronomy	M.S.	University of Nebraska	Dr. R. Waldern	8/80
2. EL MOURID, Mohamed	Cereal Agronomy (Physiology)	Doc.	Iowa State	Dr. I.C. Anderson	1/83
3. KACEMI, Mouloud	Cereal Agronomy (Cropping Systems)	Doc.	Colorado State	Dr. Gary Peterson	1/86
4. KARROU, Mohamed	Cereal Agronomy	M.S.	University of Missouri	Dr. H. Minor	8/83
5. MERGOUM, Mohamed	Cereal Breeding	Doc.	Colorado State	Dr. J. Quick	1/86
6. NSARELLAH, Nasserlegaq	Cereal Breeding	Doc.	North Dakota	Dr. R. Cantrell	1/86
7. OUASSOU, Abdellah	Cereal Breeding	Doc.	University of Nebraska	Dr. J. Schmidt	1/83
8. SELMANI, Abdellaziz	Cereal Breeding (corn)	Doc.	Kansas State	Dr. J. Wassom	1/86
9. JLIBENE, Mohamed	Cereal Breeding	Doc.	University of Missouri	Dr. P. Gufstason	1/84
10. AMRI, Ahmed	Cereal Breeding	Doc.	Kansas State	Dr. S. Cox	1/85
-FOOD LEGUMES-					
11. SAKAR, Bouazza	Food Legumes (Agronomy)	M.S.	Washington State		1/86
12. KAMEL, Mohamed	Food Legumes (Breeding)	Doc.	Washington State	Dr. F. Muehlbauer	8/82
-FORAGES-					
13. MAZHAR, Mohamed	Forage Agronomy	Doc.	University of Missouri	Dr. E. Peters	8/80
14. ARIF, Abderrahman	Forage Agronomy	Doc.	University of Nebraska	Dr. J. Stubbendieck	1/83
15. DERRAOUI, Mohamed	Forage Breeding	Doc.	Oklahoma State	Dr. J. Caddel	8/82

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TABLE 4. (con't)

NAME	SPECIALTY	DEGREE	UNIVERSITY	ADVISOR	DEPARTURE DATE	R
			PLANT PROTECTION			
16. LHALOUI, Saadia	Entomology	M.S.	University of Nebraska	Dr. D. Keith	8/83	
17. EL BOUHSSINI, Mustapha	Entomology	M.S.	Kansas State	Dr. G. Wilde	8/83	
18. LYAMANI, Abderrahman	Plant Pathology (Mycology)	Doc.	Iowa State	Dr. D. McGee	1/83	
19. EL YAMANI, Mohamed	Plant Pathology (Virology)	Doc.	Iowa State	Dr. J. Hill	8/83	1
20. TOUFIQ, El Mostapha	Plant Pathology	M.S.	University of Minnesota	Dr. R. Wilcoxen	8/83	
21. TANJI, Abbes	Weed Science	M.S.	Kansas State	Dr. D. Regehr	8/83	
			SOIL SCIENCE			
22. AZZAOUI, Abdelmalek	Soil Fertility	M.S.	University of Missouri	Dr. R. Hanson	1/83	
23. EL GHAROUS, Mohamed	Soil Fertility	M.S.	Oklahoma State	Dr. R. Westerman	1/83	
24. EL MEJEHAD, Khalil	Soil Fertility	Doc.	University of Nebraska	Dr. Don Sander Dr. Gary Hergert	1/86	
25. BOUZZA, Abderrahman	Soil Management	Doc.	University of Nebraska	Dr. G. Peterson	8/80	
26. TIKDIRENE, Ali	Soil Management	Doc.	Oklahoma State	Dr. J. Crabtree	1/86	

Doc. - Doctor of Science

TABLE 5. INRA SHORT-TERM PARTICIPANT TRAINING SHOWING DISCIPLINE TRAINING SCHEDULE

	1979	1980	1981	1982	1983	1984	1985	1986
	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J
GRAIN STORAGE TECHNICIANS								
HASSANE, J. (6/6/82-8/3/82)				=				
BRAHIM, J. (6/8/82-8/3/82)				=				
SOILS/FORAGE TECHNICIANS								
GHAI, L. (10/13/83-4/30/84)					++++++++++++++++++++++++			
MAHMAJ, A. (10/13/83-4/30/84)					++++++++++++++++++++++++			
FIELD STATION MANAGERS (Tour of research stas)								
BENHOUMT, M. (7/20/85-8/23/85)							=	
BOUTFIRASS, M. (7/20/85-8/23/85)							=	
JELLOULI, A. (7/20/85-8/23/85)							=	
SAMIR, M. (7/20/85-8/23/85)							=	
ADMINISTRATORS (USDA Technical course 140-24)								
*KETTOUCH, M. (7/24/85-9/7/85)						XXXXX	X=	
*RACHIQ, Z. (7/24/85-9/7/85)						XXXXX	X=	
ZOUTTANE, E. (7/24/85-9/7/85)						XXXXX	X=	

xx Intensive English training = Training outside Morocco ++ New on project

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TABLE 5 (con't)

	1979 J A J O	1980 J A J O	1981 J A J O	1982 J A J O	1983 J A J O	1984 J A J O	1985 J A J O	196 J
FAO AG DATA ANALYSIS (ROME)								
ZAGDOUNI, Larbi (6/11/84-7/16/84)						-		
BENATYA, Driss (6/11/84-7/16/84)						-		
ALIOUIA, Farouk (6/11/84-7/16/84)						-		
CIMMYT TRAINING COURSE								
JLIBENE, Mohamed-Wheat Breeding-2/23/80-10/29/80	———							
EL TAOUFIK, Mostapha-Wheat Path-2/23/80-10/20/80	———							
NSARELLAH, Nasserehaq-Wheat Breed-2/15/84-9/30/84						———		
CHERKAOUI, Mohamed-Corn Breed-1/1/86-7/1/86							xxxxxxxxx	———
ICARDA TRAINING COURSE IN CEREAL BREEDING								
5 technicians (adjoint techniques) in cereal breeding (2/15/86-6/15/86)								-
								-
								-
								-
								-

*Station Centrale in Rabat
xx Intensive English training — Training outside Morocco

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TABLE 5 (con't)

	1979 J A J O	1980 J A J O	1981 J A J O	1982 J A J O	1983 J A J O	1984 J A J O	1985 J A J O	1 J
INT'L PLANT PROTECTION CONGRESS								
KELILI, Driss (8/3/79-8/15/79)	-							
HAFRAOUI, Abderrahmane (8/3/79-8/15/79)	-						-	
							-	
PROFESSIONAL DEVELOPMENT								
BOUZZA, Abderrahmane (Soil Water Conservation Workshop-5/18/84-6/4/84)						-		
BERRADA, Abdelfettah (IPSNAT Cereal Modeling Seminar-8/7/84-8/28/84)						-		
BRAHLI, Azzedine (Int'l Weed Control Congress 4/2/84-4/6/84)						-		
MAZHAR, Mohamed (Farming Systems Workshop at ICARDA-12/8/84-12/12/84)						-		
EL MOURID, Mohamed (SIMTAG Model) 1/15/86-2/15/86						-		
OTHER								
EZZAHRAOUI, Thami (CIMMYT & MIAC orientation - 8/15/84-9/6/84)								-
ELABDIDINE, Fatima Zine (Barley Disease control at Montana State - 6/17/85-9/11/84)						-		
						-		

++ Intensive English training == Training outside Morocco

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TABLE 6. MIAC FIELD STAFF SHOWING DISCIPLINES, HOME INSTITUTION AND DATE OF ARRIVAL ON PROJECT

NAME	DEGREE	SPECIALTY	HOME INSTITUTION	PREVIOUS AFFILIATION	D A
BRENGLE, Kenneth	Ph.D.	Soil Management	University of Nebraska	Colorado State University	
CAMPBELL, Arden	Ph.D.	Cereal Breeding	Iowa State University	Iowa State University	
CROY, Lavoy	Ph.D.	Cereal Agronomy	Oklahoma State University	Oklahoma State University	
HAMILTON, John	B.S.,P.E.	Agricultural Engineering	University of Nebraska	International Harvester	
KEITH, Dave	Ph.D.	Entomology	University of Nebraska (sabbatical leave)	University of Nebraska	
PRIMOV, George	Ph.D.	Sociology	University of Missouri	University of Missouri	
RAFSNIDER, Giles	Ph.D.	Agricultural Economics	University of Nebraska	Colorado State University	
REGEHR, Dave	Ph.D.	Weed Science	Kansas State University	Kansas State University	
ROMMANN, Loren	Ph.D.	Forage Agronomy	Oklahoma State University	Oklahoma State University	
SMITH, Ed	Ph.D.	Cereal Breeding	Oklahoma State University	Oklahoma State University	
SOLTANPOUR, Parvis	Ph.D.	Soil Fertility, Soils Lab	Colorado State University	Colorado State University	
SWANSON, Wally	B.S.	Mechanization-Station Development	University of Nebraska	USAID Direct Hire-Morocco	
WATTS, Darrell	Ph.D.	Team Leader-Water Management	University of Nebraska	University of Nebraska	
CARTIER, Richard	B.A.	Administrative Officer	University of Nebraska	Fluor Corporation	
MULLEN, Matthew	B.S.	Facilities Operation & Maintenance	Local Hire	Peace Corps-Morocco	
RAFSNIDER, Jean	M.S.	Technical Reference Center	Consultant	University of Denver	
REGEHR, Judy	M.A.	Computer Center	Consultant	Kansas State University	
SNYDER, John	M.S.	Soil Chemistry-Lab Development	Short term consultant	Colorado State University	

TABLE 7. MIAC STAFFING PATTERN SHOWING DISCIPLINE, TYPE OF SERVICE PROVIDED AND TIME PROVIDED FOR EACH DISCIPLINE.

Technical Asst.	Long Term				Participant Advisors				Other Consultants			
	Number		Persons Months		Number		Person Months		Number		Person Months	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Discipline										Proj.:No Pay :Cost		Proj.: No Pay :Cost
Ag Engi.(Tillage & Mechanization												
Ag Eng (Till)		1	61	15						7 : 3		2.23: .77
Ag Equip main		1	49	47						:		:
Cereals Agronomy		2	82	64		4			1.70	4 :		.83:
Breeding						2			.83	3 :		1.13:
Var. Sel.		2	67	58						:		:
Senior Breed		1	49	7						:		:
Farming Systems										1 : 2		.30: .27
Food Legumes						1			.27	:		:
Forages		1	82	21		5			2.27	1 :		.40:
Plant Protection Entomology			49						2.43	: 3 : 1		: 1.50: .10
Plant Path						2			1.10	1 :		.37:
Weed Science		1		19		1			.37	1 :		.47:
Socio-Economics Ag Econ		1*	49	11*						:		:
Sociologist		1*	49	22*						:		:

*Additional local hire counterparts have also been hired by MIAC since INRA has not been able to provide them. 16/April/1

TABLE 7. (con't)

Technical Asst.	Long Term				Participant Advisors				Other Consultants			
	Number		Persons Months		Number		Person Months		Number		Person Months	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actua
									Proj. Pay	No. Cost	Proj. Pay	
Soil Science												
Fertility		3	91	52		3		1.23	2	1	.77	
Management		1	49	7		5		2.60	5	1	3.00	
Water Management		1							2	4	1.13	
Administration									29	2	11.20	
Team Leader		3	103	63								
Admin Officer		1	49	19								
Train. Officer		1		6								
Admin Advisory									3		.90	
Agron Dpt Heads									4		1.20	
Contract Amend									5		1.83	
Project Dev									4		1.60	
Research Link.										1		
USAID										6		
Sabbatical Scient.	4	1	48	7								
Res Asst Collab.	4	1	48	22								
Res Assoc-Lab Dev.		1		9								

TABLE 7. (con't)

Technical Asst.	Long Term				Participant Advisors				Other Consultants			
	Number		Persons Months		Number		Person Months		Number		Person Months	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
										Proj. Pay : No Cost		Proj. Pay
Local Hire Amer.												
Fac Op & Main		1		20								
TRC		1		3.5								
Computer Center		1		9.5								
Project Asst		1		28								
Guesthouse Sup		2		10								
Staff Sec I		1		5.5								
Lang. Tutor		1		9								
Admin Tech		1		2								
MIAC Board										: 9		
Scientific Panel										9 : 3		2.73
Greenhouse Arch										1 :		.33
Tech. Ref. Cent.										1 :		.27
Tot LT Tech Asst			925									
w/out local hire				449								
with local hire				536.5								
Tot ST Tech Asst.										86 : 33	174	32:19
Tot Part Advisor						28		12.80				

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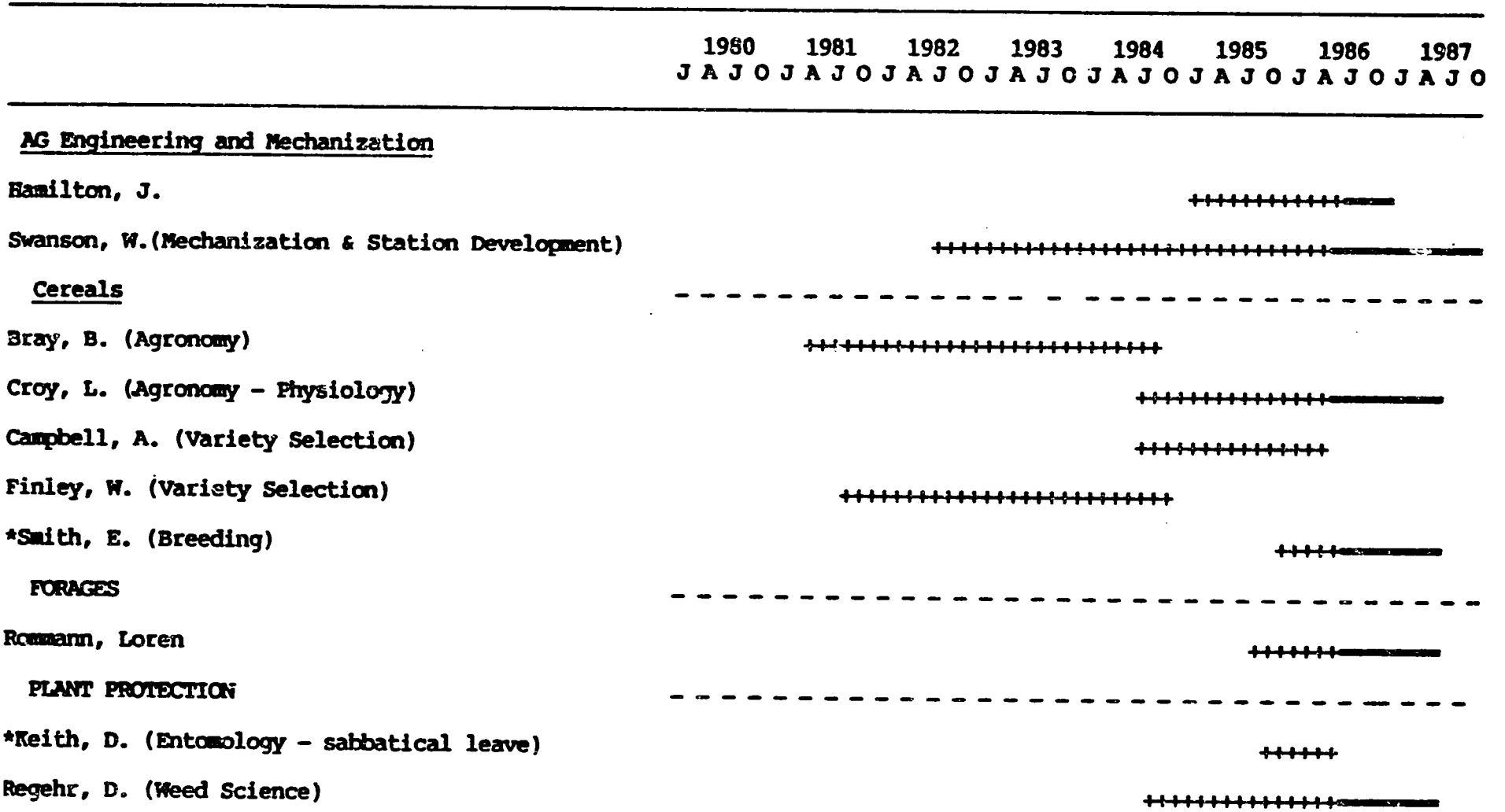
TABLE 8. HIAC FIELD STAFF SHOWING DISCIPLINE, TIME ON PROJECT AND EXPECTED TERMINATION DATE



*Stationed in Rabat ++Time spent on Project ▬ Project additional time on Project.

TABLE 8. (con't)

	1980				1981				1982				1983				1984				1985				1986				1987		
	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O
SOCIO-ECONOMIC																															
Primov, G. (Sociology)																															
Rafsnider, G. (Agricultural Economics)																															
SOIL SCIENCE																															
Soltanpour, P. (Fertility)																															
Tallyrand, H. (Fertility)																															
Troeh, F. (Fertility)																															
Brengle, K. (Management)																															
TEAM LEADER, ADMINISTRATION																															
Bertramson, R. (Team Leader)																															
Cartier, R. (Administrative Officer)																															
Scott, G. (Interim Team Leader, Training Manager)																															
Watts, D. (Team Leader - Water Management)																															

++Time spent on Project ——Projected additional time on Project;

TABLE 9. VISITS TO MOROCCO BY GRADUATE CANDIDATES ADVISORS SHOWING NAMES, HOME UNIVERSITIES AND DATES OF VISITS

			Advisor Visits		
Participant	Advisor	Date of Part. Return	First Visit	Second Visit	Third Visit
EL MOURID, M.	I.C. Anderson Iowa State University	8/85	3/85	3/86	
OUASSOU, A.	J. Schmidt University of Nebraska	10/85	4/83		
KAMEL, M.	F. Muehlbauer Washington State University	3/85	5/83		
MAZAR, M.	E. Peters University of Missouri	11/83	11/83	2/85	1/86
DERKAOUI, M.	J. Caddell Oklahoma State University	10/85	2/85		
ARIF, A.	J. Stubbendieck University of Nebraska	2/86	2/85		
LYAMANI, A.	D. McGee Iowa State University	8/85	5/84	4/86	
EL YAMANI, M.	J. Hill Iowa State University	12/85	4/84		
BOUZZA, A.	G. Peterson University of Nebraska	3/83	3/83	3/84	4/85

TABLE 10. SUMMARY OF PROJECT CONSULTANT AND PARTICIPANT ADVISORY VISITS 1983-31 MARCH 1986

Discipline	1983				1984				1985				1986				Totals			
	Part. Advisor		Project Consultant		Part. Advisor		Project Consultant		Part. Advisor		Project Consultant		Part. Advisor		Project Consultant		Part. Advisors		Project Consulta	
	No.	Days	No.	Days	No.	Days	No.	Days	No.	Days	No.	Days	No.	Days	No.	Days	No.	Days	No.	Da
Cereal Agronomy	-	-	-	-	1	14	1	4	2	27	-	-	1	11	-	-	5	52	1	
Cereal Breeding	1	15	-	-	-	-	-	-	1	10	1	11	-	-	-	-	2	25	1	
Forage Crops	1	14	-	-	-	-	-	-	3	41	-	-	1	13	-	-	5	68	-	
Food Legumes	1	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Soil Manag.	2	38	1	28	1	14	-	-	2	28	-	-	-	-	-	-	5	80	2	
Plant Pathology	-	-	1	11	2	33	-	-	-	-	-	-	-	-	-	-	-	-	-	
Entomology	1	17	-	-	3	41	2	30	1	15	1	15	-	-	-	-	5	73	3	
Soil Fertility	-	-	-	-	1	15	-	-	-	-	-	-	-	-	1	12	1	15	1	
Agri. Eng.	-	-	-	-	-	-	1	19	-	-	-	-	-	-	3	37	-	-	4	
Totals	6	92	2	39	8	117	4	53	9	121	2	26	2	24	4	49	23	313	12	1

TABLE 11. SUMMARY OF CONSULTANT VISITS SHOWING DISCIPLINE AND LENGTH OF VISIT (through March 31, 1986)

DISCIPLINE	1980	1981	1982	1983	1984	1985	1986	PROJ 1986*	TOTAL VISIT	TOTAL DAYS**
Ag Eng. (Tillage & Mechanization)	1			1	3	2	3	2	12	120 (150)
Cereal Agronomy			1		3	2	1		7	87
Cereal Breeding				1	2	2		2	7	59 (89)
Farming Systems					2	1		1	4	18 (33)
Food legumes				1					1	8
Forages				1	1	3	1	3	9	80 (125)
Entomology				1	5	3		2	11	121 (151)
Plant Pathology				1		1			7	44 (89)
Weed Science			1		1				2	25
Socio-Economics					3	2		3	7	44 (89)
Soil Fertility		1	1		3		1	2	8	76 (106)
Soil Management		2	1	3	1	3		1	11	170 (185)
Water Management	1	1	1		2	1		1	7	67 (82)
Administration	4	4	4	9	12	14	1	2	50	504 (534)
USAID				2	4				6	22
Computer Center								1	1	(15)
Technical Ref Cent						1			1	8
MIAC Board							9		9	63
Scientific Panel						6	6		12	104
Greenhouses						1		1	2	10 (25)
TOTAL	6	8	9	20	44-	41	22	24	174	1630 (1990)

*Additional consultant visits projected as based on 1985-86 Workplan.
**Total in ( ) includes days for consultants projected for remainder of 1986.

TABLE 12. CONSULTANT VISIT LIST SHOWING CONSULTANT NAME, DISCIPLINE, HOME ORGANIZATION AND LENGTH OF VISIT TO PROJECT (Through March 31, 1986)

YEAR	NAME	ORGANIZATION	DISCIPLINE	DATES OF TRAVEL	# DAYS	# DAYS/YEAR
1980	Hanway, D.G.	Univ. of Nebraska	Administrative	March 12-26	15	
	Hanway, D.G.	Univ. of Nebraska	Administrative	May 18-31	14	
	Hanway, D.G.	Univ. of Nebraska	Administrative	September 22-October 4	13	
	Hanway, D.G.	Univ. of Nebraska	Administrative	November 15-27	13	
	@Silleto, Tom	Univ. of Nebraska	Ag Eng & Mech	March 12-27	15	
	@Watts, D.G.	Univ. of Nebraska	Water Management	March 12-27	15	
						85
1981	Hanway, D.G.	Univ. of Nebraska	Administrative	January 30-February 11	13	
	Hanway, D.G.	Univ. of Nebraska	Administrative	July 17-August 11	26	
	Hanway, D.G.	Univ. of Nebraska	Administrative	October 24-November 7	15	
	Schulze, Larry	Univ. of Nebraska	Administrative	December 4-19	16	
	@Hergert, Gary	Univ. of Nebraska	Soil Fertility	December 4-19	16	
	Dickey, Elbert	Univ. of Nebraska	Soil Management	October 24-November 7	15	
	Fenster, Charles	Univ. of Nebraska	Soil Management	October 24-November 14	22	
	Watts, D.G.	Univ. of Nebraska	Water Management	December 4-19	16	
						139
1982	Francis, Charles	Univ. of Nebraska	Administrative	October 6-17	12	
	Hanway, D.G.	Univ. of Nebraska	Administrative	January 3-9	7	
	Hanway, D.G.	Univ. of Nebraska	Administrative	February 16-27	12	
	Kleis, R.W.	Univ. of Nebraska	Administrative	January 3-9	7	
	Leubs, R.E.	Private Consultant	Cereal Agronomy	December 2-20	19	
	Troeh, Fred	Iowa State Univ.	Soil Fertility	May 19-June 2	15	
	Fenster, Charles	Univ. of Nebraska	Soil Management	May 8-22	15	
	Watts, D.G.	Univ. of Nebraska	Water Management	May 5-22	18	
	Strizke, J.F.	Oklahoma State Univ.	Weed Science	April 4-17	14	
						119

YEAR	NAME	ORGANIZATION	DISCIPLINE	DATES OF TRAVEL	# DAYS	# DAYS/YEAR
1983	Arnold, Roy	Univ. of Nebraska	Administrative	March 28-April 2	6	
	Francis, Charles	Univ. of Nebraska	Administrative	March 27-April 6	11	
	Mueller, Carl	Univ. of Nebraska	Administrative	April 3-April 7	5	
	Kolmer, Lee	Iowa State Univ.	Administrative	March 28-April 2	6	
	Kleis, R.W.	Univ. of Nebraska	Administrative	August 13-August 16	4	
	Brown, Tom	Univ. of Missouri	Administrative (Project Dev.)	November 17-28	12	
	Francis, Charles	Univ. of Nebraska	Administrative (Project Dev.)	November 17-24	12	
	McKinsey, Wendell	MIAC	Administrative (Project Dev.)	November 17-28	12	
	Withee, Van	Kansas State Univ.	Administrative (Project Dev.)	November 17-28	12	
	Evans, Conrad	Oklahoma State Univ.	Ag Mech	January 22-February 5	15	
	*Schmidt, John	Univ. of Nebraska	Cereal Breeding	April 19-May 3	3	
	*Keith, Dave	Univ. of Nebraska	Entommology	April 7-23	17	
	*Muehlbauer, Fred	Washington State U	Food Legumes	May 21-May 28	8	
	*Peters, E.J.	Univ. of Missouri	Forages	November 18-December 1	14	
	Singleton, Larry	Oklahoma State Univ.	Plant Pathology	April 6-16	11	
	Fenster, Charles	Univ. of Nebraska	Soil Management	October 6-November 2	28	
	*Peterson, Gary	Univ. of Nebraska	Soil Management	March 5-23	19	
	*Sander, Don	Univ. of Nebraska	Soil Management	March 5-23	19	
	@Furtick, Bill		USAID	April 20-22, May 2-5	6	
	@Voth, Lee		USAID	April 20-22	3	
						235

YEAR	NAME	ORGANIZATION	DISCIPLINE	DATES OF TRAVEL	# DAYS	# DAYS/YEAR
1984	Frank, Ken	Univ. of Nebraska	Administrative	September 23-October 6	14	
	Kleis, R.W.	Univ. of Nebraska	Administrative	September 2-6	5	
	Pfander, Bill	Univ. of Nebraska	Administrative	September 26-28	3	
	Miller, William	Univ. of Nebraska	Administrative (Admin. Advis. Com)	November 30-December 8	9	
	Omtvedt, I.T.	Univ. of Nebraska	Administrative (Admin. Advis. Com)	November 30-December 8	9	
	Pesek, John	Iowa State Univ.	Administrative (Admin. Advis. Com)	November 30-December 8	9	
	Bigbee, Dan	Univ. of Nebraska	Administrative (Contract Amend.)	February 25-March 3	8	
	Kolmer, Lee	Iowa State Univ.	Administrative (Contract Amend.)	February 25-March 7	12	
	Kleis, R.W.	Univ. of Nebraska	Administrative (Contract Amend.)	February 25-March 7	12	
	McKinsey, Wendell	MIAC	Administrative (Contract Amend.)	February 25-March 7	12	
	Hamilton, John	Private Consultant	Ag. Eng & Mech. (Recruiting)	November 23-December 1	9	
	Swallow, Clarence	Kansas State Univ.	Ag. Eng. & Mech.	February 17-March 6	19	
	Thierstein, G.E.	ICRISAT	Ag. Eng. & Mech. (Recruiting)	September 21-October 7	17	
	Croy, Lavoy	Oklahoma State Univ.	Cereal Agronomy (Recruiting)	March 8-19	12	
	Ritchie, Joe	Michigan State Univ.	Cereal Agronomy	April 12-15	4	
	*Waldren, Richard	Univ. of Nebraska	Cereal Agronomy	March 29-April 10	14	
	Campbell, Arden	Iowa State Univ.	Cereal Breeding (Recruiting)	March 8-18	11	
	Saith, Ed	Oklahoma State Univ.	Cereal Breeding (Recruiting)	May 12-23	12	

YEAR	NAME	ORGANIZATION	DISCIPLINE	DATES OF TRAVEL	# DAYS	# DAYS/YEAR
1984	Foster, John	Purdue	Entomology	April 22-May 6	15	
	Hatchett, Jim	Kansas State-USDA	Entomology	April 22-May 6	15	
	*Keith, Dave	Univ. of Nebraska	Entomology	April 22-May 6	15	
	*Keith, Dave	Univ. of Nebraska	Entomology	December 27-January 6	11	
	*Wilde, Gerald	Kansas State Univ.	Entomology	April 22-May 6	15	
	@Cooper, Peter	ICARDA	Farming Systems	May 16-19	4	
	@Cooper, Peter	ICARDA	Farming Systems	December 15-19	5	
	Rommann, Loren	Oklahoma State Univ.	Forages (Recruiting)	March 8-19	12	
	*Hill, John	Iowa State Univ.	Plant Pathology	April 22-May 6	15	
	*McGee, Dennis	Iowa State Univ.	Plant Pathology	May 22-June 8	18	
	@Goldsworthy, Peter	ICARDA	Research Linkages	May 16-19	4	
	Craven, Kathryn	Private consultant	Socio-economics (Recruiting)	July 9-12	4	
	Primov, George	Univ. of Missouri	Socio-economics (Recruiting)	February 21-March 4	13	
	Rafsnider, Giles	Colo. St. - ERS	Socio-economics (Recruiting)	November 23-December 1	9	
	*Hanson, Roger	Univ. of Missouri	Soil Fertility (Recruiting)	March 8-17	10	
	Soltanpour	Colorado State Univ.	Soil Fertility (Recruiting)	September 23-30	8	
	*Westerman, Robert	Oklahoma State Univ.	Soil Fertility	March 28-April 11	15	
	*Peterson, Gary	Univ. of Nebraska	Soil Management	March 28-April 10	14	
	@Grayzel, John		USAID	October 2-8	7	
	@Papendick, Robert		USAID	October 15-16	2	
	@Parr, Jim		USAID	October 15-16	2	
	@Saxton, Keith		USAID	October 15-16	2	
	@Gilley, Jim	Univ. of Nebraska	Water Management	May 7-14	8	
	@Martin, Derrel	Univ. of Nebraska	Water Management	October 10-17	8	
	*Regehr, Dave	Kansas State Univ.	Weed Science (Recruiting)	March 8-18	11	
						445

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YEAR	NAME	ORGANIZATION	DISCIPLINE	DATES OF TRAVEL	# DAYS	# DAYS/YEAR
1985	@Abbott, Bill	Oklahoma State Univ.	Administrative	January 14-17	4	
	Bigbee, Dan	Univ. of Nebraska	Administrative	February 4-23	20	
	Bigbee, Dan	Univ. of Nebraska	Administrative	November 8-27	20	
	Browning, Charles	Oklahoma State Univ.	Administrative	April 18-24	7	
	Frank, Ken	Univ. of Nebraska	Administrative	September 20-25	6	
	Furgason, Robert	Univ. of Nebraska	Administrative	April 18-24	7	
	@Ketchum, Edwin	Okla. State (regent)	Administrative	January 14-17	4	
	McKinsey, Wendell	MIAC	Administrative	November 12-21	10	
	Ham, George	Kansas State Univ.	Administrative (Agron. Dept. Heads)	March 29-April 6	9	
	Nelson, Darrell	Univ. of Nebraska	Administrative (Agron. Dept. Heads)	March 29-April 6	9	
	Santelman, Paul	Oklahoma State Univ.	Administrative (Agron. Dept. Heads)	March 29-April 6	9	
	Volk, Bob	Univ. of Missouri	Administrative (Agron. Dept. Heads)	March 29-April 6	9	
	Vollmar, Glen	Univ. of Nebraska	Administrative	November 13-19	7	
	Wright, W.C.	Oklahoma State Univ.	Administrative	September 6-17	12	
	@Bachmayor, Johann	Germany	Ag. Eng. & Mech	May 30-June 2	4	
	@Betzwar, Werner	Germany	Ag. Eng. & Mech	May 30-June 2	4	
	*Anderson, I.C.	Iowa State Univ.	Cereal Agronomy	March 15-31	17	
	*Minor, Harry	Univ. of Missouri	Cereal Agronomy	January 5-14	10	
	*Cox, Stan	Kansas State Univ.	Cereal Breeding	April 18-27	10	
	Smith, Ed	Oklahoma State Univ.	Cereal Breeding	April 18-28	11	
	@Campbell Jack	Univ. of Nebraska	Entomology	October 20-22	3	
	Hatchett, Jim	Kansas State-USDA	Entomology	January 9-23	15	
	*Wilde, Gerald	Kansas State Univ.	Entomology	March 22-April 5	15	
	Humpal, Don	Private consultant	Farming Systems	April 10-18	9	

YEAR	NAME	ORGANIZATION	DISCIPLINE	DATES OF TRAVEL	# DAYS	# DAYS/YEAR
1985	*Caddel, John	Oklahoma State Univ.	Forages	February 16-March 2	15	
	*Peters, E.J.	Univ. of Missouri	Forages	February 15-March 4	18	
	*Stubbendieck, Jim	Univ. of Nebraska	Forages	February 16-23	8	
	Volesky, Jerry	Private consultant	Greenhouse Arch.	February 6-February 15	10	
	@Cooper, Peter	ICARDA	Scientific Panel	January 27-February 2	7	
	Fisher, Tony	CSIRO	Scientific Panel	January 27-February 2	7	
	@Klatt, Arthur	CIMMYT	Scientific Panel	January 27-February 2	7	
	Osman, Ahmed	ACSAD	Scientific Panel	January 27-February 2	7	
	Quick, James	Colorado State Univ.	Scientific Panel	January 27-February 2	7	
	Smika, Darryl	ARS-Colorado	Scientific Panel	January 27-February 2	7	
	Miller, William	Univ. of Nebraska	Socio-economics	November 29-December 7	9	
	Nordblom, Tom	ICARDA	Socio-economics	November 29-December 7	9	
	Brengle, Ken	Private Consultant	Soil Management (Recruiting)	July 19-28	10	
	*Peterson, Gary	Colorado State Univ.	Soil Management	April 6-19	14	
	*Sander, Don	Univ. of Nebraska	Soil Management	April 6-19	14	
	Jizba, Richard	Univ. of Nebraska	Tech. Ref. Center	October 5-12	8	
	@Stewart, Ian	Univ. Calif. Davis	Water Management	March 31-April 1	2	
						390

YEAR	NAME	ORGANIZATION	DISCIPLINE	DATES OF TRAVEL	# DAYS	# DAYS/YEAR
1986	Schulze, Larry	Univ. of Nebraska	Administrative	January 28-February 15	19	
	Bell, R.D.	NIAE, Great Britain	Ag. Eng. & Mech.	January 6-16	11	
	Splinter, Bill	Univ. of Nebraska	Ag. Eng. & Mech.	January 4-16	13	
	Thierstein, G.E.	Kansas State Univ.	Ag. Eng. & Mech.	January 4-16	13	
	*Anderson, I.C.	Iowa State Univ.	Cereal Agronomy	March 22-April 1	11	
	*Peters, E.J.	Univ. of Missouri	Forages	January 24-February 5	13	
	@Arnold, Roy	Univ. of Nebraska	MIAC Board	February 16-22	7	
	@Browning, Charles	Oklahoma State Univ.	MIAC Board	February 16-22	7	
	@Kolmer, Lee	Iowa State Univ.	MIAC Board	February 16-22	7	
	@Larson, Verson	Kansas State Univ.	MIAC Board	February 16-22	7	
	@McKinsey, Wendell	MIAC	MIAC Board	February 16-22	7	
	@Mitchell, Roger	Univ. of Missouri	MIAC Board	February 16-22	7	
	@Nolan, Mike	Univ. of Missouri	MIAC Board	February 16-22	7	
	@Scott, J.T.	Iowa State Univ.	MIAC Board	February 16-22	7	
	@Vollmar, Glen	Univ. of Nebraska	MIAC Board	February 16-22	7	
	Cooper, Peter	ICARDA	Scientific Panel	March 8-15	8	
	Fisher, Tony	CSIRO	Scientific Panel	March 8-15	8	
	@Klatt, Arthur	CIMMYT	Scientific Panel	March 8-15	8	
	Osman, Ahmed	ACSAD	Scientific Panel	March 8-15	8	
	Quick, James	Colorado State Univ.	Scientific Panel	March 8-15	15	
	Smika, Darryl	ARS-Colorado	Scientific Panel	March 8-15	15	
	Hanson, Roger	Univ. of Missouri	Soil Fertility	February 25-March 8	12	
						217
				GRAND TOTAL # DAYS		1630

*Participant Advisor

@non-project funding

TABLE 13. INRA-MIAC STAFF LIST SHOWING NAME, DEGREE, DISCIPLINE AND LOCATION

NAME	DEGREE	SPECIALTY	LOCATION
AGRICULTURAL ENGINEERING AND MECHANIZATION			
BAHRI, Abdeljabar	Ing. d'application	Agricultural Engineering	Settat
HAMILTON, John	B.S.,P.E.	Agricultural Engineering	Settat
MULLEN, Mattew	B.S.	Facilities Operation & Maintenance	Settat
SWANSON, Wally	B.S.	Mechanization-Station Development	Settat
CEREALS			
BOUCHOUTROUCH, Mustapha	(M.S.)	Cereal Agronomy	Settat
CROY, Lavoy	Ph.D.	Cereal Agronomy	Settat
EL MOURID, Mohamed	(Doc.)	Cereal Agronomy (Physiology)	Settat
KACEMI, Mouloud	(Doc.)	Cereal Agronomy (Cropping Systems)	Colorado State (return 6/88)
KARROU, Mohamed	(M.S.)	Cereal Agronomy	Settat
AMRI, Ahmed	(Doc.)	Cereal Breeding	Kansas State (return 9/87)
CAMPBELL, Arden	(Ph.D)	Cereal Breeding	Settat
JLIBENE, Mohamed	(Doc.)	Cereal Breeding	Univ. of Missouri (return 1/87)
MERGOUM, Mohamed	(Doc.)	Cereal Breeding	Colorado State (return 6/88)
NSARELLAH, Nasserlehaq	(Doc.)	Cereal Breeding	North Dakota (return 6/88
OUASSOU, Abdellah	(Doc.)	Cereal Breeding	Rabat
SELMANI, Abdellaziz	(Doc.)	Cereal Breeding (corn)	Kansas State (return 6/88)
SMITH, Ed	Ph.D.	Cereal Breeding	Rabat
FOOD LEGUMES			
SAKAR, Mohamed	(M.S)	Food Legumes (Agronomy)	Washington State (return 1/88)
KAMEL, Mohamed	(Doc.)	Food Legumes (Breeding)	Settat
FORAGES			
MAZHAR, Mohamed	(Doc.)	Forage Agronomy	Settat
ROMMANN, Loren	(Ph.D.)	Forage Agronomy	Settat
ARIF, Abderrahman	(Doc.)	Forage Agronomy	Univ. of Nebraska (return 2/86)
DERKAOUI, Mohamed	(Doc.)	Forage Breeding	Settat

( ) denotes degree in process Doc. - Doctor of Science

NAME	DEGREE	SPECIALTY	LOCATION
PLANT PROTECTION			
EL BOUHSSINI, Mustapha	(M.S.)	Entomology	Settat
KEITH, Dave	Ph.D.	Entomology (sabbatical)	Rabat
LHALOUI, Saadia	(M.S.)	Entomology	Settat
LYAMANI, Abderrahman	(Doc.)	Plant Pathology (Mycology)	Settat
EL YAMANI, Mohamed	(Doc.)	Plant Pathology (Virology)	Settat
TOUFIQ, El Mostapha	(M.S.)	Plant Pathology	Settat
EL BRAHLI, Azzedine	Ing. d'etat	Weed Science	Settat
REGEHR, Dave	Ph.D.	Weed Science	Settat
TANJI, Abbes	(M.S.)	Weed Science	Settat
SOCIO-ECONOMIC SECTION			
HAMIDA, Mustapha	M.S.	Research Associate in Agricultural Economics	Settat
RAFSNIDER, Giles	Ph.D.	Agricultural Economics	Settat
HERZENNI, Ahmed	M.S.	Sociology	Settat
RIDDLE, Richard	(Ph.D.)	Sociology	Rabat
SAID, Ismail	B.S.	Research Associate in Sociology	Settat (leaving this summer)
PRIMOV, George	Ph.D.	Sociology	Settat
SOIL SCIENCE			
SNYDER, John	M.S.	Soil Chemistry-Lab Development	Settat
AZZAOUI, Abdelmalek	(M.S.)	Soil Fertility	Settat
EL GHAROUS, Mohamed	(M.S.)	Soil Fertility	Settat
EL MEJEHAD, Khalil	(Doc.)	Soil Fertility	Univ. of Nebraska (return 6/88)
SOLTANPOUR, Parvis	Ph.D.	Soil Fertility, Soils Lab	Settat
BOUZZA, Abderrahman	(Doc.)	Soil Management	Settat
BRENGLE, Kenneth	Ph.D.	Soil Management	Settat
TIKDIRENE, Ali	(Doc.)	Soil Management	Oklahoma State (return 6/88)
ADMINISTRATION AND SUPPORT STAFF			
CARTIER, Richard	B.A.	MIAC Admin. Officer	Settat
RAFSNIDER, Jean	M.A.	Technical Reference Center	Settat
REGEHR, Judy	M.A.	Computer Center	Settat
WATTS, Darrell	Ph.D.	Team Leader-Water Management	Settat
ZOUITANE, El Madani	Ing. d'etat	INRA Regional Director, Director of Center	Settat

( ) denotes degree in process

TABLE 14. SUMMARY OF INRA-MIAC STAFF SHOWING DISCIPLINES, NUMBER OF STAFF AND ACADEMIC DEGREE

Discipline	MIAC (No.)		INRA (No.)				
			Candidate Doc. Science		Candidate M.S.		
	Ph.D.	Other	On Project	In U.S.	On Project	In U.S.	Other
Agronomy							
Cereal Agronomy	1	-	1	1	2	-	
Cereal Breeding	2	-	1	5	-	-	
Food Legumes	-	-	1	-	-	1	
Forage Agronomy	1	-	2	-	-	-	
Forage Breeding	-	-	1	-	-	-	
Soil Science							
Soil Fertility	1	-	-	1	2	-	
Soil Chemistry (Lab)	-	1 M.S.	-	-	-	-	
Soil Management	1	-	1	1	-	-	

TABLE 14. (con't)

Discipline	MIAC (No.)		INRA (No.)				
			Candidate Doc. Science		Candidate M.S.		
	Ph.D.	Other	On Project	In U.S.	On Project	In U.S.	Other
Plant Protection							
Entomology	1 (sabbatical)		-	-	2	-	
Plant Pathology	-		2	-	1	-	
Weed Science	1		-	-	1	-	1 M.S.
Agricultural Engineering							
Agri. Eng. & Mechanization	1	1 P.E. 1 B.S.	-	-	-	-	1 B.S.
Facilities Maintenance	-	1 B.S.	-	-	-	-	
Socio-Economics							
Agricultural Economics	1	1 M.S. (L)	-	-	-	-	
Sociology	1	1 M.S. (RA) 2 B.S. (L)	-	-	-	-	

(L) = Local Hire
(RA) = Research Associate

TABLE 15. INRA-MIAC FIELD STAFF SHOWING NAME, DISCIPLINE AND TIME ON THE PROJECT

	1980	1981	1982	1983	1984	1985	1986
	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O
AG ENGINEERING AND MECHANIZATION							
?Bahiri,A.						++++++++	
@Hamilton, J.						+++++++++++	
@Swanson, W.(Mechanization & Station Development)			++++++++++++++++++++++++++++				
CEREALS	- -						
@Bray, B. (Agronomy)		++++++++++++++++++++++++++					
‡Bouchoutrouch, M. (Agronomy)				++++++++++++++++++++++			
?Boutfirass, M. (Agronomy)				++++++++++++++++++++++++			
@Croy, L. (Agronomy - Physiology)					++++++++++++++		
‡El Mourid, M.(Agronomy - Physiology)						++++++	
‡Karrou, M. (Agronomy)						+++++++++++	
?Oubaha, L. (Agronomy)			++++++++++++++++++++++				
@Campbell, A. (Variety Selection)					++++++++++++++		
@Finley, W. (Variety Selection)			++++++++++++++++++++++++				
*‡Ouassou, A. (Breeding)						+++++++	
*@Smith , E. (Breeding)						+++++++	

*Stationed in Rabat. ? INRA Staff(non-participant) ‡‡INRA staff (Participant) @MIAC staff

TABLE 15. (con't)

	1980				1981				1982				1983				1984				1985				1986		
	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J	O	J	A	J O
FOOD LEGUMES																											
#KAMEL, M. (Breeding)																					+	+	+	+	+	+	+
FORAGES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#ARIF, A. (Agronomy)																										+	
#MAZHAR, M. (Agronomy)																	+	+	+	+	+	+	+	+	+	+	+
@ROMMANN, Loren (Agronomy)																		+	+	+	+	+	+	+	+	+	+
?DERKAOUI, M. (Breeding)																						+	+	+	+	+	
PLANT PROTECTION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#EL BOUHSSINI, M. (Entomology)																						+	+	+	+	+	
#LHALOUI, S. (Entomology)																						+	+	+	+	+	
*@KEITH, D. (Entomology - sabbatical leave)																						+	+	+	+	+	
#EL YAMANI, M. (Plant Pathology - Virology)																								+	+	+	
#LYAMANI, A. (Plant Pathology - Mycology)																						+	+	+	+	+	
#TOUFIQ, E. (Plant Pathology)																						+	+	+	+	+	

*Stationed in Rabat ?INRA staff (non-participant) #INRA staff (participant) @MIAC staff

TABLE 15. (con't)

	1980	1981	1982	1983	1984	1985	1986
	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O
PLANT PROTECTION (CONT.)							
?EL BRAHLI, A. (Weed Science)				++++	++++	++++	++
@REGEHR, D. (Weed Science)					++++	++++	++
#TANJI, A. (Weed Science)						++++	++
SOCIO-ECONOMIC	- - -	- - -	- - -	- - -	- - -	- - -	- - -
$HMIDA, M. (Agricultural Economics)							+++
@RAFSNIDER, G. (Agricultural Economics)						++++	++
$HERZENNI, A. (Sociology)						++++	++
@PRIMOV, G. (Sociology)					++++	++++	++
$SAID, I. (Sociology)				++++	++++	++++	++
SOIL SCIENCE	- - -	- - -	- - -	- - -	- - -	- - -	- - -
#AZZAOUI, A. (Fertility)						++++	++
#EL GHAROUS, M. (Fertility)						++++	++
#EL MEJAHED, K. (Fertility)				++++	++++		
@SOLTANPOUR, P. (Fertility)					++++	++++	++
@TALLYRAND, H. (Fertility)		++++	++				
@TROEH, F. (Fertility)				++++	++++	++++	++

?INRA staff (non-participant) #INRA staff (participant) @MIAC staff $MIAC local hire

TABLE 15. (con't)

	1980	1981	1982	1983	1984	1985	1986
	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O	J A J O
SOIL SCIENCE (CONT.)							
#BERRADA, A. (Management)				++++++++++++++++			
#BOUZZA, A. (Management)				++++++++++++++++++++++++++			
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A P P E N D I X L

PROJECTIONS BY MIAC STAFF OF TIME REQUIRED TO ACHIEVE RESULTS AND EXPECTED IMPACT ON MOROCCAN AGRICULTURE

APPENDIX L. PROJECTIONS BY MIAC STAFF OF TIME REQUIRED TO ACHIEVE RESULTS AND EXPECTED IMPACT ON MOROCCAN AGRICULTURE

Table 1. Projected Time Table for Development of Agricultural Economics Program

Table 2. Projected Time Table for Development of Agricultural Engineering Program

Table 3. Projected Time Table for Development of New Plant Varieties

Table 4. Projected Time Table for Development of Cereal Agronomy Program

Table 5. Projected Time Table for Development of Forage Program

Table 6. Projected Time Table for Development of Soil Fertility Program

Table 7. Projected Time Table for Development of Sociology Program

TABLE 1. PROJECTED TIME TABLE FOR DEVELOPMENT OF AGRICULTURAL ECONOMICS PROGRAM

Description of Research	Expected Benefit[1]	Stage of Development[2]											
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. "Example - Barley Variety X"	10%	a b	a b c	b c	b c d	c d	e						
2. FARM ENTERPRISE BUDGETS FOR BARLEY, CORN, HARD WHEAT, AND SOFT WHEAT	First base line data developed in Morocco which has statistical validity	f a	f a,d e										
3. ANNUAL UP-DATE OF FARM ENTERPRISE BUDGETS FOR BARLEY, CORN, HARD WHEAT, AND SOFT WHEAT	Monitor changes in technology and costs and revenues		f a	f a,d, j,e	f d,j, e	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g
4. FARM ENTERPRISE BUDGETS FOR FEED AND FOOD LEGUMES, AND FORAGES	First base line data developed in Morocco which has statistical validity			f a	f a,d e								
5. ANNUAL UP-DATE OF FARM ENTERPRISE BUDGETS FOR FEED AND FOOD LEGUMES, AND FORAGES	Monitor changes in technology and costs and revenues				f a	f a,d, e	f d,j, e	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g	f d,j, e,g
6. EXPECTED VALUE-VARIANCE AND STOCHATIC DOMINANCE ANALYSES OF WHEAT VARIETAL TESTS TO IDENTIFY OPTIMUM VARIETIES	Identify optimal bio-economic varieties	f b	f b	f b,a, j	f b,a, j	b,g, j	b,e, j	b,e, j	b,e, j	b,e, j	b,e, j	b,e, j	b,e, j
7. DUALITY BASED ESTIMATES OF COST FUNCTIONS FOR MAJOR CEREAL AND LEGUME CROPS BASED ON ENTERPRISE BUDGET DATA	Provide on-farm and policy decision makers with comparative advantage data	f b	f b	f b,a	f b,a	b,g, j	b,g, j	b,g, e,j	b,g, e,j	b,g, e,j	b,g, e,j	b,g, e,j	b,g, e,j
8. INTRODUCTION OF FARM RECORDS KEEPING SYSTEM FOR DRYLAND PRODUCERS AND MODELS OF FARM PRODUCTION OPTIMIZATION	Provide control system necessary for new technology management	b	b	a,b	a,b	f a,b, c	f a,b, d	f c,b, e,j	f g,b, e,j	f b,e, j	f b,e, j	f b,e, j	f b,e, j
9. ECONOMIC ANALYSIS OF FIELD TESTS WITH AGRICULTURAL ENGINEERING AND WEED SCIENCE GROUPS ON THEIR RESPECTIVE PROJECTS	Assess costs associated with adoption of new technology	f b	f b	f c	f d	f e							
10. COST-OF-PRODUCTION COMPARISONS FOR GRAIN PRODUCTION IN THE USA, EEC, AND MOROCCO	Provide Moroccan gov't officials with crop cost comparisons		f b	f b	f b	f e							

[1]Expected increase in yield/ha or describe with comments if not applicable.

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Table 2. PROJECTED TIME TABLE FOR DEVELOPMENT OF AGRICULTURAL ENGINEERING PROGRAM

Description of Research	Expected Benefit[1]	Stage of Development[2]											
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. "Example - Barley Variety X	10%	a b	a b c	b c	b c d	c d	e						
2. TEN YEAR AGRICULTURAL ENGINEERING OPERATING PLAN	85	a b c d	a b c d f g	a b c d f g	a b c d f g	a b c d f g	a b c d f g	a b c d f g	a b c d f g h	a b c d f g h	a b c d f g h	a b c d f g h	a b c d f g h
3. ARID REGION TILLAGE MACHINE SWEEP MACHINE - GENERATION I	65	a b c d	a b c d	a b c d	a b c d e h i								
4. ANIMAL-TRACTION SMALL FARMS PROGRAM IMPLEMENTATION	50		a b c d	a b c d e h i	a b c d e h i	a b c d e h i							
5. AGRICULTURAL ENGINEERING RESEARCH AND DEVELOPMENT BUILDING	100		a b c d e f	a b c d e f	a b c d f g h i	a b c d f g h i	a b c d f g h i	a b c d f g h i	a b c d f g h i	a b c d f g h i	a b c d f g h i	a b c d f g h i	a b c d f g h i
6. ARID REGION PLANTING EQUIPMENT DEVELOPMENT	100	a b c d	a b c d	a b c d	a b c d	e g h i	e g h i						
7. PRIVATE SECTOR MANUFACTURING PROGRAMS	100					e	e	e g	e g	e g	e g	e g	e g
8. ARID REGION AND GENERAL TILLAGE FOR MOROCCO - SWEEP MACHINE GENERATION II	85	a	a b	a b c d	a b c d	a b c d e g h i							
9. FIELD OPERATING INSTRUMENTATED TRACTOR - ARID REGION RESEARCH	100		a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d
10. GRADUATE STUDENT EXCHANGE PROGRAMS - INSTITUTION BUILDING	85		XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	

[1]Expected increase in yield/ha or describe with comments if not applicable.
[2]a = participant training on station; b = on-station research; c = on-farm trial research; d = on-farm test or verification;
e = expected public release or adaption; f = Center development activities; g = Moroccans assume supervisor roles; h = extension training;
i = extension dissemination
XX = IN EFFECT

Table 3. PROJECTED TIME TABLE FOR DEVELOPMENT OF NEW PLANT VARIETIES

Description of Research	Expected Benefit[1]	Stage of Development[2]											
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. "Example - Barley Variety X	10%	a b	a b c	b c	b c d	c d	e						
CEREAL BREEDING													
2. HESSIAN FLY RESISTANT VARIETIES OF BREAD WHEAT AND DURUM WHEAT	15-20%	a b j	a b j	a b j	a b j	bdgj	bdejk	bdejk	bdejk	bdejk	bdejk	bdejk	bdejk
3. DROUGHT TOLERANT VARIETIES OF BARLEY, BREAD WHEAT, AND DURUM WHEAT WITH RESISTANCE TO PREVALENT DISEASES AND HESSIAN FLY	10-25%	a b j	a b j	a b j	a b d j	bdegjk	bdejk	bdejk	bdejk	bdejk	bdejk	bdejk	bdejk
4.													
PATHOLOGY													
5. DETERMINE EFFECT OF DISEASES ON CROP YIELDS	SUPPORT	a b f	a b f	a b f	a b f	b g h	b g h	b g h					
6. IDENTIFY DISEASE RESISTANCE GENOTYPES AND INCORPORATE INTO VARIETY DEVELOPMENT (CEREALS AND EDIBLE LEGUMES)	20	a b	a b	a b	a b	b g	b g	b g	b g	b g	b g	b g	b g
7.													
FOOD LEGUMES													
8. IDENTIFY WINTER CHICK PEA VARIETIES WITH DISEASE RESISTANCE	100	a b c	a b c h	a b c h	abcehi	abcehi	bcehi	bcehi	b c e i	b c e i	b c e i	b c e i	b c e i
9. DEVELOPE ADAPTED VARIETIES OF FOOD LEGUMES, AND PRODUCTION SYSTEMS	30	a b f	a b f	a b f	b c g h	b c g h	bcdgh	bcdgh	bcdgh	bcdgh	bcdgh	bcdgh	bcdgh

[1]Expected increase in yield/ha or describe with comments if not applicable.

[2]a = participant training on station; b = on-station research; c = on-farm trial research; d = on-farm test or verification; e = expected public release or adoption; f = Center development activities; g = Moroccans assume supervisor roles; h = extension training; i = extension dissemination; j = forming cooperative variety development program among breeders, entomologists, and pathologists; k = seed multiplication

COMMENT: These time tables for cereals are the most optimistic I can come up with. Based on what little experience I have here, I think it would not be out of line to double them.

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Table 4. PROJECTED TIME TABLE FOR DEVELOPMENT OF CEREAL AGRONOMY PROGRAM

Description of Research	Expected Benefit[1]	Stage of Development[2]											
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. "Example - Barley Variety X	10%	a b	a b c	b c	b c d	c d	e						
2. WHEAT PRODUCTION SYSTEMS FOR IMPROVED GRAIN AND FORAGE YIELDS[3]	50	a b c	abcde	abcde	abcdeh i	abcdehi g	bcdehi g	bcdehi	bcdehi	bcdehi	bcdehi	bcdehi	bcdehi
3. BARLEY PRODUCTION SYSTEMS FOR IMPROVED GRAIN & FORAGE YIELDS[4]	40	a b c	abcde	abcde	abcdeh i	abcdeg h i	bcdehi g						
4. CORN PRODUCTION SYSTEMS FOR IMPROVED GRAIN & FORAGE YIELDS	60	a b	a b c	b c e h	bcehi	bcehi	bceghi						
5. IMPROVE TILLAGE AND ROTATION SYSTEMS FOR WHEAT PRODUCTION	20	a b	a b	a b	b c e	b c e h	bcehi	bcehi g	bcehi g	bcehi g	bcehi g	bcehi g	bcehi g
6. EVALUATE CLIMATE-YIELD RELATIONSHIPS FOR MODELING YIELD POTENTIALS	20	a b	a b	a b	a b	a b e h	b e h i	b e h i	b e h i	b e h i	b e h i	b e h i	b e h i
7. PHYSIOLOGY OF WATER & NITROGEN USE FOR IMPROVED VARIETY DEV.[5]	30		b f	b f	b f	b f	b	b	b e	b e	b e	b e	b e
8. DEVELOPMENT OF LABS, RESEARCH STATION, GREENHOUSES, OFFICES	SUPPORT	f	f	f	f	f	f						
9.													
10.													

[1]Expected increase in yield/ha or describe with comments if not applicable.
[2]a = participant training on station; b = on-station research; c = on-farm trial research; d = on-farm test or verification;
e = expected public release or adaption; f = Center development activities; g = Moroccans assume supervisor roles; h = extension training;
i = extension dissemination
[3]Research will be modified to include new machines developed by Engineers, new varieties, and fertility recommendations
[4](Same as for wheat above)
[5]New genotypes which are identified will be incorporated in breeding program for variety development

NOTE: Research as described is very ambitious and will be difficult to accomplish in time allocated. Research under best of conditions takes about a given amount of time (i.e. a new variety-10-12 years) and it is difficult to speed this up much. Only hope is adaptation of research from other localities to Morocco.

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Table 5. PROJECTED TIME TABLE FOR DEVELOPMENT OF FORAGE PROGRAM

Description of Research	Expected Benefit[1]	Stage of Development[2]											
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. "Example - Barley Variety X	10%	a b	a b c	b c	b c d	c d	e						
2. LEY FARMING	20% plus 20% increase in animal production	a b d	h i b	g b e h i	b h	b h i d	b h i d	b h i d	b h i d	b h i d	b h i d	b h i d	b h i d
3. MEDICAGO GENOTYPE X ENVIRONMENT INTERACTION[3]	INDIRECT												
4. DROUGHT TOLERANCE FOR ESTABLISHMENT & SURVIVAL OF RANGE GRASSES	5%	a	a b	c b	c b d	i g d e h	i g d e h	i g d e h	i g d e h	i g d e h	i g d e h	i g d e h	i g d e h
5. TEMPORARY PASTURE CONVERSION		c	c	c e g h i	c e g h i	c e g h i	c e g h i	c e g h i	c e g h i	c e g h i	c e g h i	c e g h i	c e g h i
6. MEDICAGO AND OTHER NATIVE LEGUMES COLLECTION AND EVALUATION		b	b g	b g	b g	b g	b g e	b g	b g	b g	b g	b g	b g
7. ANIMAL GRAZING & FEEDING TRIALS	20% rate of gain			b g	b g	b e g h i	b e g h i	b e g h i	b g h i	b g h i	b g h i	b g h i	b g h i
8. FORAGE STORAGE	20% reproductive efficiency		b g	g d	h i	e h i	e h i	e h i	e h i	e h i	e h i	e h i	e h i
9. FORAGE TREES	UNKNOWN		b	b g	b g	b d g c	bdghic	bdehic	bgehi	bgehi	bgehi	bgehi	bgehi
10. FORAGE LABORATORY DEVELOPMENT	SUPPORT FACILITY	f g	f g	f g	f g	f g	f g	f g	f g	f g	f g	f g	f g

[1]Expected increase in yield/ha or describe with comments if not applicable.
[2]a = participant training on station; b = on-station research; c = on-farm trial research; d = on-farm test or verification;
e = expected public release or adaption; f = Center development activities; g = Moroccans assume supervisor roles; h = extension training;
i = extension dissemination
[3]Fundamental research which may help determine other research directions

Table 6. PROJECTED TIME TABLE FOR DEVELOPMENT OF SOIL FERTILITY PROGRAM

Description of Research	Expected Benefit[1]	Stage of Development[2]											
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. "Example - Barley Variety X	10%	a b	a b c	b c	b c d	c d	e						
2. SOIL TEST CALIBRATION FOR MAKING FERTILIZER RECOMMENDATION	30%	a b c	a b c	a b c	abcdh	abcdeh	abcdhi	abcdhi	g				
3. SOIL AND PLANT ANALYSIS LABORATORY FOR RESEARCHERS	NOT APPLICABLE SUPPORT ACTIVITY FOR ITEM 2	f	f	f	f	f	f	f	g				
4. DEVELOPMENT OF MOBILE LABS FOR ANALYZING FARMER SAMPLES AND MAKIING FERTILIZER RECOMMENDATION					h	h i	h i	h i	g				
5.													
6.													
7.													
8.													
9.													
10.													

[1]Expected increase in yield/ha or describe with comments if not applicable.

[2]a = participant training on station; b = on-station research; c = on-farm trial research; d = on-farm test or verification; e = expected public release or adaption; f = Center development activities; g = Moroccans assume supervisor roles; h = extension training; i = extension dissemination

COMMENT: The soil test calibration studies should be an on-going program and should not be stopped. As new varieties are released, one must do soil test calibration research on these new varieties to find their fertilizer requirements. Also as cultural practices change, e.g. farmer acceptance of ley farming, one should determine fertilizer needs under this new management technique.

Table 7. PROJECTED TIME TABLE FOR DEVELOPMENT OF SOCIOLOGY PROGRAM

Description of Resear	Expected Benefit[1]	Stage of Development[2]											
		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. "Example - Barley Varie	10%	a b	a b c	b c	b c d	c d	e						
2. TRITICALE	INTRODUCTION OF NEW CULTIVAR	c	d	e h									
3. ABDA FARMING SYSTEMS ANA[illegible]S	NOT APPLICABLE	Analysis of all data to be completed in 86-87											
4. ANIMAL TRACTION AND SMALL MACHINERY	NOT APPLICABLE	Introduction and on-farm testing of new models and designs											
5. TEMPORARY PASTURE FERTILIZATION	UNCLEAR	See by section		Report Forage									
6.													
7.													
8.													
9.													
10.													

[1]Expected increase in yield/ha or describe with comments if not applicable.
[2]a = participant training on station; b = on-station research; c = on-farm trial research; d = on-farm test or verification;
e = expected public release or adapion; f = Center development activities; g = Moroccans assume supervisor roles; h = extension training;
i = extension dissemination